What hampers innovation in Mexican family firms?

¿Qué Obstaculiza La Innovación En Las Empresas Familiares Mexicanas?

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Abstract

Purpose – The purpose of this paper is to explore to what extent different obstacles (financial, knowledge, market, and perception) affect the propensity of Mexican family firms to engage in innovation activity. Second, it examines whether the perception of these obstacles differs between two subgroups of family firms, considering levels of ownership and family management control.

Design/methodology/approach – Information was gathered through a CIS methodology-based questionnaire applied to 161 CEOs of Mexican family firms. Binomial logistic regressions were performed identifying obstacles that were truly relevant for the family firm subgroups in the sample.

Findings – For subgroup 1, knowledge and market factors were significant and negatively related to the propensity to engage in innovation activities; for subgroup 2, only market factors were relevant. The results also show how the tenure of the CEO, the number of generations involved, and the family involvement in management and non-management positions affect the results obtained.

Practical implications – Implications for family business scholars embrace the assessment criteria of different family business definitions. While the implications for managers and policy makers include the recognition of the factors that affect innovation in Mexican family firms in order to design and implement adequate strategies to overcome them.

Originality/value – This study addresses some of the raised demands in the literature. First, to the best of the authors' knowledge, it is the first attempt to explore the factors hampering innovation in family firms in Latin America. Second, this study was undertaken in response to the call for exploring variations in innovation behavior across different family business types in regards to ownership and family management control. Moreover, this study responds to the call to analyze financial and non-financial factors separately and to expand the geographical areas, sectors, and sizes of family firms, more specifically in Latin America.

Keywords Obstacles, Innovation, Family firms, CIS, Latin America, Mexico

Paper type Research paper

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Resumen Estructurado

Propósito – En este trabajo se explora hasta qué punto los diferentes obstáculos (financieros, de conocimiento, de mercado y de percepción) afectan a la propensión de las empresas familiares en México para participar en actividades de innovación. En segundo lugar, se examina si la percepción de estos obstáculos se diferencia entre los dos subgrupos de empresas familiares, considerando los niveles de propiedad y el control de la gestión familiar.

Diseño/metodología/enfoque – La información se obtuvo a través de un cuestionario basado en la metodología CIS aplicado a 161 CEOs de empresas familiares mexicanas. Se llevaron a cabo regresiones logísticas binomiales para la identificación de los obstáculos verdaderamente relevantes para los subgrupos de empresas familiares en la muestra.

Resultados – Para el subgrupo 1, los factores de conocimiento y de mercado fueron significativos y negativamente relacionados con la propensión a participar en actividades de innovación; para el subgrupo 2, sólo los factores de mercado fueron relevantes. Los resultados también muestran como la permanencia del director general, el número de generaciones que participan, y la participación de la familia en puestos directivos y no directivos afectan los resultados obtenidos.

Implicaciones prácticas – Implicaciones para los investigadores en empresas familiares incluyen los criterios de evaluación de diferentes definiciones de empresa familiar. Mientras que las implicaciones para gerentes y responsables políticos incluyen el reconocimiento de los factores que afectan a la innovación en las empresas familiares mexicanas con el fin de diseñar e implementar estrategias adecuadas para superarlas.

Originalidad/valor – Este estudio aborda algunas de las demandas planteadas en la literatura. En primer lugar, en la medida del conocimiento de los autores, se trata del primer intento por explorar los factores que dificultan la innovación en empresas familiares en Latinoamérica. En segundo lugar, este estudio se llevó a cabo en respuesta a la llamada para explorar variaciones en el comportamiento innovador entre diferentes tipos de empresas familiares considerando los niveles propiedad y el control de la gestión familiar. Por otra parte, este estudio responde al llamado para analizar los factores financieros y no financieros por separado y para expandir a otras áreas, sectores geográficos y tamaños de empresas familiares, más específicamente en América Latina.

Palabras clave Obstáculos, innovación, empresas familiares, CIS, América Latina, México

Tipo de Documento Trabajo de investigación

1. Introduction

Given today's environment of rapid and unremitting globalization and technological change, the competitiveness of both firms and the economy depend on their innovative capacity (Porter, 1990). The need to be innovative affects firms of any size, sector, and ownership type. This does not mean that all firms have the same innovative behavior or that they have to face the same challenges and difficulties. In this line, and regardless of the economic and social importance of family firms (Bertrand and Schoar, 2006; La Porta *et al.*, 1999; Lee, 2006; Schulze *et al.*, 2001; Shanker and Astrachan, 1996; Sraer and Thesmar, 2007), several research questions remain to be answered in terms of innovation and family firms:

RQ1. How do family firms innovate?

RQ2. What are the obstacles perceived by family firms during the process of innovation?

RQ3. Do they face the same barriers to innovate as non-family firms?

RQ4. Is there any reliable and valuable knowledge available to managers and policy makers about the impact of these obstacles and the way these affect firms?

While previous studies have supplied valuable insights into the innovation processes of family firms, the factors that hamper innovation activity in family firms is a topic that has received only limited and fragmented theoretical treatment. To date, the knowledge about the barriers to innovation in family firms has derived

from the research aimed at studying other innovation issues (De Massis *et al.*, 2013b; Munoz-Bullon and Sanchez-Bueno, 2011; Nieto *et al.*, 2015). Furthermore, the results of the very few existing empirical studies on the topic are still contradictory to a certain extent. Besides, no large scale quantitative studies have emerged so far (Classen *et al.*, 2013; De Massis *et al.*, 2013a).

Therefore, this work focusses on analyzing the influence of different barriers (financial, knowledge, market, and perception factors) on the propensity of Mexican family firms to engage in innovation activities. An empirical study was carried out, which used a CIS methodology-based questionnaire, gathering information from small, medium, and large enterprises from the industry and service sectors mainly located in four different regions in Mexico. In addition, by using an econometric approach based on binomial logistic regression models, the authors identify which of these obstacles are truly relevant for the family firms in the sample in order to explain the propensity to engage in innovative activities.

This study attempts to address some of the questions raised in previous literature on innovation and family firms. First, it deals with research on barriers by separately analyzing a range of financial and non-financial factors. Second, it performs a type of study that focusses solely on family firms as opposed to most previous studies that concentrate on the comparison between family and non-family firms. Therefore, this study responds to the call for exploring variations in innovation behavior across different family business types (De Massis *et al.*, 2013a). In this line, the authors identify two subgroups of family firms in the data set based on key criteria: ownership and family management control. The comparison of these two subgroups allows us to identify significant differences. Third, and regarding the sample, this study responds to the call to expand the geographical areas, sectors, and sizes of family firms analyzed in studies on innovation (De Massis *et al.*, 2013a; Nordqvist and Melin, 2010), specifically located in Latin America, so far not included in studies dealing with innovation in family business (De Massis *et al.*, 2013a). Latin America lags behind more advanced economies in terms of innovative activities (Olavarrieta and Villena, 2014), with its countries being characterized by the exogenous nature of technological change, the informality of innovation processes, the adaptive and incremental nature of innovation (Malaver Rodriguez and Vargas Perez, 2004), and the weak linkages that characterize national innovation systems in those countries (Alcorta and Peres, 1998; Crespi and Zuniga, 2012) with inefficient legal courts and labor market regulations that are perceived by business firms as important obstacles to their innovative activities (Botero *et al.*, 2004; Schneider, 2009). In this line, an analysis of Mexico can be useful for the Latin American region, given their similar institutional framework characteristics as compared to the USA or European countries (Calderón-Martínez and García-Quevedo, 2013).

The remainder of the paper is structured in the following manner. Section 2 is concerned with barriers to innovation, and contains a description of the current state of the literature with special reference to the family influence on innovation. Section 3 provides a description of the data set, the variables, and the methods adopted in the econometric analysis. Section 4 presents the empirical analysis, and its results and implications, and Section 5 concludes by discussing the contributions, limitations, and significant issues for future research.

2. Literature background: barriers to innovation and family firms

Barriers to innovation

Innovation has been identified as a factor that contributes to firm growth, performance, and competitiveness. Innovations are the expression of entrepreneurial activity and may contribute to the long-term survival of family firms (Leenen, 2005).

However, a firm undertaking an innovative endeavor faces several problems such as market risks, financial restrictions, legal and bureaucratic barriers, and even resistance within the firm. In general, obstacles to innovation identified in the literature are context-specific (Iammarino *et al.*, 2009), but also influenced by ownership and other organizational characteristics such as firm size and sector. If the need to be innovative affects firms of any size, sector, and ownership type, not all firms have the same innovative behavior, nor do they face the same challenges and problems. As stated before, this study analyzes the financial and non-financial factors, as well as the family specific factors on the propensity of Mexican family firms to innovate. The different factors are discussed below.

Cost factors. Factors such as the high costs of innovation are the most frequently cited factors as barriers to innovation in different sectors (Camacho and Rodríguez, 2005; Coronado *et al.*, 2008; Doloreux and Melançon, 2008; Preissl, 1998; Sirilli and Evangelista, 1998; Tether, 2001), as well as in SMEs (Camisón-Zornoza *et al.*, 2004; Madrid-Guijarro *et al.*, 2009), and in family firms (Sirmon and Hitt, 2003). The transaction costs perspective clarifies that firms' innovation decisions could be mainly explained in attending to economic considerations. Therefore, attention should be paid to the capital constraints that could limit the possibility of initiating innovation activities. But, in the case of family firms, there is growing evidence that the combination of economic and non-economic goals influence their strategy (Gomez-Mejia *et al.*, 2007).

In the case of family firms, the reluctance to embark on higher costs may be increased by the effects on short-term benefits and, therefore, on the socio-emotional wealth of the family (Gomez-Mejia *et al.*, 2011). Unlike the founders of family firms, successors are more likely to be conservative, and interested in preserving the family's wealth. Since there is no guarantee of financial success, subsequent generations may be less willing to support innovation, focussing instead on how the expenses of pursuing innovations may threaten their family wealth (Kellermanns *et al.*, 2010).

Financial factors. Public intervention endeavors to solve the problem of financial restrictions by means of financial support in the form of subsidies, fiscal incentives, or loans. Such financial support constitutes the principal instrument for stimulating industrial R&D, reducing its effective cost, and thus, increasing firms R&D spending (González and Pazó, 2008; Negassi, 2004). The attitude of financial institutions and public support programs toward financing innovation is typically determined by innovations in large firms. Institutional support has traditionally been geared toward large corporations, and that makes it difficult for small and medium size family businesses to obtain resources in this way. Moreover, the attitude of family firms about external financing could affect their perceptions of this aspect. It is accepted that family firms are reluctant to use external financing due to their desire to maintain ownership as well as the control of the business policies which may be restricted by lending banks or institutions (Gallo *et al.*, 2004; Gomez-Mejia *et al.*, 2010; Kim *et al.*, 2008). The refusal to use external financial resources may block costly activities, such as R&D investments (Munoz-Bullon and Sanchez-Bueno, 2011).

Knowledge factors. Family firms need to perform innovation as much as non-family firms because profit and competitiveness come as a result of the innovation strategy. Therefore, when family firms face deviations of performance outcomes below the aspiration level that could imply a loss of competitive advantage relative to the industry, they become more likely to adopt more aggressive innovation behaviors in order to speed up innovativeness and identify new business opportunities

(Chrisman and Patel, 2012; De Massis *et al.*, 2013a). Thus, the availability of information is a critical element at the initial stages of innovation (Slater and Narver, 1995). Wang and Qualls (2007) point out that the lack of information can limit firms' knowledge about the availability of alternative technologies, compatibilities with existing systems, and more importantly, new ways to introduce technologies. They also argue that the probability of a firm deciding to innovate increases with the availability, quality, and value of the information. Bergfeld and Weber (2011), in a recent study in Germany, found that successful family firms that engage in innovation have the ability to constantly address information on new markets and technologies based on a clear long-term strategy, whereas Crespi and Zuñiga (2012), in a study on the Latin American region, found that firms that invest in knowledge are better at introducing new technological advances. The question under consideration is whether a lack of market information is a factor that interferes with innovation. In light of the behavioral agency perspective, the goal of preserving socio-emotional wealth in family firms explains why these firms are less likely to acquire external technology, even if this means accepting below target performance (Kotlar *et al.*, 2013; Nieto *et al.*, 2015; Zahra *et al.*, 2007).

Market factors. Organizations in today's competitive marketplace are increasingly recognizing the need to innovate in partnership with their customers (García-Morales *et al.*, 2007). Consequently, firms should not overlook consumer behavioral responses to innovations, and they should verify that the proposed innovation would not encounter resistance from consumers (Ram and Sheth, 1989). Focussing on latent market needs, alerts firms to new market and technology developments and increases the firms' ability to add new market information in innovation developments (Atuahene-Gima *et al.*, 2005), resulting in innovations with unique benefits. Additionally, exploring a realm of knowledge previously unexplored is positively related to new, breakthrough innovations (Ahuja and Morris Lampert, 2001). In regards to family firms, the decrease in the acquisition, dissemination and utilization of market information after first-generation ownership might be a possible explanation for the small number of firms that survive second-generation ownership (Beck *et al.*, 2011). Accordingly, it is necessary to clarify whether customers' lack of interest in innovation and previous innovations introduced to the market are factors that hamper the propensity of family firms to innovate.

Specific characteristics of family firms

There is much evidence to argue that specific characteristics of family firms could, to a certain extent, influence the obstacles that hamper innovation activities. In short, there is both theoretical and empirical evidence that family ownership and family involvement in management influences their innovation strategies (Classen *et al.*, 2013; De Massis *et al.*, 2013b). Therefore, a number of family variables are included in this study, and discussed below.

CEO tenure. Several authors have focussed on the analysis of CEO tenure and performance in non-family firms (Audia *et al.*, 2000; Finkelstein and Hambrick, 1996; Miller, 1991, 1993; Walters *et al.*, 2007). Their results show that long-tenured CEOs often slow down their knowledge acquisition, growth, and development (Audia *et al.*, 2000), decrease their commitment to learning, and narrow their information search (Finkelstein and Hambrick, 1996), thus hampering performance (Miller, 1991, 1993; Walters *et al.*, 2007). In the particular case of family firms, the fact that family CEOs tend to enjoy long tenures driven by the desire to maintain control (Munoz-Bullon and Sanchez-Bueno, 2011) could enable them to focus on innovative activities that can

rejuvenate their firm's operations and improve their competitive positions (Hadjimanolis, 2000; Zahra, 2005). Furthermore, the idea that, in family firms, long-tenured family CEOs might provide a strong formal and informal control that enhances relationships, investments, etc., required to carry out innovation activities should be considered.

Family involvement. Following Chua *et al.* (1999), and Zahra (2005) the authors define family involvement as the degree to which the members of a family control the ownership of the firm and participate in its management organization and structure. Agency theory highlights that as ownership increases the owner and the firm achieve greater alignment (Fama and Jensen, 1983;. Jensen and Meckling, 1976). The alignment of interests between the firm and the family owner will contribute to the pursuit of risky activities such as innovation (Zahra, 2005). Firms with a greater level of family involvement are under less pressure to obtain higher profits in the short-term and have a greater long-term vision than non-family firms (Bruton *et al.*, 2003; Donckels and Frohlich, 1991; James, 1999; Mustakallio *et al.*, 2002) to enhance business growth, create opportunities for their children, and protect the family firm from aggressive competitors (Poza and Messer, 2001).

3. Database, variables, and methodology

Database

The empirical analysis has been conducted based on recent data from a survey carried out among Mexican firms. The questionnaire was developed in part by following the European CIS methodology, and by incorporating elements from other studies as a result of an extensive literature review, which explore a wide range of issues relating to family characteristics and innovation activities. To achieve the objectives of the study, a sample of firms located in Mexico was used.

The research conducted took place from April 2013 to February 2014. The collection of data considered firms in four federal entities in Mexico characterized by their industrial growth, thus including high concentration of manufacturing firms. The four-targeted states in Mexico were Chihuahua, Queretaro, Nuevo Leon, and San Luis Potosi. Data were gathered through a field study using questionnaire-based surveys applied to CEOs. The surveys consisted of sections pertaining to demographic and descriptive variables about the firm, variables related to organizational control including family characteristics, and innovative performance of the firm. No incentives were given for survey completion.

Initially, five different CEOs from local firms in the cities of Queretaro and San Luis Potosi were surveyed. These surveys served as pre-tests for the questionnaire to ensure the correct wording, overall structure, and confirm that all the response options were given. Once the pre-test was completed, Qualtrics online survey software was used to administer the adequate delivery, response progress, and follow-up of the surveys. Three different sources were considered to gather reliable contact information about firms. The first was an internal database provided and trusted by the Entrepreneurship Institute *Eugenio Garza Lagüera* at the *Tecnologico de Monterrey* (ITESM) in Mexico, containing a listing of firms in Mexico, most of them with the CEOs contact information. Companies located in the four provinces in this study were targeted. The second source was the ITESM business incubators and technological parks located in the four different states in this study. The campuses of these ITESMs are located in the capital cities of the four states. The institutions supplied a list of

companies with their corresponding contact information. Finally, the third source was made up by currently enrolled graduate students at Queretaro Campus and post-graduate students at the ITESM Virtual University, many of whom were CEOs, occupying top-level positions in Mexican firms, or had the authorization to supply the contact information of the CEOs in their companies. The special interest of ITESM to develop quality research in Mexico and the close collaboration among colleagues and the researchers involved in this study was decisive in obtaining the information and conducting this research.

A personalized invitation to respond to the online version of the questionnaire was then delivered to each of the contacts found in the databases mentioned above. From the 627 invitations initially sent, replies from 431 firms were received. Because of some data problems (i.e. missing data or incomplete questionnaires), it was necessary to refine the sample. A total of 105 observations were suppressed from the initial sample (i.e. those that presented incomplete answers and when people other than the CEO answered the survey), resulting in 326 valid questionnaires. No outliers were identified as derived from the non-quantitative nature of the questions asked. Companies in the sample were of all sizes, and belonged to industrial and private service sectors. The sampling error is 5.71 percent[1]. In most survey research, sampling error levels typically lie between 2 and 6 percent with 95 percent confidence levels (Särndal *et al.*, 2003; Chrisman and Patel, 2012). Therefore, it can be said that the sample represents the general population and the results from this study could have important implications for the questions researched.

First, a basic operational definition of family firms was used bearing in mind that definitions of family firms abound in the literature and definitional ambiguities persist (Voordeckers *et al.*, 2007). Therefore, based on the commonly selected criteria of ownership control, the respondents were asked if there was a family or group of families that had a significant percentage of ownership and/or voting rights over the company. From the 326 firms in the sample, a total of 161 companies responded affirmatively and were considered in this study as family firms. The remaining non-family firms were excluded from this study. Second, a review of the literature suggests three principal ways in which definitions of family firms can be considered, basically according to content, purpose, and form (see Klein *et al.*, 2005). Furthermore, according to Chua *et al.* (1999), a family business definition should be clear and unambiguous about which dimensions it considers, and should assist in providing reliable (replicable) research results. Thus, based on rigorous criteria of ownership and family management control, this study differentiated between two subgroups of family firms. Firms classified in subgroup 1 complied with a rigorous definition of family firms in which a family or group of families accounted for more than 50 percent of the firm's ownership, with a CEO that was a member of the business family. In this case, 94 firms were identified. Firms in subgroup 2 followed a less rigorous definition of family firms in which a family or group of families had less than 50 percent of the firm's ownership, and in most cases their CEOs were not members of the business family. So, 67 firms out of the total of 161 family businesses initially identified fulfilled these criteria. Table I provides information about the main characteristics of the sample.

Variables

Dependent variable. Innovation activities (INNOVA) is a dichotomous variable, which assumes a value of "1" when the respondent indicated that the family firm had performed activities conducted specifically in order to develop or implement any type

of innovation (product innovation, process innovation, and/or management innovation) during the previous three years, and a value of "0" otherwise (Mohnen and Röller, 2005).

Independent variables. As previously addressed, items developed according to the European CIS methodology were used, which have been conducted since the mid-1990s in the European Union member states, and which are coordinated by the Statistical Office-EUROSTAT under the definitions of the OSLO Manual (OECD and EUROSTAT, 2005). Thus, the survey included questions regarding the importance of the following factors that make innovation difficult:

- very high innovation costs (COST);
- lack of funds within the enterprise or group and financial support (FINANCING);
- lack of information on markets and technology (KNOWLEDGE);
- market dominated by established companies and uncertainty over the demand for innovative goods and services (CONTEXT);
- lack of demand for new goods and services (NODEMAND); and
- no need due to previous innovations (PREVINNOV).

These factors may act to inhibit or limit the innovation capacity of firms. The scale in the questionnaire ranges from 1 "unimportant" to 5 "very important." Following Baldwin and Lin (2002), and Galia and Legros (2004), a dummy variable was created, which takes the value "1" if firms answered 4 (important) or 5 (very important), and "0" otherwise.

The dimensions of family influence were measured as follows. First, CEOTENURE measures the number of years the current CEO has held her or his position in the company (Kellermanns *et al.*, 2008; Li and Srinivasan, 2011; Minichilli *et al.*, 2010; Voordeckers *et al.*, 2007; Zahra, 2005). We coded "1" for less than ten years, "2" from 11 up to 25 years, and "3" for more than 25 years.

Also, family involvement was assessed by using a GENERATIONS variable, which collects the number of generations involved in the business and holding management positions (Kellermanns *et al.*, 2008; Zahra, 2005). We coded "1" for one generation, "2" for two generations, and "3" for three or more generations. In addition, the number of family members holding management positions (FAMMGMT) and non-management positions in the company (FAMNOMGMT) were considered. In these cases, we coded "0" for none, "1" for one member, "2" for two members, and "3" for three or more members.

Table I. Sample descriptive statistics

	All family firms
Sample	161
Sector (%)	
Service	114 (70.8%)
Industrial	47 (29.2%)
Size (%)	
Small (< 50)	84 (52.2%)
Medium (> 50 up to 250)	43 (26.7%)
Large (> 250)	34 (21.1%)

Control variables. Two control variables identified in prior literature were introduced to measure certain firm's characteristics.

SECTOR. Firms have been classified, respectively, into the service sector or industrial sector (Tödtling and Trippl, 2009). A dummy variable was created to classify firms in the service sector as "0" and firms in the industrial sector as "1."

SIZE. Firms have been classified, respectively, considering their total number of employees. Three categories were used depicting small companies (less than 50 employees) coded as "1," medium companies (from 50 to 250 employees) coded as "2," and large companies (more than 250 employees) coded as "3."

Methodology

The theoretical model proposed here is tested by the estimation of a binomial logistic regression model. The suitability of this technique is derived from the nature of the dependent variable (qualitative and dichotomous) and the explanatory variables (where dichotomous variables are combined with polychotomous variables). Logistic regression analysis allows us to estimate the probability of a firm deciding to carry out innovation activities as a function of various internal and external factors. The regression coefficients estimate the impact of the explanatory variables on the probability of carrying out innovation activities, with a positive sign for the coefficient meaning that the variable increases that probability. The aim is to establish a profile for firms engaged in innovation activities.

The underlying regression has been defined as:

$$\begin{aligned}\text{INNOVA}_i = {} & \beta_1 + \beta_2\text{COST}_i + \beta_3\text{FINANCING}_i + \beta_4\text{KNOWLEDGE}_i \\ & + \beta_5\text{CONTEXT}_I + \beta_6\text{NODEMAND}_i + \beta_7\text{PREVINNOV}_i + \beta_8\text{SECTOR}_i \\ & + \beta_9\text{SIZE}_i + \beta_{10}\text{GENERATIONS}_i + \beta_{11}\text{CEOTENURE}_i \\ & + \beta_{12}\text{FAMMGMT}_i + \beta_{13}\text{FAMNOMGMT}_i + \varepsilon_i\end{aligned}$$

where β are the estimated coefficients and ε_i is an error term (Greene, 2003). The statistical software IBM SPSS v.22 was used for the analyses.

4. Results

We observe (Table AI) moderate levels of correlations among our variables (all correlations being smaller than 0.555). However, before the analysis, multicollinearity checks were conducted. The maximum VIF value found was less than 1.706. This falls far short of 10, the cut-off considered by Neter *et al.* (1983) or Hair *et al.* (1998) as a limit. Hence, multicollinearity was not a problem in the analyses.

As it is addressed in the literature, perceived barriers could depend on whether the companies are trying to introduce an innovation or are engaged in innovative activities (Mohnen and Röller, 2005). This may require a correction of the possible existence of endogeneity bias of the regressors. However, due to the lack of appropriate tools[2] (Iammarino *et al.*, 2009; Mohnen and Röller, 2005), this study did not try to correct for endogeneity, as the attempt to correct it is constrained by the current estimation procedure and well beyond the scope of this paper. However, this is considered to be included in the research agenda.

Logistic regression estimations were carried out to estimate the impact of the explanatory variables on innovation activities. Three regression models were used.

Model 1 included all the sample of family firms, and models 2 and 3 included the subgroups 1 and 2 of family firms previously discussed, corresponding to those following a strict definition and a less strict definition of family firms. In addition, each of the models included three steps to incorporate the different variables in this study. As a first step, the model controlled for family variables, including GENERATIONS, CEOTENURE, FAMMGMT and FAMNOMGMT. In the second step, both *c*ontrol variables related to SECTOR and SIZE were included, as well as the family variables from the previous step. In the third step, all the variables related to the barriers such as Cost, Financial, Knowledge, and Market factors were included, as well as the family variables and control variables from steps 1 and 2. For a summary of the results and significant variables please refer to Table II.

The results of the logistic regression are presented in Tables III-V. The three models and their corresponding steps χ^2 were significant at $p < 0.001$, showing that including the independent variables the prediction of the probability of the innovation activities in family firms is superior. The strength of the models is assessed through the calculation of a pseudo R^2, figured by dividing the model χ^2 by the overall −2 log likelihood. This statistic is one of the most straightforward of the various pseudo R^2 statistics proposed for assessing logistic regression models (DeMaris, 1995). The pseudo R^2 gives a rough measure of goodness of fit that can be compared across models. There is an increase of the pseudo R^2 value from each of the corresponding steps in models 1-3.

To correctly interpret the parameters of the logistic equation, it is important to assess the results of the third column (OR) of Tables III-V. The OR refers to the incremental odds ratio corresponding to an increase of one unit in an independent variable, assuming that the values of all other variables remain unchanged. Odds ratios of 1 indicate no effects (similar to a regression coefficient of 0). Odds ratios greater than 1 indicate a positive association between the independent variable and the risk of the event's occurrence, and odds ratios of less than 1 indicate a negative association (Hosmer *et al.*, 2013). Other studies examining the effects on the firms' innovative performance have used this methodology (Jensen *et al.*, 2007).

The first model included all the family firms in the sample. In the first step, GENERATIONS was significantly positively related to innovation activities ($\beta = 0.642$, $p < 0.05$), and FAMNOMGMT was significantly negatively related to innovation activities ($\beta = -0.380$, $p < 0.05$). In the second step, SIZE was significantly

Table II.
Model summary – significant variables results of the logistic regressions for innovation in Mexican family firms

Sample	All family firms	Family firms subgroup 1	Family firms subgroup 2
Model	1	2	3
Definition	All the sample of family firms	Rigorous definition: Family ownership > 50% and CEO is a member of the business family	Less rigorous definition: Family ownership < 50% and in most cases the CEO is not a member of the business family
n	161	94	67
Barrier variables	NODEMAND	NODEMAND KNOWLEDGE	PREVINNOV
Control variables	SECTOR	SIZE SECTOR	–
Family variables	–	GENERATIONS CEOTENURE FAMNOMGMT	–

Variables	Step 1 B^a	Step 1 SE[b]	Step 1 OR[c]	Step 2 B^a	Step 2 SE[b]	Step 2 OR[c]	Step 3 B^a	Step 3 SE[b]	Step 3 OR[c]
Cost variables									
1. COSTS							−0.169	0.452	0.845
Financial variable									
2. FINANCING							0.041	0.516	1.042
Knowledge variables									
3. KNOWLEDGE							−0.673	0.660	0.510
Market variables									
4. CONTEXT							0.191	0.574	1.211
5. PREVINNOV							−0.548	0.611	0.578
6. NODEMAND							*−1.301**	*0.625*	0.272
Control variables									
7. SECTOR				0.591	0.374	1.806	*0.952**	*0.467*	2.591
8. SIZE				*0.481***	*0.279*	1.618	0.360	0.296	1.433
Family variables									
9. GENERATIONS	*0.642**	*0.308*	1.900	0.213	0.339	0.530	0.255	0.399	1.290
10. CEOTENURE	0.032	0.202	1.033	−0.101	0.217	0.640	−0.095	0.240	0.910
11. FAMMGMT	0.159	0.231	1.172	−0.114	0.261	0.664	−0.015	0.285	0.985
12. FAMNOMGMT	*−0.380**	*0.162*	0.684	*−0.399**	*0.165*	0.016	−0.296	0.183	0.743
χ^2	*49.809****			*60.556****			*75.847****		
−2 Log likelihood	173.384			162.637			147.347		
Pseudo R^2	0.287			0.372			0.514		

Notes: $n = 161$. Dependent variable: INNOV (innovation). [a]Parameter estimate; [b]standard error; [c]odds ratio. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; ****$p < 0.1$

Table III.
Model 1 – results of the logistic regression for innovation in Mexican family firms – all family firms

Table IV.
Model 2 – results of the logistic regression for innovation in Mexican family firms – subgroup 1

Variables	Step 1 B^a	Step 1 SE[b]	Step 1 OR[c]	Step 2 B^a	Step 2 SE[b]	Step 2 OR[c]	Step 3 B^a	Step 3 SE[b]	Step 3 OR[c]
Cost variables									
1. COSTS							0.356	0.690	1.427
Financial variable									
2. FINANCING							−0.664	0.815	0.515
Knowledge variables									
3. KNOWLEDGE							*−2.539**	*1.048*	0.079
Market variables									
4. CONTEXT							−0.447	0.863	0.639
5. PREVINNOV							1.360	0.998	3.896
6. NODEMAND							*−2.579***	*0.953*	0.076
Control variables									
7. SECTOR				0.646	0.563	1.908	*1.743**	*0.805*	5.714
8. SIZE				*0.874**	*0.400*	2.397	*0.891****	*0.471*	2.438
Family variables									
9. GENERATIONS	*1.033**	*0.467*	2.811	0.649	0.497	1.914	*1.237****	*0.691*	3.445
10. CEOTENURE	0.030	0.281	1.031	−0.428	0.334	0.652	*−0.884**	*0.434*	0.413
11. FAMMGMT	−0.159	0.319	0.853	−0.450	0.370	0.638	−0.544	0.460	0.581
12. FAMNOMGMT	*−0.673***	*0.235*	0.510	*−0.818***	*0.260*	0.441	*−0.890***	*0.338*	0.410
χ^2	*29.673****			*40.689****			*56.767****		
−2 Log likelihood	100.638			89.622			73.544		
Pseudo R^2	0.294			0.454			0.772		

Notes: $n = 94$. Dependent variable: INNOV (innovation). [a]Parameter estimate; [b]standard error; [c]odds ratio. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; ****$p < 0.1$

Table V.
Model 3 – results of the logistic regression for innovation in Mexican family firms – subgroup 2

Variables	Step 1 B^a	Step 1 SE[b]	Step 1 OR[c]	Step 2 B^a	Step 2 SE[b]	Step 2 OR[c]	Step 3 B^a	Step 3 SE[b]	Step 3 OR[c]
Cost variables									
1. COSTS							−0.537	0.826	0.584
Financial variable									
2. FINANCING							0.181	0.915	1.199
Knowledge variables									
3. KNOWLEDGE							1.512	1.526	4.537
Market variables									
4. CONTEXT							1.436	1.271	4.204
5. PREVINNOV							*−2.742**	*1.139*	0.064
6. NODEMAND							−0.064	1.361	0.938
Control variables									
7. SECTOR				*1.173***	*0.658*	3.230	0.765	0.869	2.149
8. SIZE				−0.195	0.489	0.823	−0.103	0.541	0.902
Family variables									
9. GENERATIONS	0.564	0.517	1.758	0.229	0.575	1.257	0.040	0.669	1.041
10. CEOTENURE	0.086	0.327	1.090	−0.054	0.343	0.947	0.262	0.428	1.300
11. FAMMGMT	0.291	0.404	1.338	−0.049	0.471	0.952	0.316	0.592	1.372
12. FAMNOMGMT	−0.187	0.267	0.830	−0.019	0.286	0.982	−0.201	0.365	0.818
χ^2	*26.101***			*30.032****			*41.346****		
−2 Log likelihood	66.781			62.850			51.536		
Pseudo R^2	0.390			0.477			0.802		

Notes: $n = 67$. Dependent variable: INNOV (innovation). [a]Parameter estimate; [b]standard error; [c]odds ratio. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; ****$p < 0.1$

positively related to the dependent variable ($\beta = 0.481$, $p < 0.1$), and FAMNOMGMT remained negatively significant ($\beta = -0.399$, $p < 0.05$). In the third step, as can be observed in Table III, the −2 log likelihood showed a χ^2 value of 75.847 with 12 df. The pseudo R^2 value of 0.514 is the highest among the three steps in the model indicating that these variables were useful for classifying the firms and that the model put forward has a high explanatory power.

The results confirm a significantly negative relationship between innovation activities in family firms and market factors, NODEMAND ($\beta = -1.301$, $p < 0.05$). This result suggests that the lack of demand for innovation is an important factor considered by Mexican family firms that hamper their propensity to engage in innovation activities. In regards to the control variables, only SECTOR ($\beta = 0.952$, $p < 0.05$) remained significantly positively related to innovation activities. Firms in the industrial sector are more innovative than firms in the service sector. Insofar as the family variables, none of them remained significant in this step.

The second model included the firms in subgroup 1 (classified according to a rigorous definition of family firms) in which the property was higher than 50 percent, and the CEO was a member of the business family ($n = 94$). In the first step, GENERATIONS was significantly positively related to innovation activities ($\beta = 1.033$, $p < 0.05$), and FAMNOMGMT was significantly negatively related to innovation activities ($\beta = -0.673$, $p < 0.01$). In the second step, SIZE was significantly positively related to the dependent variable ($\beta = 0.874$, $p < 0.05$), and FAMNOMGMT remained negatively significant ($\beta = -0.818$, $p < 0.01$). In the third step, as can be observed in Table IV, the -2 log likelihood showed a χ^2 value of 56.767 with 12 df. The pseudo R^2 value of 0.772 is the highest among the three steps indicating that these variables are useful for classifying the firms and that the model put forward has a high explanatory power.

The results confirm a significantly negative relationship between innovation activities in family firms and knowledge factors and market factors, KNOWLEDGE ($\beta = -2.539$, $p < 0.05$) and NODEMAND ($\beta = -2.579$, $p < 0.01$) correspondingly. These results suggest that the lack of information about the market and technologies, as well as the lack of demand for innovation are factors that hamper Mexican family firms' propensity to engage in innovation activities.

As far as the family factors, CEO TENURE turned out to be significant with a negative sign ($\beta = -0.884$, $p < 0.05$), as well as FAMNOMGMT ($\beta = -0.890$, $p < 0.01$). A result that suggests that CEO tenure at the firm can be perceived as an inhibitor to innovation, as well as the number of family members occupying non-managerial positions in the company. In addition, GENERATIONS was significantly positively related to innovation ($\beta = 1.237$, $p < 0.1$), which highlights the benefits to innovation with the participation of different generations in the firm. In regards to other control variables, both SIZE ($\beta = 0.891$, $p < 0.1$), and SECTOR ($\beta = 1.743$, $p < 0.05$) remained significantly positively related to innovation activities. Firms in the industrial sector were more innovative than their counterparts in the service sector, and larger firms were more innovative than smaller ones.

The third model included the firms in subgroup 2, which had less than 50 percent of the ownership, and regardless of whether the CEO was a member of the business family ($n = 67$). In the first step, none of the family variables were significantly related to innovation, although the model showed a level of significance of $p < 0.001$ with a χ^2 of 26.101 and a Pseudo R^2 ratio of 0.390. In the second step, SECTOR remained positively related to the dependent variable ($\beta = 1.173$, $p < 0.1$).

In the third step, as shown in Table V, the −2 log likelihood showed a χ^2 value of 41.346 with 12 df. The pseudo R^2 ratio of 0.802 is the highest among the three steps in this model, indicating the model's explanatory power. These results confirm a significantly negative relationship between innovation activities in this subgroup of family firms and market factors (PREVINNOV $\beta = 2.742$, $p < 0.01$). No other family or control variable introduced showed significant to innovation activities. This result is meaningful when considering the analysis of a sample of different family businesses in terms of a rigorous definition of family business, which includes particular characteristics of ownership and family management control.

5. Conclusions

The aim of this work was to analyze the influence of the different obstacles on the propensity of family firms to innovate. To achieve this objective, an empirical study was carried out by using an econometric approach based on binomial logistic regression models with a sample of Mexican family firms through which the authors tried to address several gaps identified in the literature. First, in regards to the variables analyzed in this study, a wide range of potential barriers of financial and non-financial nature have been introduced, which are also analyzed separately and not grouped by categories, two demands that are up-to-date in the literature on barriers to innovation. Second, the sample under study includes companies of different sizes and sectors in Latin America, a region with low levels of innovative activity, which are not expected to dramatically change at least in the short term. It therefore responds to the demand of extending samples regarding these three aspects in previous literature on innovation in family business. Finally, a third important contribution of the study is the exclusive consideration of family firms, as opposed to most previous studies that focus on a comparison between family and non-family businesses. Additionally, the authors have identified two subgroups of family firms to assess whether they presented significant differences in relation to the subject under investigation. Thus, responding to the existing demand of research in this regard. The results of the empirical study confirm, first, the existence of significant differences between the two subgroups of family firms, thus confirming the heterogeneity within the group of companies considered family firms and the usefulness of this study´s approach. In addition, this has important implications for future studies, upon deciding to follow a rigorous definition level of family firms in terms of ownership and family management control, which could unveil important findings and have different implications for family firm studies.

The results confirm the heterogeneity of family firms, and the approach of this study is important when considering analyzing a sample of different family businesses in terms of a rigorous definition level of family business as to characteristics of ownership and family management control. In short, when applying a more rigorous definition (model 2), knowledge and market factors are significant and negatively related to the propensity to engage in innovation activities in Mexican family firms. In addition, there are three family factors that affect the perception of barriers: GENERATIONS, which is significant with a positive sign, and CEOTENURE and FAMNOMGMT, which are significant with negative signs. As opposed to a less rigorous definition (model 3) or a broad classification of family firms with a lack of differentiation when considering all the sample of firms (model 1), in both cases only market factors appear to be relevant. In addition, in terms of family specific factors, three variables are significant for model 2 vs none in models 1 and 3. Finally, regarding

the control variables, model 2 shows that size and sector are significant, as opposed to model 1 in which only sector is significant, and model 3 in which none of the factors are significant. Therefore, we can conclude that by employing different family firm definitions and subgroups of family firms, studies could provide unique, richer, and more precise insights than those that use a single definition.

Regarding the type of barriers identified as significant in the two subgroups of family firms analyzed, both include different aspects. The finding that knowledge factors represent a significant barrier only for businesses with a strong family control is consistent with suggestions that innovation may be constrained by the availability of information as a critical element at the initial stages of innovation (Slater and Narver, 1995). In addition, Wang and Qualls (2007) and Frenkel (2003) pointed out that the lack of information could limit the firms´ knowledge about the availability of alternative technologies, compatibilities with existing systems, and more importantly, ways to introduce the technologies. Furthermore, this subset of companies seems to be adversely affected by their perception of the desires of the market. Globally considered, this evidence seems to indicate that these types of family businesses were less open to the outside and have greater difficulty in incorporating external knowledge and resources in line with the approach of socio-emotional wealth theory. In addition, a different type of market factor (namely, the lack of demand for innovation due to previous innovations) represents the only significant barrier for the second subset of family firms. However, the factors of economic and financial nature widely discussed in the general literature on innovation, are not significant whatever the definition adopted for family firms. First, the above results confirm the usefulness and desirability of including in studies on barriers to innovation, those that are of a non-financial nature. Second, based on the literature review, the results suggest that family firms have different perceptions than non-family firms regarding the consideration of financial factors as an element that can hinder their innovative activity. Third, in regards to the inclusion of family variables in the proposed models, these are significant only when a more rigorous definition of family business is employed. In such cases, the longest tenure of the CEO, and the presence of family members occupying non-managerial positions in the company are factors that significantly adversely affect innovation activities, while the number of family generations involved in the business is a significant positive factor. Concerning the CEO variable, this result is in line with previous empirical evidence for the case of non-family firms, while the positive effect found between greater family involvement in the business, tied with high rates of family ownership, is in line with the theoretical arguments borrowed from agency theory. Agency theory indicates that concentrated ownership and control reduces agency costs and aligns managers' and shareholders´ interests. Such alignment of incentives will encourage managers to make key innovation-related decisions aimed at boosting firm value. Conversely, arguments indicating that for family firms, family involvement could generate agency costs because of problems related to the family's desire to maintain its socio-emotional wealth, self-control, and altruism (Schulze *et al.*, 2001), have not found empirical support in this study. In contrast, these results provide important implications for Mexican family firms to strive for the generational involvement and non-managerial positions policies for family members.

The study of barriers to innovation is important for both policy makers and managers. For policy makers because they need to know the main reasons that prevent or exclude firms from innovating in order to implement measures, which effectively contribute to increase the number of companies engaged in innovation. Innovation

activities may lead to a mitigation of the effects of innovation barriers faced by family firms in their home countries. However, engaging in innovation activities requires a deep and thorough understanding of internal business processes and of business environment conditions in the country concerned. For managers, this knowledge is important, as recognizing the obstacles faced by innovative firms may help them to design and implement strategies geared at overcoming them.

This study shows some limitations and future considerations. The present design utilized a cross-sectional sample rather that a true longitudinal sample, measuring the companies over time: before and after the family firm engage in innovation activities. In addition, for future studies new explanatory variables could be considered such as family and business objectives, or the strategy orientation of the firm. On the other hand, and given that both the industry and the size factors of the companies have been relevant to the proposed models, may also be interesting to deepen the analysis of the differences between small and medium family firms and large family businesses. Due to the lack of studies on innovation and family firms in Latin America and other emerging economies, it may be interesting to replicate this study for a more detailed view of the barriers to innovation affecting family firms.

Notes

1. Confidence level: 95 percent ($z = 1{:}96$; $p = q = 0{:}5$).
2. Mohnen and Röller (2005) considered four specific obstacles, one from each category. They correct for endogeneity when estimating the determinants of the intensity of innovation, finding no reverse causality. No correction was made in case of the propensity equation due to a lack of instruments (p. 1445).

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	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13
Dependent variable															
1. INNOV	0.770	0.422	1												
Cost variables															
2. COSTS	0.400	0.491	−0.099	1											
Financial variable															
3. FINANCING	0.401	0.443	0.061	0.226**	1										
Knowledge variables															
4. KNOWLEDGE	0.301	0.372	−0.134	0.11	−0.045	1									
Market variables															
5. CONTEXT	0.317	0.390	−0.011	0.105	0.120	0.307**	1								
6. PREVINNOV	0.200	0.405	−0.308**	0.153	−0.112	0.334**	0.101	1							
7. NODEMAND	0.170	0.375	−0.308**	0.179*	−0.087	0.129	0.019	0.555**	1						
Control variables															
8. SECTOR	1.370	0.483	0.109	0.067	0.069	0.182*	0.110	−0.003	0.073	1					
9. SIZE	1.690	0.800	0.139	−0.113	−0.185*	0.054	−0.033	−0.072	−0.054	0.296**	1				
Family variables															
10. GENERATIONS	1.660	0.698	0.013	−0.046	−0.078	.175*	0.117	0.002	0.097	0.107	0.260**	1			
11. CEOTENURE	1.240	0.877	−0.089	0.028	−0.132	−0.143	−0.147	0.039	0.031	−0.087	−0.055	0.059	1		
12. FAMMGMT	2.070	0.833	−0.040	−0.027	−0.191*	0.149	−0.015	0.121	0.08	0.071	0.176*	0.495**	0.044	1	
13. FAMNOMGMT	0.780	1.116	−0.213**	0.090	−0.221**	0.189*	0.037	0.168*	0.118	−0.072	−0.006	0.122	0.085	0.071	1

Notes: $n = 161$. *,**Correlations are significant at the 0.05 and 0.01 level (two-tailed), respectively

Table AI.
Descriptive statistics and Pearson correlations among the analysis variables

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