Beyond financing innovation: The rise of non-financial barriers to innovation in emerging economies, evidence from Chilean companies from 2007 to 2016

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Abstract

Understanding the impact of perceived obstacles on various inputs and outcomes within the innovation process is essential for firms engaged in innovation activities. While much of the existing theoretical framework focuses on financial barriers, that is, the economic constraints that limit firms' ability to develop and implement new ideas, products, or processes, this article expands and complements the literature by examining the influence of non-financial obstacles. These include knowledge limitations, organizational challenges, market constraints, and regulatory hurdles, all of which can hinder innovation even when financial resources are available. Thus, the objective of this study is to analyze the evolution of the perception of obstacles to innovation in Chilean companies. The study draws on data from versions VI to X of the Chilean National Innovation Surveys, covering the period 2007–2016, and applies confirmatory factor analysis to identify latent perceptions of barriers, along with multiple linear regression models to evaluate their relationship with inputs, outcomes, and R&D activities. The findings show that non-financial barriers are as significant as financial ones and reveal distinct temporal trends: while financial obstacles tend to decrease over time, barriers related to knowledge, cooperation, demand, and regulation have gained relevance, particularly affecting small and medium-sized enterprises. This longitudinal perspective provides a novel empirical contribution to the study of innovation in developing economies and offers key insights for the design of more targeted and adaptive public policies.

Keywords: product innovation, process innovation, Chile, innovation barriers, non-financial barriers.

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Introduction

While the existing literature has predominantly emphasized financial barriers, several significant studies have highlighted the presence of other critical factors that influence business innovation. According to Beyer (2022), the most reported barriers to innovation are organizational culture, lack of organizational development strategies, ineffective communication with external stakeholders, a rigid and vertical communication structure, reluctance to try new things, inability to identify opportunities, and a hostile attitude toward change and innovation. In a similar sense, Hall (2019) investigates the challenges faced by small and medium-sized enterprises (SMEs) in financing research, development, and innovation activities, placing particular emphasis on non-financial barriers. Although financial limitations are revisited, the study also highlights other crucial factors, such as resistance to change, information management deficiencies, and the pressing need for skilled personnel capable of adapting to dynamic environments. Public policy initiatives are likewise considered pivotal in mitigating these barriers, fostering collaboration among firms, and promoting support from a variety of stakeholders, including government agencies, with the ultimate goal of cultivating a more favorable environment for innovation and technological advancement.

By focusing on the perception of obstacles to innovation across a set of inputs, outputs, and R&D activities, and by utilizing data from the 6th to the 10th edition of the Chilean National Innovation Survey, which covers the period from 2007 to 2016, this research enables a disaggregated analysis of the different survey editions to examine how perceptions of barriers to innovation have evolved over the full study horizon. Thus, the objective of this study is to analyze the evolution of the perception of barriers to innovation in Chilean companies during the period 2007–2016, based on a set of inputs, outputs, and R&D activities, using data from the National Survey of Innovation in Chilean Companies.

From the perspective of business innovation, Chile has implemented a series of public policies and instruments to promote innovation in recent decades (CORFO, R&D Law, public-private cooperation programs), but it continues to have low levels of private investment in R&D. In addition, considering the data, Chile has the availability and continuity of innovation surveys in Chile, which allows for rigorous longitudinal analysis. It is one of the few countries in the region with multiple comparable waves of innovation surveys, aligned with the Oslo Manual, which allows for sophisticated temporal analysis of the evolution of obstacles.

Empirical findings from this study reveal that, although financial barriers remain significant, non-financial barriers play an equally, if not more, critical role for innovating firms. These obstacles encompass fundamental factors intrinsic to the core functions of modern

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enterprises, directly linked to productivity enhancement and sustainable long-term economic development. Understanding the barriers to innovation can inform the development of business strategies and public policies that promote economic growth, job creation, and wealth generation (Madrid, Domingo, & Auken, 2009).

From a practical standpoint, understanding the dynamics and relative significance of non-financial barriers is essential for designing more effective organizational strategies and public policies. Such understanding contributes to the development of institutional and regulatory frameworks that foster innovation. Additionally, it supports the identification of critical areas for intervention —particularly for small and medium-sized enterprises— which are especially susceptible to internal challenges related to capabilities, organizational culture, and management practices.

The structure of this article is as follows: Section 2 presents a review of the literature on barriers to innovation. Section 3 outlines the research objectives and methodological framework. Section 4 describes the dataset, defines the dependent and explanatory variables, and details the sample used for statistical estimation. Section 5 reports the empirical findings and offers a corresponding discussion. Finally, Section 6 concludes by summarizing the principal results of the study.

Literature Review

In the modern industrial landscape, innovation is indispensable for maintaining competitiveness, as it enables firms to swiftly adapt to dynamic market conditions (Porter, 2021). Barriers to innovation are present across all economies, though they are particularly pronounced in developing nations (Pereira, 2020). Within the Latin American context, innovation emerges as a pivotal driver of economic growth, empowering firms to compete effectively in global markets (Crespi & Zuniga, 2012). Analyzing these barriers provides comprehensive insights into the innovation process, allowing researchers to discern which constraints most critically hinder innovative activity amidst the myriad factors at play (Pereira, 2020).

Firms operating in highly competitive markets tend to underinvest in research and development (R&D), failing to allocate sufficient resources to attain their desired levels of innovation (Hall & Lerner, 2019). A key contributing factor is the limited ability of firms to appropriate the economic returns from their innovations, particularly when these outcomes cannot be fully protected or kept confidential. Empirical research by Triguero and Córcoles (2013) on Spanish manufacturing firms indicates that resource allocation towards innovation is heavily influenced by the firm's historical financial and strategic behavior, suggesting a tendency for firms to maintain consistent R&D budgets rather than enact radical shifts.

Research on innovation has predominantly concentrated on the factors that shape perceptions of barriers (Baldwin & Lin, 2002) or on the impacts of such barriers, typically financial, on firms' propensity to innovate and their commitment to innovation efforts (Savignac, 2008; Tiwari et al., 2007) It is important to highlight that while existing literature largely emphasizes financial constraints and access to credit (Cardoso et al., 2005), other critical dimensions remain underexplored. A growing body of research underscores that non-financial barriers are equally consequential (Pellegrino & Savona, 2017; Mohan et al., 2016).

According to Kozioł-Nadolna & Beyer (2021), barriers to innovation arise from the lack of an organizational development strategy, a lack of communication with external stakeholders, a rigid communication structure, an inability to identify opportunities, and a refusal to change and innovation. Furthermore, factors such as the company's size, growth, internationalization, and the sectoral intensity of innovation influence the presence and magnitude of these barriers. It is important to highlight that an organization's innovation capacity is a key element for its sustainable development, which must be implemented taking into account the principles of economic, social, and environmental sustainability. For this reason, most of the literature divides barriers to innovation into internal or external (Kozioł-Nadolna & Beyer, 2021; Beyer, 2022), the former being those that affect the innovation process within the company, such as organizational culture, competition, organizational structure, and allocation of resources to R&D. External barriers refer to the absence of innovation drivers related to institutions and the market, such as the educational system, labor market, financial system, or competition (Holzl & Janger, 2012; Jakimowicz & Rzeczkowski, 2019), in addition to a lack of information and government support (Madrid, Domingo, & Auken, 2009). There is strong empirical research confirming the relationship between company size and the perception of barriers to innovation and their level of importance, stating that barriers decrease as the size of an organization increases (Arza & López, 2018; Pinget et al. 2015).

The once-prevailing notion that innovation is solely an outcome of internal corporate management is being increasingly challenged, as firms turn to external knowledge networks to enhance their innovative capabilities (Audretsch & Belitski, 2017). The open innovation paradigm advocates for leveraging external networks before relying solely on in-house capabilities (Chesbrough, 2006). Thomä and Bizer (2013) argue that firms benefit from knowledge exchanges with universities, private research centers, and specialized service providers, which in turn catalyzes internal innovation processes. University-industry collaborations are mutually advantageous, fostering the transfer of expertise, technology, and research findings while opening avenues for new research opportunities (Figueiredo & Ferreira, 2022). Such partnerships are vital for economic growth, as they enable universities to align their expertise with real-world challenges and equip firms with access to cutting-edge research and capacity development (Perkmann et al., 2013). External knowledge acquisition can be characterized by breadth, the range of knowledge sources accessed, and depth, the extent to which firms exploit these external resources (Laursen & Salter, 2006).

Audretsch (2019) emphasizes the profound link between culture, entrepreneurship, and innovation. He highlights the role of cultural context in shaping economic performance and explains how culture can modulate the effectiveness of policies aimed at fostering entrepreneurial activities. Market size and the efficacy of network cooperation

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are also crucial environmental factors influencing business innovation (Balcerzak & Pietrzak, 2016). Lind et al. (2013) classify collaborative interactions into four typologies: (1) remote collaboration, where firms fund research but delegate project decisions to research teams; (2) transactional collaboration, where firms maintain oversight but refrain from daily involvement; (3) specific collaboration, characterized by pre-negotiated firm engagement; and (4) developed collaboration, featuring active, joint participation in core activities.

De Mel et al. (2009) contend that an owner's capabilities, personal attributes, and even ethnicity significantly influence a firm's inclination toward engaging in R&D activities. D'Este et al. (2012) observes that participation in innovation activities heightens firms' awareness of the challenges involved, noting that firms actively engaged in innovation perceive barriers as more significant than those that are not. Likewise, companies that do not engage in innovative activities perceive the importance of barriers to a lesser extent.

Empirical studies further illustrate that firms of varying sizes encounter distinct innovation barriers (Madrid, Domingo, & Auken, 2009). Larger firms typically pursue incremental innovations, whereas smaller firms are more adept at implementing radical changes. However, large enterprises may face barriers related to operational inertia and resistance to change (Ferriani et al., 2008).

Seitz and Watzinger (2017) argue that improving firms' hiring environments is crucial for advancing R&D, particularly for resource-constrained firms reliant on external talent. Research by Ayyagari et al. (2011) spanning 47 developing countries links access to external finance and exposure to international competition with heightened innovation levels. Furthermore, deregulation of banking systems, as part of broader economic liberalization, has been shown to spur innovation, as evidenced by Amore et al. (2013) in their analysis of patent activity during periods of banking deregulation in the United States.

García-Quevedo et al. (2017) explore how demand uncertainty and demand absence shape Spanish firms' R&D investment decisions, concluding that these factors are perceived as distinct barriers. Specifically, they argue that a lack of demand exerts a strongly negative influence, whereas demand uncertainty may paradoxically stimulate R&D investment, particularly in low-tech sectors.

Finally, Maldonado-Guzmán et al. (2017) examined the impact of financial factors, human capital, and the external environment on innovation activities in small and medium-sized enterprises (SMEs) in Mexico, concluding that the external environment is the most significant factor. These findings are consistent with those reported by Cardoso et al. (2005), who identify access to financing, tax policies, and operational sustainability as the primary challenges faced by small and medium-sized enterprises (SMEs) in Brazil. SMEs that fail to integrate innovation into their core business strategies risk losing competitiveness as their products and processes become obsolete (Madrid, Domingo, & Auken, 2009).

In summary, monotonous processes and organizational inertia hinder the identification of new opportunities, making it difficult for companies to adapt to changes in their environment (Dougherty, 1992). Larger companies are generally more inclined to pursue innovation, as they tend to have stronger financial foundations and better access to human capital (Pinget et al., 2015). In contrast, small businesses primarily face obstacles such as limited resources, lack of knowledge, organizational capabilities, and expertise (Katila & Shane, 2005).

While the literature recognizes that barriers to innovation go beyond financial barriers, significant gaps remain in the systematic analysis of non-financial barriers. There is little empirical evidence addressing their evolution over time and their differentiated impact according to organizational and sectoral contexts. This underexploration is particularly problematic, as it hinders a comprehensive understanding of the factors that influence innovation, especially those related to internal capabilities, organizational structures, and cultural dynamics, which are not necessarily resolved through access to financing. Neglecting these dimensions leads to incomplete policy and strategic interventions that fail to address the root causes of the challenges faced by firms. Moreover, the lack of longitudinal studies on non-financial barriers prevents the identification of whether their effects have intensified, diminished, or transformed over time—an essential insight for the design of adaptive and context-sensitive public policies. Thus, the objective of this study is to analyze the evolution of the perception of barriers to innovation in Chilean companies during the period 2007–2016, based on a set of inputs, outputs, and R&D activities, using data from the National Survey of Innovation in Chilean Companies.

This research seeks to contribute to the advancement of knowledge in this area by conducting a longitudinal analysis of firms' perceptions of innovation barriers, using a framework based on inputs, outputs, and R&D activities. The analysis draws on data from versions 6 through 10 of the Chilean Business Innovation Survey, covering the period from 2007 to 2016. Examining multiple editions of the survey enables the identification of trends and structural changes in innovation barriers, offering valuable insights for the development of public policies and organizational strategies aimed at fostering more conducive environments for innovation.

Methodology

Data

The data source for this study is the Chilean Business Innovation Survey (*Encuesta de Innovación en Empresas de Chile*, ENI), conducted by the Ministry of Economy and the National Institute of Statistics (INE) of Chile. The ENI aims to provide comprehensive information on the structure of the innovation process within Chilean companies, including inputs and outputs, and to illustrate the relationships between this process and firms' innovation strategies, innovation efforts, the factors influencing their capacity to innovate, and their economic performance.

The survey is administered biennially, with its first edition launched in 1994. Both the design of the survey questionnaire and the methodology used for its administration align with the general guidelines set by the OCDE's Oslo Manual. For the purposes of this study, data from the 6th to the 10th editions of the survey are used, as these editions offer consistent availability of relevant variables and allow for

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comparability across analyses. These five editions cover the period from 2007 to 2016. This alignment ensures international comparability of the results and guarantees that the definitions of innovation and the classification of barriers are consistent with internationally recognized standards in academic research and policy design.

Independent Variables

This study focuses on how the perception of financial and non-financial barriers influences inputs, outputs, and R&D activities. Perception itself is a latent variable, not directly observable; however, it can be extracted through confirmatory factor analysis based on the responses provided by company managers regarding barriers to innovation (Ortiz & Fernández, 2022)

Factor analysis is a statistical technique designed to explore and describe the variability among a set of observed, correlated variables (p) by reducing them to a smaller number of unobserved variables, known as factors (q) (Maldonado-Guzmán et al., 2017). The primary purpose of this technique is to identify underlying patterns in the data that can explain the relationships among the observed variables. The process begins by examining the relationships between the observed variables to identify those that display common patterns of variation. Next, the principal component method is used to extract the initial factors, which helps reduce the dimensionality of the data while retaining as much relevant information as possible. Subsequently, orthogonal rotation is applied, specifically the Varimax method (Dien, 2010; Abdi, 2003). This rotation maximizes the variance of the factor loadings within each factor, making it easier to determine which observed variables are most strongly associated with each factor. The result of the confirmatory factor analysis is a representation of the original variables in terms of a smaller set of underlying factors, which explain the relationships among the variables.

The adequacy of the model was assessed using statistical indicators such as the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity, ensuring the validity of the factor structure. Additionally, separate models were estimated for each survey wave to maintain internal consistency, given that some variables were not available in all editions.

However, it is important to acknowledge that these techniques are not without limitations. A common issue is selection bias in the data, which can lead to counterintuitive results. For instance, positive associations have been found between perceived barriers and the intensity of investment in innovation (Baldwin & Lin, 2002). This phenomenon can be explained by the fact that the most innovative firms, those that invest more heavily in R&D, are also more likely to perceive these barriers clearly, given their direct experience with them.

To address potential selection bias, this study follows the approach proposed by Pellegrino & Savona (2017) and D'Este et al. (2012), which recommends focusing on a relevant sample of potential innovators. Firms were classified into two groups: (1) those that consistently reported no engagement in innovation activities and no perception of barriers across all survey waves, and (2) those that either engaged in innovation or perceived at least one type of obstacle. Only the second group was retained for analysis, as it reflects firms that are actively involved in or constrained by the innovation process. This filtering strategy ensures that the analysis focuses on firms facing real innovation-related decisions and helps mitigate bias arising from the inclusion of structurally non-innovative firms. The final sample comprises 17,951 observations, representing approximately 75 percent of the original dataset.

It should be noted that not all innovation obstacle variables were consistently available across all ENI survey waves. Specifically, obstacles 7 (difficulty finding innovation partners), 10 (previous innovations), 11 (lack of demand), and 12 (regulatory difficulties) were not included in the sixth wave (2007-2008). Consequently, analyses involving these variables were conducted only from the seventh wave onward. This limitation was explicitly accounted for in the construction of latent variables through confirmatory factor analysis, where version-specific models were implemented to prevent biases arising from temporal incomparability.

Method and Dependent Variables

The factor loadings associated with barriers to innovation serve as the independent variables, while a set of inputs, outputs, and R&D activities act as the dependent variables (see Table 1 for more details of barriers).

Table 1: Obstacles to innovate according to Chile Business Innovation Survey

Obstacle	Survey question	Survey category	Our category
1	Lack of own funds	Cost	Financial
2	Lack of external financing to the company	Cost	Financial
3	High cost of innovation	Cost	Financial
4	Lack of qualified personnel	Knowledge	Knowledge
5	Lack of information on technology	Knowledge	Knowledge
6	Lack of information on markets	Knowledge	Knowledge
7	Difficulty in finding innovation partners	Knowledge	Cooperation
8	Market dominated by established firms	Market	Market
9	Uncertain demand for innovative goods & services	Market	Demand
10	Previous innovations	Other	Demand
11	Lack of demand for innovation	Other	Demand
12	Regulatory difficulty	Other	Regulatory

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For inputs, the study includes the probability of engaging in R&D expenditure (R&D Dummy) and the intensity of R&D spending, measured as the logarithm of expenditure per employee (see Table 2 and Table A1 for more details of types of innovation and variables). Regarding outputs, the variables include Product Innovation, Service Innovation, Logistics Innovation, Invoicing Method Innovation, overall Innovation, and Technological Innovation. For R&D activities, the variables capture whether the firm conducted in-house R&D (Internal R&D), outsourced R&D (External R&D), and whether the firm has a formal R&D unit, department, or laboratory (Department R&D).

The relationships are analyzed using multiple linear regression, incorporating the survey's expansion factor. Each regression is estimated independently, applying robust standard errors to account for heteroskedasticity. Control variables commonly used in the barriers-to-innovation literature are also included, such as export status (dummy variable: 1 if the firm exports, 0 otherwise), the natural logarithm of the number of employees (to control for firm size), firm age (log-transformed, considering both linear and non-linear effects), and R&D investment normalized by sales (Pellegrino & Savona, 2017).

Table 2: Types of innovation according to Chile Business Innovation Survey

Innovation	Survey question	Survey category
1	New or significantly improved goods	Product
2	New or significantly improved services	*Product*
3	A new or significantly improved method of manufacturing or producing goods or services	*Process*
4	A new or significantly improved method of logistics, delivery or distribution for your inputs, goods or services	*Process*
5	A new or significantly improved support activity for your processes, such as maintenance system or purchasing, accounting or computing operations	*Process*
6	New business practices for process organization (e.g., supply chain management, process reengineering, quality management, etc.)	*Organizational*
7	New methods of organization of responsibilities and decision-making (e.g., new responsibility management system, restructuring, training systems, etc.	*Organizational*
8	New methods of organizing external relations with other companies or public institutions (e.g., first use of alliances, subcontracting, etc.	*Organizational*
9	Significant changes in the design, packaging and packaging of the product (goods and services). Excludes changes that alter the functionality or usage characteristics of the product (this corresponds to a product innovation)	Marketing
10	New media or techniques for product promotion (e.g., the first use of a new advertising medium, new brand image, etc.)	*Marketing*
11	New methods for product distribution channels (e.g., the first use of franchises or license distribution, direct sales, new product presentation concept, etc.)	*Marketing*
12	New methods of charging goods or services (e.g., the first use of demand price variables, discount system, etc.)	Marketing

Results

Descriptive Statistics

In the correlation tables panel (Tables A2 to A6), we observe that across the different versions of the survey analyzed, there is a positive and significant correlation between demand-related and regulatory barriers, as well as between cooperation and knowledge barriers, within the restricted sample of potentially innovative firms. These correlations illustrate the complementarity and clustering of obstacles, which has remained consistent over time. However, caution is warranted in interpreting these results, as the correlation between two barriers does not provide information about the causal relationship between them.

Regarding innovation inputs and R&D activities, Table 3 presents descriptive statistics for the sample of potentially innovative firms. As shown, these firms spend more on innovation per employee and are more likely to engage in both technological and non-technological innovations. The descriptive statistics for innovation barriers in Table 4 and Figure 1 indicate that the lack of internal funding has remained fairly stable from the 6th to the 10th version of the survey, ranging between 50% and 58%. Therefore, at least this particular barrier has not shown significant changes over the period considered. However, the lack of external financing has steadily declined over time, falling from 50% to 41% in the latest survey version. Lastly, the percentage of firms reporting that high innovation costs were a barrier has tended to increase, rising from 57% to 61%.

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Table 3: Descriptive statistics of inputs, outputs and R&D activities: relevant sample

	Measure	Relevant Sample	Relevant Sample	Relevant Sample	Relevant Sample	Relevant Sample
		6	**7**	**8**	**9**	**10**
		mean	**mean**	**mean**	**mean**	**mean**
Inputs	R&D dummy	0.01	0.09	0.07	0.05	0.04
	ln(Innovation exp./ Employment)	2.23	1.57	1.74	1.13	2.97
Outputs	Innovates	0.27	0.17	0.21	0.15	0.12
	Technological innovation	0.27	0.17	0.21	0.15	0.12
R&D activities	Internal R&D	0.01	0.06	0.06	0.04	0.03
	External R&D	0	0.04	0.02	0.01	0.02
	Department R&D	0.01	0.03	0.02	0.03	0.02
	N	3,219	2,753	3,587	4,029	4,363

Notes: (1) **R&D Dummy** = 1 if the firm declared R&D expenditure, 0 otherwise. (2) **ln(Innovation exp. / Employment)**: Ln of the ratio of innovation expenditure (in thousand pesos) over average employment for the two years covered by each survey. (3) **Innovates** Dummy = 1 if the firm declares to have done any kind of innovation, 0 otherwise. (4) **Technological Innovation** Dummy = 1 if the firm declares to have done product or process innovation, 0 otherwise. (5) **Internal R&D** Dummy = 1 if the firm performed R&D in the firm itself in the last two years or 0 in another case (6) **External R&D** Dummy = 1 if the firm performed R&D outside the firm in the last two years or 0 otherwise (7) **Department R&D** Dummy = 1 if the firm has a formal unit, department or laboratory of R&D or 0 otherwise.

Table 4: Descriptive statistics of obstacles to innovation: relevant sample

Obs.	Survey question	Our category	Relevant	Relevant	Relevant	Relevant	Relevant
			Sample	Sample	Sample	Sample	Sample
			6	**7**	**8**	**9**	**10**
			mean	**mean**	**mean**	**mean**	**mean**
1	Lack of own funds	Financial	0.58	0.50	0.56	0.57	0.56
2	Lack of external financing to the company	Financial	0.52	0.41	0.48	0.42	0.41
3	High cost of innovation	Financial	-	0.57	0.60	0.56	0.61
4	Lack of qualified personnel	Knowledge	0.37	0.30	0.42	0.40	0.40
5	Lack of information on technology	Knowledge	0.29	0.29	0.37	0.34	0.39
6	Lack of information on markets	Knowledge	0.31	0.25	0.37	0.30	0.35
7	Difficulty in finding innovation partners	Cooperation	-	0.37	0.45	0.36	0.45
8	Market dominated by established firms	Market	0.37	0.42	0.54	0.47	0.53
9	Uncertain demand for innovative goods & services	Demand	0.36	0.38	0.44	0.44	0.47
10	Previous innovations	Demand	-	0.10	0.22	0.16	0.21
11	Lack of demand for innovation	Demand	-	0.14	0.25	0.23	0.26
12	Regulatory difficulty	Regulatory	-	0.15	0.23	0.20	0.22
N			3,219	2,753	3,587	4,029	4,363

Notes: In sixth version obstacles 7, 10, 11 and 12 are not found. For more details contact the authors.

Regarding knowledge-related barriers, there appears to be a trend towards an increase in both the percentage of firms reporting a shortage of qualified personnel (rising from 37% to 40%) and the percentage reporting a lack of information about technology (increasing from 29% to 39%). In terms of cooperation barriers, the proportion of firms experiencing difficulties in finding partners rose from 37% to 45%. Additionally, with respect to market-related barriers, an increase was observed in the percentage of firms stating that their market was dominated by established companies, growing from 37% to 53%. Similarly, the percentage of firms reporting that uncertain demand for innovative goods and services was a barrier to innovation activities increased from 36% to 47%. Finally, regulatory barriers also saw an increase over the study period.

Thus, no changes have been observed in the lack of internal funding, while there has been a decline in the lack of financing for companies and an increase in the high cost of innovation. Therefore, the results regarding financial barriers are heterogeneous. In contrast, barriers

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related to knowledge, cooperation, market, demand, and regulation have all increased from the 6th version (covering 2007–2008) to the 10th version (covering 2016–2017).

Furthermore, the descriptive statistics in Table 5 show that innovation activities conducted by potentially innovative firms have remained low over the years, ranging between 5% and 17%, depending on the type of innovation.

Table 5: Descriptive statistics types of innovation: relevant sample

	Relevant Sample	Relevant Sample	Relevant Sample	Relevant Sample	Relevant Sample
	6	7	8	9	10
	mean	mean	mean	mean	mean
Product Innovation	0.14	0.10	0.11	0.05	0.05
Service innovation	0.14	0.09	0.10	0.06	0.06
Invoicing method innovation	-	0.08	0.09	0.06	0.06
Logistics innovation	0.17	0.06	0.09	0.05	0.05
N	3,219	2,753	3,587	4,029	4,363

Notes: **Product Innovation**: New or significantly improved goods; **Service innovation**: New or significantly improved services; **Invoicing method innovation**: A new or significantly improved support activity for your processes, such as maintenance system or purchasing, accounting or computing operations; **Logistics innovation**: New business practices for process organization (e.g., supply chain management, process reengineering, quality management, etc.). In sixth version Logistics innovation are not found. For more details contact the authors.

Regression Results

Tables A7 through A11 present the results of the regressions estimated for each survey version. In Table A7, 6th version, 2007–2008, it is observed that financial barriers are negatively associated with the probability of engaging in R&D expenditure, as well as with all innovation outcomes, although they do not have a negative impact on R&D activities. Knowledge-related barriers also have a negative effect on R&D spending per employee, as well as on four out of the five types of innovation outcomes, but they do not affect R&D activities. Regarding market-related barriers, no negative effect is observed on inputs, outputs, or activities. As for demand-related barriers, while there is no effect on inputs, they have a negative impact on only one of the five innovation outcomes and no impact on activities.

In Table A8, Version 7 years 2009–2010, financial obstacles have a negative and significant effect both on the probability of engaging in R&D spending and on the intensity of such spending. They also negatively affect all innovation outcomes and all R&D activities. Knowledge-related obstacles impact the probability of conducting R&D spending but not the intensity of the expenditure. No significant effects are observed for innovation outcomes or R&D activities. Cooperation obstacles have a negative and significant effect on both the probability of R&D spending and its intensity. However, they show a significant negative impact on only one innovation outcome (product innovation) and on a single R&D activity (internal R&D). Market and demand obstacles are significant and negative across both inputs, all six innovation outcomes, and all three R&D activities. Finally, regulatory obstacles do not present any significant negative effect on inputs, outputs, or R&D activities.

In Table A9, Version 8 years 2011–2012, financial obstacles are significant and negative for the intensity of R&D spending, as well as for only 2 out of the 6 innovation outcomes (Product Innovation and Invoicing Method Innovation), and for just one R&D activity (Department R&D). Knowledge-related obstacles are significant and negative for the probability of engaging in R&D spending, also significant and negative for a single innovation outcome (Logistics Innovation), and for one R&D activity (Internal R&D). Cooperation obstacles are significant and negative only for the intensity of R&D spending, along with 4 out of 6 innovation outcomes (Product Innovation, Service Innovation, Innovates, and Technological Innovation), but show no impact on R&D activities. Market obstacles have a negative and significant effect on the intensity of R&D spending, as well as on 5 out of 6 innovation outcomes (only Service Innovation shows no effect). In addition, they have a negative and significant effect on 2 out of the 3 R&D activities (External R&D and Department R&D). Demand obstacles do not have a negative effect on the inputs. They have a negative and significant effect on only 2 innovation outcomes (Service Innovation and Invoicing Method Innovation), and for R&D activities, they have a negative and significant effect only for External R&D. Finally, regulatory obstacles affect the probability of engaging in R&D spending among the inputs. They also show a negative and significant effect on 4 out of the 6 innovation outcomes (Service Innovation, Logistics Innovation, Innovates, and Technological Innovation). For R&D activities, they have a negative and significant effect only on External R&D.

In Table A10, Version 9 years 2013–2014, financial obstacles have a negative and significant impact on the intensity of R&D spending, while for innovation outcomes, they have a negative and significant

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effect on 5 out of the 6 outcomes (with no impact only on Service Innovation). Meanwhile, they show no impact on R&D activities. Knowledge-related obstacles have a negative and significant effect on both input variables, that is, the probability of engaging in R&D spending as well as its intensity. Regarding innovation outcomes, they have a negative and significant effect on 5 out of the 6 outcomes (with no impact only on Service Innovation). Cooperation obstacles do not have a negative and significant effect on inputs, outputs, or R&D activities. Market obstacles do not have a negative and significant effect on inputs, while they do have a negative effect on 4 out of the 6 outcomes (Product Innovation, Service Innovation, Innovates, and Technological Innovation), but they show no effects on R&D activities. Demand obstacles have a significant and negative effect across all inputs, outputs, and R&D activities. Finally, regulatory obstacles do not have a negative and significant effect on inputs. They show a negative and significant effect only on the outcome of Service Innovation and have no effect on R&D activities.

In Table A11, Version 10 years 2015–2016, financial obstacles have a negative effect only on the intensity of R&D spending, with no negative and significant effect on outcomes or R&D activities. Knowledge-related obstacles are negative and significant for both the probability of engaging in R&D spending and its intensity. Regarding innovation outcomes, they have a negative and significant impact on 5 out of the 6 outcomes, with no significant effect only on Logistics Innovation. In R&D activities, they have a significant and negative effect only on the External R&D activity. Cooperation obstacles do not have a negative and significant effect on inputs. For innovation outcomes, they have a negative and significant effect on Product Innovation, Innovates, and Technological Innovation. However, they show no negative and significant effect on R&D activities. Market obstacles have a negative and significant impact on both the probability of engaging in R&D spending and its intensity. Furthermore, they have a negative and significant effect on 5 out of the 6 innovation outcomes, with Service Innovation being the only one unaffected. They also have an impact on all 3 R&D activities (Internal R&D, External R&D, and Department R&D). Demand obstacles have a negative and significant effect on all inputs, outputs, and R&D activities. Finally, regulatory obstacles have no significant negative impact on inputs, outputs, or R&D activities.

Financial Obstacles

The probability and intensity of R&D spending have been negatively and persistently impacted by financial obstacles, although the magnitude of this effect varies across the survey versions. Between the period spanning from 2007 to 2010, the lack of internal and external funding represented a significant barrier to R&D investment, affecting both the decision to spend on innovation and the intensity of the expenditure per employee. This impact has diminished with the more recent survey versions, particularly concerning the intensity of R&D spending, suggesting an improvement in access to financing.

Financial obstacles have had a widespread negative effect on innovation outcomes, mainly impacting the introduction of improvements and changes in products and processes. Despite this, in the most recent periods, their impact on specific outputs has been less pronounced, indicating that companies may be finding alternative mechanisms to overcome these barriers.

Regarding R&D activities, the results have shown less consistency. While some versions of the survey indicate that financial constraints have reduced the likelihood of conducting both internal and external R&D, others have found no significant effect. This could be associated with differences in the financing strategies of companies over time, where financial barriers have a more direct impact on the decision to invest in innovation than on the organizational structure of R&D activities.

Knowledge Barriers

Regarding the effects of knowledge barriers, these have become more significant and intense in the latest versions of the survey. While between 2007 and 2012, a significant but moderate effect was found on innovation inputs, affecting the probability of spending on R&D but not reducing the intensity of the expenditure, starting from 2013, the lack of qualified personnel and the scarcity of technological information have begun to influence more drastically, reducing both the probability and the intensity of R&D spending. This indicates that the lack of internal capabilities has become a structural challenge for innovative companies in Chile.

The impact of these barriers on innovation outcomes has been consistently negative across most of the outputs analyzed, particularly in product and service innovations. In the more recent versions, this relationship has intensified, suggesting that access to specialized knowledge has become a more critical factor for innovation.

The results have been mixed for R&D activities. In some periods, the lack of knowledge has reduced the probability of conducting both internal and external R&D, while in others, its effect has been less clear. However, in the latest version of the survey, a significant negative relationship is observed with the probability of conducting external R&D, indicating that companies may be facing increasing difficulties in accessing knowledge outside their organization.

Cooperation Barriers

Barriers to establishing strategic partnerships have increasingly become a relevant obstacle to innovation over time. When analyzing the period from 2007 to 2010, cooperation barriers did not appear to have a significant impact on innovation inputs. These results suggest that companies did not perceive the lack of partners as a determining factor in their R&D investment decisions.

From 2011 onwards, the results show that these barriers began to affect both the probability and intensity of R&D spending, indicating that collaboration has become more important in the innovation ecosystem, and its absence now represents a hindrance to innovative development.

Regarding innovation outcomes, cooperation barriers have mainly hindered the introduction of product and service innovations, with

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this effect becoming more pronounced in the more recent versions. This could be related to the increasing need to work within networks and collaborative ecosystems to develop more sophisticated innovations tailored to global markets.

In terms of R&D activities, the impact has been less clear. We found that in some periods, these barriers affected the implementation of internal R&D and the existence of research departments within companies, suggesting that the lack of cooperation may be hindering the development of structural capabilities for innovation.

Market Barriers

Over the course of the surveys, market barriers have emerged as one of the most significant obstacles. Between 2007 and 2012, their impact on innovation inputs was limited, showing no clear relationship with either the probability of spending on R&D or the intensity of the expenditure. Starting from 2013, a negative and persistent effect is observed, indicating that competitive conditions and market dominance by established companies have started to constrain decisions regarding innovation investment.

Regarding innovation outcomes, market barriers have shown a growing negative effect, impacting the likelihood of introducing product and service innovations, as well as technological innovations in general. When examining the more recent versions of the survey, these effects have intensified. This indicates that companies are increasingly facing difficulties in positioning their innovations in markets dominated by already established competitors.

Regarding R&D activities, market barriers have increasingly shown a negative impact on the likelihood of engaging in both internal and external R&D, indicating that market uncertainty not only affects innovation outcomes but also shapes strategic decisions related to investments in innovation capabilities.

Demand-Side Obstacles

The perception of demand-related obstacles has increased over the course of the surveys, amplifying its negative impact on innovation. During the period between 2007 and 2012, the relationship with innovation inputs was weak, occasionally affecting the likelihood of investing in R&D, but without a clear effect on its intensity. However, in the most recent survey versions, a significant negative impact has been observed on both indicators. This suggests that uncertainty regarding demand for innovative products has become a key factor in decisions to invest in innovation.

Demand-side obstacles have shown a growing negative effect on almost all types of innovation, especially in product and service innovations. This pattern suggests that, as the perception of uncertain demand has increased, companies have either reduced their innovation efforts or redirected their investments toward areas with lower market risk.

Regarding R&D activities, these obstacles show a sustained negative impact on the likelihood of conducting internal and external R&D, as well as on the existence of dedicated research departments. This reflects that demand uncertainty not only affects commercial strategy but also the organizational structure of innovation within companies.

Regulatory Obstacles

The impact of regulatory obstacles on innovation has fluctuated over time. In the early years, between 2007 and 2012, their effect on innovation inputs was marginal, with no clear relationship to R&D investment. However, from 2013 onwards, a negative impact has been identified on the likelihood of investing in R&D, indicating an upward trend and suggesting that the perception of regulatory difficulties has begun to influence innovation investment decisions.

Regulatory obstacles have had a negative effect on certain types of innovation, although not uniformly. In recent years, their impact has been concentrated in service and logistics innovations, suggesting that regulatory restrictions may be affecting specific areas of innovation.

Regarding the likelihood of conducting external R&D, these obstacles have shown a negative effect, indicating that companies may be facing increasing difficulties in collaborating with external partners due to stricter regulatory constraints.

Discussion

The results reveal a differentiated evolution in the effects of innovation obstacles on inputs, outputs, and R&D activities over time. A notable finding is the decline in the incidence of financial obstacles, which aligns with the improvement in financing conditions for innovation. Other types of barriers, such as those related to knowledge, cooperation, and demand, have gained relevance.

The decrease in the perception of financial obstacles is consistent with previous research that has identified greater availability of innovation financing in emerging economies with active R&D support policies (Pellegrino & Savona, 2017). The reduction in these obstacles may also be linked to changes in corporate financing strategies, as firms have diversified their sources of funding. Nevertheless, the persistence of constraints on the intensity of R&D spending points to structural challenges that prevent companies from sustaining adequate levels of investment in innovation.

The literature has emphasized that firms facing knowledge barriers are often those with less experience in innovation (Arza & López, 2018). Our data show an increase in the perception of knowledge-related obstacles, which could indicate that a growing number of Chilean companies are engaging in innovation and encountering learning barriers. The lack of suitable partners may be limiting firms' ability to access complementary resources, such as specialized knowledge and advanced technologies.

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Market and demand obstacles have shown steady growth, affecting companies' ability to commercialize their innovations. This suggests that innovative firms in Chile face significant challenges in the adoption and diffusion of their innovations. Literature in the field has noted that demand uncertainty can act as a brake on innovation, as firms may perceive greater risks when investing in new products or services (García-Quevedo et al., 2017).

As for regulatory obstacles, they have shown an upward trend, potentially reflecting changes in the regulatory environment that have increased the complexity of the innovation process. In some sectors, regulations may act as barriers to the adoption of new technologies, particularly when regulatory frameworks have not evolved at the same pace as technological advances.

The implications of these findings suggest that public policies and corporate strategies need to account for the changing nature of innovation barriers. While past initiatives have been somewhat successful in reducing financial obstacles, it is now crucial to address emerging challenges related to access to knowledge, cooperation, and demand for innovation. Promoting more integrated innovation ecosystems, along with incentives for inter-firm collaboration and public-private partnerships, could be key to overcoming these challenges.

Beyond statistical significance, the relative magnitude of the estimated coefficients reveals critical practical insights. For example, the effect of knowledge-related barriers on the probability of engaging in R&D was modest but significant in early survey waves (2007–2010), with coefficients around $\beta = -0.016$ ($p < 0.05$), but became more pronounced in later waves (2013–2016), reaching $\beta = -0.023$ ($p < 0.01$). This trend suggests a structural shift where deficits in human capital and access to information now represent more binding constraints than financial limitations. Similarly, market-related barriers—particularly those linked to dominance by established firms—showed a growing negative impact on technological innovation, with coefficients increasing in magnitude from $\beta = -0.276$ in 2013–2014 to $\beta = -1.275$ in 2015–2016 (both $p < 0.01$). Demand-side obstacles, such as uncertain or insufficient demand, also exhibited strong and consistent effects on innovation outcomes, with coefficients on technological innovation reaching $\beta = -0.941$ ($p < 0.01$) in the final wave. These effects persisted even after controlling for firm size, age, and export status, underscoring their robustness. In practical terms, these findings suggest that policies aimed at stimulating demand for innovation and reducing market concentration may yield greater marginal returns than traditional financing programs, especially when complemented by initiatives to strengthen firms' internal capabilities. The results align with evolutionary economic theories that emphasize the role of knowledge recombination and demand-side dynamics in driving innovation, particularly in emerging economies.

The limitations of this study are typical of innovation studies that use business surveys. Regarding the inability to control for heterogeneous temporal effects, given that it is not a true panel. However, Chile presents data sorted by survey version in line with the Oslo manual, which allows for reliable cross-sectional analysis and macro tracking of variables. Another limitation experienced by other innovation studies is methodological changes that make it difficult to track all variables over time. Finally, the most important variable is perception, which is a latent variable self-reported by the company representative, thus adding significant cognitive biases when considering companies with different innovative experiences. Given this, factor analysis is applied to obtain statistical validation of the results prior to performing the regressions.

Future lines of research arising from this study include a more extensive analysis of temporality, which would allow for a broader view and examination of the evolution of barriers to innovation. In addition, it would be interesting to analyze the effects of public policy on these barriers experienced by companies. It would also be interesting to analyze more countries and make a comparison. For example, there is recent data consolidated by the Inter-American Development Bank that points in this direction. Thus, the barriers between countries could be analyzed, as well as how institutional factors relate to these barriers to innovation.

Conclusion

This research analyzed the perception of barriers to innovation among Chilean companies during the period 2007-2016, assessing their impact on inputs, outputs, and R&D activities. Unlike previous studies, six types of barriers are analyzed, along with a set of diverse inputs, outputs, and R&D activities. The main finding is that while financial barriers tend to decrease over time, barriers related to knowledge, cooperation, demand, and regulation have become more relevant, particularly affecting small and medium-sized enterprises.

The results show that financial barriers continue to affect the likelihood and intensity of R&D spending, but their magnitude and impact have decreased over time. In contrast, knowledge-related barriers have increased in importance, affecting both R&D investment and the likelihood of innovation, especially in products and services. Cooperation barriers, meanwhile, have impacted technological innovations, reflecting their growing importance. Market barriers and demand barriers have shown a sustained and growing negative impact on innovation outcomes and R&D activities, highlighting the difficulties companies face in positioning their innovations in dominated or uncertain markets. Finally, regulatory barriers have negative effects on some specific activities, such as external R&D and logistical innovations.

The challenges faced by firms in their innovation efforts have evolved throughout the period under study, highlighting the need to adapt innovation support policies to address these emerging issues. The decreasing impact of financial obstacles reflects improvements in access to financing, possibly due to support policies and the increasing sophistication of the financial system (, 2010; Pellegrino & Savona, 2017). Nevertheless, the persistence of constraints on R&D expenditure intensity, especially for SMEs (Crespi & Zuniga, 2012), indicates that financing remains a limiting factor.

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The rise in knowledge and cooperation barriers underscores the need to strengthen technological capabilities and foster collaborative networks for innovation. The shortage of skilled personnel and the lack of information on new technologies have become growing challenges, in line with studies that highlight the availability of human talent as a key determinant of innovative performance (Arza & López, 2018).

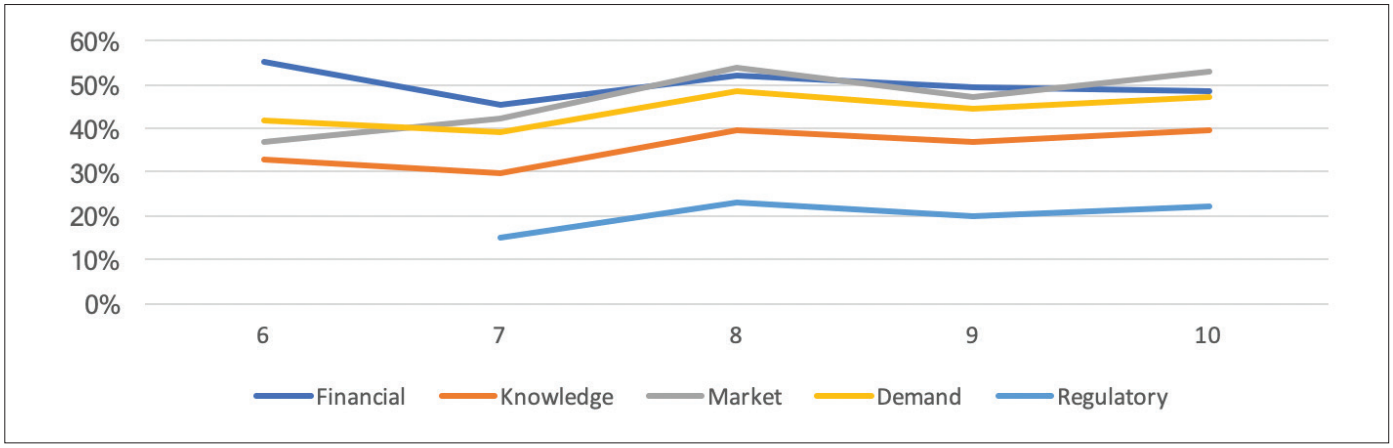
The increase in market and demand-related obstacles reveals the difficulties faced in commercializing and adopting innovations, which in turn limits the economic impact and benefits of R&D investment. Demand uncertainty has been identified as a key factor hindering innovation, particularly in emerging economies (García-Quevedo et al., 2017; Pellegrino & Savona, 2017), suggesting the need for policies that stimulate demand for innovation, such as incentives for the acquisition of advanced technologies and technology transfer programs (Tiwari et al., 2007; Savignac, 2008).

Moreover, the growing perception of regulatory obstacles highlights the need to design more flexible regulatory frameworks that are better aligned with the dynamics of innovation. While regulations are necessary to ensure quality and safety standards, their design should avoid creating unnecessary barriers that hinder R&D investment (Jakimowicz & Rzeczkowski, 2019). This implies that governments should work towards streamlining procedures and establishing regulations that foster a favorable environment for innovation without compromising quality standards.

The contribution of this research lies in offering a unique longitudinal perspective for an emerging economy, based on data from five comparable versions of Chile's Business Innovation Survey. This approach allows us to identify trends in the evolution of obstacles and analyze how their impact has changed structurally over time. Unlike cross-sectional studies, this temporal design reveals that non-financial barriers—especially those related to knowledge, demand, and cooperation—have become more restrictive than financial barriers, which has important implications for public policy design.

The results of this study underscore the importance of adopting a dynamic approach to innovation policy, recognizing that the barriers perceived by firms evolve over time and require differentiated strategies. While the reduction of financial constraints represents a positive step forward, strengthening access to knowledge, cooperation, and innovation demand emerges as a priority to consolidate a more robust innovation ecosystem in Chile (Figure 1).

Figure 1. Average evolution of barriers to innovation 2007-2016



Notes: Financial is the average of obstacles 1, 2, and 3 in Table 4. Knowledge is the average of obstacles 4, 5, and 6. Demand is the average of obstacles 9, 10, and 11. All others are the obstacles reported in Table 4 without modifications.

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Appendix

Table A1 Definition of variables used in this study

	Variable	Definition
Inputs	*R&D Dummy*	Dummy = 1 if the firm declared expenditure in R&D, 0 otherwise
	ln(Innovation exp//Employment)	Ln of the ratio of innovation expenditure (in thousand pesos) over average employment for the two years covered by each survey.
Outputs	*Product Innovation*	Dummy = 1 if the company introduced new or significantly improved goods, 0 otherwise.
	Service innovation	Dummy = 1 if the company introduced new or significantly improved services, 0 otherwise.
	Logistics innovation	Dummy = 1 if the firm introduced a new or significantly improved support activity for your processes, such as maintenance system or purchasing, accounting or computing operations, 0 otherwise.
	Invoicing method innovation	Dummy = 1 if the firm introduced a new business practices for process organization (e.g., supply chain management, process reengineering, quality management, etc.), 0 otherwise.
	Innovates	Dummy = 1 if 1 if the firm declares to have done any kind of innovation, 0 otherwise.
	Technological Innovation	Dummy = 1 if the firm declares to have done product or process innovation, 0 otherwise.
R&D activities	*Internal R&D*	Dummy = 1 if the firm performed R&D in the firm itself in the last two years or 0 otherwise
	External R&D	Dummy = 1 if the firm performed R&D outside the firm in the last two years or 0 otherwise
	Department R&D	Dummy = 1 if the firm has a formal unit, department or laboratory of R&D or 0 otherwise

Table A2 Correlation between innovation barriers: relevant sample sixth version

	Financial	Knowledge	Cooperation	Market	Demand	Regulatory
Financial	1					
Knowledge	0.204*	1				
Cooperation						
Market	0.137*	0.250*		1		
Demand	0.150*	0.257*		0.358*	1	
Regulatory						

Notes: * significance at the 0.01 level. Sixth version of the survey years considered 2007 – 2008.

Table A3 Correlation between innovation barriers: relevant sample seventh version

	Financial	Knowledge	Cooperation	Market	Demand	Regulatory
Financial	1					
Knowledge	0.250*	1				
Cooperation	0.246*	0.429*	1			
Market	0.239*	0.213*	0.206*	1		
Demand	0.088*	0.207*	0.147*	0.203*	1	
Regulatory	0.126*	0.143*	0.172*	0.128*	0.283*	1

Notes: * significance at the 0.01 level. Seventh version of the survey years considered 2009 - 2010.

Table A4 Correlation between innovation barriers: relevant sample eighth version

	Financial	Knowledge	Cooperation	Market	Demand	Regulatory
Financial	1					
Knowledge	0.363*	1				
Cooperation	0.346*	0.503*	1			
Market	0.293*	0.308*	0.262*	1		
Demand	0.246*	0.378*	0.273*	0.313*	1	
Regulatory	0.267*	0.321*	0.289*	0.260*	0.536*	1

Notes: * significance at the 0.01 level. Eighth version of the survey years considered 2011 - 2012.

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Table A5 Correlation between innovation barriers: relevant sample ninth version

	Financial	Knowledge	Cooperation	Market	Demand	Regulatory
Financial	1					
Knowledge	0.344*	1				
Cooperation	0.316*	0.491*	1			
Market	0.246*	0.276*	0.257*	1		
Demand	0.203*	0.308*	0.261*	0.267*	1	
Regulatory	0.251*	0.310*	0.306*	0.259*	0.452*	1

Notes: * significance at the 0.01 level. Ninth version of the survey years considered 2013 - 2014.

Table.A6 Correlation between innovation barriers: relevant sample tenth version

	Financial	Knowledge	Cooperation	Market	Demand	Regulatory
Financial	1					
Knowledge	0.370*	1				
Cooperation	0.376*	0.513*	1			
Market	0.308*	0.297*	0.336*	1		
Demand	0.219*	0.344*	0.284*	0.319*	1	
Regulatory	0.283*	0.292*	0.294*	0.285*	0.484*	1

Notes: * significance at the 0.01 level. Tenth version of the survey years considered 2015 - 2016.

Table A7 Model for inputs, outputs and R&D activities on perceived obstacles based on the sixth version: relevant sample

	Relevant Sample										
	Inputs		Outputs						R&D activities		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Financial obstacles	-0.001	-0.786***	-0.071***	-0.086***		-0.052***	-0.118***	-0.118***	-0.001	0.001	-0.002
	-0.003	-0.087	-0.01	-0.009		-0.011	-0.012	-0.012	-0.003	-0.001	-0.002
Knowledge obstacles	0	-0.411***	-0.053***	-0.027***		0.009	-0.041***	-0.041***	0	0.001	0.001
	-0.003	-0.075	-0.008	-0.008		-0.009	-0.01	-0.01	-0.003	-0.001	-0.002
Market obstacles	-0.006	0.227*	0.095***	-0.012		0.005	-0.018	-0.018	-0.006	-0.003	-0.003
	-0.005	-0.122	-0.014	-0.013		-0.015	-0.017	-0.017	-0.005	-0.002	-0.003
Demand obstacles	0.024	0.086	-0.022	-0.138***		-0.08	0.237***	0.237***	0.024	0.013*	0.011
	-0.018	-0.476	-0.053	-0.051		-0.059	-0.066	-0.066	-0.018	-0.008	-0.013
Constant	-0.076	3.544	-0.117	-0.758**		-0.306	0.452	0.452	-0.089	0.055	-0.210***
	-0.111	-2.865	-0.318	-0.305		-0.357	-0.398	-0.398	-0.111	-0.045	-0.077
Observations	3,219	3,219	3,219	3,219		3,219	3,219	3,219	3,219	3,219	3,219
Controls	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. *Inputs:* (1) **R&D Dummy** = 1 if the firm declared R&D expenditure, 0 otherwise. (2) **ln(Innovation exp. / Employment)**: Ln of the ratio of innovation expenditure (in thousand pesos) over average employment for the two years covered by each survey.; *Outputs:* **(3) Product Innovation**: New or significantly improved goods; (4) **Service innovation**: New or significantly improved services; (5) **Invoicing method innovation**: A new or significantly improved support activity for your processes, such as maintenance system or purchasing, accounting or computing operations; (6) **Logistics innovation**: New business practices for process organization (e.g., supply chain management, process reengineering, quality management, etc.). In sixth version Logistics innovation are not found. For more details contact the authors. (7) **Innovates** Dummy = 1 if the firm declares to have done any kind of innovation, 0 otherwise. (8) **Technological Innovation** Dummy = 1 if the firm declares to have done product or process innovation, 0 otherwise.; *R&D activities*: (9) **Internal R&D** Dummy = 1 if the firm performed R&D in the firm itself in the last two years or 0 in another case (10) **External R&D** Dummy = 1 if the firm performed R&D outside the firm in the last two years or 0 otherwise (11) **Department R&D** Dummy = 1 if the firm has a formal unit, department, or laboratory of R&D or 0 otherwise. Sixth version of the survey years considered 2007 – 2008.

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Table A8 Model for inputs, outputs and R&D activities on perceived obstacles based on the seventh version: relevant sample

	Relevant Sample										
	Inputs		Outputs						R&D activities		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Financial obstacles	-0.028***	-0.504***	-0.025***	-0.021***	-0.030***	-0.028***	-0.059***	-0.059***	-0.016**	-0.015***	-0.012***
	-0.007	-0.069	-0.008	-0.008	-0.007	-0.006	-0.01	-0.01	-0.006	-0.005	-0.005
Knowledge obstacles	-0.016**	0.105	0.013	0.009	-0.011	-0.009	0	0	-0.01	-0.008	-0.008
	-0.008	-0.075	-0.008	-0.008	-0.007	-0.007	-0.01	-0.01	-0.007	-0.005	-0.005
Cooperation obstacles	-0.025**	-0.505***	-0.038***	0.011	0.028**	0.026**	0.013	0.013	-0.033***	0.007	0.013
	-0.013	-0.122	-0.013	-0.013	-0.012	-0.011	-0.017	-0.017	-0.011	-0.009	-0.008
Market obstacles	-0.069***	-0.651***	-0.060***	-0.080***	-0.072***	-0.034***	-0.105***	-0.105***	-0.033***	-0.046***	-0.031***
	-0.011	-0.109	-0.012	-0.012	-0.011	-0.01	-0.015	-0.015	-0.01	-0.008	-0.008
Demand obstacles	-0.034***	-0.665***	-0.034***	-0.030***	-0.034***	-0.028***	-0.055***	-0.055***	-0.026***	-0.010*	-0.013**
	-0.009	-0.083	-0.009	-0.009	-0.008	-0.007	-0.012	-0.012	-0.007	-0.006	-0.006
Regulatory obstacles	0.086***	0.885***	0.075***	0.090***	0.048***	-0.002	0.071***	0.071***	0.048***	0.048***	0.01
	-0.017	-0.159	-0.018	-0.017	-0.016	-0.014	-0.022	-0.022	-0.014	-0.011	-0.011
Constant	-0.171	1.868	0.788**	0.076	-0.253	-0.033	0.643	0.643	0.047	-0.164	0.105
	-0.334	-2.824	-0.356	-0.35	-0.319	-0.289	-0.449	-0.449	-0.29	-0.227	-0.222
Observations	2,751	2,724	2,751	2,751	2,751	2,751	2,751	2,751	2,751	2,751	2,751
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Are the same variables Table A7. Seventh version of the survey years considered 2009 - 2010.

Table A9 Model for inputs, outputs and R&D activities on perceived obstacles based on the eighth version: relevant sample

	Relevant Sample										
	Inputs		Outputs						R&D activities		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Financial obstacles	0.017***	-0.240***	-0.023***	0.01	-0.022***	0.009	-0.001	-0.001	0.020***	-0.005	-0.012***
	-0.007	-0.076	-0.008	-0.008	-0.007	-0.008	-0.01	-0.01	-0.006	-0.003	-0.004
Knowledge obstacles	-0.014**	-0.093	-0.006	0.002	-0.009	-0.018**	-0.01	-0.01	-0.018***	-0.002	-0.006*
	-0.006	-0.074	-0.008	-0.007	-0.007	-0.007	-0.01	-0.01	-0.006	-0.003	-0.003
Cooperation obstacles	-0.012	-0.380***	-0.048***	-0.023*	-0.006	0.046***	-0.050***	-0.050***	0.004	-0.004	0.010*
	-0.01	-0.121	-0.013	-0.012	-0.012	-0.012	-0.016	-0.016	-0.01	-0.005	-0.006
Market obstacles	-0.009	-0.458***	-0.031***	0.017	-0.020*	-0.036***	-0.065***	-0.065***	0.001	-0.012**	-0.009*
	-0.01	-0.11	-0.012	-0.011	-0.011	-0.011	-0.015	-0.015	-0.009	-0.005	-0.005
Demand obstacles	0.013*	-0.101	-0.009	-0.019**	-0.017**	0.025***	-0.007	-0.007	0.022***	-0.009**	-0.005
	-0.007	-0.077	-0.008	-0.008	-0.007	-0.008	-0.01	-0.01	-0.006	-0.003	-0.004
Regulatory obstacles	-0.041***	-0.25	0.008	-0.036**	0.016	-0.071***	-0.062***	-0.062***	-0.074***	0.032***	0.008
	-0.015	-0.17	-0.018	-0.017	-0.016	-0.017	-0.023	-0.023	-0.014	-0.008	-0.008
Constant	-0.259	-1.637	-0.006	-0.594**	-0.156	-0.417	0.086	0.086	-0.421**	0.287**	0.119
	-0.222	-3.011	-0.271	-0.262	-0.247	-0.254	-0.347	-0.347	-0.209	-0.116	-0.121
Observations	3,565	3,535	3,565	3,565	3,565	3,565	3,565	3,565	3,565	3,565	3,565
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Are the same variables Table A7. Eighth version of the survey years considered 2011 - 2012.

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Table A10 Model for inputs, outputs and R&D activities on perceived obstacles based on the ninth version: relevant sample

	Relevant Sample										
	Inputs		Outputs						R&D activities		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Financial obstacles	0	-0.379***	-0.011**	-0.008	-0.031***	-0.017***	-0.044***	-0.044***	-0.001	-0.002	0.005
	-0.005	-0.128	-0.005	-0.006	-0.005	-0.005	-0.008	-0.008	-0.005	-0.002	-0.004
Knowledge obstacles	-0.023***	-0.461***	0	0.002	-0.001	0.007	0.018**	0.018**	-0.022***	-0.008***	-0.021***
	-0.005	-0.136	-0.005	-0.006	-0.005	-0.005	-0.008	-0.008	-0.005	-0.002	-0.004
Cooperation obstacles	-0.001	0.416*	0.001	-0.015	0.011	0.024***	0.01	0.01	0.003	0.009**	0.017***
	-0.008	-0.221	-0.009	-0.01	-0.009	-0.009	-0.013	-0.013	-0.008	-0.004	-0.007
Market obstacles	0.008	0.276	-0.019***	-0.055***	-0.004	-0.004	-0.065***	-0.065***	0.007	0.005	-0.006
	-0.007	-0.191	-0.007	-0.008	-0.008	-0.008	-0.012	-0.012	-0.007	-0.003	-0.006
Demand obstacles	-0.023***	-0.628***	-0.021***	-0.013**	-0.023***	-0.034***	-0.059***	-0.059***	-0.020***	-0.007***	-0.006*
	-0.005	-0.116	-0.005	-0.006	-0.005	-0.005	-0.008	-0.008	-0.005	-0.002	-0.004
Regulatory obstacles	0.009	0.131	-0.009	-0.020*	0.017	0.003	-0.001	-0.001	0.004	0.004	0.006
	-0.01	-0.272	-0.01	-0.012	-0.011	-0.01	-0.016	-0.016	-0.009	-0.005	-0.008
Constant	-0.654***	3.87	-0.007	0.1	-0.906***	-0.529**	-1.006***	-1.006***	-0.727***	-0.062	-0.362**
	-0.194	-4.298	-0.202	-0.232	-0.216	-0.208	-0.318	-0.318	-0.187	-0.092	-0.153
Observations	4,029	1,028	4,029	4,029	4,029	4,029	4,029	4,029	4,029	4,029	4,029

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Are the same variables Table A7. Ninth version of the survey years considered 2013 - 2014.

Table A11 Model for inputs, outputs and R&D activities on perceived obstacles based on the tenth version: relevant sample

	Relevant Sample										
	Inputs		Outputs						R&D activities		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Financial obstacles	0.005	-0.563***	0.012**	0.013**	0.004	0.003	0.014*	0.014*	0.005	0.001	-0.001
	-0.004	-0.171	-0.005	-0.005	-0.005	-0.005	-0.007	-0.007	-0.004	-0.003	-0.003
Knowledge obstacles	-0.017***	-0.773***	-0.008*	-0.010**	-0.016***	-0.008	-0.013*	-0.013*	-0.003	-0.016***	-0.003
	-0.004	-0.175	-0.005	-0.005	-0.005	-0.005	-0.007	-0.007	-0.004	-0.003	-0.003
Cooperation obstacles	0.024***	1.019***	-0.019**	-0.008	-0.006	0.008	-0.023*	-0.023*	-0.006	0.030***	-0.005
	-0.007	-0.287	-0.009	-0.009	-0.009	-0.009	-0.012	-0.012	-0.006	-0.005	-0.005
Market obstacles	-0.020***	-1.275***	-0.033***	-0.01	-0.018**	-0.035***	-0.065***	-0.065***	-0.009*	-0.013***	-0.010**
	-0.006	-0.245	-0.007	-0.008	-0.008	-0.007	-0.01	-0.01	-0.005	-0.004	-0.004
Demand obstacles	-0.015***	-0.941***	-0.018***	-0.026***	-0.012**	-0.028***	-0.044***	-0.044***	-0.011***	-0.008***	-0.011***
	-0.004	-0.197	-0.005	-0.005	-0.005	-0.005	-0.007	-0.007	-0.004	-0.003	-0.003
Regulatory obstacles	0.024***	-0.032	0.019*	0.011	0	0.031***	0.037**	0.037**	0.026***	0.008	0.029***
	-0.009	-0.329	-0.01	-0.011	-0.011	-0.011	-0.015	-0.015	-0.007	-0.006	-0.006
Constant	-0.079	7.545**	0.257	0.385**	0.310*	0.303*	0.599**	0.599**	-0.222*	0.189*	-0.027
	-0.15	-3.204	-0.175	-0.18	-0.182	-0.179	-0.25	-0.25	-0.127	-0.099	-0.102
Observations	4,361	1,118	4,361	4,361	4,361	4,361	4,361	4,361	4,361	4,361	4,361

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Are the same variables Table A7. Tenth version of the survey years considered 2015 - 2016.

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