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The role of cooperation on the propensity to innovate: evidence from the Chilean innovation survey

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Abstract

Innovation and cooperation have been directly linked with main topics in recent management bibliography. The perspective of open innovation has considered the importance to capitalize revenues from cooperation in an intent to innovate; however, there is a lack of empirical investigation of this issue for emerging economies. This study aims at analyzing the impact of cooperation in the propensity to innovate in organizations, using data from the Chilean Innovation Survey. It shows that cooperation has a positive impact, statistically significant, in the propensity to innovate. The outcomes of this research are closely related with the implementation of policies as, according to what is observed, its paradigm should be transferred to an interlinking and strategic business environment, making it more possible the participation of companies in collaborative networks.

Key words

Innovation, industrial cooperation, emerging economies, administration, company innovations

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El rol de la cooperación en la propensión para innovar: evidencia de la encuesta chilena de innovación

Resumen. *La innovación y la cooperación han estado estrechamente relacionadas como tópicos principales en la literatura reciente sobre management. La perspectiva de innovación abierta ha tomado en cuenta la importancia de capitalizar las ganancias de la cooperación en los esfuerzos para innovar, sin embargo, hay una falta de investigación empírica de este fenómeno para las economías emergentes. Esta investigación tuvo por objetivo analizar el efecto de la cooperación en la propensión a innovar de las firmas, utilizando datos de la Encuesta Chilena de Innovación. Se encontró que la cooperación tiene un efecto positivo, estadísticamente significativo, en la propensión a innovar. Las implicancias del trabajo están relacionadas con la implementación de políticas, ya que según lo observado, el paradigma debiese desplazarse hacia un entorno entrelazado y estratégico de negocios, que haga más plausible la participación de las firmas en esfuerzos de redes colaborativas.*

Palabras clave. *Innovación, cooperación industrial, economías emergentes, administración, innovaciones en la empresa.*

Le rôle de la coopération dans la propension à innover: résultats d'une étude chilienne sur l'innovation

Résumé. *L'innovation et la coopération sont étroitement liées dans la littérature moderne de gestion des entreprises. La perspective de l'innovation ouverte prend en compte l'importance de la capitalisation des gains apportés par la coopération dans les efforts d'innovation même s'il existe un manque de données et d'investigations empiriques de ce phénomène pour les économies émergentes. L'objectif de cette étude est d'analyser, grâce aux données fournies par l'investigation chilienne sur l'innovation, l'effet de la coopération sur la propension des entreprises à innover. Nous pouvons constater que la coopération apporte un effet positif et statistiquement significatif sur la propension à innover. Les implications des différents travaux étudiés sont liées à la mise en œuvre de politiques spécifiques car, selon les observations, le paradigme devrait évoluer vers un environnement commercial aux liens complexes et stratégiques qui rendrait davantage plausible la participation des entreprises aux réseaux de collaboration.*

Mots clefs. *Innovation, coopération industrielle, économies emergentes, gestión, innovations dans l'entreprise.*

O papel da cooperação na propensão para inovar: evidência da pesquisa chileno de inovação

Resumo.*A inovação e a cooperação têm estado estreitamente relacionadas como tópicos principais na literatura recente sobre management. A perspectiva da inovação aberta tem considerado a importância de capitalizar os ganhos da cooperação nos esforços para inovar, no entanto, há uma falta de pesquisa empírica deste fenômeno para as economias emergentes. Esta pesquisa teve como objetivo analisar o efeito da cooperação na propensão a inovar das empresas, utilizando dados da Pesquisa Chilena de Inovação. Encontrou-se que a cooperação tem um efeito positivo, estatisticamente significativo, na propensão a inovar. As implicações do trabalho estão relacionadas com a implementação de políticas, já que segundo o observado, o paradigma deve ser deslocado para um meio entrelaçado e estratégico de negócios, que torne mais plausível a participação das empresas em esforços de redes colaborativas.*

Palavras-chave. *Inovação, cooperação industrial, economias emergentes, administração, inovações na empresa*

1. Introduction

Innovation has been widely studied by its impact on national economic growth and the role it plays for economies (Nelson, 1993; Freeman, 2002; Verspagen, 2005;Galindo & Méndez, 2014). Competitiveness and technological progress have made firms improve their capabilities to innovate (Miotti & Sachwald, 2003). Furthermore, the environment encourages firms to search for opportunities to devise new technological cycles (Teece, Pisano, & Shuen, 1997, cited by Costa *et al.*, 2017).

Innovation, as taken from The Oslo Manual is « [. . .] the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization, or external relations» (OECD & Eurostat, 2005, p. 46).

Innovation phenomena can be regarded as a result of interactions between individuals, teams, and groups located both inside and outside the firm. Hence, cooperation has been proven to be highly associated with innovation (Tether, 2002). This is due to the changing environment that forces and stimulates firms to develop innovation in partnership with other firms, and engage in what has been called co-innovation: inter-organizational co-creation and innovation (Lee, Olson, & Trimi, 2012). Other coined terms have been crowdsourcing innovation, collaborative innovation, collective innovation (Zhong & Nieminem, 2015), and open innovation (Chesbrough, 2003). Even though there has been increasing attention to the qualities of the open innovation process, not much empirical evidence has been shown to prove its impact on performance, representing an appealing issue for researchers (Temel, Mention, & Torkkeli, 2013).

The objective of this research is to analyze the impact that cooperation with external sources has on innovation for the case of Chile as an emerging economy. By pursuing this objective, the expected contribution is related to the following idea: taking into account the profoundly positive effects that have been attributed to innovation for national economies, which in turn are influenced by a cooperative phenomenon, it is in consequence, worth to thoroughly analyze all the ways to increase the firms' probability to innovate.

This article is structured as follows: in section two, we present the theoretical framework, followed by the hypothesis to be tested. In section three, we briefly describe the data and the methodology. In section 4, the results and a brief discussion are presented. Finally, section 5 shows the main conclusions of this research.

2. Theoretical framework

According to Lee *et al.* (2012) «our entire world is undergoing transformation. In this rapidly changing and often unpredictable environment, innovation is the imperative key factor for organizations to develop competitiveness and succeed in the market» (p. 818). In response to this changing environment, organizations are moving towards interconnected networks that make more likely the opportunity to bring together internal capabilities of different firms to a process of cooperative creation (Romero & Molina, 2011).

«When there is a regime of rapid technological development, research breakthroughs are so broadly distributed that no single firm has all the internal capabilities necessary for success» (Powell, Koput, & Smith-Doerr, 1996, p. 117). In this sense, the interaction between innovation and cooperation is related to the fact that breakthroughs generally occur outside the firm and hence, firms are not capable to fully develop innovations or novel technologies solely through in-house research and development (R&D) (Rothaermel & Hess, 2007). These partnerships have been considered as a necessary response for the demanding environment of organizations, especially those that experience the need for a swift pace of technological evolution (Miotti & Sachwald, 2003).

Bossink (2002, p. 314) presents a stage model as a guideline for organizations that are interested in participating in co-innovation processes, which have to settle how and with whom they cooperate. He describes a sequential process composed by:

«1. Autonomous strategy making: firms act strategically on their own.

2. Cooperative strategy making: firms decide to get closer to other organizations and collaborate in their innovation strategies.

3. Founding an organization for co-innovation: interested parties found a joint organization to build their collaborative programs.

4. Realization of innovations: development of innovations based on the co-innovation strategy established in the previous phases».

Based on the literature review and as it is outlined above, some of the characteristics which make more likely for companies to engage in innovation arrangements are size, in-house R&D, technology intensity of the sector, industry characteristics, absorptive capacities, technology seeking level, and geographical patterns (Tether, 2002; Miotti & Sachwald, 2003; Becker & Dietz, 2004; Fritsch & Franke, 2004; Tether & Tajar, 2008).

Thus, the primary hypothesis that is going to be tested is:

- Hypothesis 1: Cooperating with external sources has a positive effect on the innovation propensity of the firm.
- This hypothesis can be extended to disaggregation of the external source, by:
- Hypothesis 1a: Cooperating with suppliers has a positive effect on the innovation propensity of the firm.
- Hypothesis 1b: Cooperating with other firms within the same group has a positive effect on the innovation propensity of the firm.

- Hypothesis 1c: Cooperating with consulting firms has a positive effect on the innovation propensity of the firm.
- Hypothesis 1d: Cooperating with clients or consumers has a positive effect on the innovation propensity of the firm.
- Hypothesis 1e: Cooperating with universities or other institutions of higher education has a positive effect on the innovation propensity of the firm.
- Hypothesis 1f: Cooperating with public research institutes has a positive effect on the innovation propensity of the firm.
- Hypothesis 1g: Cooperating with competing firms in the same industry has a positive effect on the innovation propensity of the firm.

Other four hypotheses related to the control variables that are going to be used are the following:

- Hypothesis 2: The size of the firm measured by sales has a positive impact on the propensity to innovate.
- Hypothesis 3: Having an R&D Unit has a positive impact on the propensity to innovate.
- Hypothesis 4: The investment?in R&D activities has a positive impact on the propensity to innovate.
- Hypothesis 5: The government funding support has a positive impact on the propensity to innovate.

3. Data and methodology

The data was obtained from the *9th Chilean Innovation Survey* developed by the National Institute of Statistics (INE by its abbreviation in Spanish). Regarding the design of the survey, it follows the guidelines from the Oslo Manual and the Community Innovation Survey from Eurostat, which makes it comparable to the results of other national innovation surveys. This survey presents comprehensive and representative data regarding the innovation activity in Chile at different levels (INE, 2015), covering the Chilean national territory and, as its methodological notes state, it is a representative sample of the country. The firms here included are related to every economic sector -agriculture, fishing, tourism, financial services, R&D firms, among others- considering the first, second, and third industrial sectors. This survey covers the period 2013-2014 and has a valid sample of 5,620 firms.

In order to test the hypotheses presented, we use a binary choice model, specifically a logistic regression. This type of analysis was chosen due to its extensive use and convenience, given that « [. . .] the formula for the choice probabilities takes a closed form and is readily interpretable» (Train, 2009, p. 34). Hence, the model to be tested takes the simple form of a set of explanatory variables with a dependent binary variable, taking value 1 if the firm did make a product –good or service– innovation, or 0 otherwise.

The first part of the empirical work takes a dummy variable of cooperation with external sources as an explanatory variable –1=cooperated; 0=otherwise–, and other control variables such as size –in terms of the natural logarithm of sales–, the natural logarithm of the R&D expenditure, support

from government funds (CORFO, CONICYT, FIA, IFM, FIP, PROCHILE, or other), and having a formal R&D Unit.

The second part takes the same dependent variable, but instead, cooperation is disaggregated regarding the partner with whom the innovation was made; control variables remain the same. The possible partners for joint innovation considered in the Chilean National Innovation Survey are:

1. Other firms within its group.
2. Suppliers of equipment, materials, components, or software.
3. Clients or Consumers.
4. Competing Firms or other firms within its sector.
5. Consulting Firms, Laboratories, or R&D Institutes.
6. Universities or other institutions of higher education.
7. Public research institutes.

It is important to note that, for the case of this research, the partner's country of residence is not considered.

4. Results

The following table summarizes the regression results for the first part described in the previous section.

Table 1. Logistic Regression Analysis – Cooperation as Explanatory Variable

Dependent Variable= Product Innovation	Coefficient	Std. Error	P-value	Conf. Interval	Odds-Ratio
Constant	0.7324177	0.4592489	0.111	[0.43;1.12]	0.4807453
Cooperation (Binary)	0.7750015	0.1763717	0.000	[0.58;1.2]	2.170595
Formal R&D Unit (Binary)	0.9336687	0.151744	0.000	[0.63;1.24]	2.543825
Government Aid (Binary)	-0.1340617	0.1756031	0.445	[-0.48;0.21]	0.8745361
Size (Log Sales)	-0.1687799	0.0227538	0.000	[-0.21;-0.12]	0.8446948
Log of R&D Expenditure	0.1620842	0.0333853	0.000	[0.1;0.23]	1.175959

Source. Prepared by the author

Table 1 shows the results of the estimates with cooperation as an explanatory variable. The statistically significant variables are cooperation with external sources, formal R&D Unit, size and R&D expenditure. In this regard, there is substantial evidence to support the hypothesis 1, which happens to be the primary concern of this research, i.e., that cooperating with external sources has a positive effect on the innovation propensity of the firm. Furthermore, it presents a higher odds ratio than the size of the firm and expenditure in research and development activities.

Additionally, Table 1 shows two other interesting results. On the one hand, the size of the firm is statistically significant, but imposes a negative effect on the innovation, meaning that, the bigger the size, the less probable for the firm to innovate, hence, hypothesis 2 is rejected. On this matter -the relationship between innovation propensity and the size of the firm- some works have found both a positive relation (Becker & Dietz, 2004) and a negative relation (Plehn-Dujowich, 2009). An explanation for this ambiguous results is that «in general, the state-of-the-art review evidence that the relation of size with innovation depends on the innovation activity», e.g., bigger firms will outperform smaller firms in markets with «mature and relatively stable technologies» (Edwards-Schachter, Castro-Martínez, & Fernández-de-Lucio, 2011, p. 133).

On the other hand, the government's aid, as in support funding, was not statistically significant. Thus, it does not explain the product innovation decision, neither further inference can be made related to its parameter, making hypothesis 5 to be rejected too. Some empirical evidence supporting this phenomenon has also been found in other research (Guan & Yam, 2015; Barona *et al.*, 2015).

Disaggregating by cooperation partner, it is possible to observe that only partnering with suppliers is statistically significant and positively affects the propensity of firms to innovate (Table 2). However, the other partnering relationships do not provide results that are statistically relevant –rejecting hypothesis 1b to 1g–. This is also related to the results in Temel *et al.* (2013) where most of the partnering relationships were not found to be significant, but the variable of cooperation, as in Table 1, did have a positive and significant odds-ratio. These conflicting results might require further research by considering other relevant variables that are not included in the survey. Hence, they are not within the scope of this investigation. In the literature, for example, public research institutes and universities have been studied as relevant actors when innovating (Etzkowitz & Leydesdorff, 2000; Powell *et al.*, 2006; Perkmann & Walsh, 2007).

Table 2. Logistic Regression Analysis – Disaggregating by Partnership

Dependent Variable= Product Innovation	Coefficient	Std. Error	P-value	Conf. Interval	Odds-Ratio
Constant	-1.983998	.3729388	0.000	[-2.71;-1.25]	.1375184
Suppliers	0.9051443	0.2823394	0.001	[0.35;1.46]	2.472289
Clients	0.2993825	0.2943011	0.309	[-0.28;.0.88]	1.349025
Competing Firms	-0.1058941	0.3124268	0.735	[-0.72;0.51]	0.8995199
Consulting Firms	0.3424002	0.3458295	0.322	[-0.34;1.02]	1.408324
Universities	0.1401948	0.306476	0.647	[-0.46;0.74]	1.150498
Public Research Institutes	-0.5721293	0.306476	0.126	[-1.31;0.16]	0.5643225
Formal R&D Unit	0.9801764	0.1506922	0.000	[0.68;1.28]	2.664926
Government Aid	0.062972	0.177512	0.723	[-0.28;0.41]	1.064997
Size (Log Sales)	-0.095948	0.0261061	0.000	[-1.47;-0.04]	0.9085113
Log of R&D Expenditure	0.2345189	0.0115092	0.000	[0.21;0.26]	1.2643

Source. Prepared by the author.

5. Conclusions

This article has analyzed Chilean data for the impact of cooperation on the innovation propensity at a firm level. By the use of a logistic regression analysis, it has been found that collaboration does have a positive effect on the innovation propensity. Other control variables that were found to be significant are: having a formal R&D unit, the size of the firm, and the R&D expenditure. The government's aid, using funding, was not found to be significant; therefore, it would require further study. In summary, there is substantial evidence to support hypothesis 1, 1d, 3, and 4.

It is interesting to note that our findings are similar to those provided by Temel *et al.* (2013) who analyzed the Turkish Innovation Survey. So, an important aspect is that the results are consistent with those found for another emerging economy. This aspect implies that there could be some common characteristics among firms in emerging economies that might be worth to take a look at.

The limitation of this work is the focus on a single country, which limits the generalizability of the results. However, this paper provides relevant insights, as there is a gap of empirical research that explores the widely theoretically studied phenomena of open innovation.

For future work, it is essential to bear in mind that there is another relevant factor to be analyzed to understand the cooperation effect on innovation rates, i.e., organizational structure as a crucial element in the diffusion of technological innovations. In fact, it has been shown that the costs of changes could be higher and the benefits smaller if the organizational structure is left apart (DeCanio, Dibble, & Amir-Atefi, 2000). This is also related to the internal capabilities of the firm, and also,

to what the literature has called dynamic capabilities: «the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments» (Teece *et al.*, 1997, p. 516).

Furthermore, it is important for future research, to take advantage of the fact that the guidelines from the Oslo Manual make the Community Innovation Surveys from countries across the world comparable. Thus, it is expected to study a broader sample, with a particular focus on emerging economies, and then, comparing them with developed economies. Additionally, other quantitative methods could be applied to analyze if cooperation has different effects depending on the type of innovation, i.e., product or process innovation.

There is an essential implication from a policy perspective. Due to the relevant role that innovation plays for the development of emerging economies, it should be a priority to better comprehend the impact of open innovation on the performance of firms, regions, or countries (Temel *et al.*, 2013).

As a concluding remark, it appears that there is still a long way to go if collaborative innovation is desired as a paradigm for the case of the Chilean enterprises. This could also be extended to the reality of other emerging economies. Hence, new policies and instruments should be developed to support firms' collaboration network via different mechanisms, to have better results on innovation rates, reminding the positive economic effects that have been attributed to innovation.

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