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THE IMPACTS OF OPEN INNOVATION STRATEGIES ON INNOVATIVE PERFORMANCE: THE CASE OF COLOMBIAN FOOD AND BEVERAGE FIRMS

JEL classification: O31, L25

Abstract

The Open Innovation theory has received great attention in the international literature, but their study is non-existent in Colombia´s academic spectrum. In this sense, the aim of this paper is to fulfil such academic gap by the identification of the open innovation strategies effects on firm´s innovative performance, measured by the share of innovative sales. The partners and objectives of cooperation were the main open innovation strategy used for the estimations. The analysis was made taking into account three different novelty levels of innovations. We conducted the analysis with a sample of 1404 Colombian agrifood industries, finding that in early stages of the innovation process the main strategy of open innovation to impact firm´s performance is to cooperate with suppliers. Meanwhile, at a radical level, cooperation with the objective of R&D is the key OI strategy to improve the innovative performance.

Key words: open innovation, cooperation agreements, innovative performance

1. INTRODUCTION

The Food and Beverage Industry (hereafter F&BI) is one of the most representative economics sector of Colombia. According to the Colombian National Institute of Statistics (DANE for its acronym in spanish) in 2012, 18.7% of the manufacturer belonged to this sector. In terms of impact, 23.2% of the industrial labor force was employed by the F&BI, the sector also generated 27.3% of gross production and created 29.3% of the aggregate value.

Worldwide, this sector is characterized by a low Research and Development (R&D) intensity, hence most innovations are based on external acquisition of technology and rarely based on science (Costa, 2013; Garcia Martínez & Briz, 2000; Samadi, 2014). As a result, the F&BI is usually classified as a mature industry with low technology (Costa & Jongen, 2008; Galizzi & Venturini, 1996). In addition, innovations performed by firms within this sector are mostly incremental and in very few cases radical (Costa & Jongen, 2006; Garcia Martinez & Briz, 2000; Noordman & Meijer, 2013). In this regard, Garcia Martinez (2013) shows that innovation in this sector are limited and mostly related to greater variety and new flavors.

Beyond the incremental characteristics of innovation in the F&BI it is interesting to note that, in spite of its low R&D intensity this sector generates a significant number of innovation (Galizzi y Venturini, 1996; Grunert et al., 1997). This behavior has been explained because of a widely adopted strategy to use innovation as a mechanism to confront the sector´s high competence (Capitanio et al., 2009; Galizzi y Venturini, 1996), to maintain competitive advantage over increasingly powerful retail chains with own-labeled products (Bayona-Sáez et al., 2013; Hughes, 1996), satisfy the main needs of demand (Costa, 2013; Samadi, 2014), and in more extreme cases, as a mechanism of long term market survival (Tepic et al., 2013).

In spite of the above mencioned characteristics, Open Innovation (OI) has been a widely adopted strategy for firms within the sector (Noordman & Meijer, 2013). To illustrate, Archibugi et al. (1991) found that agrifood firms rely, to a higher extend, on external sources of innovation when compare to other industries. Chesbrough (2003) introduced the term OI as an alternative to the traditional conception of innovation. The author defined OI as a paradigm in which firms incorporate both, internal and external ideas, and internal and external paths to market, as they advanced in their technology.

OI has received in recent years great attention in the international economic literature, however, its study has been inexistent in the colombian academic spectrum. In this sense, it is the aim of this article to fulfil such gap by investigating the effect of OI on the performance of firms within the F&BI. Innovation performance will be measured as the share of innovative sales. Three dependents variables were analyzed, each related with a specific level of novelty (to the firm, to the national market, to the international market). Additionally,

several models were estimated to reflect the propensity of a firm to innovate in each of the mentioned novelty levels. This analysis is important because we conceived innovation as a process in which the first step concerns to the decision of innovate.

The OI strategies were analyzed using two sets of variables related to cooperation in innovation. This group of variables were measured separately in order to differentiate the effect on the firms probability to innovate and on the firms sales performance.

The paper is organized as follows. In the second section we explore the literature examining the relations between OI strategies and innovative performance, describing the hypothesis that will drive our investigation. The third section presents the effect of OI strategies on the innovative performance. The subsequent section reports the results and the last section presents the discussion and conclusions.

2. COOPERATION IN THE FOOD AND BEVERAGE INDUSTRY AND RESEARCH HYPOTHESIS

In this section we aim to describe the main features of cooperation behavior and innovative performance of firms within the F&BI. In order to meet this target and to fully understand our research results, we used the Development and Technological Innovation Survey (EDIT for its acronym in spanish), IV edition, which gathers data from the period 2007-2008i. The survey is carried out by the DANE following the guidelines of the Oslo manual from the Organisation for Economic Co-operation and Development (OECD), and of the Bogotá Manual, designed by the Iberoamerican Research Network on Science and Technology (RICYT for its acronym in spanish).

Before the descriptive statistics, we present two sub-sections in which the two sets of OI strategies are explained with more detail. Each one of them ends with the hypothesis that will drive the development of our research.

2.1. Cooperation partners

The acquisition of external knowledge, cooperation agreements and co-creation with customers and suppliers have been some of the most utilized OI strategies in the F&BI. Empirical researches has demonstrated that the technological development of high-tech industries like biotechnology, nanotechnology, pharmaceutical, electronics and the chemical industry have been fundamental for the technological progress of the companies within the F&BI (Acosta et al., 2013; Bröring, 2013; Galizzi & Venturini, 1996; Garcia Martinez, & Briz, 2000).

Even though it is frequent for scholars to include formal collaboration connections in innovation as a dimension for OI that affects the performance in agrifood firms, the way in which such variables are usually measured differs from our approach. While most authors (Bayona-Sáez, 2013; Laursen & Salter, 2006; Lazzarotti & Manzini, 2009; Pellegrini et al., 2014) utilize a variable for collaboration depth (measured as the sum of cooperation partners), we prefer to include dummies for each cooperation partnerii. Having independent dummies allow us to separate the effect of each type of partner on innovation performance.

In specific F&BI studies, Batterink et al. (2006) found in a study for the Dutch agrifood industry that clients, suppliers, competitors, universities and research centers are only important as sources of information and not as cooperation partners for innovation. In contrast, Bigliardi & Dormio (2009) did find a positive and significant effect of cooperation with certain partners on the firm´s innovation outcomesiii.

Bascavusoglu-Moreau & Tether (2012) focus their analysis in determine the effects of customer cooperation on innovation performance, measured by both, the introduction of new products, and the sales of innovative products. The author found that cooperation with customers positievely affects innovation propensity, but has no effects on the sales of new products.

Based on related literature on both, agrifood and non agrifood related manufactures, we developed the following hypothesis for the colombian F&BI:

H1: Cooperation in innovation with suppliers or customers has a positive effect on the firm´s innovative performance and on the propensity to innovate at an incremental level.

H2: Cooperation with universities or research centers has a positive effect on the propensity to innovate at a radical level.

2.2. Cooperation objectives

Besides cooperation partners it is also of our interest to study the objectives of cooperation. Scholars on innovation have considered the number and type of phases within the innovation process for which firms are open to external sources of technology and know-how (Lazzarotti & Manzini, 2009). In general terms, these phases are: idea generation, prototyping, production and commercialization. In our case, we will study the objectives of innovation and no the different phases of innovation process, therefore, a second set of models will include dummy variables for each of the 8 different cooperation objectives presented in the EDIT IV.

These estimations differ considerably from previous investigations on OI because we could not find related works in which the cooperation objectives were included as a dimension for OI and on the analysis of its effect on the firm´s innovation performance. In this sense, we developed two additional hypothesis related with cooperation objectives for the colombian agrifood companies.

H3: Firms that cooperate for the R&D objective have a higher innovative performance for the most radical level of novelty

H4: Cooperation with the objective of acquisition of machinery and equipment has a positive effect on the firm´s propensity to obtain purely incremental innovations

2.3. Cooperation for innovation in Colombia

Now that the OI dimensions and hypothesis consider in this study were mentioned, we will proceed to describe the variables of our interest. As a starting point, we will analyzed the information concerning cooperation for innovation in general. According to the data in the EDIT IV survey, 19.9% of firms in the F&BI cooperated in innovation (table 1). This result illustrate the lack of formal cooperation links in innovation of companies within the food sector in Colombiaiv.

Table 1

Cooperation in the Colombian F&BI

Type of partner	Cooperate	Cooperation objective							
		R&D	Acquisition of machinery and equipment	Technologies of information and telecommunications	Innovations marketing	Technology transfer	Technical assistance & consulting	Engineering & industrial design	Education and specialized training
Suppliers	13.0%	6.1%	7.0%	3.3%	5.7%	3.3%	7.5%	2.8%	5.4%
Customers	8.3%	4.8%	3.9%	2.4%	5.1%	2.3%	4.9%	2.1%	3.5%
Competitors	2.1%	1.4%	1.0%	0.9%	1.4%	0.9%	1.3%	0.6%	1.0%
Consultants	9.2%	4.9%	4.8%	3.3%	3.6%	2.6%	7.3%	2.8%	5.0%
Universities	5.8%	4.2%	3.0%	1.7%	2.9%	2.2%	4.1%	1.9%	3.4%
Research Centers	3.1%	2.8%	1.7%	1.1%	1.6%	1.5%	2.5%	1.1%	2.3%
Other partners	2.9%	2.2%	1.4%	1.5%	1.6%	1.1%	2.4%	1.3%	2.0%
Any partner	19.9%	8.3%	8.0%	4.5%	7.4%	3.9%	11.7 %	3.8%	7.4%

Source: authors with EDIT IV dataset.

When analyzing the type of partner, 13% of colombian agrifood firms have cooperated in innovation with suppliers, making them, the main partner of cooperation. In contrast, only 2.1% of cooperation agreements are made with competitors. Even though the models for partners and objectives of cooperation are estimated separately, a cross analysis will turn helpful for the future description of the results. In this sense, it is of interesting to note that most firms that cooperate with suppliers do it for the objectives of technical assistance and consulting, and acquisition of machinery and equipment.

Consultants as key partners of cooperation in innovation (9.2% of firms cooperated with them), are important for the objectives related with technical assistant and consulting, education and specialized training, and R&D. For those cooperation objectives, firms within the F&BI are also likely to engaged formal connections with universities.

Meanwhile, costumers are a key partner for firms pursing marketing of innovations and R&D projects. Competitors, research centers, and other partners are not import allies for cooperation in innovation.

In the case of objectives, most firms cooperated in innovation for technical assistance and consulting, while engineering and industrial design was the least pursued objective of cooperation (3.8%). In order of importance, R&D is the second most pursued objective of cooperation, having 8.3% of agrifood firms cooperating for it. It can be pointed out that the main partners of cooperation, regarding this R&D objective, are suppliers and customers.

If cooperation in innovation is taken as the variable to measure OI, contrary to investigations in foreign countries, our data shows that in the colombian case OI is not a widely adopted strategy. Nevertheless, it remains important to investigate which partners and objectives for cooperation are the ones whit a greater impact on the firm´s innovative performance in the F&BI.

3. THE EFFECT OF OI STRATEGIES ON THE INNOVATIVE PERFORMANCE OF FIRMS

The aim of this section is to analyze the effect of OI strategies on the innovation performance of firms within the F&BI in Colombia. With the information available in the EDIT IV survey and following Laursen & Salter (2006) and Bayona-Sáez et al., (2013), we use three proxies that represent different types of innovative performance by firms. The first variable measures the portion of the company´s revenue relating to products that are new to the firm. The second, measures the share of sales associated to the introduction of new products for the national market. Finally, the third variable denotes the fraction of the firm´s turnover relating to product new to the international market.

In order to characterize the different levels of innovation novelty in the dependent variables, we consider the proportion of sales from new products to the

international market as radical innovation, while the remaining two variables correspond to incremental innovations.

As we briefly described in the introduction, it is also of our interest to estimate the propensity of firms within the F&BI to innovate in each of the mentioned novelty levels. For this reason, we built the next three dummy variables: (1) new product to the firm (NPF); (2) new product to the national market (NPNM); and (3) new product to the international market (NPIM). This additional dependent variables take the value of 1 when the firm has innovated in each particular level of novelty and 0 in the opposite case.

Thereby, there have been estimated a total of 12 models, 6 for each set of OI variables (partners and objectives). Within each group of 6 models, 2 correspond to the novelty of the innovation, being one for the probability to innovate at this level (Logit), and the other one for the innovative performance (Tobit).

3.1. Explanatory variables

The first set of OI strategies is related with the cooperation partners. The measures that include this group of variables correspond to the first 6 models estimated (model 1 – model 6). We included 7 explanatory variables for this estimations, representing each one of them a specific cooperation partner. All these variables are dummies that take the value of 1 if the firm has cooperated in innovation with the partner and 0 in the contrary case. The cooperation partners included in the analysis, with their respective variable name used in our research are: (1) suppliers “COOP_SUP”, (2) customers “COOP_CUS”, (3) competitors “COOP_COM, (4) consultants “COOP_CON”, (5) universities “COOP_UNI”, (6) research centers “COOP_RC”, (7) other partners “COOP_OTH.

When we moved our attention to models 7 to 12, the explanatory variables of interested are the dummies of cooperation objectives. The 8 objectives of cooperation in innovation included in the EDIT IV, with their respective variable name are: (1) R&D “COOP_R&D”, (2) acquisition of machinery and equipment “COOP_AME”, (3) information and communications technology “COOP_ICT”, (4) innovations marketing “COOP_IMA”, (5) technology transfer “COOP_TTR”, (6) technical assistance & consulting “COOP_TAS”, (7) engineering & industrial design “COOP_EID”, and (8) education and specialized training “COOP_EST”. The independent variables for the second group of models are also dichotomous taking the value of 1 if the company cooperated in innovation for a specific objective and 0 otherwise.

3.2. Control variables

We have included in the estimations a measure of R&D intensity (RD_INT), calculated as the ratio of firm R&D expenditure and the number of

employees. Most articles who address similar investigations, use as measures of R&D intensity the firm R&D expenditure divided by firm sales (Laursen & Salter, 2006; Lichtenthaler, 2009; Bayona-Sáez, 2013; Hung & Chou, 2013). However, we could not use that measure because the EDIT IV survey do not include information about firm sales. Nevertheless, we believe that our alternative measure is quite a good proxy of firm R&D intensity.

Firm size may affect the behavior of firms regarding OI strategies. Usually, larger firms have more available resources to innovate. In this sense, we include firm size on the estimations. The variable (expressed in logarithms) is measured by the number of employees (LOGEMP).

Finally, we consider important to control for firm´s perception of obstacles to innovationv. Similar to Batterink et al., (2006) and Bigliardi & Dormio (2009) we group the related obstacles into three categories: (1) obstacles associated with information and internal capabilities (e.g. lack of own resources, lack of qualified staff); (2) obstacles associated whit risk (e.g. uncertainty about demand for innovative products, low profitability of innovative products); and (3) obstacles associated with the environment (e.g. ease of imitation by others, difficulties in accessing to external financing). All these variables were built as the average perception of the obstacles conforming each category. In this sense, the variable takes values between 0 and 1.

3.3. Empirical approach

It is clear that the main objective of this paper is to identify the impacts of the OI strategies on the innovative performance of firms within the colombian F&BI. However, we strongly believe that innovation is a process in which firms, normally, cannot obtained successful results by quickly passing thru the stages shaping the innovation process. This implies that before firms can even improve their innovative performance it is imperative that they have introduced new products to any of the spaces representing the novelty levels of innovation. In this sense, as a secondary aim of the research we are also interested in identify the effects of OI strategies on firm´s propensity to innovate for the international market, to the national market, and to the firm.

In consequence, we have to sets of independent variables for each level of novelty, one related with the innovative performance, and the other to the probability to innovate. We used two different methods for the multivariate analyses. First, a Tobit analysis was conducted for the three dependent variables representing the share of innovative sales in the different novelty levels stablished before. Whereas Laursen & Salter (2006) and Bayona-Sáez et al., (2013) also rely on Tobit analyses for contrasting their hypothesis, other scholars (Batterink et al., 2006; Bigliardi & Dormio, 2009; Lichtenthaler, 2009; Hung & Chou, 2013) rely on linear regression analysis for the same purposes. Nonetheless, we prefer to estimate the models using Tobit analyses because the dependent variables are the

share of innovative sales, and by definition, these variables are doubly censored in ranges between 0 and 100.

For the dummy dependents variables that show if the firm within the F&BI obtains product innovations in the three levels of novelty specified, binary logistic regression were conducted.

4. RESULTS

More than 25% of companies within the F&BI innovated in products for the firm. Meanwhile, the proportion of firms that innovated in products for the national and for the international markets were 11.8% and 2.9% respectively. These results show that most companies in the sector obtained product innovations at a purely incremental novelty level. Regarding to the innovative performance variables, the average share of sales related to new-to-the-firm products is 9.1%. The same indicator but for national and international market is 3.6% and 0.9% respectivelyvi.

The results of the Logit and Tobit analysis that include cooperation partners as the OI strategies are found in table 2. We found evidence on favor of H1 stating that in colombian F&BI, cooperate with suppliers or customers affects positively firms innovative performance and firm´s propensity to innovate, both at an incremental level. However, such hypothesis could not be completely accepted because: (1) the variable cooperation with suppliers (COOP_SUP) is not significant for model 3, therefore, to cooperate with the named partner do not affect firm´s propensity to innovate for the national market; (2) to cooperate with costumers is not important to the innovative performance on the purely incremental novelty level (model 2).

There is no support for H2 asserting that cooperation with universities or research centers affects positively company´s propensity to innovate at a radical level. For model 5, these cooperation variables were not significant. In fact, cooperation with universities was not significant for neither of the 6 model where it was include. Meanwhile, cooperation with research centers reduce firm's probability to obtain products new to the company (model 1). This result could be an outcome of a bad choice of cooperation partner. As we have mentioned before, innovation for the firm is purely incremental, such that the actions needed to meet this target should be based on technological surveillance rather than on science. On essence, innovation for the firm is quick and inexpensive, characteristics that normally research centers can´t offer.

Perhaps the most remarkable result from the first 6 models is that consultants are identified as key partners for both, the innovative process and for the success of innovations on each one of the three levels of novelty. The closer the innovation is to the company, the higher will be the impact of cooperate with consultants. Thereby, as the radicalism of the innovation is augmented, the will

to cooperate with these partners marginally decreases. However, when companies from the F&BI have successfully innovated, consultant's cooperation increases significantly the probability of attaining a higher participation from the innovation sales over the total sales as innovations are more radical.

Other results show that competitors are an important partner for companies to innovate for the firm (model 1). Bigliardi & Dormio (2009) obtained a different result in their investigation, finding that competitors are conceived as important partners for radical rather than for incremental innovations.

For the control variables, we observe that size (LOGEMP) and R&D intensity (RD_INT) are significant on all 6 models. The bigger the firm the higher the innovative performance. In this sense, It is worth noting that on the first levels of innovation (where innovation activities are characterized to be incremental), R&D intensity and size play a more important role than in more advance levels of innovation (characterized for being radical). This means that after a certain level of innovation, size and R&D intensity are not sufficient on their own and additional inputs are required. Furthermore, the results indicate that size and R&D intensity have a marginally decreasing impact on both the F&B firm´s propensity to innovate and their innovative performance.

Table 2

Results of the multivariate analyses (cooperation partners)

Multivariate analyses	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Dependent variable:	New product for the firm	ROS from new products for the firm	New product for the national market	ROS from new products for the national market	New product for the international market	ROS from new products for the international market
Regression type:	Logit	Tobit	Logit	Tobit	Logit	Tobit
COOP_SUP	0.1163**	2.7781***	0.0391	1.9534*	-0.0044	-1.3000
	[0.0475]	[1.0167]	[0.0249]	[1.0631]	[0.0050]	[1.4484]
COOP_CUS	0.1271**	1.7329	0.0767**	2.9299**	0.0059	1.8419
	[0.0595]	[1.1427]	[0.0352]	[1.1962]	[0.0090]	[1.5029]
COOP_COM	0.2224*	3.0772	0.0163	1.3699	0.0219	2.4732
	[0.1211]	[1.9618]	[0.0411]	[1.9096]	[0.0214]	[1.9763]
COOP_CON	0.2305***	3.6030***	0.0721**	3.1644***	0.0534**	5.1299***
	[0.0625]	[1.1598]	[0.0329]	[1.1719]	[0.0258]	[1.5679]
COOP_UNI	-0.0419	1.2368	0.0003	1.2403	0.0043	1.9147
	[0.0512]	[1.3803]	[0.0255]	[1.3770]	[0.0097]	[1.6946]
COOP_RC	-0.1068**	-2.0654	-0.0056	1.0233	-0.0017	-0.3476

	[0.0457]	[1.7003]	[0.0284]	[1.6635]	[0.0065]	[1.7251]
COOP_OTH	-0.0801	-2.8504*	0.0034	-0.9985	0.0052	0.8965
	[0.0556]	[1.6588]	[0.0324]	[1.6244]	[0.0096]	[1.7238]
LOGEMP	0.0945***	2.0419***	0.0386***	1.8837***	0.0043***	0.6282*
	[0.0089]	[0.2472]	[0.0046]	[0.2710]	[0.0016]	[0.3542]
RD_INT	0.0001***	0.0014***	0.0000***	0.0014***	0.0000***	0.0011**
	[0.0000]	[0.0005]	[0.0000]	[0.0005]	[0.0000]	[0.0005]
OBS1	0.0066	1.7358	-0.0530*	-1.7570	-0.0171*	-3.7949*
	[0.0523]	[1.3159]	[0.0281]	[1.5299]	[0.0095]	[2.1762]
OBS2	0.0993**	2.0404*	0.0482**	1.3300	0.0102	2.2997
	[0.0415]	[1.0544]	[0.0220]	[1.2232]	[0.0074]	[1.6670]
OBS3	0.0447	0.9835	0.0535*	4.2033**	0.0074	1.4938
	[0.0555]	[1.3931]	[0.0298]	[1.6445]	[0.0097]	[2.2111]
ll	-630.3526	-1759.68	-386.2136	-838.8576	-128.7273	-210.2526
r2_p	0.0945***	2.0419***	0.0386***	1.8837***	0.0043***	0.6282*

Note: *p-value <0.1; ** p-value<0.05; *** p-value<0.01; standard errors in brackets

In table 3, the estimates of the Logit and Tobit models related with the second set of OI strategies (cooperation objectives) are presented. As in table 3, there are two models for each novelty level of innovation. With H3 we argued that firms that cooperate for the R&D objective have a higher innovative performance at a radical novelty level. We found strong support for this hypothesis since the variable COOP_R&D is significant and has the expect sign for model 12. Moreover, cooperation for the R&D objective also positively affects the share of sales related to new product to the national market.

With respect to our hypothesis stating that cooperation with the objective of acquisition of machinery and equipment has a positive effect on firm´s propensity to obtain purely incremental innovations (H4), we do find evidence on favor. The variable COOP_AME is significant and has the expected sign in model 7. Furthermore, this variable also affects, in a positive way, firm´s innovative performance at the first level of novelty (model 8).

Table 3

Results of the multivariate analyses (cooperation objectives)

Multivariate analyses	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Dependent variable:	New product for the firm	ROS from new products for the firm	New product for the national market	ROS from new products for the national market	New product for the international market	ROS from new products for the international market
Regression type:	Logit	Tobit	Logit	Tobit	Logit	Tobit
COOP_R&D	0.0419	-0.3020	0.0443	2.4258*	0.0347	4.1153**
	[0.0556]	[1.2243]	[0.0300]	[1.2394]	[0.0223]	[1.6002]
COOP_AME	0.2671***	3.9963***	0.0061	0.7325	-0.0027	-0.1023
	[0.0686]	[1.2292]	[0.0234]	[1.2478]	[0.0059]	[1.4562]
COOP_ICT	-0.0491	-0.9714	0.0038	-0.3012	0.0103	1.6700
	[0.0525]	[1.4156]	[0.0268]	[1.4257]	[0.0133]	[1.7416]
COOP_IMA	-0.0355	-0.8071	0.0800**	1.3554	-0.0078*	-2.4069
	[0.0449]	[1.2057]	[0.0364]	[1.2370]	[0.0044]	[1.5949]
COOP_TTR	-0.0316	2.6408	-0.0107	2.0876	-0.0039	0.5200
	[0.0608]	[1.6174]	[0.0237]	[1.5425]	[0.0059]	[1.6872]
COOP_TAS	0.1405***	1.2136	0.0331	2.0285*	0.018	3.9523***
	[0.0541]	[1.0816]	[0.0261]	[1.1773]	[0.0143]	[1.4490]
COOP_EID	-0.0075	0.5295	-0.0067	-0.5322	0.0052	0.4769
	[0.0678]	[1.6139]	[0.0254]	[1.5225]	[0.0111]	[1.7941]
Coop_EST	0.1105	2.8476**	0.0793*	3.2750**	0.0007	-0.6973
	[0.0696]	[1.3524]	[0.0409]	[1.4019]	[0.0078]	[1.5880]
LOGEMP	0.0936***	2.0560***	0.0385***	1.9181***	0.0051***	0.5894*
	[0.0088]	[0.2442]	[0.0045]	[0.2665]	[0.0016]	[0.3434]
RD_INT	0.0001**	0.0013**	0.0000***	0.0012**	0.0000***	0.0009*
	[0.0000]	[0.0005]	[0.0000]	[0.0005]	[0.0000]	[0.0005]
OBS1	0.0100	1.7898	-0.0422	-1.3195	-0.0145	-3.1343
	[0.0521]	[1.3120]	[0.0281]	[1.5449]	[0.0103]	[2.1491]
OBS2	0.0987**	1.9359*	0.0374*	0.6875	0.0077	2.1091
	[0.0416]	[1.0550]	[0.0222]	[1.2401]	[0.0079]	[1.6447]
OBS3	0.0587	1.5861	0.0594**	4.6617***	0.0078	1.3805
	[0.0549]	[1.3866]	[0.0293]	[1.6541]	[0.0106]	[2.2036]
ll	-633.0636	-1763.4245	-379.6286	-833.6615	-133.6580	-211.6220
r2_p	0.2026	0.0657	0.253	0.1225	0.2646	0.1618

Note: *p-value <0.1; ** p-value<0.05; *** p-value<0.01; standard errors in brackets

Technical assistance and consulting is a cooperation objective that has a positive and significant influence on company´s probability to obtain new-to-the-firm products (model 7). Moreover, such cooperation objective positively affects innovative performance related to innovation for both, national and international markets. It is interesting to note that the marginal effect of this variable on the innovative performance grows as more radical innovation is.

The cooperation for education and specialized training impacts in a positive manner the innovative performance of firms within the colombian F&BI at the incremental levels of novelty (models 8 and 10). This objective also increases company´s propensity to obtain new products for the national market (model 9).

With regard to the variables representing the remaining objectives of cooperation (ICT, technology transfer, and engineering & industrial design), they were not significant in the six models presented. Perhaps, in the colombian case the firms within the F&BI doesn´t support their innovative activity in these strategies making the mentioned cooperation objectives unimportant for the firms innovative performance.

The control variables maintain the behavior, in terms of significance and marginally decreasing impact, presented on the previous models in which the independent variables of interested were the cooperation partners. This result demonstrates robustness in the selection of the control variables.

5. DISCUSSION AND CONCLUSIONS

The aim of this paper was to analyze the relationship and the effects of cooperation in innovation over the firm's capacity to innovate. Accordingly, we estimate two sets of regressions, analyzing on one hand the firm’s propensity to innovate and on the other hand, on the firm’s ROS. The cooperation variables were measured as the type of partner and the objective of the cooperation.

Separately, objectives and partners of cooperation in innovation offer some insights about OI strategies in the F&BI, but is possible to observe a complete OI strategy if we analyze the partner and objective together. Such analysis shows that the strategies are focus on the acquisition of machinery and equipment, mainly with suppliers, to obtain incremental innovations. Moreover, cooperation for the objectives of R&D and technical assistance and consulting are important OI strategies for the innovative performance at a radical level. Conjointly analysis reveals that for these objectives, firms within the F&BI cooperate, principally, with consultants and suppliers. As with F&BI firms around the world, co-creation and market-pull innovations are realities of agrifood firms in Colombia. The above is proved by the importance of customers as cooperation in innovation partners at the incremental levels of novelty.

The non-importance of institutional[vii] cooperation as an OI strategy affecting company´s innovative performance might be explained in the low specificity or expertise of those institutions on the specific issue of food and beverage. Perhaps universities and research centers are not identified as key partners for the innovation process because they doesn´t offer solutions that entrepreneurs need to resolve in this specific discipline. It is important to remember that the dependent variables are directly related with technological innovation, issue in which it is more complicated to cooperate with such institutions.

The present investigation found that in the colombian F&BI the OI strategy represented by both, partners and objectives of cooperation has a nuanced impact on innovative performance and on firm´s propensity to innovate at the stablished level of novelty. Dependent on the novelty level, there are partners and objectives that have bigger impacts over the variables of interested. In general terms, when the innovation is purely incremental (innovation for the firm), the main strategy of F&BI firms are to cooperate with suppliers for the acquisition of machinery and equipment. In the case of innovations for the national market, customers and consultants are the partners that highly influence firm´s willingness to obtain new-to-the-national market products and their innovative performance. Finally, in the field of radical innovations, the distinct objective of cooperation pursued by companies is R&D, for which the main cooperation partner are consultants.

These results encourage the reconstruction of the current innovation policy. The public sector is one of the key actors to encourage the development of innovation activities. In this regard, it should be understood cooperation in innovation as one of the main strategies in minimizing the risk associated with these activities. Thus, public policy can be directed toward identifying the optimal strategy for cooperation with the level of innovation of the company and also guide the establishment of cooperation agreements based on complementarity between innovators. The implication derived from de empirical analysis shows that at the first levels of innovation the cooperation with suppliers and customers are the winning strategy, but if the objective of the innovation policy is to reinforce the radical innovation the cooperation agreements must be oriented to the R&D strategies.

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[i] EDIT has so far 6 editions, being the corresponding to the period 2011-2012 the most recent and 1996´ the oldest.

[ii] The same approach was used by Belderbos et al. (2004) and Aschhoff & Schimidt (2008) for manufacturing firms.

[iii]The authors found that cooperation with universities and research centers has a positive effect on the impact of product innovations in total sales. In the same way, cooperate with competitors increases the probability of the firm to obtain radical innovations in process.

[iv] Bayona- Sáez et al., (2013) found that that 40.2% of the agrifood companies in Spain cooperate in innovation.

[v] EDIT IV survey include the degree of importance (high, medium, null) for each obstacle. However, we recode the variable to take into account only the influence or not of each hamper.

[vi] It is interesting to note that when the analysis involve sub-samples in which we only take into account the firms that innovate in each novelty level, the share of innovative sales is bigger. For example, if we analyze companies that obtained new products to the international market, the average share of sales of those products is 30.3%.

[vii] Institutional cooperation refers to the cooperation agreements made with universities and research centers (Belderbos, 2004)