REAL CHANGE BEGINS INSIDE: DETERMINANTS AND EFFECTS OF ORGANIZATIONAL INNOVATION, THE CASE OF THE COLOMBIAN AGROINDUSTRY SECTOR

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Abstract

Using data from the Colombian innovation survey for the period 2007-2008 (EDIT IV[1]), this paper analyzes determinants of organizational innovation and its effects on the propensity and capacity to innovate in products of Colombian agro industries. Factors explaining organizational innovation are analyzed with a logit model. In line with the existing literature and a sector analysis, four different groups of explanatory variables were included (one for the firm's basic characteristics, one for variables approximating administrative capacities, one for innovation capacities which includes perception hampers and one for what we called "standardization" that includes process and product quality certificates). In addition using a propensity score matching (PSM) the paper analyzes the effect of organizational innovation on the firm´s innovation performance measured as innovation return of sales (ROS) and on the firm´s propensity to innovate in products. The results for both models are divided into small and medium-sized enterprises (SMEs) and large firms. The study findings primarily suggest that organizational innovation among the agroindustry varies depending on the firm's characteristics, especially size. There is strong evidence of the importance of public funding to organizational innovation. This paper´s results suggest that firms that perform organizational innovations are more likely to increase their innovation ROS on products new to an international market and to increase their propensity to innovate at a radical level. The investigation provides evidence of complementary between organizational innovation and innovation in goods and services and remarks the importance of public policies aiming to increase the firm's organizational capacities for innovation.

Keywords: Organizational innovation, effects of organizational innovation, goods and services innovation, agroindustry
JEL classification: L25, O31, O32

[1] The EDIT database is a statistical instrument for monitoring the technological innovation activity for Colombian firms in the industrial sector.

1. Introduction

In recent years the topic of organizational innovation (org-inn from now on) has gain popularity among innovation scholars (Armbruster et al., 2008; Lam, 2004; Bruland and Mowery, 2004; Greenan, 2003; Piva and Vivarelli, 2002; Caroli and Van Reenen, 2001 among others). One possible reason is the well spread notion that in order for innovation strategies to succeed, companies need to go beyond R&D and adopt an **"**innovation mindset**"** that involves openness as in Laursen and Salter (2006), knowledge management and learning capacities as in Nonaka (1994) and Nonaka and Takeuchi (1995), and cooperation as in Belderbos (2004). Several authors have agreed that organizations play a fundamental role in the process of innovation. (Van de Ven et al. 1999; Lam, 2004; Weick, 1979), some have even stated that innovation constitutes part of the system that creates it, which makes the ability of an organization to innovate "a precondition for the successful utilization of inventive resources and new technologies" (Lam, 2004).

The importance of org-inn for competitiveness has also been proven by several studies (Bruland and Mowery, 2004; Caroli and Van Reenen, 2001; Damanpour et al., 1989; Greenan, 2003; Piva and Vivarelli, 2002 among others). Nonetheless, technological innovation remains an area of higher attention when compared to non-technological innovation. One possible reason might be the lack of available data; most national innovation surveys focus on technological factors such as investment, patent and R&D activity leaving aside relatively intangible changes as those of an organizational kind (such as knowledge creation, idea management and openness to change). In fact, as of the year 2000, very few national innovation surveys had attempted to measure non-technological innovation; one of the first attempts was done by the ABS[2] in 1994 for the Australian Industry (OECD, 1997).

The 1996 OECD Analytical Report on Technology, Productivity and Job Creation (Soete, 1996), showed that technological innovation and organizational change were highly interconnected. However, it wasn´t, until 1997 that the second edition of the Oslo Manual recognized organizational innovation as a factor for significant improvement in a firm´s performance and it took an additional 8 years for org-inn to be included on the manual´s third edition as a type of innovation (OECD, 2005). According to it, organizational innovation refers to the implementation of new organizational methods in the firm´s business practices, workplace organization or external relations (OECD, 2005). Up to now, most national surveys have adapt this definition (including the Colombian EDIT IV used in this paper), however an ongoing discussion still remains about the most adequate methodological approach to measure, monitor and even define organizational innovation, causing a not very well integrated and coherent theoretical framework on the topic (Lam, 2004; Armbruster et al., 2008).

[2] Australian Bureau of Statistics

One example could be the way some authors have approached org-inn through the link between the structural form of the firm and its propensity to innovate (Burns and Stalker, 1961; Lawrence and Lorsch, 1967; Mintzberg, 1979 among others). This approach addresses questions related to the links between environment, structure and organizational performance. The aim of investigations in this area has been to identify the structural characteristics of an innovative organization and to determine the effects of organizational structural variables on innovation. Other scholars have focused on how organizations develop new ideas for problem solving, this approach has provided singular insight on the process of how organizations learn and create knowledge (Argyris and Schön, 1978; Nonaka, 1994; Nonaka and Takeuchi, 1995). Finally an alternate strand of research has concerned on how organizations change and adapt (Child, 1997; Weick, 1979). This particular strand of research has concerned mainly on the process through which organizations overcome inertia and adapt to environmental shifts and technological changes (Lam, 2004).

Even though some theoretical overlaps, these approaches remain different as each conceives organizational innovation as determined by different factors (Lam, 2004). Regardless of whether organizational innovation is determined by the firm´s structural form or its ability to learn and adapt to change, the approach of org-inn determinants remains generic and not easy to adapt to a particular industry or economic sector. Organizational innovation strategies will not be the same for a firm in a high tech sector compared to a low tech sector and will even differ for similar sectors in developing and developed countries.
It is the purpose of this article to contribute in this area by analyzing determinants and effects of org-inn in the Colombian agroindustry sector. Using data from the 2008 EDIT IV survey, an intra-sectorial analysis is done to estimate the effect of org-inn on the firm´s propensity to innovate in products and on the firm's share of innovation sales. Our motivation is to contribute to the discussion on what a firm (and policy makers) should really do in order to improve the firm´s innovation capacities and performance.

This article is organized as follows. Section 2 presents notes and findings on organizational innovation and makes a literature review on determinants and forms to measure it. Section 3 introduces the variables and model used to estimate determinants of org-inn in the Colombian agroindustry sector. Section 4 presents the econometric strategy and results of the impact of org-inn on the firm´s innovation performance and on the firm´s propensity to innovate. Section 5 presents final remarks and concludes the paper.

2. Theoretical background and hypothesis

2.1. Determinants of Organizational Innovation

As it was already mentioned, the study of organizational innovation has not followed a well-integrated and coherent theoretical framework, notwithstanding Lam (2004) identified three different strands of research. The first one (organizational design) embraces theories that have focus on the link between the structural form of the firm and its propensity to innovate (Burns and Stalker, 1961; Lawrence and Lorsch, 1967; Mintzberg, 1979 among others). The second strand puts together theories of organizational cognition and learning and focuses on how organizations develop new ideas for problem solving. This specific approach has provided singular insight on the learning and organizational knowledge creation process (Argyris and Schön, 1978; Nonaka, 1994; Nonaka and Takeuchi, 1995). The third strand of research concerns organizational change and adaptation, these are investigations concerning the process through which organizations overcome inertia and adapt to environmental shifts and technological changes (Lam, 2004).

In spite of the different theoretical approaches, the real importance of innovation relies on how the firm´s "innovation journey" is interpreted (Van de Ven et al., 1999). On one hand, innovation may be seen as a process of different stages (i.e. invention – development – testing – commercialization) where stability is achieved through a trial an error learning process (March and Olsen, 1975; Cohen and Sproull, 1991) or a "sense making" process (Weick, 1979, 1993; Brunsson, 1982, 1985). On the other hand, innovation may also be conceived as a "living system" where equilibrium doesn´t exist (Dooley, 1997). This second approach implies that innovation "just happens" making organizations futile in the innovation developing process (Aldrich, 1979). Nonetheless the implications of both approaches, most scholars agree that the process of innovation is the result of a nonlinear dynamic system; in other words, the innovation journey is neither stable and predictable nor stochastic and random which gives initial conditions and the organization itself a fundamental role in the process of innovation. (Van de Ven et al. 1999; Lam, 2004; Weick, 1979).

In this sense, how a firm is organized and especially how it develops a strategy to innovate becomes the core question. Theorists like Burns and Stalker explored in the 60s whether the firm´s environment affected its structure and management processes. They concluded that organizations could be grouped into two main types: mechanistic and organic, and that belonging to one or another group was highly correlated with the firm´s technological and market environment being stable or unstable (Burns and Stalker, 1961).

Other authors have focused on the link between structural variables like size and age and their effect on org-inn. Sapprasert (2010) found that older and larger firms were more inclined to make an attempt at organizational change, however concerning the outcome; smaller firms were found to be more able to succeed in such attempts. Other variables like specialization (different professional specialties found within the organization), studied by Kimberly and Evanisko (1981) and Aiken and Hage (1971) where found to have a positive impact on innovation, the hypothesis behind the results was that a greater variety of specialists

would provide a broader knowledge base (Kimberly and Evanisko, 1981) and increase the cross-fertilization of ideas (Aiken and Hage, 1971).

Other findings worth mentioning are the ones related to administrative intensity (ratio of managers to total employees). Daft and Becker (1978) and Damanpour (1987) found that a higher proportion of managers facilitate innovation as it provides the necessary leadership, support and coordination for the successful adoption of innovations. Corporate culture has also been demonstrated to play a significant role on the firm´s propensity to innovate. Scholars like Dewar and Dutton (1986) and Hage and Dewar (1973) found that the managerial attitude towards change play a fundamental role in the firm's innovation capacity. Manager's favorable attitude towards change creates a climate that fosters innovation by providing support thorough the different stages of the innovation process (Dewar and Dutton, 1986; Hage and Dewar, 1973).
Summarizing, literature on organizational design suggests that org-inn is highly dependent on the structural form of the firm as well as on the firm´s capacity (or willingness) to support innovation activities. Such support has been affiliated with the proportion of managers within the firm and the personnel dedicated to innovation activities. Consequently, our first hypothesis states that:

> **H1: The propensity of a firm to conduct organizational innovation is determined by the proportion of managers as well as by the proportion of employees dedicated to innovation activities.**

In line with the reviewed literature, as above mentioned, we expect higher proportion of managers and higher proportion of employees dedicated to innovation activities both positively influence the firms propensity to innovate at an organizational level. The argument behind our expectation is that both (managers and innovation personnel) provide the necessary leadership, support and coordination for the successful adoption of innovations.

Different studies have approach organizational innovation as a way in which firms bring new problem-solving ideas into use (Amabile, 1988; Kanter, 1983). These theories have been called "organizational cognition and learning" (Lam, 2004) and regard innovation as a process of absorbing, managing and exploiting knowledge (Glynn, 1996; Woodman et al., 1993; Senge, 1990; Argyris and Schön, 1978, among others). In this line, scholars like Nonaka (1994) and Nonaka and Takeuchi (1995) defined an innovative firm as one that is able to create and diffuse new knowledge, while other theorists have focused on the organization´s capacity to absorb and transform knowledge and turn it into use (Cohen and Levinthan, 1990).

Damanpour (1991) and Daft (1978) studied the role that managers play on the firm´s org-inn capacities. Both found that general management plays a fundamental role in a company´s org-inn performance (Damanpour,

1991 and Daft, 1978). The topic has been recently approached by the study of absorption capacity that has been measured through a large series of proxy variables[3]. The ultimate goal of scholars that have studied management and its relation to org-inn, has been to identify the conditions that need to be met for organizations to be able to absorb and transform knowledge. One of the seminal investigations in this area was the study performed by Pierce and Delbecq, 1977 who in general terms, concluded that professionalism has a positive impact on the firm´s propensity to perform org-inn by *increasing boundary spanning-activity, self-confidence and commitment to move beyond the status quo,* this same hypothesis was later corroborated by Damanpour (1991). This approach has been replicated on several studies that reinforce the importance that cultural and managerial characteristics play on a firm´s innovation output (Foss et. al, 2009; Rosenbusch et. al, 2011). Some of these characteristics have been measured through *management professionalism* (higher levels of education and expertise) (Pierce and Delbecq, 1977; Damanpour, 1991) and *managerial tenure* (longevity of managers on their jobs) (Kimberly and Evanisko, 1981). All in all, studies on organizational cognition an learning that have focus on the manager's role, have brought as a result, not only, the validation of Pierce and Delbecq (1977) and Damanpour (1991) hypotheses, but also have provide particular insight on how organizations learn, create and diffuse knowledge (Argyris and Schön, 1978; Nonaka, 1994; Nonaka and Takeuchi, 1995; Foss et. al., 2009).

In summary, cognition and learning theories have focused on how knowledge is created, diffused and adopted within the firms. In this line, it is expected for innovation *practitioners* (leaders and managers, and middle managers) to follow Whittington´s (2006) approach, to be closely related to the firm´s organizational innovation performance. It is in this sense that we constructed our second hypothesis for the Colombian agroindustry:

> **H2 The propensity of a firm to conduct organizational innovations is determined by the level of professionalism of its managers and of the personnel in charge of the firm´s innovation activities.**

In line with the above-mentioned literature, we expect for higher levels of professionalism to have a positive impact on the firm´s organizational innovation performance. The higher the level of professionalism the higher the level that knowledge is created and better integrated into the firm´s innovation activities.

Particularly, Agro-industries (especially those in the food business) are characterized by performing routinize tasks through formalization of worker skills and experiences. Moreover following Mintzberg´s (1979) classic approach Colombian agro-industries fall into Mintzberg´s *machine bureaucracy* archetype with a high level of specialization, standardization and centralized control. It is in the interest of this article to further analyze the

[3] For a broader insight on this regard see the work of Flatten et. al (2011).

relation between process standardization and the firm´s propensity to innovate. For this a variable that describes the number of process and/or product quality certificates was included. Our goal is to demonstrate that when it comes to org-inn, certain levels of standardization (as the ones required to obtain a quality certificate in processes or products) can foster innovation activities within the firm by forcing the development of new mechanisms to manage and transfer knowledge. As per above hypothesis 3 was develop for Colombian agroindustry firms:

H3 The propensity of a firm to conduct organizational innovations is determined by a level of standardization that can be achieved by certifying process and products.

Hypotheses 1-3 are related to org-inn determinants. However as described in the title of the article it is within our interest to further explore not only org-inn determinants but also its effects on the firm´s propensity to innovate in products. Hypothesis 4 related to org-inn effects is presented in the following section.

2.2. Measurement and effects of organizational innovation

Measurement of org-inn has also been a topic of constant evolution ever since the ABS survey in 1994. The Community Innovation Survey (CIS[4]) included for the first time a question about org-inn in 2001 (CIS III). This survey asked about innovative management techniques and new organizational structures on one single question (Armbruster et al., 2008). Originally, firms were questioned whether during the period of analysis they implemented advance management techniques or new or significantly changed organizational structures without any specific description of what these activities were. For the next survey, however, the questionnaire was reworded and explanatory amendments were included on three separate questions (one for innovative management, one for organizational structure and one for the firm´s external relations) (Armbruster et al., 2008).

Org-inn measurement has evolved from general questions at an aggregate level to more specific questions. Different surveys provide different levels of aggregation and label organizational changes differently (Armbruster et al., 2008). While the best methodological approach to measure org-inn keeps evolving, one area that remains practically untouched is the importance of organizational change across different industry sectors (Armbruster et al., 2008). An analysis on this may contribute to develop better national surveys that take into account specific innovation strategies for different sectors.

[4] The CIS survey t is the main statistical instrument of the European Union for measuring innovation activities at a firm level.

Similarly, the effect of org-inn on the firm´s performance has also been a topic under discussion. Henderson and Clark (1990), Dougherty (1992) and Danneels (2002) focused on demonstrating that firms that performed innovation activities of the technological kind (i.e. product and process innovation) adopted complementary organizational practices. In this approach technological innovation was seeing a driver for organizational changes within the firm (Mothe et al. 2010). Others have demonstrated an inverse relation between org-inn and technological innovation. These approaches have studied the extent at which organizational changes facilitates the development of technological innovations by enhancing flexibility and creativity within the firms. Lokshin et. al., (2009) studied the effect of organizational skills on the firm´s innovation performance concluding that German firms that combined customer, organizational and technological skills introduced on average more innovations than those who didn´t. In line with the above, hypothesis 4 was developed for Colombian agro industries:

H4 Firms that are successful in organizational innovation have a greater propensity to innovate in products and a better innovation performance than those who don´t.

3. Organizational innovation: a model for the agroindustry sector

3.1 Data

The information used in this paper was obtained from the Colombian National Institute of Statistics (DANE for its acronym in Spanish) and its EDIT IV survey of 2009 for the periods 2007-2008. The EDIT database is a statistical instrument for monitoring the technological innovation activity for Colombian firms in the industrial sector, with the collaboration of the National Planning Department (DNP) and the Colombian Administrative Department of Science Technology and Innovation (COLCIENCIAS).

The EDIT IV survey was done to a total of 8.654 firms from which information was obtained for a total of 7.683. According to the size of the firms the EDIT IV survey gathered information from 5.194 small firms (67.6%), 1.760 medium firms (22.9%) and 729 large firms (9.5%) in the period of reference (2007-2008). Based on the company's capital composition 93.8% of the information was gathered from national companies and 6.2% from foreign companies.

As agroindustry might be considered a broad definition, we restricted the industry sectors included in the analysis. The industry sectors included in the analysis are 151, 152, 153, 154, 155, 158, 159, 174, 201, 202, 241 and 242 as per ISIC 3rd Version revised for Colombia. Our sample for the agroindustry contains 1683 firms from which 1443 (86%) are SMEs and 240 are large firms (14%).

The reason for choosing agroindustry is derived from the sector´s importance to Colombian economy. Colombian agroindustry sector has historically be one of the major pillars of the country's economic development. It contributes with over 9% of Colombia´s GDP and generates over 20% of the country's total

employment. According to the 2014 Industry report, 6 out of the 10 most dynamic industrial subsectors are agroindustry related[5], in addition agroindustry contributes with 39% of Colombia's industrial GDP (MINCIT, 2014) and its exports represent 21% of the nation´s total. In the period 2004-2009 the sector´s real GDP grew on average 2.3% annually, reaching 3.9% on both 2006 and 2007 (SAC, 2012). For the agri-food only, according to DANE in 2012 nearly 17% of the country's manufacturing firms belonged to this businesses. In terms of impact, agro-food firms created, in the same year, over 27% of the country´s aggregate value.

Recent studies have characterized the agro-food industry sector as one with low innovation and R&D intensity. Even though most innovations in this sector are not sustained on research (Garcia Martínez & Briz, 2000), innovation has been a widely adopted strategy in agro industries as a mechanism to confront the sector´s high competitiveness, to maintain competitive advantages and to satisfy demand needs (Capitanio et. al, 2009; Bayona-Sáez et al., 2013). It is in this sense that the sector´s characteristics combined with its relevance to the country´s economic wealth and off course the need for differentiation through innovation, give special relevance to intra-sectorial analysis like the one presented in this investigation.

3.2. Variables of analysis

The EDIT IV database permits to identify four different groups of explanatory variables that as previously mentioned the literature has found to be important to explain the firm´s propensity to perform organizational innovation. The first group contains variables related to firm´s characteristics. Here we include variables such as firm´s size, R&D per employee and innovation investment different from R&D. As for the expected relationships, although some contradictions[6] exist in terms of the real impact of the firm's size to org-inn, it is expected for larger firms to be associated with certain features that may trigger efforts at org-inn (Saprassert, 2010). Such features may include larger resources (Kimberly and Evanisko, 1981) and maturity that has been associated with "a more powerful impetus" to innovation in comparison to younger firms with immature and undefined routines (Saprassert, 2010).

As for R&D investment per employee, it is expected for higher levels of investment to have a positive impact on org-inn. All hypotheses behind R&D intensity derived from Cohen and Levinthal (1989), who introduced the term absorption capacity to describe the need of some pre-existing knowledge inside the firm to be able to absorb external information or knowledge and take advantage of it. Absorption capacity grants "R&D intensity" a dual role as it not only contributes to the firm´s knowledge stock but it also sets the firm in a position where extramural knowledge is better accepted and understood.

[5] Other foods, sugar refineries, dairy products, beverages, basic chemicals and fibers and tobacco related products (MINCIT, 2014).

[6] Size has been associated with higher inertia that hinders organizational change (Hannan and Freeman, 1984; Caroll and Hannan, 2000).

We called the second group of variables "administrative and innovation capacities". The variables included were: the percentage of employees dedicated to innovation activities, percentage of employees dedicated to managerial or administrative activities, management professionalism (general directors + administrative personnel) and R&D team professionalism. According to Daft & Becker (1978) and Damanpour (1987), it is expected for innovations to depend largely from leadership, support and coordination, which can be facilitated by a higher proportion of managers.

The third group named "other characteristics and hampers" includes a dummy to indicate whether the firm received public support for innovation activities, three additional variables for the utilization of methods of intellectual property right protection (Patent, Industrial Secret and Confidentiality agreements), and thirteen variables to measure the importance of the innovation hampers associated with internal capacities, perceived risks and firm's environment. The last group was included to capture the effect of product and process standardization. For this, two variables were added to indicate whether during the period of analysis, the firm had at least one quality certificate in processes and products.

3.3. Econometric strategy

Given the fact that the dependent variable can only take two values, performing org-inn or not, a logit model was used for the estimations. The model was run for firms with over 10 workers and was done for three scenarios: the whole agroindustry sample, small and medium sized agroindustry enterprises (SMEs) and large agroindustry firms[7]. Showing up next is the equation used to estimate the probability of a firm to perform organizational innovation:

[7] Following Colombian law, the current definition of the characteristics necessary for a productive unit to be considered as micro, small, medium or large are in the Article 2 of Act 590 of 2000. The Article 2 of Law 905 of 2004, Article 75 of Law 1151 of 2007 and Article 43 of Law 1450 of 2011 have amended this three times. Overall, small and medium enterprises or SMEs are those with 11 to 200 employees and large, those with more than 201 employees.

$$logit\ (p_i) = \ln\left(\frac{p_i}{1 - p_i}\right)$$
$$= \beta_0 + \beta_1 x_{1,i} + \beta_2 x_{2,i} + \beta_3 x_{3,i} + \beta_4 x_{4,i} + \beta_5 x_{5,i} + \beta_6 x_{6,i} + \beta_7 x_{7,i} + \beta_8 x_{8,i} + \beta_9 x_{9,i}$$
$$+ \beta_{10} x_{10,i} + \beta_{11} x_{11,i} + \beta_{12} x_{12,i} + \beta_{13} x_{13,i} + \beta_{14} x_{14,i} + \cdots + \beta_{26} x_{26,i}$$

Where:

p_i = Organizational innovation
$x_{1,i}$ = Firm's size
$x_{2,i}$ = R&D Investment per employee
$x_{3,i}$ = Innovation investment different from R&D
$x_{4,i}$ = % of employees dedicated to innovative activities
$x_{5,i}$ = % of employees dedicated to managerial or administrative activities
$x_{6,i}$ = Professionalism of managers and administrative personnel
$x_{7,i}$ = Professionalism of R&D personnel
$x_{8,i}$ = Government Support
$x_{9,i}$ = Patent
$x_{10,i}$ = Industrial Secret
$x_{11,i}$ = Confidentiality agreements
$x_{12,i}$ = Quality certificate in processes
$x_{13,i}$ = Quality certificate in products
$x_{14,i}\ through\ x_{26,i}$ = 13 hampers for internal capacities, perceived risks and environmental risks

The results of the above model for determinants of organizational innovation is presented in table 1. Results are shown for total agroindustry, SMEs and Large Firms.

Table 1. Determinants of Organizational Innovation in the Agroindustry

	Total agroindustry	**SMEs**	**Large Firms**
Firm´s Characteristics			
Firm´s Size	0.0006363** (0.0002769)	0.0027304* (0.0016468)	0.0009445** (0.0004145)
R&D investment per employee	0.000034 (0.0000269)	-0.0000474 (0.000033)	0.000225*** (0.0000728)
Innovation investment different from R&D	5.38e-08** (2.22e-08)	3.39e-07** (1.53e-07)	4.91e-08** (2.51e-08)
Administrative and innovative capacities			
% of employees dedicated to Innovative activities	10.28315*** (3.427505)	9.621627** (3.564128)	3.125.614 (14.29438)

% of employees dedicated to managerial or administrative activities	0.4809349 (0.9351284)	-0.0233309 (0.8237223)	3.620.971 (4.314588)
Professionalism (manages and administrative personnel)	0.632125** (0.3222553)	0.6255399** (0.2854161)	-0.1395487 (0.7445569)
Professionalism (R&D personnel)	0.0230823 (0.2479888)	0.5550331 (0.391358)	-0.4636348 (0.6074331)
Other characteristics and hampers			
Government Support	0.8935021* (0.4805124)	1131638* (0.6406163)	0.7561733 (0.6712156)
Patent	0.4270664 (0.4458714)	0.307669 (0.7839587)	1467382*** (0.5478684)
Industrial Secret	0.7027415*** (0.2435458)	0.6907742** (0.2424964)	0.6499537 (0.541638)
Confidentiality agreements	0.4358645** (0.1952443)	0.4703904* (0.2845768)	0.1190863 (0.4937118)
Lack of internal resources	0.5432999*** (0.0884739)	0.4772789*** (0.1397781)	0.7138631** (0.3312409)
Lack of qualified personnel	0.2855746 (0.2104184)	0.3122413* (0.1857309)	0.2537412 (0.5018346)
Difficulties to meet technical regulations	0.0365215 (0.1746242)	0.0552274 (0.188716)	0.3702057 (0.2919343)
Lack of market information	-0.0712576 (0.1630633)	-0.1390463 (0.2233722)	0.2960246 (0.2888899)
Lack of information about available technologies	0.5620544*** (0.1441475)	0.5785578*** (0.1589038)	0.3294165 (0.4196687)
Lack of information about public support instruments	-0.0890907 (0.2123098)	0.04336 (0.2271926)	-0.8718812* (0.4740614)

Uncertainty about the demand for innovative goods and services	0.174391 (0.1846203)	0.2006584 (0.2251823)	0.2173204 (0.3713481)
Uncertainty about the technical success of the project	-0.0409634 (0.1651137)	-0.1066801 (0.2173282)	0.1346943 (0.2423272)
Low profitability of Innovation	0.0669637 (0.1472983)	0.0374598 (0.2156556)	0.4790817 (0.41433)
Difficulties to obtain external funding	-0.0163223 (0.1857159)	0.0136751 (0.2497899)	-0.2279101 (0.4059686)
Difficulties to cooperate with other firms or institutions	-0.0138635 (0.1150958)	0.0063926 (0.1647944)	-0.214351 (0.4818822)
Imitation by others	0.3010551 (0.2265388)	0.1751827 (0.2625789)	0.5644784 (0.4167434)
Insufficient capacity of the intellectual property right system to protect innovation	-0.249216 (0.1672922)	-0.1922216 (0.1599881)	-0.2138716 (0.3313273)
Standarization			
Quality certificate in processes	0.6220329*** (0.2181322)	0.7098078** (0.2788264)	0.3910037 (0.3646637)
Quality certificate in products	-0.1431473 (0.1759104)	-0.1456818 (0.1981939)	-0.1002688 (0.4326144)
Pseudo R2	0.1350	0.1311	0.1763
Number of obs	1683	1443	240

Source: Author´s creation based on EDIT IV. Note: The number of observations is 1683. *, **, *** Indicate significance level of 90%, 95% and 99%, respectively. Robust Clustered Standard Errors with economic activities within the agroindustry are used. In addition, none of the variance inflation factors surpassed the 5 points tolerance level.

Table 1 shows (for all three scenarios) a positive relation between the firm's size and the propensity to achieve organizational innovations. A possible explanation is that more workers represent a higher possibility to distribute tasks and activities making organizational strategies more necessary. In line with our expectations, larger agro industries are associated with larger resources to support innovation including org-inn. Similarly R&D investment (internal and external) is a key factor to explain the propensity to achieve organizational

innovations. Results for R&D investment are positive and statistically significant for large firms but not for SMEs. These results are in line with findings that suggest that innovation in small firms (including org-inn) is more dependent on access to external systems of knowledge (spillovers) than on R&D (Conte and Vivarelli 2005; Santarelli and Sterlacchini 1990; Vaona and Pianta 2008). For larger firms R&D investment is associated with the firm's capacity to generate new knowledge that can result in more flexible labor practices and can also force the firm to establish knowledge management protocols which are considered as organizational innovations.

The results also show that innovation investment different from R&D has a positive impact on the probability to engage on organizational innovation activities for all three scenarios (total agroindustry, SMEs and Large firms). As already mentioned, one characteristic of the agroindustry is that in this sector innovations are process oriented and characterized by the external acquisition of machinery and equipment (Capitanio et. al, 2009; Bayona-Sáez et al., 2013), thus the positive impact can be explained via the acquisition of technology which forces the firm to establish better guidelines to define external relations and training dynamics related to the use of the new technologies. Such dynamic affects SMEs as well as large firms in a similar way, thence the positive and significant results on all scenarios.

The variable "public funding" was included to gather the effect of the firm's capacity to scan and take advantage of the environment and to arrogate market opportunities; its effect was also positive and significant at a 90% level for the total agroindustry and SMEs. As innovation scholar suggest, public funding is usually related to a higher capacity to scan and manage internal and external resources and to a well-defined funding strategy, which can be related to a higher propensity to achieve organizational innovations.

The percentage of employees dedicated to R&D activities has a positive effect on the propensity to engage in org-inn for the total agroindustry sample and SMEs. This result goes in line with the results shown for R&D investment. Together, the results indicate that financial resources aren't enough on their own, in order for org-inn to succeed, firm's need to have an installed capacity (including personnel) to exploit and take advantage of R&D investment. Against hypothesis number 1, the ratio of employees dedicated to managerial or administrative activities over the firm's total employees does not have a meaningful effect on the propensity to conduct organizational innovations. However, there is significant evidence to corroborate hypothesis number 2. Professionalism appears as a clear determinant of the propensity to achieve org-inn for it represents a higher capacity to take decisions related to how the firm's internal resources should be managed and organized.

With regard to intellectual property right protection, industrial secret and confidentiality agreements show a positive and significant effect on the propensity to introduce organizational innovations on SMEs while Patents play an important role for larger firms. In line with previous findings, a possible reason is that these methods are characterized by a higher interaction with external agents, which also can lead to an improvement in the firm's capacity to build and maintain external relations.

In line with hypothesis 3, a positive and significant relation was found between being certified in process and the propensity to introduce organizational innovations in the whole Agroindustry sample and on SMEs. Process certifications usually involve standardizing activities within the firm, forcing the creation of new mechanisms to manage and transfer knowledge and to optimize processes. These results confirm hypothesis 3 for the agroindustry as a whole and for SMEs. Finally, the results show that the hampers associated with the firm's internal capacities are the ones that increase the firm's propensity to succeed in organizational innovation. Among these barriers lack of internal resources and lack of information about available technologies stand out above the rest. An explanation is that knowing the firm's limitations in terms of resources and knowledge, forces managers to reorganize the firm's capacities via org-inn.

The comparison between SMEs and large firms is a logical step in explaining the determinants of organizational innovation and above all, to understand the impact of org-inn in the introduction of new (or improved) goods and services. In this sense a key factor to understanding the differences between the propensity to innovate organizationally between SMEs and large firms is the allocation of resources to innovation activities. In SMEs, technology acquisition (innovation investment different from R&D) is more important, whereas in large firms R&D is the most influential factor. As already mentioned, in SMEs R&D personnel over total employees is not a determining factor to increase the firm´s propensity to achieve organizational innovations as it is in larger firms.

Moreover, public funding has a positive effect on SMEs' propensity to innovate organizationally, while on large agro industries no effect was found. This is due to temporality differences in the innovation process of SMEs and larger firms. While SMEs are more dependent on external resources, larger firms have a greater capacity to use private sources for funding innovation activities. Furthermore, competition between larger firms is much more aggressive which forces them to innovate faster affecting their ability to meet deadlines on applications for public funding.

4. Estimating the effects of Organizational Innovation

4.1. Empirical approach

For estimating the impact of org-inn on the firm´s propensity to innovate and on the firm´s innovation performance (innovation ROS), methodologies of impact evaluation were used. Quantitative impact evaluation methods use matching techniques to determine the causal link between the impact and the implementation of a project. For our study the "project" is the situation in which firms performed org-inn, so that the implementation of the project generates a group of companies that made such innovation, known as "treatment". Of the companies that are not part of the treatment, another group, referred to as "control", serves as input for the construction of a counterfactual scenario. The quantitative evaluation method requires construction of this scenario as an approximation to the beneficiary situation, had he not participated in the project.

Under these definitions, participation in the project is not random, since only companies with certain characteristics can carry out org-inn, and another few will actually do it, under this assumptions treatment, rather than a state, is a decision. This situation, known as selection bias, creates problems during the definition of the control group and the building of the counterfactual scenarios, as it is very likely that the variable that will estimate the impact will differ between the treatment and control group, *even if the project had not existed*. Empirically this problem is solved using a Propensity Score Matching methodology, which works as a parametric approach that serves as input for the impact evaluation, as well as an econometric model to analyze the determinants of org-inn. Our model calculates the effect of org-inn on the firm's propensity to innovate in products and on the firm's innovation performance measured as the share of innovate sales that came from new or significantly improved goods or services at a firm, a national market and at an international market level.

As in the model of org-inn determinants presented on section 3, a logistic model was used to estimate the effects. Additionally, for the estimation of these models, cluster-robust standard errors, with the economic sector variable were used. This was done to control for preexisting or inherent conditions in agro industries that because of simplicity or lack of information, were not part of the explanatory variables. Finally, we estimate models with subsamples defined by the number of employees in each firm (Whole agroindustry sample, SMEs and large firms).

4.2. Impact Evaluation - Propensity Score Matching

The Propensity Score Matching (PSM) is a semi-parametric technique that matches each project participant with a member of the control group with the same values for observed characteristics (collected in a vector X). The alternative applied in PSM compares cases that are "close" in terms of X, such that individuals or participating units are associated (or matched) with the untreated by an estimate of the probability of the unit to become part of the project (Propensity score) [8]. In the analysis, the vector X consists of explanatory variables constructed following the ones used to calculate org-inn determinants on section 3 of this paper; within a binary choice model to estimate both the propensity score and structure an analysis of determinants of org-inn.

By calculating the propensity score, the first instance defines the participation in the treatment group and the control. This means, in the group of companies that have achieved organizational innovations, as defined in EDIT IV, and the group of companies that have the necessary features to perform such type of innovation, but did not. Following this, we can estimate an average impact, which determines the magnitude of the difference between the treatment and the control group. The methodology allows us to find the average treatment effect – ATE – or the average treatment effect on the treated – ATT–. The first is particularly relevant when evaluating universal projects, but, in our case we focus on companies that performed a specific economic activity, so the second was analyzed.

As already mentioned, the ATT is estimated for the firm's innovation performance (innovation ROS) and for the probability of a firm to innovate in products. The first set of variables was taken directly from specific questions in the survey and the probabilities were estimated using a logit model where the dependent variable was a dummy that took the value of one if the firm introduced innovations in products in the 2007-2008 period, and zero otherwise. The dependent variables are size (measured as natural logarithm of the number of employees), percentage of employees dedicated to innovation activities, percentage of employees dedicated to research and development, process innovation, public funding, 13 hampers for internal capacities, perceived risks and environmental risks and two variables for the firm's usage intensity of internal and external sources of information. Table 2 presents descriptive statistics and difference in means between the group of firms that perform organizational innovations and those who don't.

[8] For an exhaustive analysis of this methodology, it is recommended to review Heinrich, Maffioli, & Vazquez, (2010) and Vinha (2006).

Table 2. Descriptive statistics and difference in means between the control and the treatment group

	Difference in means		
	Total	**SMEs**	**Large**
Propensity to innovate in products new to the firm	0.308	0.283	0.261
Propensity to innovate in products new to the national market	0.235	0.198	0.275
Propensity to innovate in products new to an international market	0.087	0.064	0.130
Innovation ROS of good and services new to the firm	8.244	7.665	7.027
Innovation ROS of good and services new to the national market	5.395	4.834	6.636
Innovation ROS of good and services new to the international market	1.246	1.417	0.539

Source: EDIT IV. Results are shown for significance above 95%

For a proper calculation of the ATT, we need to make considerations regarding the quality of the matching and its weighting. As the match is not made conditional on all observed variables, but only in the probability of participation, it is necessary to determine if the balancing condition is met. This means, that the average probability of participation as well as the means of the variables in the vector X are identical between the treatment and control groups, so that, after conditioning for the probability of participation, there are no differences between the observable characteristics on the treatment and on the control group (Bernal & Peña, 2011).

This condition is not met by the original X vector defined trough theoretical and empirical review. In order to obtain similar samples, the variables innovation investment different from R&D, quality certificates in process and products, and hampers 1, 3 and 9 were dropped from the analysis. The change in specification did not significantly diminish the model's explanatory power or the classification statistics. Regarding the weight, although in large samples, asymptotically all matching algorithms should produce the same results; this isn't so in the case in small samples so the decision of the selected matching algorithm is fundamental as it can change the estimated impact. Taken the previous into consideration, we estimated the effects for all matching algorithms (nearest neighbor, stratified, radius and kernel matching), however based on Frölich (2005) we decided to analyze only the results of the kernel, as per the specification of Epanechnikov, it seeks to maximize the efficiency of the estimator (Scott, 2009).

Table 3 presents the results of org-inn in the firm's propensity to innovate and on the firm's innovation performance of products new to the firm, new to the national market and new to the international market. The results are shown for the whole agroindustry sample, SMEs and large firms.

Table 3. Effects of Organizational innovation

	Impact ratio	Stratification matching	Radius matching	Nearest neighbor matching	Kernel-based matching
Total agroindustry					
Propensity to innovate in products new to the firm	1,412	0.308*** (0.015)	0.314*** (0.016)	0.166*** (0.019)	0.166*** (0.015)
Propensity to innovate in products new to the national market	1,664	0.235*** (0.017)	0.241*** (0.015)	0.138*** (0.020)	0.139*** (0.014)
Propensity to innovate in products new to an international market	1,932	0.087*** (0.008)	0.090*** (0.009)	0.055*** (0.009)	0.054*** (0.007)
Innovation ROS of good and services new to the firm	1,691	8.244*** (1.636)	8.152*** (1.656)	5.732** (2.492)	6.161*** (1.830)
Innovation ROS of good and services new to the national market	3,359	5.395*** (1.161)	5.302*** (0.957)	4.818*** (0.995)	4.712*** (0.972)
Innovation ROS of good and services new to the international market	2,052	1.246*** (0.380)	1.280*** (0.439)	0.657 (0.506)	0.729 (0.507)
SMEs					
Propensity to innovate in products new to the firm	1,524	0.283*** (0.019)	0.288*** (0.017)	0.189*** (0.023)	0.176*** (0.016)
Propensity to innovate in products new to the national market	1,828	0.198*** (0.019)	0.203*** (0.016)	0.145*** (0.018)	0.133*** (0.016)
Propensity to innovate in products new to an international market	2,192	0.064*** (0.009)	0.066*** (0.009)	0.047*** (0.010)	0.045*** (0.008)

Innovation ROS of good and services new to the firm	1,790	7.665*** 1.568	7.639*** (1.751)	6.478* (3.389)	6.085*** (1.645)
Innovation ROS of good and services new to the national market	3,462	4.834*** (0.946)	4.775*** (0.994)	3.459** (1.354)	4.289*** (1.022)
Innovation ROS of good and services new to the international market	5,961	1.417*** (0.476)	1.431** (0.565)	1.044** (0.528)	1.290** (0.533)
Large Firms					
Propensity to innovate in products new to the firm	1,226	0.261*** (0.034)	0.240*** (0.033)	0.127*** (0.038)	0.136*** (0.026)
Propensity to innovate in products new to the national market	1,433	0.275*** (0.028)	0.261*** (0.036)	0.148*** 0.041	0.155*** (0.034)
Propensity to innovate in products new to an international market	1,747	0.130*** (0.020)	0.126*** (0.022)	0.076*** (0.024)	0.087*** (0.023)
Innovation ROS of good and services new to the firm	1,458	7.027 (4.371)	6.636 (4.380)	3.649 (6.702)	5.997 (4.013)
Innovation ROS of good and services new to the national market	3,121	6.636*** (2.396)	6.512*** (2.492)	6.122** (2.712)	5.988** (2.338)
Innovation ROS of good and services new to the international market	0,517	0.539 (0.384)	0.642 (0.438)	-1.203 (1.023)	-0.958 (0.798)

Source: EDIT IV. Note: *, **, *** indicate significance level of 90%, 95% and 99%, respectively.

The results (Kernel based ATT) indicate, that in general, firms that introduced org-inn, receive greater outcomes or payouts for their effort or abilities in their innovation performance; thus proving Hypothesis 4. For instance, in the whole sample (first 3 rows under Total agroindustry in table 3) firms that introduced org-inn have a propensity to innovate of 16.6 percentage points (pp) in products new to the firm, 13.9 pp in products new to the national market and 5.4 pp in products new to the international markets higher than their peers that did not.

It is important to note that is relatively easier to achieve innovations at incremental levels than in the radical ones. Accordingly, the differences must be evaluated considering the magnitude of the innovation

performance variables. In order to have a more accurate approach we propose to analyze the impacts using the ratio of innovation performance between treated and control groups (Colum named Impact ratio in table 3). In this way, a 16.6 pp difference means that the introduction of org-inn generates a 1.4 higher propensity to innovate in products new-to-the-firm, accordingly, a 5.4 pp difference means a 1.9 impact ratio for the innovation in products new to the international markets. This way, analyzing the impact ratios allows us to see that the effect of org-inn is higher in the propensity to introduce radical innovations and in the innovation ROS in products new to the national market, contrary to the prevalence of innovation performance in products new to the firm from the original measure.

The impact over the propensity to innovate is always higher in SMEs than in large firms; and the impact increases with the level of innovation. Regarding to Innovation ROS, this ratios are not directly comparable between SMEs and large firms, since increasing 1 pp in the innovation ROS is harder to achieve for large firms than it is for SMEs, due to the magnitudes of their respective turnover. Nonetheless, the significance of the estimations, allows us to conclude that, even though org-inn is an important factor for SMEs performance, larger firm's success in radical innovations seems to be driven by different factors.

5. Conclusions and final remarks

We have demonstrated that real (and we might add structural) change begins inside. On one hand, for all three scenarios (whole sample, SMEs and large firms) performing org-inn increases the firm's propensity to innovate in products, and on the other hand, it increases the firm´s innovation ROS for products new to the firm, new the national market and new to the international market. The results show that org-inn is not only important to improve the firm's internal capacities but also that strengthening such capacities leads to better sales and radical innovations. Our findings emphasize the need for public policies and funding to improve the firm's internal capabilities for innovation.

Furthermore, in line with hypothesis number 1 and 2, we have demonstrated that management intensity and professionalism play an important role on a firm´s propensity to achieve organizational innovations. Additionally for all firm sizes, the bigger the firm, the greater the likelihood to achieve organizational innovations. This result also supports the fact that larger agro industries are associated with larger resources to support innovation including org-inn.

One important deduction is that innovation should be seeing as a process not strictly related to R&D investment. Even though R&D plays an important role increasing the propensity to engage in org-inn, it needs to be accompanied by a higher ability to exploit and generate knowledge. Analogously the percentage of workers within the firm that perform innovation related activities have a positive effect on SMEs but not on

large firms as evidence of the above. This result should be taking into account in the design of public policies oriented to increase the firms´ innovation performance. In this manner, it is necessary for policy makers to foster the creation on SMEs of the right innovation structures including manager´s training, spaces and tools necessary for knowledge to be shared and exploited. Structures in this context also include new managerial methods, tools and processes that permit the combination of external knowledge and internal capabilities to transform opportunities into tangible products, these paper shows evidence that such structures, associated with org-inn, are related to the level of professionalism (formal and specific training) of the company's management.

We found that on SMEs standardizing processes is an important first step in increasing the propensity to achieve organizational innovations; this result provides important evidence about the need for small and medium size firms to certify its process, for such certificates are usually requires to map their productive activities and to create protocols to optimize them. In this way, the public innovation policy must move to relax the financial and technical constrains associated to the certification processes

The evidence found in this research suggests that org-inn is a key factor of the firm's performance and propensity to innovate at a radical level, and enhances the proposition that not only financial resources but also adequate internal capabilities are necessary for success in technical innovation. Furthermore, it is compulsory to analyze the determinants and the impacts associated with each type of organizational innovation.

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