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Innovation Training and Product Innovation Performance: The Moderating Role of External Cooperation

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Abstract: Training has traditionally been considered as an effective mechanism to leverage human capital and as a consequence improve firms' innovation performance. However, studies specifically analyzing the effect of training on innovation performance are scarce and the results inconclusive. This paper examines the influence of specific innovation training on product innovation performance and analyzes how external cooperation can moderate this relationship. The empirical analysis used here is based on a representative panel of 176 Spanish firms in high-tech industries. The findings suggest that the positive impact of innovation training on product innovation performance occurs when firms are cooperating with external agents. Thus, our results suggest that through external cooperation firms can overcome the problems that a focus-oriented training can have regarding product innovation performance.

Keywords: product innovation; innovation training; external cooperation; high-tech industries.

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1. Introduction

Highly competitive pressures and continuous development characterize the current turbulent business environment. Products' life cycles become shorter over time, driving firms towards the faster development of new products. As a consequence, managers and researchers have taken a special interest in the mechanisms that enable firms to achieve innovations due to their potential to become a source of competitive advantage (Subramaniam and Youndt, 2005).

In this process of continuous development, firms' human capital plays a fundamental role. Employees' knowledge, expertise, and abilities used to be a key factor in the development of innovations (Santos-Rodríguez et al., 2010; Youndt et al., 1996). However, the turbulent and changing environment makes that relying exclusively on a current firm's knowledge may produce a path dependence that generates rigidities within the firm, thus making product innovation difficult (Danneels, 2002). As the life cycle of employees' knowledge and skills is being shortened, firms need to invest in the continuous development of their workers (Aragon-Sanchez et al., 2003). In this sense, training can be a critical tool to develop human capital and enable firms to respond to environmental changes (Coetzer and Perry, 2008). Through training, firms can leverage the knowledge base of their employees by allowing them to acquire new knowledge and skills (Fan and Wei, 2010).

However, despite the importance that training may have on firms' innovation performance, until now the studies that have analyzed this specific relationship are scarce and the results inconclusive (Sung and Choi, 2014). One of the limitations of these previous studies is that they have not considered the content of the training and this is important to the extent that it conditions the knowledge that will be acquired by the employees (De Saá-Pérez et al., 2012; Loewe and Chen, 2007). In this sense, in this paper we focus on the innovation training, that is, a focus-oriented training whose aim is to develop the specific knowledge that employees need to carry out product innovations. By receiving specific and specialized training, employees will be more prone to acquire the appropriate knowledge to develop product innovations (Bae and Lawler, 2000). Nevertheless, at the same time, a specific training can reduce the range of diverse knowledge that can be acquired by employees, thus making the development of innovations harder (Leiponen and Helfat, 2010). This sets out a paradoxical situation for human resource managers.

In order to solve this paradoxical situation, previous scholars have highlighted the necessity of considering that firms have more sources of knowledge that can complement human capital (e.g., Kang and Snell, 2009). In this sense, external cooperation can become a mechanism that firms can use to solve this problem by increasing the number of knowledge sources and thus increasing the probability of obtaining valuable and complementary knowledge (Leiponen, 2005). In this paper, we analyze the joint effect of innovation training and external cooperation on product innovation performance. More specifically, we analyze whether the effect of innovation training can be more positive when firms cooperate with external agents.

Thus the contribution of this paper is twofold. Firstly, our results contribute to the human resource management literature by specifically analyzing the effects of innovation training on the product innovation performance of high technology firms. Although the importance of training on innovation performance has featured in the literature, until recently less attention has been paid to the effect of specific innovation training. Secondly, we also contribute to this literature and also to literature on intellectual capital by analyzing how innovation training and external cooperation can be two mechanisms that, although are oriented to different source of knowledge, can have a synergistic effect on innovation performance.

With this objective in mind, the following sections of the work present our hypotheses. Then we present our sample and some methodological analyses. Results obtained from the analysis of a six-year data panel of 176 Spanish firms in high-tech sectors will follow. We then discuss the academic implications, as well as the limitations and directions for future research.

2. Theoretical framework and research hypothesis.

Firms' knowledge has been considered as a main source to develop innovations. Indeed, from a knowledge-based point of view, innovation can be considered as a process in which firms "create and define problems and then actively develop new knowledge to solve them" (Nonaka, 1994, p.14). Thus, firms' human capital, that is, the knowledge that firms can obtain and exploit from employees, is critical for innovations.

However, the aforementioned variability and the continuous technological development of the business environment produce a continuous evolution of the knowledge, skills, and abilities that are required in an organization. This implies that, for innovation, not only is it necessary that firms process information, but also they need to be able to exploit their current knowledge and convert it into new knowledge. Current organizations are conscious that it is not only necessary to hire employees who contribute with new knowledge and skills, but also that these employees develop their knowledge and skills once they are part of the organization (Bassi et al., 2002). As a consequence, firms need employees with a high qualification but also with the capacity to leverage their knowledge and skills through continuous learning (Hedge and Shapira, 2007). Otherwise, firms may suffer a loss of competitiveness. In this sense, human resource practices play a fundamental role in the development of firms' human capital. Previous studies have confirmed how different human resource management systems positively influence innovation performance of firms by favoring the development of firms' human capital (e.g., Chen and Huang, 2009; Collins and Smith, 2006; Shipton et al., 2006).

Among all the human resource practices, training must be especially considered if we take into account the importance of this practice in the acquisition and development of employees' knowledge. In this sense, training is critical in order to leverage the human capital of firms to make an efficient contribution to the firms' efficacy and performance (Arthur, 1994; Bauernschuster et al., 2009; Chen and Huang, 2009; Delaney and Huselid, 1996; Richard and Johnson, 2001; Shipton et al., 2005; Tharenou et al., 2007; Van Eerde et al., 2008). Thus, it is not surprising that more innovative firms pay more attention to the training of their employees (Baldwin and Johnson, 1998; Freel, 2005).

However, despite the presumed importance of training in firms' innovation performance, until now studies focusing on this issue have been scarce and the results can be considered as inconclusive. In fact, only some recent studies have specifically analyzed the effect of training on innovation (e.g., Bauernschuster et al., 2009; Sung and Choi, 2014; Vega-Jurado et al., 2008a) while most of previous studies have considered training just as part of a bundle of human resource practices (e.g., Beugelsdijk, 2008; Chen and Huang, 2009; Shipton et al., 2006). Additionally, results can be considered as inconclusive. Although some previous studies have identified a positive relationship between training and innovation performance (e.g., Laursen and Foss, 2003; Shipton et al., 2006; Walsworth and Verma, 2007), others have not identified any significant relationship between them (e.g., Caloghirou et al., 2004; Sung and Choi, 2014), have only found relationship between training and incremental but not radical innovation (e.g., Beugelsdijk, 2008), or have even found a negative relationship between training and innovation performance of small- and medium-sized firms (e.g., De Saá-Pérez et al., 2012). We propose that one reason explaining this fact can be that these studies have not taken into account the content of the training, despite the importance of matching this content with the organizational outcome that is considered (Tharenau et al., 2007).

In this sense, most of previous studies analyzing the effect of training on innovation have been focused on generic instead of specific training (e.g., Laursen and Foss, 2003; Shipton et al., 2006; Sung and Choi, 2014; Walsworth and Verma, 2007). Through training, firms can leverage both the general and/or the specific knowledge and skills of their employees (Guidetti and Mazzanti, 2007). Although generic training may be important in order to contribute to the development of a broader vision of the organization and increase employees' general skills (Guthrie, 2001; Kang and Snell, 2009), at the same time it cannot have the expected effect on firms' innovation performance. The main problem is that sometimes the knowledge that is acquired through generic training is not based on current necessities of the firms (Macdonald et al., 2007). This can make that a little percentage of the knowledge acquired through training will be applied to the work task (Brown, 2005; Velada and Caetano, 2007).

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However, intensive and specific training can be more effective in the development of specialized knowledge and expertise (Bae and Lawler, 2000). Specialist human capital uses to be more effective for acquiring and assimilating specific new and complex knowledge (Brown and Duguid, 1991). Taking into account that developing innovation products can require complex and more advanced knowledge and skills (Spell, 2001), it would be through specific innovation training that employees can obtain the capacity to develop product innovations (Bauernschuster et al., 2009). Indeed, one of the most common mistakes that managers usually make when they train their employees is not to offer them appropriate training on how to innovate (Loewe and Chen, 2007). Similarly, innovation training has also been shown to be important in creating an organizational culture based on continuous development (Lau and Ngo, 2004).

However, paradoxical as it may seem, a highly specialized human capital can also have a negative effect on firms' innovation performance. When individuals are too specialized in a specific area they can be more reluctant or unable to acquire and interpret new knowledge that exceeds their specialized domain (Dougherty, 1992). In order to overcome the paradox that some human resource practices can find in the development of innovations, Kang and Snell (2009) proposed that firms need also to consider other sources of firms' knowledge such as social capital.

Social capital refers to the knowledge that is derived from the interactions between individuals (Nahapiet and Ghosal, 1998). The main assumption towards the effect of social capital on innovation performance is the idea that through interactions individuals can exchange information and knowledge, and thereby promote product innovations (Tsai and Ghoshal, 1998). Social capital can be considered in terms of intrafirm and interfirm relationships (Adler and Kwon, 2002). For the purpose of this paper we focus on the external social capital of the firm, that is, the linkages to other firms and institutions.

According to the complexity of innovations, firms usually do not carry out this activity alone but cooperate with partners such as other firms, universities and research centres or even with existing suppliers and customers (Faems et al., 2005). Cooperation has some benefits for innovation. Two main theoretical perspectives have been used to explain these benefits: transaction cost economics and knowledge-based view (Sampson, 2007). Firstly, the transaction cost perspective (Williamson, 1985) implies that as the costs associated with innovation increase, firms will try to minimize these costs by cooperating with other firms. Through cooperation, firms can share the risks and costs of innovation projects (De Man and

Duysters, 2005). However, cost minimization is not the only reason to defend the cooperation between firms. Other strategic reasons underlie this decision. From a resource-based view, cooperation is driven by the logic of strategic resource needs (Das and Teng, 2000; Eisenhardt and Schoonhoven, 1996; Miotti and Sachwald, 2003). Through cooperation, firms can access certain resources that may be necessary for innovation but that cannot be developed in-house (Hannah, 2007). Among all these resources, knowledge is one of the most critical (Nonaka and Takeuchi, 1995). Developing innovations requires a wide and diverse range of knowledge that can be difficult to develop in-house. However, through cooperation, firms can access heterogeneous knowledge that is lacking or whose development would imply an unacceptable cost and/or time frame (Madhok, 1997; Quintana-García and Benavides-Velasco, 2006; Rodan and Galunic, 2004; Yli-Renko et al., 2001). Especially relevant is the possibility of accessing other firms' tacit skills (Hennart, 1991). Cooperation can be used to obtain access to the technological know-how and expertise that is embedded within other firms (Kogut, 1988; Leonard-Barton, 1992). For all these reasons, cooperation has been shown to have a positive influence on the development of new products (Becker and Dietz, 2004; Faems et al., 2005; Sharif et al., 2012) and especially for high technology firms that require most specialized and complex knowledge (Tödling et al., 2009).

Thus, we propose that through external cooperation, firms can overcome the paradoxical effect of innovation training on innovation performance. In this sense, Kang and Snell (2009) proposed that firms will improve their innovation performance to the extent that they adopt appropriate configurations of the intellectual capital sources that allow them to overcome the paradoxical effect of a specialist human capital. Indeed, this idea of considering the joint effect of these two sources of intellectual capital is consistent with the results of Subramaniam and Yound (2005), who found that human capital only had a positive influence on firms' innovation performance through their interaction with social capital. Similarly, Wu et al. (2008) found that social capital mediated the effect of human capital on firms' innovative performance. Through external cooperation firms can access a broad and diverse knowledge that complement the specialized knowledge that their human capital develop through innovation training.

Thus we propose that:

H1 External cooperation moderates the relationships between innovation training and product innovation performance in such a way that the effect is more positive when the firms cooperate with external partners.

4. Method

4.1. Sample and data

The database used in our study is the Technology Innovation Panel (PITEC). This database is based upon the Spanish Innovation Survey carried out by the INE (National Institute of Statistics), based on the Community Innovation Survey (CIS), which follows guidelines laid down by OECD's Oslo Manual to enable comparison between countries. PITEC is designed as a panel survey. This allows for both estimating the changes over time and taking the heterogeneity of a firm's decisions into account. Although the time period covered by the panel was from 2003 to 2012, there were changes in the questionnaires (e.g., some content questions or some wording of questions) that prevented the use of full panel data in our study. This implies that the results of this study are based on panel data from 2007 to 2012, a period during which all the variables considered in our model were comparable. The final sample used in this study was selected from those companies in the PITEC panel that met two requirements: a) firms in high-tech industries according to a Spanish classification named CNAE that is equivalent to the 2-digit SIC classification, and b) firms who answered all questions related to the variables of interest in our research, allowing us to have a perfectly balanced panel. Thus, our final sample is based on data from over 176 manufacturing companies whose basic characteristics are summarized in Table 1.

Insert table 1 about here

As shown in Table 1, our sample includes a similar number of large firms (average number of employees > 250) and small- and medium-sized enterprises (with an average number of employees of up to 250).

4.2. Measures

The literature contains very different proposals to measure innovation performance, such as the number of patents obtained by a firm (e.g., Ahuja and Katila, 2001; Chen et al., 2011;

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Hagedoorn and Cloodt, 2003) or various indicators related to different aspects of product and process innovation performance (e.g., De Brentani and Kleinschmidt, 2004; Griffin and Page, 1996; Prajogo and Ahmed, 2006). In this case we decided to measure product innovation performance as the percentage of total annual sales (by the year) coming from new or substantially improved products introduced in the last two years. In this sense, we utilized a similar approach to that used in previous studies (e.g., Caloghirou et al., 2004; Cassiman and Veugelers, 2006; Fosfuri and Tribó, 2008; Kampik and Dachs, 2011). This variable certainly shows those innovations that have been actually implemented by the firm, thus overcoming the limitations of other kinds of indicators. For example, despite the generalized use of the number of registered patents offer as variable to measure firms innovation, firms do not always patent their inventions, there are inventions that cannot be patented, or the economic value of the patent can differ.

To measure *product innovation performance* we built an indicator as the sum of two values:

a) Percentage of sales due to innovations in goods and services that where new for the company and were introduced in the previous two years.
b) Percentage of sales originated by innovations in goods and services introduced over a period of two years and representing a novelty for the market in which the company operates.

Our model also considers two explanatory variables: the first related to the investment made by companies in specific training to encourage innovation (*innovation training*), and the second with the cooperation of the company with other companies or entities in developing their innovation activities (*cooperation*).

In measuring training, studies often distinguish between two groups: those that use objective measures and those that use subjective measures. In this work we have chosen an objective measure: the cost of training (Aragón-Sánchez et al., 2003; Freel, 2005). Innovation training is measured by the percentage of innovation expenses dedicated to training in innovation. More specifically, this variable was calculated on a two-year period as an arithmetic average of the percentage of innovation expenses of two reference years for innovation training. Thus, innovation training reflects the importance of training expenditure in innovation with regard to total innovation investment. This training is specifically related to staff training for the development or introduction of new or significantly improved products. As we are considering that the effect of innovation training on product innovation performance is not immediate, we use data from the two previous years. Thus, when we considered the product innovation

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performance for year 2007, innovation training was measured by using the average data from 2005-2006.

On the other hand, we measured cooperation by using a dummy variable that equals 1 if the firm has cooperated over the previous two years with other companies or entities in developing its innovation activities, and 0 otherwise.

Finally, we controlled for a firm size, as previous studies have shown how size may influence innovation (e.g., Damanpour, 1991; Damanpour, 1996). As suggested by previous studies (e.g., Nieto and Rodríguez, 2011; Santamaría et al., 2009), *firm size* was measured by the logarithm of the number of employees in a firm.

4.3. Method of Analysis

Hypotheses are tested via a linear regression model for panel data. Panel data models examine the fixed and/or random effects of entities (individual or subject) or time. A fixed group effect model examines group differences in intercepts, assuming the same slopes and constant variance across entities or subjects. However, a random effect model estimates variance components for groups (or times) and errors but assumes the same intercepts and slopes across subjects. Because the proposed model could be estimated by considering fixed or random effects, we selected the most appropriate estimation method based on a Hausman test (Hausman, 1978) and the test of over-identifying restrictions proposed by Arellano (1993). Since in both cases the test was not significant (Hausman test: Prob > Chi^2 = 0.0654; Sargan-Hansen statistic = 6.97; Chi^2 (3) $p = .072$), we chose a random-effects model rather than a fixed effects model. To check the suitability of using a random-effects model versus a model estimated by OLS with dummies, we computed the Breusch-Pagan statistic (Breusch and Pagan, 1980). The result from the Breusch-Pagan LM test rejected the null hypothesis of zero variances across the units of a panel; i.e., a panel specification being preferred over a pool (Prob > c2 = 0.000), and therefore it is desirable to estimate the model using random effects.

Thus, the general model required to verify our hypotheses is:

$$Y_{it} = \alpha_i + \beta_i X_{it} + \varepsilon_{it}$$

and assuming that $\alpha_i = \alpha + \mu_i$, we have:

$$Y_{it} = \beta_i X_{it} + (\alpha + \mu_i) + \varepsilon_{it}$$

where:

α_i = individual effects

β_i = estimated coefficients for independent variables (X_i)

X_i = independent variables (explanatory)

μ_i = random effects

ε_{it} = error term

As we can see, in the random-effects model, individual effects are added to the error term. Thus, our final estimated models are:

$$\textit{Product innovation performance}_{it} = \beta_1 \textit{size}_{it} + \beta_2 \textit{cooperation}_{it} + \beta_3 \textit{innovation training}_{it} + (\alpha + \mu_i) + \varepsilon_{it}$$

Finally, when considering the interaction term:

$$\textit{Product Innovation performance}_{it} = \beta_1 \textit{size}_{it} + \beta_2 \textit{cooperation}_{it} + \beta_3 \textit{innovation training}_{it} + \beta_4 \textit{interaction}_{it} + (\alpha + \mu_i) + \varepsilon_{it}\,;$$

where *interaction* is the interaction term that reflects the moderating effect of cooperation on training expenditure for innovation. This variable is calculated by multiplying the values of *innovation training* and *cooperation* variables.

5. Results

We can summarize the results of the statistical analysis we conducted in Tables 2 and 3. Table 2 contains descriptive statistics for different years of the panel for the variables included in the model.

Insert Table 2 about here

Meanwhile, Table 3 summarizes the main results obtained from the random-effect estimation of the proposed model. Models estimation was carried out using the 'xtreg' command available in Stata statistical package, and the 'xtmod' Stata module for analyzing interaction (Seifert, 2009).

Insert Table 3 about here

As shown in Table 3, expenses in training for innovation can be a positive and relatively significant determinant of product innovation performance (β_3 = .658; p = .077). This result shows that spending on training in innovation can have a moderately direct positive impact on firm innovation performance. Similarly, results show a cooperation payoff in terms of product innovation performance (β_2 = 11.178; p = .000).

On the other hand, the results of Model 2 in Table 3 show that the interaction term between innovation training and external cooperation is positive and statistically significant (β_4 = 3.662; p = .000). This implies that in firms that cooperate with external agents, the effect of innovation training is stronger than in firms that do not cooperate. This result supports Hypothesis 1. We represent this relationship in Figure 1 using procedures outlined in Aiken and West (1991). As seen in this figure, higher innovation training only represents a significant increase in product innovation performance for companies that have chosen to cooperate with other companies or entities.

Insert Figure 1 about here

Finally, with regard to *firm size*, the size-related variable has a negative and statistically significant effect on product innovation performance (a similar result is obtained in Model 2). This reveals that greater firm size is negatively related to innovation performance, which supports those who argue that, on occasions, size may pose difficulties for innovation (e.g., Aldrich and Auster, 1986; Wade, 1996).

6. Discussion

The findings of this study support some key conclusions about the effect of innovation training on firms' product innovation performance that can have notable theoretical implications. First, our results show that innovation training can have a moderately direct positive effect on product innovation performance. This contributes to human resource literature by showing the effectiveness of specific innovation training in leveraging a firm's human capital in a way that allow firms to improve their product innovation performance. Similarly, our result also shows the necessity of considering that the effect of training on product innovation performance must be observed in future years. Thus, in order to evaluate the consequences of this training on

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product innovation performance, it is necessary to conduct longitudinal analyses that consider that the knowledge that is acquired by training requires time to be reflected in product innovation performance. Employees need time to assimilate and to be able to apply this knowledge to the development of new products.

Second, our study also contribute to human resource management literature by showing that firms must not only focus on internal mechanism to leverage their product innovation performance. Our results show how the positive effect of innovation training on product innovation mainly occurs when firms cooperate with other agents. This can serve to explain the mechanism through which innovation training contributes to the development of product innovation capacity and can serve to explain the inconclusive results previously found in the literature. According to the results of this study, if firms want to leverage their innovation performance they cannot rely on one unique source of knowledge, because in isolation, one specific mechanism could produce a paradoxical effect. In this sense, if firms want to leverage their innovation performance through leveraging their human capital, they can invest in innovation training, but this could make that they cannot access a broad and heterogeneous knowledge, thus limiting their capacity to develop new products. However, if firms adopt complementary mechanism that allow them to take advantage of different sources of knowledge, such as human capital and social capital, they can complement the knowledge that is acquired by one of them with the knowledge that is acquired by the other. Our result supports this argument by showing how firms can really take advantage of innovation training when they cooperate with external agents. These results contribute to recent calls demanding that firms need to adopt complementary mechanisms that allow them to exploit the potential of different configurations of their intellectual capital (e.g., Kang and Snell, 2009). More specifically, this study shows how firms can leverage their product innovation performance by complementary mechanisms relating to human and social capital.

Finally, although it is out of the scope of this work, it is necessary to comment the negative effect that size, measured as the natural logarithm of the number of employees, has on product innovation. Although bigger organizations usually can have more control over their environment, stronger marketing skills, more bargaining power with suppliers, distributors and regulatory agencies, more product development experience and more resources to develop technological capabilities, their disadvantages usually include being more bureaucratic, less flexible, having stronger inertia along established paths, and lower managerial commitment to innovation (Damanpour, 1996; Kimberly and Evanisko, 1981; Nord and Tucker, 1987). On the other hand, although smaller organizations can be more flexible, more adaptive to external environments, be better able to communicate throughout an organization, and more receptive to change, they often have the disadvantage of fewer resources, lacking access to complementary assets, and weaker marketing skills (Damanpour, 1996; Kimberly and Evanisko, 1981; Nord and Tucker, 1987). This paradoxical effect of size on innovation performance has produced inconclusive results. Indeed, although some previous studies have found a positive influence of size on innovation performance (e.g., De Marchi, 2012), others have found a negative effect (e.g., Taylor and Greeve, 2006), or even not significant effect between these two variables (e.g., Chang et al., 2012; Collins and Smith, 2006). By focusing in our study, taking into account the importance that external cooperation has in the development of new products in our sample, it is expected that the disadvantages of small firms, related to having fewer resources, will be overcome. So this could explain why the size has a negative influence on product innovation performance. However, taking into account the paradoxical effect of size on innovation performance, future studies could analyze whether size has a curvilinear instead of a linear effect on innovation performance.

Finally, our findings can also have some important practical implications, mainly for human resource managers. First, our study shows how specific innovation training can be an effective human resource practice to develop the innovation capacity of the firm. Thus, this can solve some human resource managers' doubts about the content of training programmes. When in doubt about invest on generic or specific training, our study show that innovation training is effective. However, in order to be able to really exploit the benefits derived from innovation training, firms should complement this training by cooperating with external agents that supply diverse and heterogeneous knowledge.

7. Limitations and Future Research

Although the results have notable theoretical implications, we have to recognize some limitations. Firstly, in order to increase the robustness of the results, it would be interesting for future works to analyze our results in other contexts. We focus on high-tech industries, where the development of innovations can be critical for firms' competitiveness. However, as the pattern of innovation can differ across industries, future research could replicate this study by focusing on other kind of industries, such as service industries. It may be necessary to analyze our hypotheses in other kinds of industries in order to identify relevant differences.

Secondly, we have considered cooperation in a general way. However, firms can collaborate with a diversity of partners (Nieto and Santamaria, 2007), and those partners could have different effects on innovation performance (Vega-Jurado et al., 2008b). Indeed, Vega-Jurado et al. (2008a) defends that in high technology industries the cooperation with non-industrial agents, such as universities or research centers, could be more positive for firms. Thus, for future studies it would be interesting to assess whether the moderation effect of cooperation on the relationship between innovation training and product innovation performance is more or less important for each one of these potential partners (Vega-Jurado et al., 2008b).

Third, although in our analysis we control for the effect of firm size, previous studies have shown how the innovation performance can also be affected for other variables such as firm age (e.g., Balasubramanian and Lee, 2008; Huergo and Jaumandreu, 2004). Future studies could also add some of these factors to the model as control variables.

Additionally, futures studies specifically focused on the learning processes that allow firms to innovate could develop our results by analyzing what specific knowledge is acquired by innovation training and what specific knowledge is acquired by external cooperation.

Finally, in relation to product innovation performance, future studies should distinguish between radical and incremental innovations (Beugelsdijk, 2008). In doing so, they could analyze whether the impact of innovation training and external cooperation have more or less influence according to the kind of considered innovation.

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Table 1. Information about sectoral sample composition

		Frequency	*Percentage*
CNAE2009	*Activity sectors*		
21	Pharmaceutical industry	93	52.84
26	Computer, electronic and optical instruments	74	42.05
30.3	Manufacture of aircraft and spacecraft	9	5.11
	Average number of employees (2007-2012 period)		
	< 10	3	1.7
	10 - 49	28	15.9
	50 - 250	65	36.9
	>250	80	45.5

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Table 2. Descriptive statistics for model variables[a]

Variable	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Product Innovation performance	35.347 (38.161)	30.616 (35.421)	34.724 (36.430)	28.197 (31.438)	27.018 (33.556)	28.333 (34.558)
Size	2.202 (.589)	2.217 (.587)	2.204 (.583)	2.205 (.557)	2.196 (.577)	2.195 (.547)
Cooperation	.551 (.499)	.602 (.491)	.557 (.498)	.579 (.495)	.574 (.496)	.642 (.487)
Innovation training	.483 (1.011)	.560 (1.161)	.929 (3.890)	.880 (3.957)	.700 (1.827)	.547 (1.216)

Notes: [a]Standard deviation is in brackets. All variables are continuous except cooperation (binary variable)

Table 3. Estimated coefficients for proposed models (Random-effects GLS regression)

	Model 1: without interaction				*Model 2: with interaction*			
Variable	*β*	*S. E*	*Z*	*P>|z|*	*β*	*S. E.*	*Z*	*P>|z|*
Constant	40.241	6.883	5.85	.000	41.798	6.822	6.13	.000
Size	-7.444	3.014	-2.47	.014	-8.020	2.986	-2.69	.007
Cooperation	11.178	2.317	4.82	.000	8.917	2.390	3.73	.000
Innovation training	0.6581	.3720	1.77	.077	0.138	0.398	0.35	.728
Interaction					3.662	1.033	3.54	.000
	Wald Chi^2(3)= 29.96 (p = .000) Number of observation=1056 Number of groups = 176				Wald Chi^2(4)= 43.02 (p=.000) Number of observation = 1056 Number of groups=176			

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Figure 1. Interaction effect of cooperation and innovation training on product innovation performance.