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Scientific articles

**Explanatory factors of technology-based entrepreneurship in
Mexico**

Factores explicativos del emprendimiento de base tecnológica en México
Fatores explicativos do empreendedorismo de base tecnológica no México

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Abstract

Entrepreneurship is important due to its contribution to national development. Technological development, recognized by various economic growth theories as essential to societal well-being and quality of life, is closely linked to the emergence of technology-based companies. These companies serve as a bridge between the production of value-added goods and services. Technology- or science-based companies originate from research conducted at research centers or higher education institutions and are characterized by having registered intellectual property. This study aims to provide empirical evidence on the key factors influencing the formation of technology-based companies in Mexico. A questionnaire was distributed to 220 entrepreneurs in Mexico through directors of business incubators and accelerators. Data analysis included descriptive statistics to outline respondent profiles and a backward stepwise binary logistic regression model to identify factors influencing the formation of technology-based enterprises (EBTs). The results indicate that the main factors promoting the formation of technology-based companies in Mexico include: the entrepreneur's experience in R&D; having an academic background in engineering or life sciences; creating the business as a team ($P < 0.10$); and utilizing services provided by technology transfer offices (TTOs) ($P < 0.05$). Identifying these factors can help redirect public policy towards more effective support for technology-based entrepreneurship in Mexico.

Keywords: innovation, technology transfer, EBTs.

Resumen

El emprendimiento es importante por su aporte al desarrollo de los países. En cuanto al desarrollo tecnológico, diversas teorías del crecimiento económico lo reconocen como fundamental para el bienestar social, al incidir en la calidad de vida. En este contexto, las empresas de base tecnológica constituyen un eslabón entre las actividades productivas de bienes y servicios con valor agregado. Las empresas de base tecnológica o científica son aquellas que surgen a partir de investigaciones realizadas en centros de investigación o instituciones de educación superior, y que cuentan con registro de propiedad intelectual. El objetivo de este estudio fue aportar evidencia empírica sobre los factores que inciden en la formación de empresas de base tecnológica en México. Se aplicó un cuestionario a 220 emprendedores en México, a través de los directores de incubadoras y aceleradoras de

empresas en México. El análisis de los datos se realizó mediante estadística descriptiva para caracterizar el perfil de los encuestados y un modelo de regresión logística binaria por etapas hacia atrás, con el fin de identificar los factores que inciden en la formación de EBTs. Los resultados identificaron como factores que favorecen la formación de empresas de base tecnológica en México: la experiencia del emprendedor en I+D, que su área de conocimiento sea Ingeniería o Ciencias de la Vida, la creación del negocio en equipo ($P < 0.10$) y el uso de servicios por parte de las oficinas de transferencia tecnológica (OTT) ($P < 0.05$). La identificación de estos factores contribuye a redireccionar la política pública en torno al emprendimiento de base tecnológica en México.

Palabras clave: innovación, transferencia de tecnología, EBTs.

Resumo

O empreendedorismo é importante por sua contribuição ao desenvolvimento nacional. Em relação ao desenvolvimento tecnológico, diversas teorias de crescimento econômico o reconhecem como fundamental para o bem-estar social, impactando a qualidade de vida. Nesse contexto, as empresas de base tecnológica constituem um elo entre as atividades produtivas de bens e serviços de valor agregado. Empresas de base tecnológica ou científica são aquelas que surgem de pesquisas realizadas em centros de pesquisa ou instituições de ensino superior e que possuem direitos de propriedade intelectual registrados. O objetivo deste estudo foi fornecer evidências empíricas sobre os fatores que influenciam a formação de empresas de base tecnológica no México. Um questionário foi aplicado a 220 empreendedores no México, por meio dos diretores de incubadoras e aceleradoras de empresas. A análise dos dados foi realizada por meio de estatística descritiva para caracterizar o perfil dos respondentes e um modelo de regressão logística binária regressiva para identificar os fatores que influenciam a formação de empresas de base tecnológica. Os resultados identificaram os seguintes fatores que favorecem a formação de empresas de base tecnológica no México: a experiência do empreendedor em P&D, seja em engenharia ou ciências da vida, a criação de negócios em equipe ($P < 0,10$) e a utilização de serviços de escritórios de transferência de tecnologia (ETT) ($P < 0,05$). A identificação desses fatores contribui para o redirecionamento das políticas públicas relacionadas ao empreendedorismo de base tecnológica no México.

Palavras-chave: inovação, transferência de tecnologia, ETTs.

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Introduction

In Latin America, investment in research and development (R&D) has been a longstanding concern. According to World Bank data (2022), only 0.67% of the region's GDP was allocated to R&D in 2019. In Mexico, this figure was even lower: 0.28% in 2019 and 0.30% in 2020, placing it below the regional average. While this issue requires urgent attention, it is also essential to foster scientific and technological innovation to enhance the market integration of these economies. One of the strategies is the formation of companies based on science and technology or EBTs (entrepreneurial technology-based businesses). Scientific/technology-based companies are those that arise from scientific and technological research carried out in public or private institutions and that have intellectual property registrations (Wright et al., 2008).

Numerous international studies have examined technology-based entrepreneurship from various perspectives, using different variables and data levels. In South America, for example, Zapata et al. (2018) analyzed the individual characteristics of entrepreneurs and proposed a typology of technology-based entrepreneurs from an individual perspective. Similarly, Hossinger et al. (2020) found that individual-level factors significantly explained the entrepreneurial behavior of academics involved in the creation of such firms.

Other studies have focused on institutional factors that facilitate the development of EBTs. For instance, Wöhrl et al. (2009) found that the age of a company can positively influence its growth and profitability throughout its life cycle.

Despite the relevance of EBTs due to the high-value returns they generate, this sector remains underdeveloped within higher education institutions. This is partly because faculty members are primarily dedicated to teaching and publishing research, and the creation of companies is not typically among their interests (Benavides-Sánchez et al., 2021). Additionally, there is a lack of consensus on the definition and scope of this type of entrepreneurship (Gómez, 2019).

Technological entrepreneurship contributes to development because technological advancement is recognized by various economic growth theories as essential to societal well-being, mainly through its impact on quality of life. In this context, technology-based companies act as a bridge between the production of goods and services and the generation of added value.



The socioeconomic, cultural, environmental, and institutional context of each country defines its specific technological needs. In the productive sector, it is essential to adapt machinery and equipment to meet the requirements of economic units. This underscores the need to focus efforts not only on the production of consumer goods but also on the development of capital goods based on technology-intensive processes that require highly qualified human capital.

In this context, the academic background of entrepreneurs emerges as a relevant factor in technology-based ventures. Therefore, the objective of this study was to provide empirical evidence on the determinants of technology-based company formation in Mexico. This aims to enrich understanding of the country's entrepreneurial ecosystem and assist policy makers in allocating resources effectively, identifying entrepreneurs with traits that increase the likelihood of launching EBTs.

Technological innovation is important for job creation and self-employment. Technology-based entrepreneurship is a driver of economic development. In Mexico, public and private organizations have established strategies to strengthen it. The National Autonomous University of Mexico (UNAM) has a technology-based business incubator as part of its InnovaUNAM System Incubator Network. One of the network's main functions is to promote entrepreneurship through business creation among academic staff, students, and graduates (National Autonomous University of Mexico, 2022).

The National Polytechnic Institute (IPN) has a Technology Business Incubation Directorate (DTBI). The purpose is to promote an entrepreneurial culture in its community and society (National Polytechnic Institute (Mexico), IPN, 2022). The Coordination of Technological and Polytechnic Universities seeks to strengthen technology-based entrepreneurship (National Association of Technological Universities, 2022). However, it has not managed to consolidate tools that allow its progress.

Public educational institutions promote technological entrepreneurship through the innovations generated and manifested through intellectual property registrations. The Science and Technology Law in Mexico was created in 2002. The National Entrepreneurship Institute (INADEM) was the public body responsible for promoting entrepreneurship development in Mexico from 2013 to 2019 (National Entrepreneurship Institute (INADEM), 2022).

Public policy supporting entrepreneurship was implemented through the National Entrepreneurship Fund (FNE), with three support options: Coaching and Technical Assistance, Group Training, Productive Equipment, and Certification (Ministry of Economy, 2022a). The Entrepreneurship System in Mexico was also established, consisting of a digital platform developed to process applications from entrepreneurs for the National Entrepreneurship Fund.

On October 17, 2019, INADEM's functions were transferred to the Productive Development Unit (UFP) of the Mexican Ministry of Economy, which is responsible for reviewing, proposing, promoting, designing, coordinating, and executing public policy to support micro, small, and medium-sized enterprises (MSMEs), with the aim of reducing inequality between people and regions (Ministry of Economy, 2022b).

The Productive Development Unit operates through programs 1. National Entrepreneur Fund and 2. National Program for Microenterprise Financing (Figure 1), which aims to provide financing to micro enterprises and entrepreneurs through the following elements:

Figure 1. Micro entrepreneur financing schemes in Mexico



Source: Authors' own elaboration, with information from the Ministry of Economy, 2022b.

Among the strategic sectors considered for the granting of loans to MSMEs are software development companies, the aerospace industry, green industries and renewable energies, the electrical and electronic sector, among others, but those mentioned are companies whose processes or components are intensive in technology.

The support for the development of Business Capacities, accompaniment, technical assistance and group training, are aimed at administrative, marketing, finance, inclusion and social responsibility aspects, among others with the purpose of improving the operation of smaller companies.

Similarly, the National Council of Humanities, Science and Technology (CONAHCYT), called under the current federal administration as the Secretariat of Science, Humanities, Technology and Innovation (SECIHTI, 2025) operated a Trust with contributions from the federal, state and municipal according to the needs of the federal entities, for the implementation of scientific and technological development and innovative projects. However, it is worth noting that the majority of the innovations developed were not consolidated as technology-based companies; they remain registered with the Mexican Institute of Intellectual Property (IMPI) but do not enter the market or commercialization, hence the relevance of This study, which, given this need, seeks to contribute to generating useful information to redefine entrepreneurship policy, especially technologically based.

Several studies have analyzed the factors associated with the formation of science- and technology-based companies. These include the level of education and field of study (Barbini et al., 2021), prior industry experience (Li & Dutta, 2018), team creation (Santos et al., 2019), intellectual property policies and the role of technology transfer offices (Fini et al., 2017), entrepreneurial culture (Scuotto et al., 2020), and external funding (Korpysa, 2019). The present study revisits these variables to assess their influence on the formation of TBCs in Mexico, grouping them into economic, behavioral, and institutional dimensions, following García-Macías et al. (2018).

Materials and Methods

This is a quantitative study with an explanatory scope and a cross-sectional, non-experimental design. Inferential statistical methods were applied for data analysis, including techniques commonly used in studies of technology-based companies (TBCs), such as those examining innovation absorption capacity (Alencar & Silva, 2021). Data were collected using a structured questionnaire composed of 25 questions. The instrument was distributed to 241 entrepreneurs in Mexico through directors of business incubators and accelerators. These institutions acted as intermediaries between researchers and entrepreneurs, as noted in prior studies (Del Giudice et al., 2017; Gonzalez, 2019; Miller et al., 2016a, 2016b; González et al., 2020; Contreras et al., 2021), which highlight the effectiveness of incubators in



supporting emerging businesses. The directors of incubators and accelerators distributed the survey link to participating entrepreneurs. After reviewing the responses, 21 were excluded due to inconsistencies, resulting in a final sample of 220 valid questionnaires. The data collection period spanned from July to December 2021.

Data analysis consisted of descriptive statistics to characterize respondents' profiles and a binary logistic regression model using the backward stepwise method to identify factors influencing the formation of EBTs.

The variables were grouped into two categories. The first included sociodemographic data such as age and gender. The second encompassed the variables used in the binary discrete choice model (Logit), which included: educational level, area of knowledge, prior industry experience, team creation, institutional intellectual property policy, use of TTO services, entrepreneurial culture, and access to external financing. These variables are supported by the literature as drivers of technology-based entrepreneurship (see Table 1).

Table 1. Operational definition of the analysis variables of technology-based entrepreneurship

| Level | Dimension | Variable | Coding |
|-------------|---------------------------------------|---|--|
| Dependent | | Type of company | 1= TBC 0= No TBC |
| Independent | Characteristics of the entrepreneur | Level of schooling | 1= Superior 0= Average higher or lower |
| | | Area of knowledge | 1 = Engineering or life sciences 0 = social sciences/business |
| | | Experience in R+D | 1= yes 0= no |
| | | Industry expertise | 1 = yes 0 = no |
| | | Team business creation | 1= yes 0= no |
| | Institutional environment | Intellectual property policy of institutions (royalties for the entrepreneur) | 1= yes 0 = no |
| | | Use of technology transfer office (TTO) services | 1= yes 0 = no |
| | | Entrepreneurial culture | 1= yes 0 = no |
| | Environmental or external environment | External financing. | 1 = yes 0 = no |

Source: Authors' own elaboration.

Based on the literature review, the study posits the following hypothesis:

H₁: Educational level, area of knowledge, prior industry experience, research and development experience, team creation, institutional intellectual property policies, use of technology transfer office services, entrepreneurial culture, and access to external financing significantly determine the likelihood of forming a technology-based company in Mexico.

The Logit discrete choice model is typically used when the dependent variable is binary. In this study, a value of 1 indicates a technology-based enterprise, while 0 represents a non-technology-based one. The following model was developed to identify the determinants of technology-based entrepreneurship (EBT):

$$P(\text{EBT}) = \beta_0 + \beta_1\text{LS} + \beta_2\text{AK} + \beta_3\text{PIexp} + \beta_4\text{ExpR\&D} + \beta_5\text{TBC} + \beta_6\text{IPP} + \beta_7\text{TTOserv} + \beta_8\text{EC} + \beta_9\text{EF} + \varepsilon$$

Where:

- o LS = Level of Schooling
- o AK = Area of Knowledge
- o PIexp = Prior Industry Experience
- o ExpR&D = Experience in Research and Development
- o TBC = Team Business Creation
- o IPP = Institutional Intellectual Property Policy
- o TTOserv = Use of TTO Services
- o EC = Entrepreneurial Culture
- o EF = External Financing

Data were collected using Google Forms and exported to Microsoft Excel. The variables were then recoded into dichotomous categories and analyzed using IBM SPSS Statistics, version 25.

Results

The sample consisted of 220 entrepreneurs from the companies surveyed. Among them, 177 (80.5%) represent non-technology-based companies, while 43 (19.5%) correspond to technology-based companies (TBCs). This implies that, on average, two out of every ten ventures are technology-based — a proportion that contrasts with findings by Zbierowski (2017) in Central and Eastern Europe and the Commonwealth of Independent States, where the share of newly created TBCs ranged from 0.7% in Russia to 5% in countries such as Slovakia, Romania, and Kazakhstan.

Table 2 shows that 36.8% of respondents are men, while 63.2% are women, indicating a higher overall female participation. However, when analyzing gender distribution specifically within the group of EBT founders, male entrepreneurs represent 55.8%. This may be explained by the fact that most technology-based ventures are associated with STEM disciplines (Science, Technology, Engineering, and Mathematics), fields in which male participation remains dominant.

More than half of the founders of EBTs are between 21 and 30 years old. This aligns with the findings of Peixoto et al. (2016), who reported an average age of 30.4 years for EBTs founders in Alagoas, Brazil. The age at which technology-based ventures are typically created coincides with the average age at which postgraduate studies are completed in Mexico, approximately 30 years. These results support previous research indicating that technological entrepreneurship is often driven by individuals with high academic qualifications (García et al., 2020).

Table 2. Sociodemographic profile of entrepreneurs in Mexico

| Variables | Categories | EBT sample (%) | EBT sample + No EBT (%) |
|--------------------------|-----------------------------|----------------|-------------------------|
| Type of company | TBC | 19.5 | 100% |
| | No TBC | 80.5 | Correspond to 220 |
| Gender | Man | 55.8 | 36.8 |
| | Woman | 44.2 | 63.2 |
| Educational level | Upper or lower middle | 11.6 | 19.1 |
| | Superior | 88.4 | 80.9 |
| Age | Less than 21 years old | 0 | 4.5 |
| | Between 21 and 30 years old | 51.2 | 39.5 |
| | | 16.3 | 23.2 |
| | Between 31 and 40 years old | 20.9 | 21.4 |
| | Between 41 and 50 years old | 9.3 | 9.1 |
| | Between 51 and 60 years old | 2.3 | 2.3 |
| Company size | 1 to 5 people | 65.1 | 78.2 |
| | 6 to 10 people | 20.9 | 12.8 |
| | More than 10 | 14.0 | 9.1 |
| Seniority of the company | 0 to 5 years | 76.7 | 76.4 |
| | 6 to 10 years | 9.3 | 11.4 |
| | More than 10 years | 14.0 | 12.3 |

Source: Authors' own elaboration.

In terms of innovation domains, the predominant sectors include services such as telecommunications, environmental technologies, materials science, and biotechnology, among others.

A binary logistic regression was applied to assess how the analyzed variables influence the likelihood of an entrepreneur forming a technology-based company. The model explained 14.8% of the variance in EBT formation and correctly classified 80.4% of the cases.

Statistically significant variables at the 5% and 10% levels include the entrepreneur's area of knowledge, experience in research and development, formation of the business as a

team, and utilization of services from technology transfer offices (TTOs), as shown in Table 3.

Table 3. Logistic regression model results

| Independent variables | Coefficients β | p-value |
|--|----------------------|---------|
| Level of schooling | .417 | .439 |
| Area of knowledge | .637 | .082* |
| Experience in R+D | .671 | .093* |
| Industry expertise | .067 | .857 |
| Team business creation | .713 | .076* |
| Intellectual property policy of institutions (royalties) | -0.209 | .234 |
| Use of technology transfer office (TTO) services | .929 | .011** |
| Entrepreneurial culture | .368 | .348 |
| External financing. | .208 | .675 |

Note: $p < 0.05$ (**) | $p < 0.10$ (*)

Source: Authors' own elaboration.

Discussion

The findings regarding area of knowledge and research and development (R&D) experience as predictors of technology-based entrepreneurship are consistent with those reported by Moog et al. (2015) and Fini and Toschi (2016). These authors indicate that academics involved in applied research, particularly in disciplines such as science, engineering, and physics, are more likely to engage in entrepreneurial activities.

The significance of team-based venture creation aligns with the work of Santos et al. (2019), who identified this factor as key for the formation of TBCs. Similarly, Benavides-Sánchez, Castro-Ruíz, and Brand-Narváez (2023) emphasize the importance of multidisciplinary teams in this type of entrepreneurship.

The use of services provided by technology transfer offices (TTOs) was also a significant factor in the formation of TBCs. Pérez and Calderón (2019) support this finding, noting that TTOs contribute to the foundational capabilities needed for university-based ventures. However, they also acknowledge that some institutions lack sufficient support mechanisms to ensure the successful materialization of such companies.

According to the Global Entrepreneurship Monitor (2022), Mexico's average score for technology transfer in research and development was 3.18 in 2021, down from 4.05 in 2020. In both years, these values were below the regional average for Latin America and the Caribbean, which stood at 4.07.

Intellectual property (IP) policies regarding royalties in Mexican higher education institutions are still underdeveloped. Their regulation largely depends on institutional guidelines where entrepreneurial initiatives emerge. In this context, the public policy framework for IP rights still requires significant progress to effectively support the creation of TBCs. This includes ensuring that academics and entrepreneurs receive adequate income from their inventions, in addition to their university salaries, through structured institutional and governmental mechanisms (González, 2016).

In contrast, entrepreneurial culture was not a statistically significant factor. This may be due to the limited presence of business training within the technological entrepreneurship sector. As Evangelista et al. (2018) argue, technology-based entrepreneurs often possess strong technical skills but lack formal business preparation. Similarly, external financing did not prove significant in this study, contrasting with the findings of García-Macías et al. (2018), who identified it as the most influential environmental factor for general entrepreneurship. However, in the specific case of technology-based entrepreneurship, external funding does not appear to play a determining role in business formation.

This study was conducted nationwide in Mexico and included responses from entrepreneurs across various cities. However, a probabilistic sampling approach was not feasible due to the absence of a comprehensive registry of technology-based entrepreneurs. Additionally, the COVID-19 pandemic limited the researchers' ability to expand the sample. Despite these limitations, the findings provide valuable insights for policymakers focused on promoting technological entrepreneurship and optimizing the allocation of resources for the development of EBTs.

Conclusions

This study provided partial evidence in support of the proposed hypothesis regarding the characteristics of entrepreneurs in Mexico and the factors influencing the formation of technology-based companies (EBTs). These findings offer a foundation for redirecting public policy on entrepreneurship in the country.

Technology-based entrepreneurship is influenced by the entrepreneur's area of knowledge and their experience in research and development. Teamwork during business creation also plays a critical role in this type of venture. Furthermore, the use of services provided by technology transfer offices (TTOs) emerged as a decisive factor. These aspects should be considered in public policy initiatives aimed at fostering technology-based ventures, including those developed by national and state centers for the promotion of research, technological development, and innovation-oriented organizations.

Conversely, variables such as level of schooling, industry experience, institutional intellectual property policies (royalties), entrepreneurial culture, and external financing did not show significant differences between TBCs and Non-TBCs. Based on these findings, it is recommended to replicate the study using a probabilistic sampling method. This may be feasible once COVID-19-related restrictions are lifted—one of the main barriers to data collection in this study. Such replication would allow for greater generalizability of the results to the broader population of technology-based entrepreneurs in Mexico.

The establishment of policies that promote the entrepreneurial ecosystem—particularly those focused on scientific and technological ventures—can significantly contribute to national development. This may occur through the creation of employment and self-employment opportunities, as well as the transformation of innovations into services and capital goods (e.g., machinery and equipment) adapted to the national context.

Future lines of research

Given that innovation is a key driver of economic growth and, consequently, national development, it must be studied from multiple perspectives. Future research should aim to identify the predominant types of innovation and their components within technology-based ventures.

Since this study found that services provided by technology transfer offices (TTOs) play a significant role in the formation of technology-based companies, future research should explore which specific services have the greatest impact on technological entrepreneurship. Such analysis would help inform the strategic allocation of TTO resources and enhance their overall effectiveness.

Team-based entrepreneurship also influences the development of technology-based ventures. Therefore, future studies should examine the sociodemographic, academic, and other relevant characteristics of individuals involved in successful team-based technological ventures. This knowledge could guide aspiring entrepreneurs in forming strategic alliances to increase the likelihood of success.

Finally, considering current global environmental challenges, it is essential to assess the degree to which social and environmental responsibility is integrated into technology-based ventures. Future research with a sustainability-oriented approach to technological entrepreneurship could inform the design or reorientation of support services, including those offered by TTOs.

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