Knowledge sourcing, domestic and international spillovers and the novelty of technological innovation in developing countries. A panel data analysis

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Introduction(1)

- The challenge for firms in developing countries is not only about whether or not to innovate, but also about increasing the novelty of their innovations.

- The Latin-American firms are improving his performance in the international markets (Multilatinas).

- In terms of innovation policy in developing countries, the challenge for policy makers is to design better institutional tools in order to not only to increase the absorption capabilities of foreign technologies but also "catching up and leaving behind".

- This study pretends to contribute to advance knowledge about the novelty of innovation in manufacturing firms in developing countries.

Introduction (2)

- The novelty of firm's technological innovation depends on a larger variety of internal and external sources.

- Innovation is a knowledge-intensive process, radical innovations imply a high proportion of newness and complexity, therefore, a higher diversity, quantity and quality of knowledge.

- To identify the factors that explain the novelty degree of innovations for firms in developing countries, this study focus on the study of knowledge spillovers from different knowledge sources.

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Main objective

- This study pretends to contribute to advance knowledge about firm's innovation novelty in developing countries.

- Focus on analyzing the effects of knowledge sourcing spillovers.

- Determine in what extent is important knowledge sourcing with different external organizations for firm's likelihood and innovation novelty.

Specifically:

1. The effects of spillovers on incremental and radical innovations ("from whom" and "from where").

Research Questions

- GQ: ¿What types of knowledge sourcing spillovers do make firms to generate radical innovations in developing countries?

- Q1 : ¿How do knowledge spillovers, which arise from the knowledge sourcing with different organizations at local and international levels, affect innovation novelty in developing countries?

- Q1a : ¿How do knowledge spillovers from knowledge sourcing with competitors, suppliers, clients and science and technology institutions affect innovation novelty in developing countries?

- Q1b: ¿How do knowledge spillovers from knowledge sourcing with local and international organizations affect innovation novelty in developing countries?

Literature Review: Radical innovations

- Schumpeter (1910) made a clear distinction between radical and incremental innovations attending to his technological content, and between creative vs. adaptative responses (1954).

- Radical innovations are the sources of the "creative destruction" and the drivers of change and capitalism growth (Baumol, 2000).

- At firm level, radical innovations are important because allow firms to move away from current organizational routines (March, 1991; Miner et al., 2001), to replace current by new knowledge bases (Hill and Rothaermel, 2003; Katila and Ahuja, 2002), to develop a competitive advantage (Barney, 1991; Teece, 1996), and to redefine existing or create new markets (Abernathy and Clark, 1985; Benner and Tushman, 2003; Danneels, 2002).

Literature Review : Radical innovations

- However, despite the research about incremental innovations and the spread, diffusion and adoption of innovation seem reasonably well comprehended in the innovation literature, what is missing is a theory of the endogenous generation of radical innovations (Becker, Knudsen and March, 2006).

Literature Review: External and internal knowledge

- Maillat (1991) stated that firms that develop radical innovations reach the limits of their internal capabilities more quickly.
- If the limits of internal capabilities are reached, one could expect the innovation outputs to be constrained.
- The acquisition and use of external knowledge can overcome these internal deficits, resulting in better performance.
- The complementarities between the use of internal and external resources (Cassiman and Veugelers, 2006) on novelty of innovation are higher and stronger for radical innovations.
- To date, there have been few econometric studies that examine whether or not a firm can use the knowledge from other organizations to improve the degree of novelty of their innovations (Cappelli, Czarnitzki and Kraft, 2013).

Literature Review: Knowledge sourcing spillovers

- Access to diverse and high quality knowledge is especially critical for firm innovation, especially for those with a more complex nature like radical innovations.

- Often, the relevant knowledge will be found elsewhere in the local or international context more than inside the organization.

- Understanding how firms, mainly from whom and from where, acquire the knowledge that they need to transform it into new products with a major degree of novelty is therefore important for scholars and managers alike.

- Knowledge sourcing describes a specific mechanism by which an individual or a firm accesses others' knowledge (Gray and Meister, 2004; Gray and Durcikova, 2006)

Literature Review: Knowledge sourcing spillovers

- Research on knowledge spillovers is driven by the goal of making knowledge available/accessible to entities who need it, when they need it in the format they need it, so they can make the best use of it (supply approach).

- Nevertheless, it is important to remark that it is not because knowledge is available ("in the air") that organizations will use it, as many approaches in spillovers literature assume.

- knowledge sourcing theory addresses this gap by helping to articulate the missing segment in the causal chain connecting knowledge availability to its creative use and exploitation.

- Firm knowledge sourcing can be understood as the process in which firms actively engage in the process of searching for, accessing, transferring, and applying other's knowledge (i.e. absorptive capacity).

Literature Review: Knowledge sourcing spillovers

- Knowledge sourcing spillovers allow firms to reflect on sourced knowledge and use it to perform their innovation activities. Is named "KSS" because they allow the firms to benefit with novel and different ideas without paying for it.

- By doing "KSS", firms can create new knowledge with a higher degree of novelty that integrates the sourced knowledge with their internal knowledge, in form of R&D activities or the existence of a R&D department.

- If the sourced knowledge is not only from local organization but international ones, the expected benefits can be higher with respect of radical innovations.

Literature Review. (Q1a)

- Keep in mind: what is really important for firm innovation in developing countries is "from whom" and "from where" do knowledge sourcing spillovers come from, and how do these spillovers determine the degree of novelty of firm innovation.
- Critical knowledge for firm innovation activities can be obtained from various organizations.
- Recent literature about spillovers has identified some types of spillovers, such as spillovers from vertical organizations (customers, suppliers), horizontal organizations (competitors) and spillovers from science and technology institutions (universities and R&D centers).
- For example, it could be that firms use knowledge spillovers from competitors and suppliers for incremental rather than for radical innovations.

Literature Review. (Q1a)

- Jirjahn and Kraft (2011) show that firms use outside knowledge from competitors for incremental rather than for radical innovations.

- Firms using spillovers from competitors tend to specialize in a follower role. They use spillovers from rivals primarily for incremental innovations, and are less likely to be leaders engaging in radical innovation activities.

- Thus, spillovers primarily serve the diffusion of new products across firms. In that case, a firm primarily exploits knowledge spillovers to imitate rival's products and, hence, to launch products which are only new for the adopting firm.

Literature Review. (Q1a)

- Another explanation is that firms face difficulties using knowledge that comes from areas they are not familiar with, they are likely to exploit outside knowledge for improving their products rather than for producing completely new products.

Literature Review. (Q1a)

- Recently, Cappelli, Czarnitzki and Kraft (2013) have found that spillovers from universities and from customers contribute significantly to a firm's sales with market novelties, but have no effect on imitation.

- The authors explain this because knowledge from rivals is used for imitation, as the knowledge is probably about already developed products.

- In contrast, knowledge inflows from research institutions (basic research) and customers will rarely be about products and processes already in use. More likely it is an input which induces additional innovative activities.

Literature Review. (Q1b)

- It's possible to advance that not only the source of the spillover matters in different ways for innovation, but also the location of the knowledge sourcing spillover.

- In the economics of innovation literature, there are two alternative explanations for the firm innovation performance.

- One stream focuses on local knowledge spillovers arising from a dense network of organizations located in a RIS, ID or innovative milieu.

- Other stream or research based on FDI literature on spillovers support the idea that for technological lagged firms is more important to benefit from international outflows of knowledge.

Literature Review. (Q1b)

- Knowledge sharing between firms embedded in the same local context could not be enough to innovate in international markets.

- In contrast with regional approaches to knowledge spillovers, geographical proximity per se is neither a necessary nor a sufficient condition for learning and innovation to take place.

- Indeed, to much proximity with local organizations may also have negative impacts on novelty of innovation due to the problem of "lock-in", redundant knowledge and information (Asheim et al., 2007; Fitjar and Rodríguez-Pose, 2011; Torre and Rallet, 2005).

- Accordingly, not only too little, but also too much proximity may be detrimental to interactive learning and innovation.

Research Hypothesis

- Hypothesis 1a: The knowledge sourcing spillovers from competitors and suppliers will be positively and directly related to incremental innovation.

- Hypothesis 1b: The knowledge sourcing spillovers from clients, universities and research centers will be positively and directly related to radical innovation.

- Hypothesis 1c: The knowledge sourcing spillovers with international organizations will be positively and directly related to radical innovation.

The data and statistical approach (1)

- EDIT (Survey on Development and Technological Innovation): New census panel database of industrial firms in a developing country (4.753 firms), 2003-2008.

- Based on Bogota Manual. Ask at the firm level about innovation activities (investments, innovation results, internal and external sources by location, collaborations, human capital, intellectual property, funding, obstacles).

- Testing H1a-H1b-1Hc: Pooled Panel and random effects model.

Results: H1. KSS and the likelihood of innovation

Likelihood of Innovation	(1)	(2)
VARIABLES	eq1	lns1_1_1
Customer	1.208***	
	(0.103)	
Competitor	0.624***	
	(0.122)	
Supplier	0.451***	
	(0.110)	
University and Research Centers	0.221	
	(0.155)	
R&D department	1.302***	
	(0.117)	
R&D investments	1.927***	
	(0.148)	
Employees	0.000917***	
	(0.000257)	
Foreing capital dummy	-0.0121	
	(0.153)	
Employees technical	-0.000490	
	(0.000782)	
Employees graduated	-0.00128	
	(0.00184)	
Employees posgraduated	0.0141**	
	(0.00580)	
Constant	-1.871***	-1.433***
	(0.0874)	(0.333)

Results: H1a and H1b. KSS from different organizations and the novelty of innovation

Novelty of Innovation	New to the firm	(2)	New to the national	(4)	New to the international	(6)
VARIABLES	eq1	lns1_1_1	eq1	lns1_1_1	eq1	lns1_1_1
Customer	1.018***		1.163***		1.108***	
	(0.101)		(0.122)		(0.183)	
Competitor	0.519***		0.404***		0.272*	
	(0.115)		(0.125)		(0.165)	
Supplier	0.593***		0.243**		0.0576	
	(0.105)		(0.124)		(0.173)	
University and Research Centers	-0.0903		0.395***		0.503***	
	(0.144)		(0.145)		(0.173)	
R&D department	1.003***		1.242***		1.303***	
	(0.110)		(0.117)		(0.172)	
R&D investments	1.585***		1.181***		0.752***	
	(0.128)		(0.125)		(0.163)	
Employees	0.000985***		0.000601**		0.000988***	
	(0.000240)		(0.000254)		(0.000276)	
Foreing capital dummy	0.0968		0.365**		0.646***	
	(0.143)		(0.164)		(0.194)	
Employees technical	-0.000469		-0.000237		-0.000871	
	(0.000728)		(0.000715)		(0.000744)	
Employees graduated	-0.00125		0.00109		-0.00238**	
	(0.00130)		(0.00140)		(0.00106)	
Employees posgraduated	-0.000591		0.00107		0.00306	
	(0.00240)		(0.00307)		(0.00210)	
Constant	-1.922***	-1.422***	-3.354***	-0.788**	-4.390***	-17.49

Results: H1a and H1b. KSS from different organizations and the novelty of innovation

- From new to the firm and new to the national market, spillovers from competitors and suppliers are more important than spillovers from customers.
- Inversely, for new to the international market spillovers from customers are more important.

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Results: H1c. KSS from domestic vs. international organizations and the novelty of innovation

Novelty of Innovation	New to the firm	(2)	New to the national	(4)	New to the international	(6)
VARIABLES	eq1	lns1_1_1	eq1	lns1_1_1	eq1	lns1_1_1
Customer (Local)	1.081***		1.181***		0.801***	
	(0.105)		(0.127)		(0.200)	
Customer (International)	0.650***		1.072***		2.208***	
	(0.206)		(0.213)		(0.241)	
Competitor (Local)	0.539***		0.383***		0.266	
	(0.122)		(0.134)		(0.194)	
Competitor (International)	0.453*		0.504**		0.0142	
	(0.250)		(0.241)		(0.272)	
Supplier (Local)	0.528***		0.239*		-0.0910	
	(0.114)		(0.134)		(0.202)	
Supplier (International)	0.833***		0.254		0.393*	
	(0.195)		(0.203)		(0.238)	
University and Research Centers (Local)	-0.0602		0.411***		0.323*	
	(0.146)		(0.149)		(0.191)	
University and Research Centers (International)	-0.530		0.225		1.214***	
	(0.488)		(0.446)		(0.436)	
R&D department	1.019***		1.244***		1.237***	
	(0.111)		(0.117)		(0.178)	
R&D investments	1.598***		1.182***		0.735***	
	(0.128)		(0.125)		(0.171)	
Employees	0.000988***		0.000607**		0.000900***	
	(0.000240)		(0.000255)		(0.000284)	

Results: H3. KSS from domestic vs. international organizations and the novelty of innovation

- Regarding the location of the knowledge sourcing spillovers, new empirical results emerge.

- As can be inferred from regression analysis, the location of the knowledge sourced is significant related to novelty of innovation.

- As was expected, spillovers from international organizations are more important drivers of radical innovation than spillovers from local organizations.

- The process of technological innovation necessitates combinations of a variety of new and existing knowledge sources located outside the focal firm, inside and outside of the country.

Results: H3. KSS from domestic vs. international organizations and the novelty of innovation

- In fact, come up with an innovation that is new to the world requires first technical knowledge, from many related and unrelated organizations.

- Second it requires a high quality of prior knowledge, because the knowledge internal capacities of the firm are limited. Moreover, some of this knowledge is usually not available within the local environment or it is not readily available in an explicit and codified form.

- So, not only knowledge sourcing with different organizations, but also with organizations at the technological frontier, that is, organizations located in an international level, is important for the understanding of innovation novelty in developing countries.

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Overview

- The overall empirical findings suggest that spillovers from external knowledge sources are significantly related not only to the likelihood of innovation but also to the novelty. An empirical finding that is similar to the recent study of Cappelli, Czarnitzki and Kraft (2013).

- Firms that have invested in absorptive capacity in the form of internal R&D activities (both R&D investments and formal R&D) are more likely to introduce an innovation new to the firm or new to the market.

- Specifically, regarding technological innovation new to the international market, formal R&D activities, measured as the presence of an R&D department, are more important than R&D investments.

- Interestingly, foreign ownership is positive and highly significant for new to international market but no for new to the firm and national market.

Some empirical issues

- Self-selection problem (with innovators and non innovators). Same results.
- Endogeneity and reverse causality (pooled and random effects).
- IV regression: Lack of good instruments (for example, instrument for KSS/address the fact that estimates of KSS could be biased).
- Anyway, good sample (size, census, balanced panel), common method bias minimized.
- Subjective approach: firms may tend to overestimate the novelty of their innovations. Objective measures are available, but are less reliable.