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COOPERATION AND NON-TECHNOLOGICAL INNOVATIONS

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Abstract

Unlike technological innovations, non-technological ones are relatively scarcely reported in the literature. Our study analyses the influence of cooperation with different external agents: (1) suppliers, (2) customers, (3) competitors, (4) experts and consultants, and (5) universities and public research centres on the development of these types of innovation, a distinction being made between organizational and marketing innovations. The results make it clear that such cooperation is significantly favourable to the development of both, but our analysis leads us to conclude that cooperation with suppliers is the most influential of the five.

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ABSTRACT

Unlike technological innovations, non-technological ones are relatively scarcely reported in the literature. Our study analyses the influence of cooperation with different external agents: (1) suppliers, (2) customers, (3) competitors, (4) experts and consultants, and (5) universities and public research centres on the development of these types of innovation, a distinction being made between organizational and marketing innovations. The results make it clear that such cooperation is significantly favourable to the development of both, but our analysis leads us to conclude that cooperation with suppliers is the most influential of the five.

Keywords: cooperation, non-technological innovation, organizational innovation, marketing innovation.

1. Introduction

Although research into innovation has traditionally been concentrated on advances in technology, non-technological advances have recently started to arouse growing interest. This change is due, among other things, to the impact these innovations have on firms' competitiveness, and by studying this, it is possible to identify and understand the factors governing success in technological innovations (Armbruster *et al.*, 2006; Camisón and Villar-López, 2011).

On the other hand, it is currently recognized that innovation increasingly requires the participation of a range of agents (Ritter and Gemünden, 2003; Wagner and Hoegl, 2006; Laursen, 2011). In this regard, cooperation agreements are a possible alternative, as they favour the acquisition of knowledge, which is conducive to the development of innovation activities (Mowery *et al.*, 1998; Caloghirou *et al.*, 2003). Cooperation with other firms, institutions or other agents offers the possibility of accessing complementary resources that can contribute to a faster development of innovation activity, gain access to new markets, exploit economies of scale and share costs (Ahuja, 2000; Cassiman and Veugelers, 2002; Hagedoorn, 2002; López, 2008; De Faria *et al.*, 2010). Owing to its advantages, many studies have analysed the relationship between cooperation and technological innovations (Frenz and Ietto-Gillies, 2009; Tödtling *et al.*, 2009; De Faria *et al.*, 2010; Tomlinson, 2010; Laursen, 2011). Nevertheless, it is necessary to study in greater depth the effects that such relationships may have on the development of innovations of other types, and it is interesting to ascertain which type of agent produces which effect.

In this context, the aim of the present study is to analyse the effects of cooperation with different partners in the development of non-technological innovations, with a view to thus improving our knowledge of this topic and obtaining empirical knowledge to help firms to make decisions on innovation processes. For this purpose, we propose an innovative analysis by presenting empirical evidence from Spanish firms on the effects of cooperating with (1) suppliers, (2) customers, (3) competitors, (4) experts and consultants, and (5) universities and public research centres in the development of different types of non-technological innovations, with a distinction between organizational and marketing innovations.

In order to do this, we have given the paper the following structure. Section 2 offers a review of the literature on non-technological innovation, again distinguishing between organizational and marketing innovations, which we relate to cooperation with different agents. Section 3 presents a description of the sample, the variables used for the study and the method of analysis for testing the hypotheses. Section 4 shows the results and their analysis. Finally, Section 5 presents the main conclusions, together with recommendations, limitations and suggestions for further research.

2. Review of the Literature

The importance of firms sharing knowledge and resources to develop innovations collectively has been recognized in countless studies. Such innovations are not attained only through isolated learning, but increasingly through social processes of knowledge exchange (Lundval, 1992; Edquist, 1997; Edquist and Hommen, 1999; Holbroock and Wolfe, 2000; Landry and Amara, 2001). These relationships are critical not only for access to knowledge to facilitate the diffusion of technological innovations within the firm but also because they make it possible to learn about work practices adopted by other organizations and contribute new perspectives to the firm that allow it to identify opportunities to innovate (Biemans, 1991; Erickson and Jacoby, 2003).

It is therefore necessary for the innovation activity to have sources of information and knowledge available outside the organization. Firms that do not complement their internal base of resources and skills with external ones have a lesser capacity to innovate (Gemünden *et al.*, 1992; Ritter and Gemünden, 2003). For this reason, many scientific and technological advances are the result of the contribution of many actors working together (Bougrain and Haudeville, 2002), so now the focus of innovation is no longer the individual or the firm in isolation but, increasingly, the network of contacts of which it forms part (Powell *et al.*, 1996). In this situation, cooperation is a tool that firms can use to carry out their innovation activity together with external partners or agents.

Many authors have researched the factors determining cooperation in innovation (Kleinknecht and Reijnen, 1992; Fritsch and Lucas, 2001; Tether, 2002; Belderbos *et al.*, 2004a), showing that the motives behind firms starting these relationships are different for each type of interlocutor. This means that they have to choose who they cooperate with very carefully (Mowery *et al.*, 1998; Fritsch and Lukas, 2001; Cassiman and Veugelers, 2002; Miotti and Sachwald, 2003; Belderbos *et al.*, 2004a, b), and interest has flourished around this point (Hakanson, 1993; Mowery *et al.*, 1998; Duysters *et al.*, 1999; Miotti and Sachwald, 2003). Some of the most common criteria for identifying a partner are the existence of complementariness between the parties regarding resources and skills (Gyenes, 1991; Hill and Hellriegel, 1994; Mowery *et al.*, 1998; Luo, 1999), trust, commitment and experience (Parkhe, 1993; Gulati, 1995, Fernández Sánchez, 1996; Wagner and Hoegl, 2006), strategic compatibility -convergence of strategic aims and divergence of competitive aims- (Fernández Sánchez, 1996; Emden *et al.*, 2006) and organizational compatibility -management styles, culture, etc.- (Fernández Sánchez, 1996; Emden *et al.*, 2006), among others.

On the other hand, it is widely recognized that cooperation favours the development of technological innovations (Laursen, 2011). This entails the generation and application of new ideas to products, processes or services, offering firms opportunities to enter new markets and expand into new areas, thus obtaining competitive advantages and improving performance (Nguyen and Mothe, 2008; Evangelista and Vezzani, 2010).

Against this backdrop, although the literature on non-technological innovations is still somewhat lacking, they are beginning to play a more and more important role as they affect firms' competitiveness (Armbruster *et al.*, 2008). For this reason, recent studies have encouraged research into the development of models and theories concerning non-technological innovations to extend and complete existing ones, which mainly derive from research into technological innovation (Damanpour and Aravind, 2012).

Taking into account the concepts in the third edition (2005) of the Oslo Manual, non-technological innovations may be defined as those involving changes in the market behaviour (marketing innovations) or new styles of organization and management in firms (organizational innovations). Marketing innovations consist in implementing new methods of commercialization, significant changes in the design of the product or its packaging without changes to its functional characteristics, new sales channels, new promotion techniques and new pricing strategies (Deshpandé *et al.*, 1993; Hurley and Hult, 1998; OECD, 2005). With these changes, firms hope to make their products or services more attractive and/or enter new markets in order to increase sales (Camisón and Villar-López, 2011).

Firms concentrating their attention on marketing initiatives are prone to have a greater capacity for improving customer satisfaction than their competitors (Baker and Sinkula, 1999), adapting to the changing needs of the market, discovering and exploiting business ideas and accessing valuable information for the development of more competitive new products or processes (Day, 1994; Rust *et al.*, 2004). This implies the need to acquire knowledge outside the organization (Deák, 2006), cooperation being very helpful for this purpose. Furthermore, cooperation on innovation can include strategic commercialization alliances to develop and later introduce new marketing concepts (OECD, 2005). Innovations of this type are important because they increase the propensity to innovate and improve innovation performance (Nguyen and Mothe, 2008).

On the other hand, organizational innovation is a wide concept embracing the firm's structural and behavioural strategies and dimensions (Gera and Gu, 2004). The concept of organizational innovation is subject to various definitions and interpretations (Lam, 2005). For Black and Lynch (2005), organizational innovation includes such components as professional training, decentralization of work and flexible assignment, greater employee participation, shared rewards (such as profit sharing and share options), etc. According to Murphy (2002) and Uhlaner *et al.* (2007), organizational innovation involves practices of three kinds: 1) management practices (teamwork, knowledge management, flexible working arrangements, etc), 2) production methods (changes in the organization of work: total quality management, re-engineering of business, etc.) and 3) external relations (outsourcing, networking, customer relations, etc.) These innovations can be implemented with the aim in view of improving a firm's performance, reducing administrative expenses or transaction costs, improving workers' satisfaction and therefore productivity, etc. (OECD, 2005; Camisón and Villar-López, 2011).

On the other hand, cooperation between firms promotes organizational innovations as thus they can learn more about new methods of management and organization, and so increase the number of sources to bring about innovations of this type (Yang *et al.*, 2008). So far, however, research into the impact of cooperation on the generation of such innovations is still basically at a conceptual level, relevant empirical studies being scarce.

In this study, it has been taken into account that firms can cooperate with different external agents, among them suppliers, customers, competitors, experts and consultants, universities and public research centres. As has already been pointed out, the aim is to ascertain the impact that these kinds of cooperation can have on the development of non-technological innovations in order to advance knowledge in this field of study.

2.1. Cooperation with Suppliers

Interest in cooperating with suppliers began in the 1980s with the success of Japanese car and electronics firms. One of the key factors of that success is thought to be the close relationships between manufacturers and suppliers (Sako, 1994; Liker *et al.*, 1996; Bidault *et al.*, 1998).

Among the reasons most often mentioned in the literature for collaborating with these agents is access to wider experience and knowledge (Clark, 1989; Conway, 1995; Lorenzoni and Lipparini, 1999; Romijn and Albaladejo, 2002; Romijn and Albu, 2002). Working together with suppliers can imply the need to reorganize the structure of the firm to ease the incorporation of these agents' knowledge and experience into the firm's activities and thus make it more efficient in developing such activities. To this end, in many cases the firm will have to implement new management practices to help improve the organization of work and the establishment and maintenance of relations of this type. Therefore, as a first hypothesis, it is posited that:

H1. Cooperation with suppliers favours the development of organizational innovations.

Furthermore, through this cooperation, firms may manage to reduce risks and avoid committing unnecessary mistakes in the design of innovative marketing strategies, as these agents facilitate access to complete and updated information on markets, sales channels and technologies (Fujimoto *et al.*, 1996; Nishiguchi and Ikeda, 1996; Robertson and Swan, 1996). This leads to the second hypothesis:

H2. Cooperation with suppliers favours the development of marketing innovations.

2.2. Cooperation with Customers

This cooperation is especially valuable in the context of new technologies and/or complex products (Urban and von Hippel, 1988; Neale and Corkindale, 1998; Lilien *et al.*, 2002; Tether, 2002; Bogers *et al.*, 2010), given that the customer's experience in their use may be of great help both in improving existing designs (Shaw, 1994) and in coming up with new models or applications. The joint development of a technology with customers helps to improve market share and strengthen the credibility of a firm's products (Jorde and Teece, 1992; Tidd and Trewhella, 1997; Tether, 2002). Moreover, this collaboration has been observed to be important in reducing risks associated with the introduction of new products to the markets (von Hippel, 1976, 1988; Rothwell, 1977; Gardiner and Rothwell, 1985; Quinn, 1985; Kline and Rosenberg, 1986; Gemünden *et al.*, 1992; Ragatz *et al.*, 1997; Tether, 2002).

It also brings advantages like a more directed development of the innovation process, with reduced time and costs (Jeppesen, 2002), which may entail changes in the design of the internal

organization to support the innovation process. This situation would imply the development of organizational innovations especially aimed at intensifying vertical and lateral communication to foment the exchange of knowledge between the firm and its customers and between the workers themselves in order to spread the ideas brought in by these external agents and apply them to the development of different types of innovation (Foss *et al.*, 2011). The third hypothesis, then, is:

H3. *Cooperation with customers favours the development of organizational innovations.*

Thanks to cooperation with customers in the innovation process, it is possible to identify needs that, in many cases, the customers themselves do not yet know (Leonard and Rayport, 1997). This fact allows today's firms to quickly tackle changes in consumer tastes of in modern societies (von Hippel and Katz, 2002). Because of this, customers' contributions may be expected to be closely linked with the development of marketing innovations aimed at increasing sales through new strategies concerning the product, price, communication and distribution. Thus, the information provided by customers may become a key point in the design of strategies of this type. On this basis we propose the next hypothesis:

H4. *Cooperation with customers favours the development of marketing innovations.*

2.3 Cooperation with Competitors

Cooperation with competitors, also known as horizontal cooperation, is frequent in high technology sectors (Mariti and Smiley, 1983; Garrete and Dussauge, 1995). Although it shares the main characteristics of vertical cooperation (suppliers and customers), that is, the reduction of costs and risks for major projects, it can be dangerous because of the possibility of anticompetitive behaviour (Tether, 2002). These risks mean that relations of this type are established in protected areas or using knowledge that is not of key importance to the firm (von Hippel, 1987; Hakanson, 1993), that is, areas of work are sought where common problems exist, avoiding those potentially giving rise to rivalry (Tether, 2002). For these reasons, cooperation with competitors is mainly aimed at basic research and the setting up of standards in the sector (Gemünden *et al.*, 1992; Tether, 2002; Miotti and Sachwald, 2003).

This type of cooperation is very valuable for the development of technological innovations, but in the case of organizational ones, it may not be the most appropriate practice, given that certain key knowledge of the internal organization of the firm could reach the hands of competitors in an involuntary way and jeopardize the firm's competitive position (Cassiman and Veugelers, 1998; Miotti and Sachwald, 2003). This leads us to the next hypothesis:

H5. *Cooperation with competitors has a negative effect on the development of organizational innovations.*

On the other hand, cooperation with competitors can turn out to be beneficial for the development of marketing innovations. It can be interesting, for example, to tackle the actions of firms belonging to other regions or countries and/or to develop innovative marketing campaigns for launching products or services produced jointly. Thus the following hypothesis is formed:

H6. Cooperation with competitors favours the development of marketing innovations.

2.4. Cooperation with Experts and Consultants

Contributions made to the firm by experts and consultants are not only concerned with saving costs but also offer the possibility of sharing experience, helping the firm to pinpoint and specify its exact needs in innovation and contribute ideas for new needs and solutions (Bessant and Rush, 1995).

Furthermore, the fact of cooperating with experts outside the firm brings a different viewpoint from that of the people inside it, as often a firm's staff is very familiar with its products, processes and structures, which can put a brake on thinking up new possibilities. Experts and consultants transmit novel and different information regarding the context in which the firm and its products operate, giving rise to the generation of a greater number of innovative ideas (Bruce and Morris, 1998). In turn, these novel ideas do not only contribute to the development of innovations of a technological type but may also be of great use if the firm considers changes at the organizational level or in the design of new marketing strategies.

Besides these general benefits, cooperation with these agents could prove necessary in the formulation and implementation of projects concerning improvements to structure or functioning in the organization, for which additional human resources may be needed other than those of the firm itself. In the light of this, the following hypothesis is formulated:

H7. Cooperation with experts and/or consultants favours the development of organizational innovations.

Nevertheless, the greater experience of these agents in comparison with the staff of the firm in some areas (Bessant and Rush, 1995), such as aspects of trade, means that collaboration with them becomes a key factor in the design of marketing strategies allowing the firm to improve its competitive position more quickly than firms that do this alone. This argument gives rise to the hypothesis:

H8. Cooperation with experts and/or consultants favours the development of marketing innovations.

2.5. Cooperation with Universities and Public Research Centres

Firms may be motivated to cooperate with these agents to gain access to scientific knowledge, technical teams or new technological options (Hagedoorn, 1996; Frenz and Ietto-Gillies, 2009). Furthermore, unlike cooperation with other external agents, cooperation with public organizations entails no commercial risk of any kind (Cassiman and Veuglers, 2002; Miotti and Sachwald, 2003) as these institutions do not seek a market application for their research but are rather aimed at generating knowledge of a basic nature (Miotti and Sachwald, 2003). Nevertheless, although their possible contributions may not be so valuable as those of members of the production chain (customers, suppliers, etc.), they have proved to be just as useful as those of other sources outside the firm's production system, such as competitors or consultants (Cohen *et al.*, 2002; Fontana *et al.*, 2003). As well as contributing additional knowledge, this kind of collaboration allows access to and recruitment of key personnel from among their teaching staff, researchers, students and graduates, necessary for the efficient development of innovation activities (Leyden and Link, 1992, 1999; Burnham, 1997; Meyer-Kramer and Schmock, 1998; Link and Scott, 2005; Azagra-Caro *et al.*, 2006).

Cooperation with universities and public research centres on the development of technological innovations is positive (Meyer-Kramer and Schmock, 1998; Beise and Stahl, 1999; Link and Scott, 2005; Veugelers and Cassiman, 2005; Azagra-Caro *et al.*, 2006). It is also expected for firms to approach such agents in search of new ideas, suggestions or advice concerning change in their organizational structure or in their marketing strategies, taking advantage of the knowledge that these organizations are able to contribute.

Firms decide to cooperate with universities because of the need to absorb knowledge and develop new skills or to reduce costs in infrastructure or technical staff (Jordá Borrell, 2005). In this regard, the aim of the collaboration may be to analyse the firm's organizational structure and management, working on improving it and also offering the possibility of giving technical training to the firm's staff during the process. These ideas lead us to the following hypothesis:

H9. Cooperation with universities and public research centres favours the development of organizational innovations.

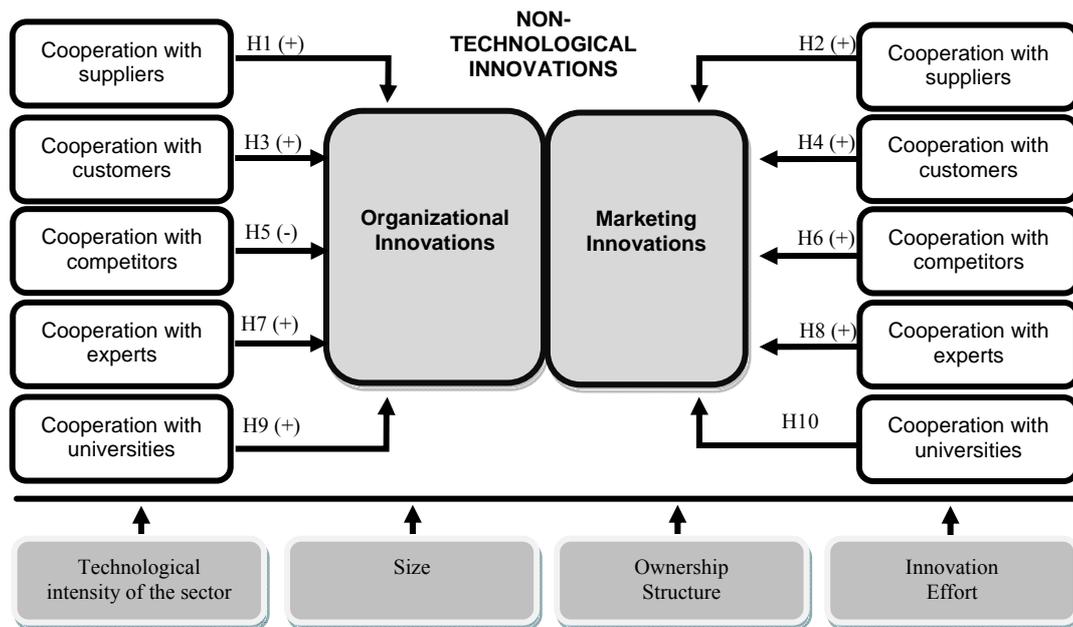
Moreover, as we are dealing with an external source of information, it is useful for the development of new ideas for accessing market information (Cohen *et al.*, 2002) or to conclude existing projects on new market tactics. Likewise, as it allows firms to share risks (Cassiman and Veugelers, 1998, 2005) and obtain funds for research (Bayona *et al.*, 2000; Fontana *et al.*,

2006), it offers the possibility of bringing down the costs of market research studies. All this forms the next hypothesis:

H10. *Cooperation with universities and public research centres favours the development of marketing innovations.*

By way of a summary, Figure 2.1 shows the research model proposed.

Figure 2.1: Research Model and Hypotheses



3. Data and Methodology

In this section, we describe the sample, the variables used for the study and the analysis used for contrasting the above hypotheses.

3.1 Sample

This research was carried out using the data supplied by the Panel of Technological Innovation (*Panel de Innovación Tecnológica – PITEC*). This panel was created with information from Spanish firms recorded by the Survey of Technological Innovation and R&D Survey drawn up by the Spanish National Statistics Institute (*Instituto Nacional de Estadística de España – INE*). The panel supplies information permitting the analysis of the innovative behaviour of Spanish firms and its evolution. Since 2003 it has gathered data from over 7,200 firms, in both the manufacturing and service sectors.

For this research the data used correspond to the years 2006 and 2009. All the variables have been measured taking in to account the data gathered in 2009, excepting the case of the variables representing the different types of cooperation and the innovation effort, which

correspond to 2006. This delay is due to the fact that the development of an innovation, regardless of its type, usually requires a more or less long period of time, so it is to be expected that the effects, both of cooperation and of the innovation effort, should be observed after a time lapse (Sánchez-González *et al.*, 2008).

After eliminating from the sample those firms for which no complete information was available for the years in question, the final sample was made up of 10,735 firms. It included both innovating and non-innovating firms, following the recommendations of Fritsch and Lukas (2001) and Miotti and Sachwald (2003) to avoid biases in the results, such as those mentioned in other studies on the behaviour of innovating firms (Bayona *et al.*, 2001, 2003; Tether, 2002; Cassiman and Veugelers, 2002; Nieto and Santamaría, 2007). It should be pointed out that of the total, 2,702 firms collaborated with external agents in the development of innovations, of which 1,325 collaborated with suppliers, 937 with customers, 637 with competitors or other firms in their sector, 892 with consultants, commercial laboratories or private R&D institutes, and 1,445 with public research organizations, universities and other centres of higher education.

3.2. Variables

3.2.1. Dependent Variables

The dependent variables of the model reflect the fulfilment of two kinds of non-technological innovations: (a) organizational innovations and (b) marketing innovations. The former were measured by means of a dichotomous variable taking the value of 1 if the firm claims to have obtained any innovation of this type in the period 2007-2009, and 0 if not. Firms may have obtained organizational innovations if they developed new business practices in the organization of work or in company procedure, new methods of workplace organization, better sharing responsibilities and decision making, and/or new methods of managing external relations with other firms or public institutions.

For the case of marketing innovations, we also used a dichotomous variable, with the value 1 if the firm claimed to have carried out some kind of marketing innovation during the period 2007-2009 or 0 otherwise. These innovations may be due to significant changes in the design or packaging of a product, new techniques or promotion channels, new methods for finding their market niches or new sales channels and/or new ways of fixing prices for goods or services.

3.2.2. Explicative Variables

The explicative variables of the model used were cooperation with five different types of external agents: (a) suppliers, (b) customers, (c) competitors -or other firms in the sector-, (d) experts or consultants -commercial laboratories or private R&D institutes- and (e) universities and other centres of higher education, and public research centres. These relationships were measured using dichotomous variables with the value of 1 if the firm claimed to have

cooperated with any of these agents during the period 2004-2006, or 0 if not (Miotti and Sachwald, 2003; Nieto and Santamaría, 2007).

3.2.3. Control Variables

As control variables, we considered those typical of studies on innovation and cooperation such as: firm size, technological intensity of the sector, ownership structure and innovation effort. The description of the measures used for these variables is shown in the following table.

Table 3.1: Description of the control variables and their measurements

VARIABLE	MEASUREMENT	DESCRIPTION
Technological intensity of the sector	High intensity (manufacturing)	1 if the firm belongs to a manufacturing sector of high technological intensity 0 if not
	Medium-high intensity (manufacturing)	1 if the firm belongs to a manufacturing sector of medium-high technological intensity 0 if not
	Medium-low intensity (manufacturing)	1 if the firm belongs to a manufacturing sector of medium-low technological intensity 0 if not
	Low intensity (manufacturing)	1 if the firm belongs to a manufacturing sector of low technological intensity 0 if not
	High intensity (services)	1 if the firm belongs to a service sector of high technological intensity 0 if not
	Low intensity (services)	1 if the firm belongs to a service sector of low technological intensity 0 if not
Size	Sales figures	Natural logarithm of the sales figure for 2009
Ownership structure	Private Spanish company	1 if the firm is a private Spanish company 0 if not
Innovation effort	Innovation expenses	Total figure of expenditure on innovation for the year 2006

3.3. Methodology

To check the hypotheses proposed, as the dependent variables are dichotomous, two independent probit models could be used, one for organizational innovations and one for marketing innovations. Nevertheless, it is to be expected that the error terms of these models considered together are correlated, which makes it more convenient to use an extended probit model, known as a bivariate probit (Greene, 2000), which also allows us to consider the existence on unobservable factors influencing these decisions.

This econometric model has previously been applied by other authors in the field of innovation, more specifically in the study of the relationship between collaboration and different aspects of innovation activity, such as regularity in the performance of in-house R&D activities

(Becker and Dietz, 2004), the degree of novelty of the innovation developed (Nieto and Santamaría, 2007), participation in national or international innovation programmes (Busom and Fernández-Ribas, 2008), the effects of cooperation on the different types of innovation developed (Sánchez-González *et al.*, 2008) or the impact of the different sources of knowledge on the results of the innovation process (Frenz and Ietto-Gillies, 2009).

Two equations are considered in the specification of this model (Breen, 1996):

$$y^*_1 = \beta_1 x_1 + \varepsilon_1 ; y_1 = 1 \text{ si } y^*_1 > 0, y_1 = 0 \text{ si } y^*_1 \leq 0$$

$$y^*_2 = \beta_2 x_2 + \varepsilon_2 ; y_2 = 1 \text{ si } y^*_2 > 0, y_2 = 0 \text{ si } y^*_2 \leq 0$$

$$(\varepsilon_1, \varepsilon_2) \sim \text{BVN}(0, 0, 1, 1, \rho)$$

where y^*_1 and y^*_2 are latent variables, while y_1 and y_2 represent the dummy variables referring to the obtaining, respectively, of organizational and marketing innovations, β_1 and β_2 are the coefficients estimated for each of the two equations, x_1 and x_2 the set of independent variables for each model and ε_1 and ε_2 the error terms following a distribution function of a bivariate normal whose correlation is determined by ρ .

Therefore, the model is constructed on the basis of two independent probit equations that can be estimated separately. However, as pointed out above, to ascertain whether it is appropriate to apply a bivariate probit, it is necessary to analyse the correlation between the error terms of the two equations and see if it is statistically significant. If it is not, it would be more appropriate to estimate each of the equations separately using separate (univariate) probits, for in such cases the bivariate probit would be less efficient (Greene, 2000). For this purpose we use the Lagrange test, which operates under the null hypothesis that ρ equals zero.

On the other hand, the interpretation of these coefficients is not as simple as in a linear regression model, so it is necessary to analyse the marginal effects by calculating the change in the probability of obtaining one or the other type of innovation derived from a unitary increase in the explicative variables.

4. Results

Table 4.1 presents the results of the bivariate probit, where models 1 and 2 are, respectively, organizational and marketing innovations. As stated in the previous section, the variables referring to cooperation with different agents and the innovation effort have been delayed a period to measure their effect on the development of the two types of innovations being considered.

In the first place, to determine whether the bivariate probit model should be applied, we analysed the correlation between the error terms of the two equations to check its statistical

significance. The LR test on the parameter ρ indicates that the correlation between the error terms of the two equations is statistically significant, the bivariate probit being the correct specification. Furthermore, according to the result of Wald's test, it may be stated that the set of variables selected are significant for both models.

Table 4.1: Bivariate probit used to analyse the effect of cooperation with different agents on organizational and marketing innovations

VARIABLES		Model 1		Model 2	
		Coeff.	dy/dx	Coeff.	dy/dx
Constant		-2.005*** (0.115)	- -	-1.874*** (0.121)	- -
Explicative					
Cooperation with suppliers		0.299*** (0.044)	0.118*** (0.017)	0.306*** (0.017)	0.105*** (0.016)
Cooperation with customers		0.220*** (0.052)	0.087*** (0.021)	0.093* (0.021)	0.031* (0.018)
Cooperation with competitors		0.145** (0.060)	0.057** (0.024)	0.098* (0.024)	0.032* (0.020)
Cooperation with experts		0.231*** (0.053)	0.091*** (0.021)	0.101* (0.021)	0.033* (0.018)
Cooperation with universities		0.233*** (0.043)	0.092*** (0.017)	0.207*** (0.017)	0.069*** (0.015)
Control					
Size		0.111*** (0.007)	0.043*** (0.002)	0.063*** (0.003)	0.020*** (0.002)
Innovational effort		4.92e-09** (2.27e-09)	1.92e-09** (0.000)	3.12e-09** (0.000)	1.00e-09** (0.000)
Technological intensity of the sector	high manufacture	0.133** (0.056)	0.052** (0.022)	0.247*** (0.022)	0.085*** (0.020)
	medium-low manufacture	-0.110*** (0.037)	-0.042*** (0.014)	-0.095** (0.014)	-0.030** (0.012)
	low manufacture	-0.161*** (0.038)	-0.062*** (0.014)	0.178*** (0.014)	0.059*** (0.013)
	low services	-0.390*** (0.038)	-0.145*** (0.013)	-0.277*** (0.013)	-0.083*** (0.012)
Capital structure	Private Spanish	0.010 (0.037)	0.004 (0.015)	0.177*** (0.015)	0.054*** (0.012)
Wald Test $\chi^2(24) = 1028.18$ Log likelihood = -11845.798 N = 10735 LR test on $\rho=0$ Value $\chi^2(1) = 1860.26(0.000)$					

*p<0.1; **p<0.05; ***p<0.01

Note: Models 1 and 2 refer, respectively, to organizational and marketing innovations.

Reference variables: sectors with a high-medium technological intensity in manufacturing and a high intensity in service firms.

dx/dy estimates the discrete change of a dichotomous variable from 0 to 1.

Standard errors in brackets.

On the basis of the results of the bivariate probit model, we can state that all the hypotheses are fulfilled except one, as there is a significant positive relationship between the collaboration with each of the different agents and the development of organizational and marketing

innovations in all cases. Hypothesis H5 is the only one that is not fulfilled, as it proposed that cooperation with competitors had a negative influence on the development of organizational innovations, but the opposite result was obtained.

Specifically, we can say that hypotheses H1 and H2, relating to cooperation with suppliers, were both fulfilled, as these agents had a positive and significant influence on the probability of both organizational and marketing innovations being developed ($\beta = 0.299$ and $\beta = 0.306$ respectively). This result may be based on the ease of access to information on markets and experiences that suppliers may provide for the development of strategies and innovation plans. Furthermore, this relationship is favoured by the special interest that suppliers may have in strengthening ties with their customers and increasing commercial activity of both through the positive effects that relationships of this type have on organizational as well as commercial activities.

Hypotheses H3 and H4 on the influence of cooperation with customers are also confirmed, as there is a significant and positive relationship between the variables ($\beta = 0.220$ and $\beta = 0.093$ respectively). These results may be explained bearing in mind that establishing relations with customers entails adapting the organization through the implementation of new ways of facilitating communication with them (organizational innovations). As for marketing innovations, they are favoured by cooperation with agents of this type as they facilitate rapid access to information useful for developing advertising campaigns, improvements in product presentation, promotions or new sales methods.

Regarding the relationship between cooperation with competitors and organizational innovations, we find the only hypothesis that is not confirmed. Hypothesis H5 proposed that this type of cooperation had a negative influence on the development of organizational innovations but the study shows there to be a significant and positive relationship between these variables ($\beta = 0.145$). This result may be explained by the fact that firms cooperating with competitors may have obtained information useful for imitating their competitors' organizational structure or management system, adapting them to their own needs. Hypothesis H6, on the other hand, was confirmed, as there is a significant and positive relationship between cooperation with competitors and the development of marketing innovations, as initially proposed ($\beta = 0.098$). This means that firms working together with competitors have been able to jointly develop innovative communication strategies, such as the joint promotion of products or services in a city, region or country, or working together on launching new products or services developed in collaboration with several firms.

Hypotheses H7 and H8, on the effects of cooperation with experts and consultants, are also confirmed, as a significant and positive relationship is obtained for the two types of innovation

($\beta = 0.231$ and $\beta = 0.101$). From these results it may be understood that the help, experience and a different viewpoint that these agents may provide regarding non-technological issues foment the development of organizational innovations (such as the design of new structures or ways of managing human resources), and also innovations in marketing (like improvements to the product image or innovations in advertising and other novel commercial strategies).

The last hypotheses, H9 and H10, which analyse the effect of cooperation with universities and public research centres on non-technological innovations are also confirmed ($\beta = 0.233$ and $\beta = 0.207$ for organizational and marketing innovations, respectively). These results enable us to maintain that cooperation with these partners does not only contribute to developing technological innovations but also permits access to technical information for improving how work and staff are organized, developing new communication strategies or sales channels, and the recruitment of new talents or creative staff.

On the other hand it is important to point out that from the analysis of the marginal effects, it appears that collaboration with suppliers has the greatest effect on the development of innovations of both types, as such cooperation increased the probability of obtaining organizational and marketing innovations by, respectively 11.8 and 10.5 percentage points, while everything else remained constant. Cooperation with the remaining agents, though with its significant and positive influence, achieves this in a proportion lower than 10 percentage points on the probability of developing innovations of both types, *ceteris paribus*. This indicates that firms must take the maximum advantage of relations with suppliers in the development of these innovations, given that with them, the relationship is usually closer and ongoing, which makes it easier to establish and maintain cooperation strategies (De Faria *et al.*, 2010).

Comparing the marginal effects of the two models shows that for the five different types of agent, the influence of cooperation on innovation is greater in organization than in marketing. This may be because to achieve innovative changes in the organizational structure and management of a firm requires a deeper understanding of these issues and therefore a greater integration with cooperating partners. This is not the case, however, for marketing innovations, although cooperation does increase the probability of achieving them, but the relationship does not have to be so close.

As for the control variables, it is to be observed that there is a significant and positive relationship between size and the development of both organizational and marketing innovations. This is because the greater a firm's size, the more resources it has for the development of innovations, not only technological ones, such as in the product and process, but also non-technological ones. Likewise, there is a significant and positive relationship

regarding innovation effort, which is to be expected, for the greater the investment in innovation, the greater the probability of any kind of innovation actually being achieved.

Regarding the technological intensity of the sector, differences exist between manufacturing and service firms. The former show a different behaviour for innovations of these two kinds according to their technological intensity. As for organizational innovations, belonging to sectors with a low technological intensity has a significant and negative effect on their development while belonging to sectors with a high technological intensity exerts a positive and significant effect (low intensity $\beta = -0.161$, medium-low intensity $\beta = -0.110$ and high intensity $\beta = 0.133$). These results are due to firms' need to adapt their organizational structure to the technological changes that they make (Dougherty, 1992; Danneels, 2002). Therefore, the greater the technological intensity of their sector is, the greater their need to innovate in general and the greater the need for organizational changes in particular will be. In contrast, in the case of marketing innovations, although there is a significant relationship, the direction is not so clear (low intensity $\beta = 0.178$, medium-low intensity $\beta = -0.095$ and high intensity $\beta = 0.247$), which could be due to the current competitive environment obliging firms to innovate continually in marketing to favour sales, regardless of the sector a firm belongs to. In the case of service firms, we observe that belonging to sectors with a low technological intensity has a significant and negative influence on both types of non-technological innovation ($\beta = -0.390$ and $\beta = -0.277$). Unlike manufacturing firms, service firms with a high technological level seem to be more motivated to make both types of innovation. These results may be due to service companies being characterized by the need for much closer contact with the market than manufacturers. Services with a low technological content are widely known in the market and do not need to make so much commercial effort. On the other hand, service firms with a high technological level are up against more competitive and dynamic environments. This obliges them to be continually innovating in the services that they offer, with the consequent need for the ongoing adaptation of their organizational structure and in their way of presenting themselves and informing of their services in the market

Finally, an analysis of capital structure shows that there is no significant relationship between being a private Spanish company and the development of organizational innovations. We may therefore conclude that capital structure does not play an important role in the development of innovations of this type. However, being a Spanish company does have a significant and positive influence on the development of innovations in marketing. This is because, if the firm is Spanish, it has the need to internally develop its own strategies for selling its products while belonging to a multinational means that such strategies emanate from the parent company.

5. Conclusions

This paper concentrates on the study of the effects of cooperation with different types of external agents on the development of non-technological innovations. To this end, we have used data from the Panel of Technological Innovation and designed a bivariate probit model with two types of non-technological innovations as dependent variables: (1) organizational innovations and (2) marketing innovations. With this model we analysed the influence of cooperation with five types of external agents: (1) suppliers, (2) customers, (3) competitors, (4) experts and consultants and (5) universities and public research centres, and the relative importance of each of them.

The results lead to three important conclusions. Firstly, it may be stated that cooperation with external agents favours the development of both organizational and marketing innovations. Secondly, suppliers are demonstrated to be the external agent that contributes most to the development of these innovations. Thirdly, cooperation with different types of agent has a greater positive effect on the development of organizational innovations than marketing ones.

In a complementary way, the results also show that size favours the development of both types of non-technological innovations, and that the greater the firm's innovation effort, the greater the probability of achieving any kind of innovation. Regarding the technological intensity of sectors, manufacturing firms belonging to sectors with a high technological level have the greatest probability of developing organizational innovations. For marketing innovations, however, this relationship is not clear. In contrast, service firms with a high technological intensity develop both types of innovation equally. Finally, regarding capital structure, the fact of being a private Spanish company has no influence on the development of organizational innovations but it does in the case of marketing ones.

This study contributes to the previously existing literature on the influence of cooperation on the development of non-technological innovations by tackling the subject in such a way that, to our knowledge, is novel. Thus, it may be said that the study contributes empirical evidence that goes beyond the scope of other studies, which merely analyse the effects of these relationships on the development of innovations in general or only technological ones (Sánchez-González *et al.*, 2008; Frenz and Ietto-Gillies, 2009; Tödtling *et al.*, 2009; De Faria *et al.*, 2010; Tomlinson, 2010; Laursen, 2011). It also complements the results of previous studies on non-technological innovations that do not consider the effects of cooperation (Dengbo *et al.*, 2008; Nguyen and Mothe, 2008; Evangelista and Vezzani, 2010; Naidoo, 2010; Afcha Chávez, 2011) and others that, while bearing in mind the effects on non-technological innovations, do not analyse them by type of agent (Armbruster *et al.*, 2008; Yang *et al.*, 2008; Camisón and Villar-López, 2011; Baraldi *et al.*, 2012).

Therefore, the fundamental idea deriving from this study is that cooperation, regardless of the type of partner, is a good strategy for firms to use with the aim in view of developing non-technological innovations. It would therefore be recommendable for firms to work in an integrated way collaborating with a wide number of agents, especially when they wish to perform structural or management changes in the organization and, though with less importance, when they wish to design innovative marketing strategies. To propose ideas to carry out innovations of an organizational type requires the external agent to know the structure of the firm in depth, along with its ways of organizing itself and working, so in these cases, a greater integration of the partner in the firm's activities is necessary. Likewise, although the five types of agent can make valuable contributions in this context, suppliers are the most influential ones. Their importance is due to the closer and more frequent ties that firms have with their suppliers, which generates conditions of trust and exchange of knowledge that are more difficult to establish with other agents and which may facilitate the development of joint activities.

Finally, it is important to point out certain limitations of the study for a correct interpretation of the results and conclusions, which also give rise to future lines of research. In the first place, the database used did not make it possible to perform an analysis by years, given that the questions in the questionnaire, both on cooperation and on obtaining innovations are made for a period of three years. Another limitation is that both the dependent and explicative variables were measured by means of dichotomous variables, and without a doubt, a greater contribution would have been possible using measurements on the intensity of cooperation and of the success of the ensuing innovations. Further work on these questions would allow us to draw father-reaching conclusions and analyse the phenomenon in greater depth.

Furthermore, the database used only contains information on Spanish firms, so the conclusions only concern Spain. Future research would enrich our knowledge by using data from other countries in order to make comparisons. On the other hand, it would be interesting to analyse the effects of cooperation by distinguishing organizational and marketing innovations according to the type of activities comprising them, and study the technological innovations (in product and process) and non-technological ones together in order to complete the study analysing their interaction.

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