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Influence of Stakeholders' interactions on the innovative vocation of Mexican SMEs[ξ]

Influencia de la interacción de grupos de interés en la vocación innovativa de PyMEs mexicanas

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Abstract

Innovation in small and medium enterprises (SMEs) constitutes a process that includes a wide range of interactions among stakeholders and organizations. In Mexico, the data regarding the interaction of stakeholders with companies has been collected in ENAPROCE survey, which is a source of information that includes statistics of a considerable number of enterprises around the country. The goal of the present work was to contribute to the understanding of the influence that relevant stakeholders such as owners, employees, finance sources, government, managers and the integration in productive chains have in the innovative vocation of such companies. The selected technique to determine which indicator is relevant to predicting the innovative vocation level of Mexican SMEs was multinomial logit regression with three possible scenarios. The results showed that factors such as having private ownership, training for employees, access to financial sources, and participation in productive chains were the most relevant influences.

Keywords: stakeholder, innovation, vocation, SMEs.

JEL Codes: M100

Resumen

La innovación en las pequeñas y medianas empresas (Pymes) es un proceso que incluye un amplio rango de interacciones entre las partes interesadas y las organizaciones. En ese sentido, los datos relacionados con la interacción entre grupos de interés con las compañías en México han sido recolectados por la encuesta ENAPROCE, la cual es una fuente de información que incluye datos estadísticos de un número considerable de empresas alrededor del país. El presente trabajo busca contribuir al entendimiento de la parte que los grupos de interés tales como dueños, empleados, fuentes de financiamiento, gobierno, administradores y la

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participación en cadenas productivas como fuentes de la innovación tecnológica. Una regresión de tipo logit multinomial fue utilizada para determinar cuál indicador relacionado con los grupos de interés mencionados es relevante para realizar predicciones de la vocación innovadora de las Pymes mexicanas. Las interacciones que resultaron de mayor relevancia incluyen tipo de dueños, capacitación y entrenamiento, financiamiento y la participación en cadenas productivas.

Palabras claves: grupos de interés, innovación, vocación, Pymes.

Códigos JEL: M100

Introduction

In terms of innovation, factors such as changes in policies, markets, technology, industry structure, and institutions have the potential to influence the introduction of new products, processes, marketing, and organizational methods in any given company (Schot & Steinmueller, 2018).

In that sense, behaviors that make organizations responsive to the needs and expectations of interest groups can encourage diverse types of innovation since it is based on a process that is stimulated by the interaction of individuals and groups with different backgrounds, benefits, and perspectives. Thus, the ability to interact constructively and work in new ways is crucial for innovation performance (Devaux *et al*., 2009).

Coordinated action between companies and their stakeholders is the central character of the generation of innovative products, processes, services, technologies, and business models that can be viable economically, environment-friendly, and socially responsible (Geissdoerfer, Savaget, Paulo, Evans, & Steve, 2017), because creativity occurs when individuals interact, it is possible to get new ideas, insights, and even knowledge (OECD, 2017).

In consideration of the influence of relevant stakeholders in organizations, researchers such as Dollinger (1990) analyzed fragmented industries and outlined that the actors of small firms search for forms of interdependence to survive (Granata, Garaudel, Gundolf, Gast, & Marques, 2016) and adapt to environments of uncertainty in the industry.

Speaking of the concept of stakeholders, Freeman defined these interest groups as relevant groups such as shareholders, customers, suppliers, and any other actor "who can affect or is affected by the organization's purpose" (Freeman, Harrison, Hicks, Parmar, & Colle, 2010); According to the seminal work of Mitchell, Agle, and Wood (1997), the relevance of this interest groups correspond to three main attributes: power *(have certain access to coercive, utilitarian or normative means to impose its will)*, legitimacy *(the legitimate right to claim a determine response in a relationship)* and urgency *(the time-sensitive call for immediate attention).*

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Consequently, different stakeholders can affect companies representing elements that drive innovation can be related to the value generated among organizations when trying to provide different types of benefits-oriented to satisfy the needs and expectations of various stakeholders (OECD & Eurostat, 2018).

For this reason, companies must collaborate with various stakeholders during the innovation and new product development processes, those relevant groups of interest must be considered, such as customers, suppliers, other partners, competitors, and different institutions (Majava, 2016), that represent pertinent sources of information, knowledge, and even a relevant change in the industry.

From a multiple-level perspective, there is a recognition that governments, firms, and other interest groups have a determinant role in the changes introduced to the organizational system, where even policymakers are relevant in terms of managing the dynamics of the diverse nature of transactions (Greenacre, Gross, & Speirs, 2012).

In that sense, for Small and Medium Enterprises (SMEs), relevant factors such as knowledge spillovers, access to networks, and engagement in collaboration with other players represent an essential influence for innovation, where globalization has brought new opportunities for cross-border collaboration and interchange of ideas, finance, skills, technologies from abroad, with a considerable impact in productions of goods, services, patents, licenses, among others (OECD, 2017).

Hence, what could be called the *entrepreneurial ecosystem* refers mainly to the interaction that takes place between organizations and individual stakeholders that are relevant to the companies (Isenberg 2010 cited by Sorama & Joensuu-Salo, 2016), being an essential aspect of management issues, even in terms of commercialization activities, that must conduct networked market actors, where new products must attract stakeholders for the diffusion of innovation in the market (Engez, 2018).

In other words, the nuanced knowledge of stakeholders is closely connected to the potential for product and process innovations and the creation of new inter-organizational relationships (Barringer and Harrison 2000 cited by Freeman *et al*., 2010). Where organizations are in constant interaction with other interest groups regularly for their normal activities, where each stakeholder is a dynamic factor, acting and reacting based on the decisions made by other stakeholders, resulting in a dramatic effect on success or failure (Waycaster *et al*., 2015).

To understand better the development of innovation activities of a given company, a stakeholder approach represents a way to acknowledge the internal and external dynamics of any company, affecting the organizational ability to continuously transform knowledge and ideas into new products, processes, and systems (Lawson and Samson, 2001, cited by Shigeno, 2017).

Having that scenario in mind, the present study analyses how significant are the interaction among stakeholders and the level of low, medium, or high innovative vocation index in the small and medium businesses of each Mexican state, considering situations present in such companies related to ownership, training, financing and whether they are integrated to productive chains, to understand the following general research question:

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RQ: How do stakeholders such as owners, employees, financial institutions, and suppliers in the productive chain contribute to explaining the innovative vocation of Mexican SMEs?

To answer *RQ*, the present work was organized as follows: first, a statement related to the concept of innovative vocation in SMEs is elaborated; second, we analyzed the relevance of the interaction that these companies have with the stakeholders in terms of innovation, as a theoretical basis to elaborate the statement related to the theoretical influence among owners, employees, financial institutions and suppliers in the productive chain in terms of innovative vocation; third, the data collected is analyzed with a multinomial logit model to explain statistically the relevance of those interactions in terms of a categorical dependent variable related to a high, medium and low innovative vocation in Mexican SME´s; fourth, the level of probability of change in the categorical variable was calculated and finally, concluding with results and conclusions.

Innovation in Mexican SMEs

Generally, there is an awareness of Mexican SMEs related to the fact that innovation and knowledge management are critical to overarching success, growth, productivity, and remaining competitive (Silva, 2017).

According to OECD, Mexico is taking measures to support productivity growth in small enterprises, including innovative programs that combine the upgrading of managerial skills with ICT adoption, encouraging worker and managerial skills upgrading, ICT adoption, and industrial modernization by small companies (OCDE, 2017).

Also, since innovation is necessary to solve problems, Mexican companies are responding to challenges such as generating sustained growth; creating positive social and environmental impact; and remaining resilient in the difficult environment in which SMEs operate (WEF, 2021).

Overall, there is evidence that a stakeholder´s approach to fostering innovation in established Mexican SMEs can be managed by providing a business environment that is conducive to growth, supporting the development of strategic assets and resources at the firm level, upgrading workforce skills in SMEs, ensuring that R&D policy is inclusive and developing an effective and inclusive national innovation system (OECD, 2018b), and to understand a correspondent network for groups of interest in Mexican companies, it is necessary to develop a concept related to innovative vocation.

The concept of innovative vocation in SMEs.

Innovative vocation can be understood as a characteristic that is present in any given company performing activities related to the introduction of innovations of products, processes, marketing, and management methods that are new to the industry or even the company itself, in a given region.

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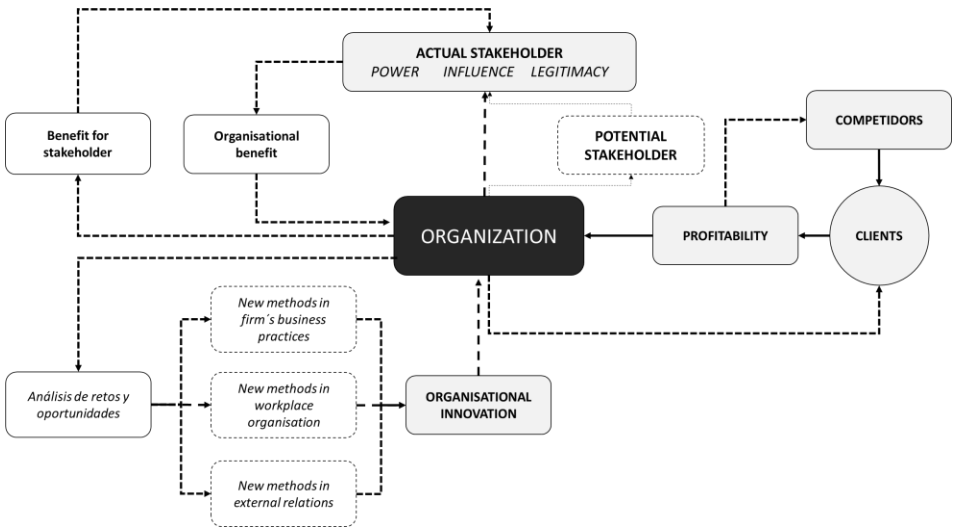
Moreover, the measurement of this characteristic makes it necessary to consider explicit indicators regarding the introduction of innovations in the company processes, that are available at a particular time, including technological maturity, as use of technology in productive operations, and improvement in operations, as making the productive processes of the company more effective as well.

Furthermore, the innovative vocation of a company is specially related to the interaction with relevant stakeholders who represent a source of ideas, knowledge, pressures, demands, co-opetition, regulations, and even opportunities for management issues.

For the present work, the concept of innovation in the same line with the Oslo manual is considered, concerning any given company that introduces a new or improved good or service in the market, and a new or improved business process for one or more business functions that has been brought into use by the firm (OECD & Eurostat, 2018).

Following the previous definition, *innovative vocation* represents the interactive activities of the companies and organizations that are part of a given state or province, that emerge from the activities of the organizations established in such regions concerning relevant groups of interest; to build a basic conceptual representation of both sequential and simultaneous interaction among organizations and relevant stakeholders related to innovation for SME´s, it is necessary to explain how interactions that enhance innovation are born in the management of stakeholders interactions, as follows.

Figure 1: Innovative vocation for SMEs



Source: Esparza-Rodríguez (2021) based on literature review.

As the figure 1 shows, the interactions among stakeholders are necessary to enhance innovation in organizations, based on a wide diversity of interrelations between external and internal stakeholders; actual stakeholders that are relevant or even definitive, and potential stakeholders are also considered in terms of applying changes in organizations to meet possible present or future demands.

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Having that information, in the present work the innovative vocation was considered as a categorical variable with values ranging from low, medium to high innovative vocation, the index was calculated by the following formula:

Formula 1: Innovative vocation index

$$InnVoc = \frac{\sum_{State} Innovation\ in\ \ products + \sum_{State} Innovation\ in\ \ processes}{Max(\sum_{Country} Innovation\ in\ \ products + \sum_{Country} Innovation\ in\ \ processes)}$$

Source: Own elaboration (2021)

As formula 1 shows, the innovative vocation index is a ratio of the total innovation in terms of products and services for a given region divided by the state with the highest number of innovations in the country, which is considered the *frontier state*. This formula allows excluding the influence of the number of companies established in a region because a higher number of companies also represent a higher total of innovations.

In that sense, the innovative vocation index provides information through a comparison of ratios, not by the total number of innovations per region, which is highly influenced by the total of companies established. This is relevant since raw data for Mexican companies show a clear dominance of some states in terms of innovation, but it is necessary to compare ratios to understand the innovative activities in those regions, not just total numbers that are related to the total number of companies.

The general hypothesis (GH) that this work tested was stated as follows:

- *GH: Stakeholders' interactions have a positive and statistically significant influence on the level of innovative vocation in Mexican SMEs.*

To test this general hypothesis, the bibliography revision is presented to have a better understanding of the stakeholder´s contribution to the conceptual representation of sequential and simultaneous interactions among organizations and groups of interest.

The influence of owners in innovative vocation.

For SMEs, innovation relies on the individual owner of the business and its exposure to the knowledge (Odwyer, Gilmore, and Carson, 2009; cited by Osuga, 2016); it also depends on the social network in which they operate.

Some authors such as Vu & Doan (2015) have found that the human capital of owners/managers of SMEs, as measured by formal education and prior experience, quality

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of physical infrastructure, and quality of workers are significant determinants of innovation in the SMEs products and processes.

For that matter, owners/managers of SMEs should develop the innovation activities to improve their performance (OECD, 2018b), through market anticipation, customer focus, and commitment of CEO/owners to new product development, processes, and new ways of working. Innovation is part of business strategy and it is goal-oriented (Sharma, 2016).

In countries like China, the majority of SMEs have owners that also are founder entrepreneurs, and that fact puts them in a situation of owner and employee simultaneously. Therefore, they have a natural tendency for innovation (Huang, 2016).

It is common in small companies that the skills of the owners represent relevant factors that influence the innovative potential of their companies since their ideas are usually the primary source of innovation (Skibiński & Sipa, 2015); even the level of education of the managers in a family business is consistent with a positive relationship with the size of the company (Hirsch, Rodriguez, & Rosas, 2020). Considering the revised literature, the first specific hypothesis (H1) tested for this specific stakeholder is stated as follows:

- *H1: The type of owners has a positive and statistically significant influence on the level of innovative vocation in Mexican SMEs.*

Following the study, a literature revision of the works that refer to the relevance of other relevant stakeholders is presented, including the influence of training employees, access to financial resources, and being part of productive chains on innovation in SMEs.

The influence of employees in innovative vocation.

Another relevant and important stakeholder in terms of innovative vocation is the talent of the workforce, and the skills people bring to the table as well, especially in small businesses where a more significant proportion of workers in large companies are involved in the implementation of business innovation (OECD, 2018b).

The relevance of employees is visible in the process of management, where they must recognize a problem, create solutions for the problem, and support embedding the solutions into organizational practice (Carmeli, Meitar, and Weisberg (2006); cited by Xerri & Brunetto, 2011).

Mainly, this is because not only employees can generate new ideas, but they can also find solutions for current problems and bridge the gaps, so they are likely to lead developments at the organizational level (Moghimi & Devi Subramaniam, 2013) using both formal training and informal knowledge to acquire the skills they need, (OECD, 2018a). In the case of Mexico, the National Employment Service is the organization through which the government provides training scholarships for individuals (Iriarte Rivas, 2018).

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To develop the constellation of complementary activities needed for success, it is essential to consider particular collaborations, specialist in-house skills, intellectual property, marketing activities, capital investments, and training for employees (Palangkaraya, Spurling, & Webster, 2015), since the process of building organizational capabilities is a critical success factor to stimulate organizational innovation in SMEs (Ali, Sun, & Ali, 2017), where innovation is based on newness and, as a consequence, may be considered as a dynamic capability (Babkin, Lipatnikov, & Muraveva, 2015).

Given the information obtained in the literature, the specific hypothesis tested for this stakeholder is as follows:

- *H2: The training of employees has a positive and statistically significant influence on the level of innovative vocation in Mexican SMEs.*

The influence of financial institutions in innovative vocation.

Financial resources are determinant to innovative firms since they affect the possibility of fostering economic growth and influence positively in terms of innovation (Monge-González, Rodríguez-Alvarez, & Leiva, 2016). A company needs to be innovative in choosing correct and appropriate financing sources to solve the company's financial challenges (Abiodun Eniola & Entebang, 2015) because small and innovative firms have more constraints and difficulties in accessing finance since they tend to have riskier projects and business models (Lee et al., 2015).

In consequence, for innovative firms, private equity and venture capital funds can provide a crucial source of funding (Arvanitis, 2015) since the positive outcome of the venture capital activities results from an impact of the improved management on the promotion of a more significant number of innovations (Dzeletovic, Milosevic, & Cicic, 2017).

Another relevant source of funding is the governmentally sponsored loans that facilitate financial resources for corporations as part of government policies to promote further investment by corporations in technological innovation and development (Khoe & Kim, 2015).

Public programs range from fostering the export capacity to supporting innovation in high-impact small businesses, tax transparency and provisions programs, capital markets, and bankruptcy laws, to subsidies to microenterprise, known as seed capital programs (SCPs) (Cumming, 2007; López-Acevedo and Tan, 2010; Reid and Nightingale, 2011; Sternberg, 2014) cited by (Cancino, Bonilla, & Vergara, 2015).

In relation to the literature, the hypothesis tested for the source of financial resources is as follows:

H3: Financial resources have a positive and statistically significant influence on the level of innovative vocation in Mexican SMEs.

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The influence of suppliers in innovative vocation.

Building cooperative networking and clustering among SMEs could be one of the successful strategies for strengthening the innovation culture within SMEs and local entrepreneurs (APEC, 2013), where partnerships provide opportunities to access the tacit knowledge and other non-tradable competencies that are critical for pursuing innovation-based competitive strategies (Delbridge & Mariotti, 2009; cited by Rezaei, Ortt, & Trott, 2018).

Firms' activities expanded in the value chain and transform their business strategies from traditional low-cost manufacturing strategies to innovative differentiation strategies and marketing differentiation strategies (Liu, 2008; cited by Dahlan, Samat, & Othman, 2015).

Improving the management of the supply chain by capitalizing on the significant shift in technology, infrastructure, and the internet will enhance innovation and business competitiveness, which is especially relevant to small and medium-sized enterprises and growing economies (Maalouf, 2018).

Concerning this specific hypothesis, it was stated as follows:

- *H4: Being part of productive chains has a positive and statistically significant influence on the level of innovative vocation in Mexican SMEs.*

The following steps for hypothesis testing are described in the next section, including the source of the data and the variable model used that is the base of the structure of the present study.

Materials and Methods

The data was obtained from the website of the National Survey of Productivity and Competitiveness of Micro, Small, and Medium Enterprises (ENAPROCE acronym in Spanish), which is a nationally representative survey related to managerial and entrepreneurial skills of the enterprises; it contains characteristics of operation and development of such companies, elaborated by a collaboration of public organisms in Mexico.

The target population was companies that perform activities related to manufacturing, commerce, and specific sectors of non-financial private services, considering the aggregation levels of SCIAN 2012. It includes industries such as manufacturing, wholesale trade and retail, and non-financial private services. The size of the sample was 26,997 companies distributed as follows: 5,493 of manufacture, 11,059 of commerce, and 10,445 related to the industry of service.

For the present work, the variable involved in the research question will be considered as the number of companies that declared to have one of two types of characteristics related to interactions with stakeholders, as follows:

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Table 1: Variable model for the study

Dependent variable			
Variable Name	**Concept**	**Type**	**Code name**
Innovative vocation	*The number of new processes and products introduced is divided by the total SME per region compared to the **frontier state** in a given period*.*	Categorical (Calculated using formula 1)	**LOW (<1) / MEDIUM (1:1) / HIGH (>1)**
Independent variables			
Ownership openness	*The number of companies whose owners are in one of two basic types, family businesses or particular subjects.*	Quantitative	**FAMILY / PRIVATE**
Employees	*The number of companies that have been in one of two training or non-training categories.*	Quantitative	**WITH / WITHOUT**
Financial institutions	*Financial resources of one of two natures obtained by the companies: Personal or external.*	Quantitative	**PERSONAL / EXTERNAL**
Productive chains	*Companies that are in one of two categories, in or out of productive chains*.	Quantitative	**IN / OUT**

*Purchasing of licenses regarding products or processes, machinery, and equipment to increase or upgrade production processes, adaptation, and modification of technologies of products or processes, to increase the levels of efficiency, generation, and development of own technology, patents, colocation of score tables in the production process and implementation of the solution and continuous improvement in the production process.

Source: Own elaboration (2021).

Table 1 shows the variable model for this study that considers quantitative independent variables including the number of SMEs for each variable that are involved in different states of organizational environment related to types of ownership, training, financial institutions, and productive chains, which can provide the information needed to test the hypothesis of the study.

Analysis of data

The statistical test selected is the logistic regression for categorical responses with more than two categories, with quantitative explanatory variables; according to (Agresti, 2007), for a multinomial model let J denote the number of categories for Y, where $\{\pi 1,...,\pi J\}$ denote the response probabilities, satisfying $\sum_j \pi j = 1$; with *n* independent observations, the probability distribution for the number of outcomes of the J types is the multinomial.

In some cases, multinominal models can be used to put a given structure on different probabilities, where research subjects are assumed to choose or fall into a given alternative; for this, a common starting point is a random utility framework, in which the utility of each alternative is a linear function of observed characteristics (individual and/or alternative specific) plus an additive error term (Verbeek, 2004).

To build the multinominal response variable, first, one of the states of the country is defined as the *frontier state*, as the Mexican state that registered the highest record of innovations in products and processes in the country; in the case of the analysis of the different states of

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innovative vocation in remaining states, this work considers three possible comparative scenarios in relation to the *frontier*:

$$y_i = \begin{cases} \textit{Low Innovation} \text{ (Low)} \\ \textit{Medium Innovation} \text{ (Medium)} \\ \textit{High Innovation} \text{ (High)} \end{cases}$$

From where we considered the following:

1. For each observation or individual, circumstances, factors, or variables that influence the model are the same that those in the rest of the sample, but the value of influence in particular among them.
2. The level of influence that each independent variable in particular for every election or state of nature.

The data regarding the number of companies, the number of innovations, and the innovative vocation of each Mexican state are listed in the following table from highest to lowest, including the state with the highest number of innovations in bold:

Table 2: Innovative vocation index of each State in Mexico

State	CODE	Number of SMEs	Number of innovations	Innovative vocation level
Mexico City	**CDMX**	**19,667**	**45,026**	**Highest (frontier state)**
Jalisco	JAL	13,667	28,128	High
Nuevo León	NVL	12,862	26,698	High
Mexico State	EDM	7,939	16,142	High
Guanajuato	GNT	6,162	12,420	High
Baja California	BC	4,850	10,900	High
Chihuahua	CHI	5,398	10,295	High
Tamaulipas	TAM	4,594	8,315	High
Puebla	PUE	4,800	7,973	High
Coahuila	COH	3,619	7,547	High
San Luis Potosi	SLP	3,391	7,158	Medium
Querétaro	QTO	3,057	6,653	Medium
Sonora	SON	3,960	6,512	Medium
Yucatán	YUC	2,377	6,071	Medium
Michoacán	MIC	2,974	5,824	Medium
Veracruz	VER	3,786	5,531	Medium
Aguascalientes	AGS	2,000	5,231	Medium
Sinaloa	SIN	3,219	5,080	Medium
Quintana Roo	QRO	2,220	3,646	Medium

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Chiapas	CPS	1,898	3,106	Medium
Hidalgo	HDG	1,502	3,006	Low
Oaxaca	OAX	1,990	2,749	Low
Durango	DRG	1,401	2,396	Low
Colima	COL	981	1,945	Low
Tabasco	TAB	1,126	1,903	Low
Baja California Sur	BCS	1,097	1,865	Low
Morelos	MOR	1,095	1,701	Low
Guerrero	GUE	1,108	1,498	Low
Campeche	CAM	908	1,258	Low
Nayarit	NAY	888	1,185	Low
Zacatecas	ZAC	691	1,135	Low
Tlaxcala	TLX	662	1,059	Low

Source: Own elaboration based on data of INEGI (2021).

The information available in the survey showed that the *frontier state* in Mexico City (CDMX) since it shows the highest index of innovative vocation; then, the descriptive analysis shows that the top states are represented by Jalisco (JAL), Nuevo León (NVL), State of México (EDM) and Guanajuato (GNT).

Results

To test the hypothesis of the study, *low innovation* was the base scenario of comparison, examining the analysis will examine the solution for the other two alternatives (in this case will be medium innovation and high innovation) which have the following functional form:

Formula 2: Alternative analysis for medium and high innovative vocation

$$y_{medium\ innovation} = \alpha_1 + \beta_{1,medium\ innovation \cdot ownership\ openness} + \beta_{2,medium\ innovation \cdot training} + \beta_{3,medium\ innovation \cdot financing} + \beta_{4,medium\ innovation \cdot productive\ chains}$$

$$y_{high\ innovation} = \alpha_1 + \beta_{1,high\ innovation \cdot ownership\ openness} + \beta_{2,high\ innovation \cdot training} + \beta_{3,high\ innovation \cdot financing} + \beta_{4,high\ innovation \cdot productive\ chains}$$

Source: Own elaboration (2021).

Then, every state regarding innovative vocation is presented in the following table 3, where the value of the multimodal logit model change in terms of the coefficients facing a unitary

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increment in the difference among low, medium, or high innovative vocation, with their correspondent p-value.

Table 3: Summary of the multinomial model of Innovative Vocation

	α	OWNERSHIP OPENNESS		TRAINING		FINANCING		PRODUCTIVE CHAINS	
		FAMILY	PRIVATE	WITH	WITHOUT	INTERNAL	EXTERNAL	IN	OUT
MEDIUM (COEF.)	10.7411	-22.32077	33.06187	12.56758	-1.826481	5.40E-02	0.003477545	26.90741	-16.16631
HIGH (COEF.)	45.47052	-19.79554	65.26607	10.95567	34.514849	7.09E-02	0.003416606	121.19666	-75.72614
MEDIUM (STD ERROR)	31.53244	-75.35021	744.47692	49.91172	-20.559143	3.61E+00	3.323024	3393.62976	-48.59011
HIGH (STD ERROR)	148.63688	-72.23135	2048.5677	52.8131	350.494618	4.12E+00	3.233238588	8064.1273	-260.3277
MEDIUM (p-value.)	**0.00000**	**0.00000**	**0.00000**	**0.00000**	**0.00000**	**3.03E-04**	**0.00089**	**0.00000**	**0.00000**
HIGH (p-value.)	**0.00000**	**0.00000**	**0.00000**	**0.00000**	**0.00000**	**3.81E-05**	**0.00122**	**0.00000**	**0.00000**

Source: Own elaboration (2021) using Rstudio.

The coefficients show a positive and significant influence of private ownership, training, and being part of productive chains in predicting innovative vocation in relation to Mexican states, and a negative influence on family ownerships, no training, and being out of productive chains; also, it is noticeable that a privately owned company and the participation in productive chains represents the factors with the highest influence in terms of medium and high innovation.

In the final rows, the results obtained showed a level of significance for a p-value <0.05, in all variables and categories, showing that the selected variables are significant to explain a Medium or High level of innovative vocation in each state. On the other hand, for financing sources, though statistically significant, the coefficient is near 0 for both options.

The probability of having a determined scenario of Innovative Vocation.

As it has been established, of every possibility in terms of innovative vocation for the Mexican State considering the quantitative data, it is feasible to calculate the likelihood of being in one of the different states of nature.

Considering *low innovative vocation* as $m=1$ the following expression will give us the probability $p_{i,m=1}$ for the mentioned scenario (calculated with the media of each variable):

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Formula 2: Probability of having a scenario of low innovative vocation as a basis

$$p_{i,m=1} = \frac{1}{1+\sum_{m=2}^{M} e^{\alpha_m + \sum_{k=1}^{K} \beta_{m,k} \cdot x_{k,i}}}, m = 1$$

$$Low\ Innovative\ Vocation = 4.770932e-06$$

Source: Own elaboration based on De la Torre (2021)[1].

The value of the low innovative vocation probability shows that there are small probabilities of having a low level of innovative vocation concerning the present variable model, considering the mean values of the samples, which are a set of values that includes extreme cases, where some states have a notably high level of innovations and many others almost have none.

In terms of options that are not considered base (in this case, medium and high innovative vocation) the performed calculus is as follows:

Formula 3: Probability of having a scenario of medium and high innovative vocation

$$p_{i,m=1} = \frac{e^{\alpha_m + \sum_{k=1}^{K} \beta_{m,k} \cdot x_{k,i}}}{1+\sum_{m=2}^{M} e^{\alpha_m + \sum_{k=1}^{K} \beta_{m,k} \cdot x_{k,i}}}, m \neq 1$$

$$Medium\ Innovative\ Vocation = 0.9380207$$

$$High\ Innovative\ Vocation = 0.06197454$$

Source: Own elaboration based on De la Torre (2021)[2].

Given the mean values of each variable found in the multinomial model for innovative vocation, is noticeable that the highest probability is referred to as medium innovative vocation in relation to the variable model of the study. The following table 4 shows the change of probabilities considering different position measures of the sample considering the referred independent variables.

[1] https://www.oscardelatorretorres.com/mod-avanz-principios-econometria
[2] https://www.oscardelatorretorres.com/mod-avanz-principios-econometria

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Table 4: Analysis made considering the Mean, Percentile 5%, and Percentile 95%

	Low Innovation	Medium Innovation	High Innovation
Mean	0.0004%	93.802%	6.197%
Percentile 5%	99.995%	0.000000021%	0.000%
Percentile 95%	99.995%	0.000000021%	0.000%

Source: Own elaboration (2021).

Table 4 shows that the variables related to the interaction of Mexican SMEs with stakeholders are consistent in the mean values with the revised literature in terms of medium innovation index.

The probability of having a determined scenario of Innovative Vocation

The following analysis presents the probability for each scenario considering each specific state, where it is possible to identify the probability for each Mexican state, the activities of the SMEs in relation to innovation, and the correspondent independent variables, as table 5 shows.

Table 5: Calculation of the probability of having a determined scenario of Innovative Vocation in each state.

State	Low Innovative Vocation	Medium Innovative Vocation	High Innovative Vocation
AGS	0.000006	**0.882114**	0.117880
BC	0.000070	0.002352	**0.997579**
BCS	**0.766348**	0.233631	0.000021
CAM	**0.999852**	0.000148	0.000000
CPS	**0.820891**	0.179021	0.000089
CHI	0.000000	0.236101	**0.763899**
CDMX	0.000000	0.000043	**0.999957**
COH	0.013857	**0.584047**	0.402096
COL	**0.713359**	0.043069	0.243572
CPS	**0.820891**	0.179021	0.000089
DRG	**0.997230**	0.002769	0.000001
EDM	0.000000	0.019402	**0.980598**
GNT	0.000000	0.000050	**0.999950**
GUE	**0.999999**	0.000001	0.000000
HDG	**0.595336**	0.404662	0.000001
JAL	0.000000	0.000343	**0.999657**
MIC	0.000024	**0.996841**	0.003135

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MOR	**0.934471**	0.065529	0.000000
NAY	**0.965187**	0.008896	0.025918
NVL	0.000000	0.000001	**0.999999**
OAX	**0.999007**	0.000993	0.000000
PUE	0.000000	0.390234	**0.609766**
QTO	0.000026	**0.936652**	0.063321
QRO	0.000000	**0.970757**	0.029243
SLP	0.000000	**0.542333**	0.457667
SIN	0.000018	**0.976279**	0.023704
SON	0.054001	**0.684535**	0.261465
TAB	**0.996166**	0.003834	0.000000
TAM	0.000000	0.005729	**0.994271**
TLX	**0.997746**	0.002254	0.000000
YUC	0.139022	**0.842932**	0.018046
ZAC	**0.999999**	0.000001	0.000000

Source: Own elaboration, 2021.

As is possible to observe in table 5, the probability related to the influence of stakeholder interactions in Mexican SMEs to predict innovative vocation is **high in 9 states, 9 in medium, and 14 in a low level of innovative vocation index.**

Calculus of marginal changes in probabilities

Another question when applying the calculus of probabilities is referred to how much will change the probabilities facing a marginal difference in some of the regressors, *Ceteris paribus.* To determine the instant change of the previous calculus $p_{i,m}$ given the value of regressor variables $x_{k,i}$ it is as follows:

Formula 4: Change of probabilities in innovative vocation index.

$$\left.\frac{\Delta p_{i,m}}{\Delta x_{k,i}}\right|_{\text{"Céteris páribus"}} = \frac{\partial p_{i,m}}{\partial x_i} = p_{i,m}\left[\beta_{k,m} - \sum_{j}^{M} \beta_{k,j} \cdot p_{i,j}\right], j \neq m$$

Source: Own elaboration based on De la Torre (2021)[3].

Considering $\alpha_{low\ innovative\ vocation}$ and $\beta_{low\ innovative\ vocation}$ as a basis and equals to 0.

[3] https://www.oscardelatorretorres.com/mod-avanz-principios-econometria

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Formula 5: Change of probabilities having low innovative vocation as a basis.

$$\frac{\partial p_{i,low\ innovative\ vocation}}{\partial x_{k,m}} = p_{i,low\ innovative\ vocation}\left[\beta_{k,low\ innovative\ vocation} - \sum_{j}^{M}\beta_{k,j}\cdot p_{i,j}\right], j \neq low\ innovative\ vocation$$

$$= p_{i,low\ innovative\ vocation}\left[0 - (\beta_{k,low\ innovative\ vocation}\cdot p_{i,medium\ innovation}) - (\beta_{k,high\ innovative\ vocation}\cdot p_{i,high\ innovation})\right]$$

Source: Own elaboration based on De la Torre (2021)[4].

Considering formulas 4 and 5, the marginal change probabilities are shown in table 6, as follows:

Table 6: Marginal change probabilities considering each independent variable

Independent variable	Low innovation	High innovation
Family-owned	*0.0001057411*	*-20.93744*
Private owned	*-1.672534e-04*	***31.012947642***
Training	*-5.948100e-05*	***11.788758455***
Non-training	*-2.031328e-06*	*-1.713254328*
Internal financing	*-2.626062e-07*	*0.050651136*
External financing	*-1.657259e-08*	*0.003262018*
Productive chains	*-1.562489e-04*	***25.240014969***
No productive chains	*9.473653e-05*	*-15.164510843*

Source: Own elaboration (2021).

The results shown in table 6 are consistent with the group of hypotheses in terms of a positive and statistically significant influence of stakeholders in predicting high innovation for organizations that are privately owned, have employee training activities, and are part of productive chains; the probability of having innovative vocation in terms of the nature of financing is statistically significative but have a very low change probability.

Conclusion

The analysis of the data showed that a privately owned enterprise, participation in productive chains, and training are the interactions with stakeholders that have the highest impact in both medium and high innovative vocation in the Mexican enterprises that were part of the survey.

[4] https://www.oscardelatorretorres.com/mod-avanz-principios-econometria

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Concerning H1, considering the ownership openness, the fact that a company in Mexico functions mainly as a way to increase profits rather than be a way of subsistence (as frequently occurs in a family business) had an essential role in the level of innovation. Hiring personnel with specific abilities for each position facilitates the introduction and development of new products and services in the company or even the industry where it belongs.

In what it comes to H2, training as a significant factor for innovative vocation represents the essential need for continuous training to develop an adequate level of innovation in the company. In counterpart, lack of training presented negative effects for the innovative vocation index, which is logical at a certain point, given the fact that if the personnel is not continued trained and developing skills, the lack of motivation can affect the performance of the people in their jobs.

In terms of H3, as mentioned before, though the coefficient is statistically significant, it is close to 0 in both cases referring to personal or private financial resources, which is an indicator that the interaction in SMEs in each state is not relevant.

For H4, the participation in productive chains is a relevant data, since a productive system is managed with interactions in terms of celebrating contracts or programs of collaboration, that allowed to have integrated processes, mainly in terms of design, supply, production, distribution, commercialization of goods, parts, components or services, having a meaningful impact in how the small companies innovate. Besides that, non-participation in productive chains results in an obstacle for organizations willing to implement dynamics oriented to innovation, because a lack of linkage with other organizations limits the capabilities of any enterprise to get new knowledge, techniques, technologies, or even a better way to cooperate with other organizations to create value.

Finally, in relation to RQ, the analysis made to determine the probability of changing the innovative vocation level of companies established in some states, BC, CHI, EDM, GNT, JAL, NVL, PUE and TAM showed that making an incentive oriented to enhance private-owned companies managed by a professional, training and being part of productive chains can represent an opportunity to have a higher level of an innovative vocation.

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