Public universities in Mexico: an analysis of entrepreneurship

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Abstract

This research aims to identify the “entrepreneurial” characteristics of public universities in Mexico that offer educational programs related to business management. To achieve this, the methodology defined by the Organization for Economic Cooperation and Development (OECD) and the European Commission was used, in addition to a Structural Equation Model (SEM). The results allowed the design of a model tailored to local universities and the identification of the main characteristics of public universities regarding their commitment to promoting entrepreneurship. However, the result showed that they lack an incentive mechanism to make this possible, together with a link to the external sector.

Keywords: public universities; entrepreneurship; Structural Equation Models (SEM); OECD; innovation management.

1. INTRODUCTION

Higher education institutions are the centers for creating professionals who, due to their characteristics, can impact a country's productive structure. In this context, the training of entrepreneurs becomes one of the most important aims of these educational centers. Entrepreneurship is related to a country's capacity to create and consolidate local companies, as well as to create jobs and income and influence economic activity, thus becoming a bastion for regional development and international competitiveness (Awad and Salaimeh, 2023; McKinsey and Company, 2011; NACIE, 2013).

In the last two decades, particularly after the 2008-2009 international economic crisis, policies to promote higher education institutions as centers for entrepreneurship have increased using different strategies. These include updating educational programs, professionalizing teachers, strengthening infrastructure, and carrying out different activities to encourage the development of students' entrepreneurial spirit.

It is important to recognize that entrepreneurial models in universities are linked to the infrastructure for the generation and landing of new ideas and are an important link to the local, national and international environment, which allows students, institutions, governments and companies involved to remain in a globalized and competitive context.

Currently, these institutions are undergoing a transformation with respect to the role they play in the economy and, in addition to performing an educational and research function, they are required to focus on participating in solving the problems of society, government, business and significant national challenges. The latter has been called the third mission that gives them the title of "entrepreneurial universities" (Shvedova and Maevskaya, 2019; Etzkowitz, 2016; Clark, 1998). To fulfill this mission, universities implement various strategies such as participating in technology transfer offices (TTOs), the creation of incubators, spin-offs, startups, industrial-scientific-technological-research parks, specialized laboratories, research centers, industrial clusters-districts, new companies, sale of specialized services such as patents, intellectual property, the creation of collaboration and financing networks, and so on. This phenomenon is also known as the Knowledge Production System, which facilitates in a more friendly and efficient way the application and exploitation of knowledge and technology (Leydesdorff and Meyer, 2006, p. 1441; Neri, 2019; Secundo and Giovanni, 2018, p. 3; Etzkowitz, 2000).

In this context, the participation of higher education institutions in the economy becomes strategic, especially because of their ability to influence development and address the problems of society. This study seeks to contribute to the knowledge of the extent to which public universities in Mexico have the capacity to act as entrepreneurial universities by referring to the international characteristics that have been identified. It focuses on those that offer educational programs in Administration, Entrepreneurial Development and Business, as areas of knowledge, which, by their very nature, place greater emphasis on promoting the development of competencies so that students can create enterprises or consolidate businesses. This will allow us to identify both strengths and weaknesses and thus move forward in the design of a better and more relevant higher education model.

This research is organized into four sections - the first deals with the different theoretical approaches that analyze universities as agents that promote entrepreneurship. The second presents the methodological model that enables the measurement of entrepreneurial characteristics in a university. The third section presents the evaluation results in public universities and, finally, the conclusions section shows the strengths and weaknesses of public universities in Mexico as sources of entrepreneurship.

2. CONTEXT

The university is an institution that offers professional training services that provide knowledge, skills, and abilities to students to enter the labor market, either as employees or by setting up companies that, in turn, create new jobs and income and contribute to economic growth (Aparicio *et al.*, 2016). For this function to be fulfilled, universities seek to train human capital willing to take risks and participate in creating companies, placing greater emphasis on those involved in educational programs related to business administration.

The development model proposed for the countries, which began in the 1980s, focused on reducing the number of states and addressing the needs of society through the free market. This gave way to an education in which the aim is for students to have the necessary skills to tackle their professional life by implementing ventures to provide goods and services required by the population, cities and governments. As a result, new models, such as entrepreneurial ecosystems, were promoted (Malecki, 2018; Durazo *et al.*, 2021).

Guerrero and Urbano (2017) note that, in the context of dynamic structural changes, such as those occurring in the political, social, and economic fields, universities become key players in promoting the development of regions by being the leading promoters of innovation and entrepreneurship. Nevertheless, they recognize the need for universities to redefine their management structure and carry out networking initiatives, update their educational programs, define support mechanisms, consolidate an entrepreneurial and innovative culture to facilitate the generation-transfer of knowledge and be aware of the social, economic and technological impact in the context (Fini *et al.*, 2017).

Studies on entrepreneurship are no longer theoretical but instead models that focus on analyzing its determining factors. These are especially useful because they permit the creation of relationships and explanations that facilitate the design of institutional business policies. Some studies include mathematical models, which provide a better understanding of the relationship between entrepreneurship and the factors that encourage it. Two main approaches to entrepreneurship have been identified: one that studies it from the perspective of young people and the other that approaches it from the viewpoint of the universities themselves. These approaches include those that make theoretical contributions and those that use mathematical factors and models.

Some studies measure entrepreneurship based on the perception of students. A particular case is represented by studies on the theory of planned behavior or entrepreneurial intention, identifying the factors that characterize an entrepreneur. In this type of study, it is common practice to use structural equation modeling (SEM), which permits the definition of constructs based on variables that measure specific skills, qualities or perceptions on a particular topic. Thus, entrepreneurship, as seen from the students' point of view, was able to be narrowed down to dimensions such as: attitude towards entrepreneurship, normative beliefs, subjective norms, perception of personal self-efficacy, perceived behavioral control, perceived risks and entrepreneurial intentions (Ajzen, 1985; King and Dennis, 2006). The cases conducted using this approach include the following:

- Karimi *et al.* (2011) conducted a study based on the model of entrepreneurial intentions, using structural equation methodology, where they verify the relationship between the entrepreneurial intention of students with variables such as the need for achievement, willingness to take risks, capacity for innovation, self-efficacy and need for independence. They identified the most significant factors as self-efficacy and the need for achievement, with the risk-taking variable as the one that most inhibits entrepreneurship.
- Boubker *et al.* (2021), in turn, used the SEM model to evaluate the entrepreneurial education of university students in Morocco. They found a direct, meaningful relationship between entrepreneurial education and attitude towards entrepreneurship on entrepreneurial intention.
- Barba *et al.* (2022) also studied entrepreneurial intention in Spanish university students using the SEM. They showed that attitude towards entrepreneurial behavior and perceived behavioral control significantly influence entrepreneurial intention.
- Martinez *et al.* (2018) produced a study on the entrepreneurial intention of students in Brazil. They carried out a comparison between public and private universities, registering increased entrepreneurial intention in the latter.
- Lin *et al.* (2022) studied entrepreneurial intention in Chinese university students in Madrid using the SEM. They discovered that the determining factors are identified with subjective norms and perceived control. However, they also found that aspects such as gender, work experience or relationship with entrepreneurial family do not represent a meaningful relationship with entrepreneurial intention.
- Arroyo *et al.* (2021) investigated entrepreneurial intention in young university engineering students in Mexico. Using the SEM, they found that entrepreneurial attitudes and entrepreneurial education are directly related to entrepreneurial intention. They recommend that education should prioritize experiential learning to encourage entrepreneurial skills.

An increasing number of studies on entrepreneurship are trying to explain it using statistical models, which allow an analysis not only of each of its factors but also of the relationships generated between them. This analytical evolution has been possible thanks to models such as SEM, which have extended its application to different problems in other areas of knowledge.

Furthermore, studies on entrepreneurship exist that use theoretical-quantitative methods focused on higher education institutions and, while they are in the minority, they have been carried out using various study techniques. These studies include the following:

- Salamzadeh *et al.* (2022) conducted a study in universities in Malaysia where they analyzed their entrepreneurial inputs, processes, and outputs, highlighting the direct relationship between social capital and entrepreneurship. In this case, they used the SEM methodology.
- Amponsah and Novak (2022), in turn, developed a study in the United Kingdom to identify the determining factors influencing knowledge transfer from universities. They showed that aspects such as financing, patents and incentives considerably influence the creation of university spin-off companies, for which they also used SEM.
- Likewise, Miranda *et al.* (2017) used SEM to verify the influence between academic entrepreneurship and the variables that allowed them to create a spin-off in Spanish universities.
- Reza *et al.* (2019) used confirmatory factor analysis and SEM to validate and test an entrepreneurial university model with a grounded theory approach constructed from the opinion of entrepreneurial university experts in western Iran. Their study identified 21 variables and 6 dimensions of entrepreneurship, concluding that this type of model allows a higher education institution to move towards a “true” third-generation university that identifies with entrepreneurship.

Studies show that entrepreneurship has been analyzed more from the perspective of students than universities, with the same frequency with respect to the use of mathematical models to explain its determining factors.

Finally, the proposal of the OECD and the European Commission (OECD, 2012) is a qualitative self-evaluation instrument for European universities. This was designed taking into consideration experts' opinions and available scientific literature. It is applied online and permits obtaining information on the "ideal" situation of universities with respect to the criteria considered to be the most important for a higher education institution to be considered "entrepreneurial". This methodology reflects a theoretical model considering seven major dimensions reflecting entrepreneurial competencies.

Although the issue of higher education institutions generates considerable controversy in Mexico, both for the attempt to fit them into a single development model and for the inequalities that exist among them (type of educational system, enrollment, educational program, funding amounts, quality, coverage, dropout rate, relevance, infrastructure, faculty, geographic location, etc.), their study is relevant because the future of higher education and its salvation as an agent of development need to be rethought.

Theories on entrepreneurial universities, whether officialist or progressive currents, propose more active participation and linkage to address society's problems and train professionals capable of influencing it. However, the dominance of teaching and incipient research activities in public universities limits these objectives (Mendoza, 2022; Acosta, 2014; UNESCO, 2021).

Given the lack of entrepreneurship models in the country, this study uses a methodology developed by the OECD (2012) to be applied in public universities and to identify areas of opportunity for improvement.

The relevance of the model proposed by the OECD is that it takes into account the international context and rescues the role of universities in addressing social and economic problems. Although its design and approach are not identified with Mexican public universities, it is an appropriate methodology to understand the challenges of moving towards more functional institutions identified with development.

The purpose of this research is not only limited to taking the OECD theoretical model as a reference but also to evaluate it with robust statistical tools using reliability indices in an SEM and to perform an integral analysis to obtain a version tailored to the characteristics of public universities in Mexico. In this way, the results are timely, relevant and valuable to support the design of long-term strategies with reliable information.

3. METHODOLOGY

The purpose of this research is to identify the "entrepreneurial" characteristics of public universities in Mexico that offer educational programs related to business management in order to measure their ability to adapt to the new roles demanded by society. To achieve this, the following specific objectives were proposed: to use the methodology developed by the OECD and the European Commission (OECD, 2012) to measure the characteristics of an entrepreneurial university; to validate the adaptation of the study model to the local case through an SEM, and; to identify the entrepreneurial strengths and weaknesses of public universities in Mexico.

In the social sciences, SEMs represent a valuable tool to confirm theoretical models related to problems of society or its individuals so that their application is viable in different fields of knowledge. Modeling consists of identifying related variables that can explain a problem, so it is important to validate the consistency of this relationship.

In this respect, SEM allows the estimation of these latent variables that cannot be measured directly. Therefore, it is carried out using observable variables, at the same time estimating the relationship between them, thus verifying the relevance of the theoretical approach (such as the OECD methodology) with respect to an observed one (in this case, in Mexico). A multivariate statistical analysis is performed, which consists of contrasting their variance and covariance matrices, estimating both the correlation and the association between these variables and the estimation errors. In addition, it allows the graphical representation of the relationship between variables, which gives increased reliability, dependability and capacity to analyze the results (Arbuckle, 2020; Manzano, 2018; Schermelleh and Moosbrugger, 2003; Chin, 2013, p. 295; Ortiz and Fernandez, 2018).

The guiding questions of the research are: what are the most important factors that characterize an entrepreneurial university? Is it possible to verify the consistency of the entrepreneurial university model through an SEM? Is it possible to identify areas of opportunity to consolidate an entrepreneurial model in public universities in Mexico? In this study, 327 professors of educational programs related to administration and business participated, of which 21 were coordinators of educational programs, 98 full-time professors and 208 hourly professors, belonging to 24 higher education institutions in 14 Mexican states. To select participants, 86 coordinators of educational programs in different public universities in the country were invited to answer the survey and share it with their professors. The information was collected through digital media between October 2021 and March 2022.

It is important to mention that the methodology defined at the international level by the OECD was validated for the results obtained in the case of Mexico through the SEM. This made it possible to adapt the theoretical model and adjust the variables considered for the case of public higher education institutions in Mexico.

The degree of institutional and cultural management of entrepreneurship in universities was evaluated based on seven dimensions, considering a total of 41 variables (5, 7, 6, 6, 7, 6, 5 and 5 for each in the OECD model). These record the perception of entrepreneurship on a scale from 1 to 10, where 10 reflects a greater consolidation of the entrepreneurial profile. In this respect, the research is based on a quantitative empirical study. The structural equation analysis was carried out with the help of the AMOS module of the SPSS (Statistical Package for the Social Sciences) software.

Various studies exist that define an entrepreneurial university (OECD, 2022; Boruck and Mafra, 2020; Bacigalupo, 2019; Guerrero *et al.*, 2015; Armbruster, 2008; Etzkowitz, 2003). However, taking into account the factors of analysis in this research, an entrepreneurial university is defined as one that recognizes itself as part of the development of its environment, measures its impact and has a physical, financial and administrative infrastructure that facilitates the interaction of its administrative staff, faculty and students with national and foreign stakeholders (business, government, social and productive organizations), to carry out joint activities that allow it to meet their needs through training, research, innovation, technology transfer, the use of knowledge and the best available methodologies, which contributes to entrepreneurship, employability and change management.

The conceptual model of this study is based on the analysis of the relationships between the following seven latent variables, which are considered characteristics of a university that successfully promotes entrepreneurship (OECD, 2012):

Leadership and governance. This shows how higher education institutions can create, promote and implement an entrepreneurial culture and strategy, as well as exercise good governance in a context of autonomy to encourage entrepreneurship at the different educational levels of the university.

Development of entrepreneurship in education. This reflects an effective organizational structure that the university has defined to offer professional training with an innovative entrepreneurial approach, making available areas, programs and human resources to provide tools to staff, students and stakeholders interested in developing entrepreneurial skills. This also includes validating the impact of the learning outcomes of entrepreneurship.

The relationship between the university and the business for exchanging knowledge. This represents the willingness shown by the university to liaise with interested parties to facilitate students, faculty and staff in related areas to approach them and mature their entrepreneurial profile, as well as to transfer knowledge and technology. Links are highlighted with companies, government, other universities, research centers, social organizations, alumni, business organizations and organizations located in the different regions, which is facilitated by the availability of infrastructure for entrepreneurship.

Learning and routes for entrepreneurs. This refers to the university’s capacity to generate awareness, experiment, develop ideas, interact with professors and businesses, access financing and use facilities that promote entrepreneurship, which can be reflected in the creation of businesses or jobs.

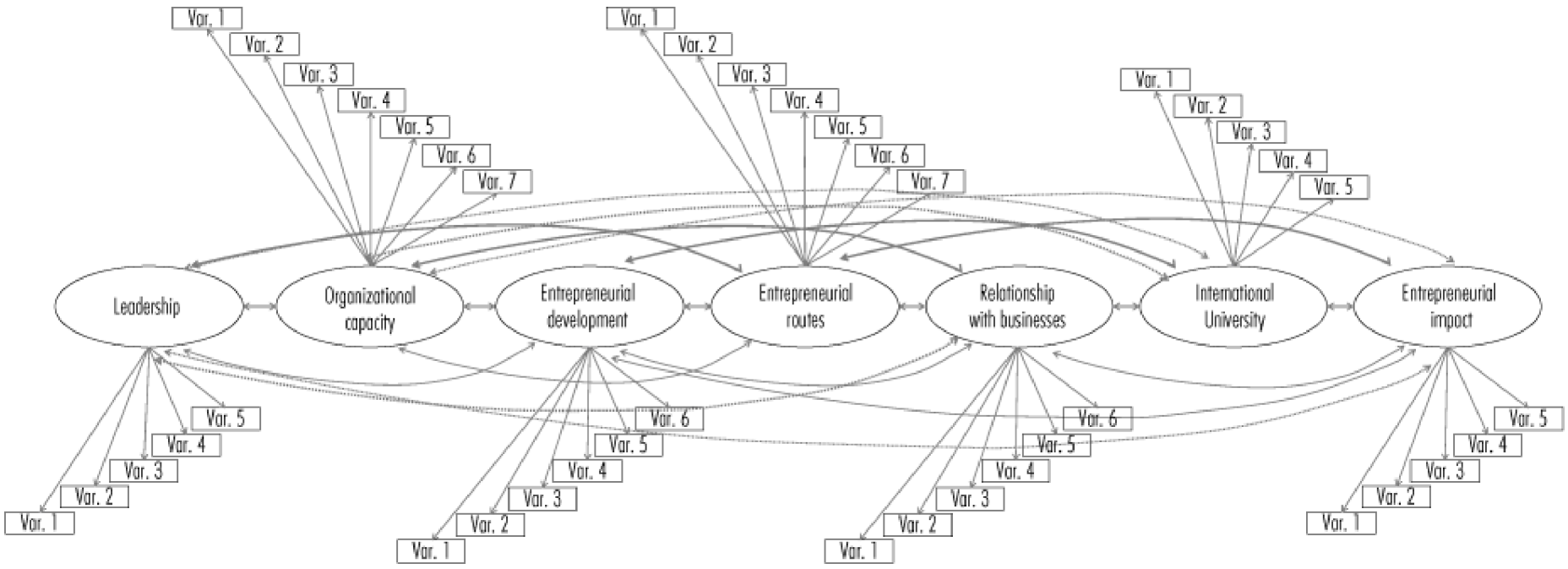
Measuring the impact of the Entrepreneurial University. This refers to the capacity demonstrated by the institution to follow up on the results and impacts that its entrepreneurial practices have on related parties such as students, staff, the institution itself (internal) or on companies, government, social organizations or the environment, both locally, nationally or internationally (external). It focuses on obtaining indicators regarding the entrepreneurship of graduates, talent retention, impacts on local economic development (companies or jobs created) or business strategies implemented.

The Entrepreneurial University as an internationalized institution. This refers to the opportunities offered by the university to administrative staff, faculty and students to access international links, institutions, programs and experts as a teaching-research-entrepreneurial practice.

Organizational capacity, people and incentives. This dimension represents the human, administrative and financial structure that the university has built to adequately and dynamically manage and encourage the development of entrepreneurial skills in students. This requires the involvement of administrative staff, professors, students and stakeholders and a mechanism for financing, monitoring and recognizing entrepreneurship.

As shown in Figure 1, the SEM of the study that represents the observed variables (rectangles) and the latent variables (ellipses) that characterize an entrepreneurial university makes it possible to show the variables that measure each dimension and how each dimension relates to the others.

Figure 1. Conceptual model for assessing the entrepreneurial profile of universities



Source: compiled by the author based on OECD (2012).

An advantage of SEM models over multivariate procedures is that they adopt a confirmatory approach (hypothesis testing), where structural (or regression) equations represent causal observation processes on multiple variables. This allows them to be statistically tested simultaneously and their consistency to be verified with a goodness-of-fit test where it is possible to evaluate estimation errors, thus requiring a confirmatory rather than an exploratory analysis.

It is important to recognize that one of the critical aspects in the use of SEM is to maintain the assumption of normality of the data, which is difficult to fulfill when a study is proposed with a large population (more than 250) since it increases the differences between the variance-covariance matrix of the sample and the proposed model. This problem is reflected in the non-compliance of the goodness-of-fit indices, especially the absolute ones such as Chi-square, X2 adjusted for degrees of freedom, RMSEA and RMR. To avoid this problem, it is recommended to consider additional goodness-of-fit indices such as incremental CFI, GFI, IFI, TLI, NFI or parsimony indices pGFI, pNFI, pCFI (Manzano, 2018; SS, 2022; Boomsma and Hoogland, 2001; Ruiz *et al.*, 2010). However, in this research, it was not necessary because, as a result of the adjustment of the model through confirmatory analysis and the reduction of variables, it was possible to verify the quality and significance of the relationships of the model of entrepreneurial universities, the case of public institutions in Mexico.

4. RESULTS

The results obtained from the research are presented in three subsections: *a)* verification of the consistency of the dimensions of the undertaking, *b)* application of the SEM, and *c)* validation of the relationships between variables.

Verification of the consistency of the dimensions of the enterprise

Although the methodology is proposed by two prestigious international organizations, the OECD and the European Commission, it was useful to evaluate the instrument with a sample of 327 professors to measure entrepreneurship in public universities in Mexico, which proved to be consistent in its design and application with significant statistical reliability coefficients for the scales and factors of each of the dimensions considered in the model.

A recurrent method for measuring the internal consistency of a latent variable, in this case, each of the dimensions used to represent entrepreneurship, with respect to the variables used to measure them, is Cronbach's alpha coefficient (α). If the selected variables correctly describe the dimension, the result should be greater than 0.7 and up to 0.9 (Grande and Abascal, 2007, p. 243; Oviedo and Campo, 2005).

The results obtained are as follows (Cronbach's alpha | number of variables observed): Leadership and Governance (α = 0.920 | 5), Organizational capacity, people and incentives (α = 0.951 | 7), Entrepreneurial development in teaching and learning (α = 0.960 | 6), Entrepreneurial pathways (α = 0.963 | 7), University-business relations for knowledge exchange (α = 0.960 | 6), Entrepreneurial University as an internationalized institution (α = 0.982 | 5), Entrepreneurial University impact (α = 0.979 | 5).

Application of structural equation modeling (SEM)

The OECD (2012) methodology defined by a group of international experts includes only content validation. The validity of the theoretical consistency of the latent variables was carried out by verifying the results obtained from 327 teachers in Mexico, performing a multivariate statistical analysis under SEM. This permitted the analysis of the relationship between the observed variables and the dimensions of entrepreneurship and the relationship between the dimensions themselves.

The criteria for verifying the conformity of the proposed model with respect to the fit of the data obtained were determined using different statistics: Normed Chi Square by Degrees of Freedom (CMIN/DF), which expects values between 1 and 5 to show acceptable model fit; incremental fit indices such as the Comparative Fit Index

(CFI), the Normed Fit Index (NFI) and the Non-Normed Tucker-Lewis Index (TLI), which should register values between 0.9 and 1 to reflect an acceptable goodness of fit of the variables in the model. In addition, the poor-fit indices were considered: Root Mean Square Error of Approximation (RMSEA), whose indicator should be between 0.6 and 0.8 to reflect a better fit to the sample size; the Root Mean Square Residual (RMSR), in this case a value approaching zero reflects a better fit (Detrinidad, 2016; Ruiz *et al.*, 2010; Cea, 2004; Hu and Bentler, 1999; Hair *et al.*, 2010; Escobedo *et al.*, 2016).

The initial model was subjected to SEM analysis in order to adjust the model according to the results of the study and the observed variables, i.e., variables were eliminated until the previously defined statistical standards were met. It was necessary to reduce the number of observed variables for the different study dimensions by 20, thus obtaining statistical indicators that allowed a reliable analysis of the characteristics of the entrepreneurial universities. After a series of confirmatory factor analyses, the resulting model comprised 21 observed variables and seven latent variables (see Figure 3). This adjustment improved all the indicators with respect to the original theoretical model: RMR = 0.093 (close to 0), RMSEA = 0.073 (between 0.05 and 0.08), CMIN/DF = 2.735 (between 1 and 5), CFI = 0.968, NFI = 0.951 and TLI = 0.96 (the latter between 0.9 and 1.0), which show better indicators of goodness of fit than those obtained by applying the original methodology (see Table 1).

Table 1. Expected fit and consistency indices for the SEM and indices obtained for the confirmatory factor analysis: original and adjusted mode

Fit index	*Expected value*	*Value obtained*	
		Original model	*Adjusted model*
Chi-square (X2)	> 0.05	3 120.2	459.4
Degrees of freedom		758.1	168
Discrepancy between X2 and degrees of freedom (CMIN/DF)	>1 y < 5	4.116	2.735
Root-mean-square residual index (RMR)	Close to 0	0.187	0.093
Root Mean Square Error of Approximation (RMSEA)	<0.05 / 0.08	0.098	0.073
Comparative fit index (CFI)	Between 0.9 and 1.0	0.877	0.968
Normed fit index (NFI)	Between 0.9 and 1.0	0.845	0.951
Non-normed fit index (NNFI or TLI)	Between 0.9 and 1.0	0.867	0.960

Source: compiled by the author using SPSS Amos v.25 software.

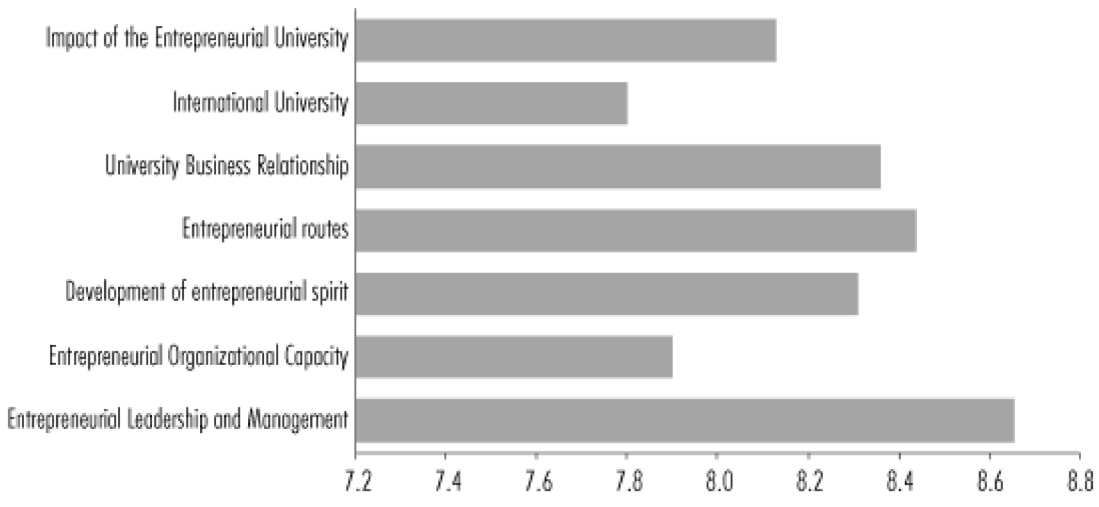
This result is also consistent with the recommendation that the number of observations should reflect 10 to 20 times more cases than the number of variables (SS, 2022). This explains why the fit in this study coincided at a number of 21 variables with 327 individuals, or a ratio of 1:15.57.

It is important to mention that the reliability coefficients obtained in the proprietary model proved significant for each of the dimensions of analysis (Cronbach's alpha | number of variables observed): Leadership and Governance (α = 0.894 | 3), Organizational Capacity, People and Incentives (α = 0.915 | 3), Entrepreneurial Development in Teaching and Learning (α = 0.926 | 3), Entrepreneurial Pathways (α = 0. 940 | 3), University-business relations for knowledge exchange (α = 0.927 | 3), Entrepreneurial University as an internationalized institution (α= 0.958 | 3), Impact of the Entrepreneurial University α = 0.968 | 3).

Validation of relationships between variables

The results show that entrepreneurial leadership, management, and entrepreneurial routes are the most consolidated dimensions. However, those dimensions related to International University and Organizational capacity of entrepreneurship show less consolidation (see Figure 2).

Figure 2. Perception of entrepreneurship in public universities in Mexico, by dimension



Source: compiled by the author using data from the entrepreneurial survey (scale from 1 to 10)

Meanwhile, the observed variables that allow the evaluation of entrepreneurship in Mexican public universities, according to their degree of consolidation, are shown in Table 2, where those related to the promotion of entrepreneurship are significant. However, the lack of international links, the attraction of entrepreneurial personnel and the recognition of stakeholders are less weighted.

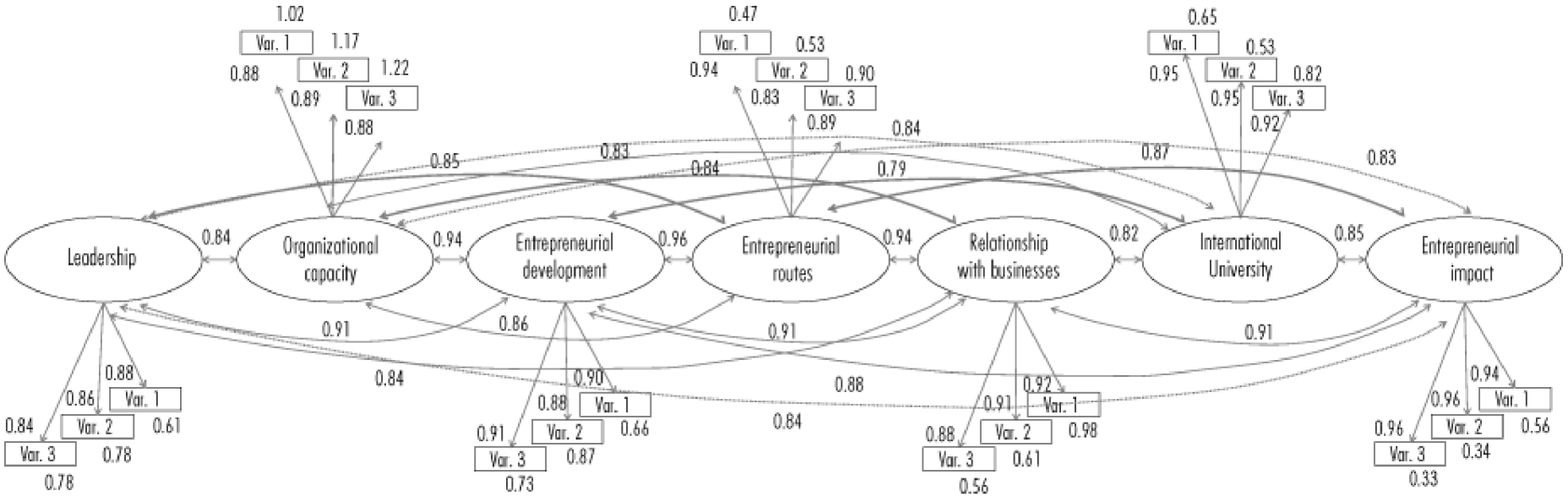
Table 2. Variables for measuring the entrepreneurial management capacity of public universities, according to their consolidation

Dimension	*The university (is / has / promotes):*	*Mean*	*D. Est.*
LyG	A driver of entrepreneurial spirit	8.82	1.64
LyG	Highly committed to entrepreneurial strategy	8.67	1.62
RE	Raises awareness of the importance of entrepreneurship	8.55	1.95
RUE	Promotes exchange with industry, society and government	8.52	1.90
LyG	Has an entrepreneurial model	8.50	1.75
RE	Encourages people to become entrepreneurs	8.44	2.02
RUE	Demonstrates involvement in partnerships and interested parties	8.43	1.89
DEE	Staff adopts an entrepreneurial approach	8.39	1.96
DEE	Supports the development of entrepreneurial mindsets and skills	8.33	1.89
RE	Provides opportunities to experience entrepreneurship	8.33	2.10
DEE	Validates entrepreneurial learning outcomes	8.20	2.11
IUE	Evaluates participation in entrepreneurial teaching and learning	8.19	2.17
IUE	Evaluates the impact of entrepreneurial teaching and learning	8.17	2.10
RUE	Participates in activities with businesses and the external environment	8.14	2.09
IUE	Evaluates the impact of its entrepreneurial strategy	8.02	2.22
CO	Encourages entrepreneurial relationships	7.98	2.15
CO	Invests in staff development	7.86	2.38
CO	Recognizes interested parties	7.85	2.37
UII	Participates in international networks	7.84	2.38
UII	Demonstrates internationalization in its approach to teaching	7.82	2.39
UII	Seeks out and attracts international and entrepreneurial staff	7.75	2.52

Notes: D.Est. = Standard deviation. The mean is estimated for an interval between 1 and 10. Dimensions: LyG = Leadership and Governance; CO = Organizational Capacity, People and Incentives; DEE = Entrepreneurial Development in Teaching and Learning; RE = Entrepreneurial Pathways; RUE = University-Enterprise Relationship for Knowledge Exchange; UII = Entrepreneurial University as an Internationalized Institution; IUE = Entrepreneurial University Impact.
Source: compiled by the author using SPSS v. 25 software.

Figure 3 shows the relationship (covariances or correlations) between the variables and dimensions that characterize the entrepreneurial profile of public universities, as well as the relationship between each of the dimensions. The role of the Entrepreneurial development dimension and its relationship with the rest of the dimensions (correlation) stands out. On the other hand, the International university dimension shows a lower impact with respect to the rest of the dimensions.

Figure 3. Model of entrepreneurial public universities in Mexico: dimensions and variables



Chi-square = 459.4, df = 168, P-value = 0.01, RMSEA = 0.073, CFI = 0.968.
Notes: bidirectional arrows show correlations, unidirectional arrows show saturation and non-standardized error data.
Source: compiled by the author using SPSS Amos v.25 software and based on OECD (2012).

With the model obtained, the relationship between the observed and latent variables (dimensions of entrepreneurship) can be analyzed in Tables 3 and 4. This is where the values of covariances, correlations and regression estimates are found, reflecting the weight of the relationship and the p-values, which are less than 0.05, confirming the relationships as significant.

Table 3 shows that the weakest relationships between latent variables are in the International University dimension with respect to the Entrepreneurial Leadership and Management dimension (F1-F6: 0.693), Entrepreneurial Pathways (F4-F6: 0.782) and Entrepreneurial Development (F3-F6: 0.785).

Table 3. Relationships of the structural model: latent variables (dimensions of entrepreneurship)

Relationships	*Covariance*	*S.E.*	*V. C.*	*p*	*Correlation*
F1 <-> F2	1.167	0.078	14.974	***	0.844
F1 <-> F4	2.134	0.207	10.333	***	0.851
F1 <-> F6	0.958	0.079	12.151	***	0.693
F1 <-> F7	1.155	0.077	15.016	***	0.836
F1 <-> F5	1.156	0.078	14.885	***	0.837
F1 <-> F3	1.256	0.077	16.399	***	0.909
F2 <-> F3	0.938	0.013	74.366	***	0.938
F3 <-> F4	1.737	0.084	20.656	***	0.957
F3 <-> F6	0.785	0.025	31.776	***	0.785
F3 <-> F7	0.875	0.016	53.743	***	0.875
F3 <-> F5	0.911	0.014	63.424	***	0.911
F2 <-> F4	1.569	0.089	17.596	***	0.864
F4 <-> F6	1.421	0.091	15.539	***	0.782
F2 <-> F6	0.831	0.021	39.286	***	0.831
F6 <-> F7	0.854	0.017	49.953	***	0.854
F5 <-> F6	0.823	0.021	38.593	***	0.823
F5 <-> F7	0.905	0.013	68.048	***	0.905
F2 <-> F5	0.886	0.017	51.514	***	0.886
F4 <-> F5	1.715	0.085	20.256	***	0.945
F2 <-> F7	0.858	0.018	46.712	***	0.858
F4 <-> F7	1.575	0.088	17.96	***	0.867

Notes: SE: Standard Error of the regression weight; V.C.: Critical ratio value of the regression; *** = 0.000. F1 = Entrepreneurial Leadership and Management, F2 = Entrepreneurial Organizational Capacity, F3 = Entrepreneurial Spirit Development, F4 = Entrepreneurial Pathways, F5 = University-Enterprise Relationship, F6 = International University, F7 = Entrepreneurial University Impact.

Source: compiled by the author using SPSS Amos v.25 software.

Table 4 shows a strong relationship and contribution of the observed variables with the constructs that enable the measurement of the dimensions of entrepreneurship in a public university in Mexico, with the p-values confirming this valid relationship. The coefficients that measure the relationship between the observed variables and the impact dimension of the entrepreneurial university (IUE) stand out.

Table 4. Relationships of the structural model: observed and latent variables

Relationships	β	*S.E.*	*V. C.*	*p*	β *Std*
LyG05 <- F1	1				0.843
LyG03 <- F1	1.093	0.056	19.561	***	0.863
LyG02 <- F1	1.026	0.051	20.027	***	0.875
C003 <- F2	1.892	0.094	20.06	***	0.882
C005 <- F2	2.112	0.104	20.378	***	0.890
C007 <- F2	2.095	0.104	20.165	***	0.885
DEE04 <- F3	1.927	0.09	21.461	***	0.914
DEE02 <- F3	1.718	0.086	20.086	***	0.879
DEE01 <- F3	1.708	0.081	21.023	***	0.903
RE01 <- F4	1				0.935
RE02 <- F4	1.037	0.032	32.23	***	0.933
RE03 <- F4	1.027	0.037	27.664	***	0.891
RUE04 <- F5	1.831	0.091	20.064	***	0.879
RUE02 <- F5	1.713	0.081	21.267	***	0.910
RUE01 <- F5	1.746	0.081	21.642	***	0.919
UII03 <- F6	2.387	0.104	22.871	***	0.947
UII04 <- F6	2.273	0.098	23.087	***	0.952
UII05 <- F6	2.191	0.1	21.873	***	0.924
IUE03 <- F7	2.015	0.085	23.581	***	0.961
IUE02 <- F7	2.084	0.088	23.654	***	0.963
IUE01 <- F7	2.088	0.092	22.68	***	0.941

Notes: β = regression estimates; SE = Standard Error of the regression weight; V.C.= Critical ratio value of the regression; *** = 0.000; β Std: standardized regression estimates. F1 = Entrepreneurial Leadership and Management, F2 = Entrepreneurial Organizational Capacity, F3 = Entrepreneurial Development, F4 = Entrepreneurial Pathways, F5 = University-Enterprise Relationship, F6 = International University, F7 = Entrepreneurial University Impact.

Source: compiled by the author using SPSS Amos v.25 software.

5. CONCLUSIONS

This research enabled us to learn about the entrepreneurial profile of public universities in Mexico, according to the characteristics identified as "ideal" at the international level, as defined in the methodology of the OECD and the European Community. In this respect, it is worth noting that universities show strong leadership and management of entrepreneurship, where there is a declared commitment of the institution to the implementation of an entrepreneurial strategy, where the development of entrepreneurship is recognized as an agent of change (leadership and management) and as a creator of awareness of the importance of developing entrepreneurial skills among staff and students, encouraging their practice. However, the study shows that, although the public university is an entrepreneurial force, it does not have enough solid internal mechanisms to promote and launch it, such as infrastructure, incentives, training and networking.

The study also showed that entrepreneurship is a topic that tends to be increasingly crucial for the economies and institutions of Higher Education as entities that influence the training of professionals and the resolution of society's problems, but which require reforms in the model of Higher Education in Mexico to fulfill this function.

Using an SEM made it possible to validate the usefulness of the theoretical instrument for measuring the dimensions of entrepreneurship and its methodological consistency and to identify the need to adjust the number of variables used in the original model to obtain a suitable version for the local case.

Furthermore, the identified strengths were that public universities in Mexico promote links with companies, society and interested parties, which involves the participation of their professors and students (university-industry relationship dimension). However, the study also shows that efforts are needed to consolidate a consistent structure to encourage and stimulate the development of entrepreneurial mindsets and skills, which will allow the involvement of all the institution's personnel in the generation of entrepreneurial ideas and, at the same time, favor the evaluation of the results of entrepreneurship (entrepreneurial spirit development dimension).

The results reveal that public universities need to work on the mechanisms for monitoring and evaluating their entrepreneurship and the relevance of educational programs related to entrepreneurship and their relationship with the context (impact of the entrepreneurial university dimension). Finally, it is shown that public universities need to redefine or prioritize actions to implement new mechanisms to promote entrepreneurship involving professors, businesses, interested parties and students. They also need to invest in infrastructure to encourage entrepreneurship and in the development of its members (organizational capacity dimension), as well as define a financing model to launch the identified entrepreneurial initiatives (internal and external) and international networking that favor entrepreneurship through experts, institutions, both in teaching and their educational programs, as well as in research (international university dimension).

Undoubtedly, entrepreneurship is a topic with great development expectations for countries such as Mexico, with more emphasis on public higher education institutions. Therefore, progress in these studies is deemed necessary not only in social sciences and business programs but also in areas related to industrial engineering and information technologies, as well as postgraduate studies and areas of research, innovation, and technology transfer, which will allow progress to be made on an integral model of entrepreneurial universities.

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