DETERMINANTS AND CONSEQUENCES OF THE INNOVATION SOURCING STRATEGIES; A FOCUS ON THE MANUFACTURING AND SERVICES SPANISH FIRMS

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Abstract

Defining the innovation sourcing strategy as Make, Buy and Make-Buy R&D, this investigation has the objective of analyze the determinants of the innovation sourcing strategy selection and its subsequent performance. The analysis was made taking a sample of 2334 manufacturing firms and 992 service Spanish firms. Results shows that the sector to which the firms belongs is the principal diver for the innovation sourcing strategy since the behaviour patron is different between manufacturing and services firms. Results show as well that the Make-Buy strategy is the more recurrent and is the one which generates the better results. Contrary, the buy strategy is the less recurrent and, accordingly, it the one which presents the lowest results.

Keywords: Make, Buy and Make-Buy R&D.

1. Introduction

Technological innovation is defined as a searching activity of optimal alternatives which is fundamentally characterized by an intense activity address to identify and solve technical problems (Nelson and Winter, 1982), it is generally subordinate to research and development activities (R&D), and it is focus in generating new products and process or the technological improvements to the existent product and process (OECD, 1997). Technological innovations pursued by R&D activities are increasingly being used by the firms in order to gain competitive advantage and it is wide recognized that these activities are central to the success of the most business (Dwyer and Mellor, 1993). More precisely, some authors describe technological innovations as the main source of competitive advantage (Prahalad and Hamel, 1990; Bone and Saxon, 2000). In this respect, due to de great importance of technological innovation activities it is worth to analyze the driving forces that affect firm's selection of the technological innovation sources and the subsequent performance of them. Before going deeper in this subject some statements should be made.

As commented by Stock *et al*. (2002), developing innovation activities is unavoidable for firms in order to maintain or increase their competitive advantage. On the other hand, due to products and process life cycles are steadily growing shorter, firms are forced to innovate

constantly in order to assure their existence and long-run growth (Perrons and Platts, 2004). But, what is innovation? Acs *et al*. (2001) defined it as the effort to create purposeful, focused change in an enterprise's economic or social potential. According to Terziovski (2002), innovation is a complex process, easily identified as being of critical importance for organizational success yet not easily managed. According the last version of the Oslo Manual (OCDE, 2005) there are four types of innovation: 1) product innovation; 2) process innovation; 3) marketing innovation and; 4) organizational innovations. The product and process innovation, which were considered as technological innovation in earlier versions of the Oslo Manual, include the new or highly improved products (goods or services) and process. Marketing innovations include the application of new practices concerning to a significant change in the 4Ps of marketing (product; pricing; promotion and placement or distribution). The organizational innovation refers to the new ways adopted by the firm in terms of business practices, external relationships and the structure of the firm as well as the decisions and responsibilities (Becheik *et al*. 2006).

With the aim of classifying and evaluating the types of innovation and their impact in the performance of the firm, several dimensions of innovation have been proposed. De Propris (2002) separates innovation into four types: product, process, incremental and radical innovation. Henard and Szymanski (2001) distingue four dimensions: product innovation, process innovation, strategy innovation and market innovation. These dimensions could be regrouped in two types of innovation. The product and process ones could be classified as technological innovations, and the last two as non technological innovations.

Usually, in order to evaluate impact of the innovation activities on the performance of the firm, the technological innovations are used as they are more easily measurable than the non technological ones. Nevertheless, as pointed out by Pereleman (1995), the link between R&D and productivity growth is one of the most difficult to observe and measure. Even the difficulties presented, several studies have tried to evaluate this link and have found a positive relationship. For example, Hall and Bagchi-Sen (2002) and Attaran and Grijalva (2001) have found than the development of technological innovation activities has an important impact on the overall firm performance. As well, Rao *et al.* (2001) found a strong positive relationship between measures of fundamental innovation, labor productivity and GDP per capita across OECD countries. Wolff (2000) finds that R&D intensity is strongly correlated with sales annual growth and profitability. Finally, Uri (2001) states that productivity improvement in telecommunication industry is due primarily to innovation.

As it can be seen, it is widely recognized in the literature that R&D activities are central to the success of most business. While the allocation of the limited resources of R&D is one of

the more difficult decisions due to the results uncertainty and the ambiguity on the R&D investments (Lin and Chen, 2005), it is worth to go further in the analysis and evaluation of the driving forces that determinate the selection of the adequate source of technology innovation and the subsequent results.

As defined by Zahra (1996), the technological investments include both in-house R&D spending and the cost associated with acquiring technology form external sources. These investments consolidate the company's position in the market by building barriers to entry and meeting customers needs. A firm which technological capacity is well know, enjoys a favorable reputation which makes it difficult for other firms to attack its markets. However, the ability to transform the R&D investments into a source of competitive advantage, will conditioned the technological efficacy.

In order to achieve the R&D activities firms must develop the more adequate innovation strategy. This strategy is part of the firm's competitive strategy since firms used it to position effectively *vis à vis* its environment (Shrivastava and Souder, 1987). Further, its objective is to guide the firm in acquiring, developing and applying the technology in order to generate a competitive advantage (Swan and Allred, 2003). Hence, the firm must select the best way to acquire the needed technology (Clarke *et al*., 1995). Traditionally, three innovation strategies have been analyzed in the literature: make, buy[1] (Murray *et al*., 1995; Veurgelers and Cassiman, 1999; Cho and Yu, 2000; Mol, 2005) and cooperate in R&D projects. However, this last one has usually been studied independently due to its specificity and complexity (*i.e.* Bayona *et al*., 2001; Cassiman, and Veugelers, 2002). Moreover, the importance of this strategy is constrained since the evidence suggests that firms spend three times as much on R&D outsourcing as they do on strategic alliances (Narula, 2001). Therefore, this investigation will focus only in the make and buy R&D and the combination of both strategies.

2. Research Questions

2.1 Internal R&D versus External R&D

Due to the new technologies development is each time faster, some firms select the externalization of the R&D activities since it is not feasible for them to develop internally such specific technology (Quinn, 2000). Besides, as stated by Barney (1999), firms do not need to own all the resources and capacities while they could access them externally. Some of the advantages of developing external R&D activities are that it is more reliable and the

[1] In this work is used indifferently make or in-house R&D and buy or externalize R&D.

results are more predictable since the technology has been already developed and tested[2] (Kessler and Bierly, 2002). Likewise, it allows calculating the risk *a priori*, offers solution for the capacity problems, increases the speed to access to new technology and reduces the risk (West, 2002). Externalization of R&D could be interpreted as a substitute of the internal knowledge of the firm (Quinn, 2000).

On the other hand, the remarkable complexity of the R&D activities, suggests the creation of internal departments for developing these activities (Dosi, 1988). The information flow between the R&D department and them who would use the new technology could considerable increase by integrating the R&D activities (Fernandez, 2005). At the same time, in-house R&D constitutes a unique source of knowledge and allows an objective valuation of the real innovation needs (West, 2002).

Analyzing the disadvantages of the strategies it can be observed that developing internal R&D is more expensive, it takes long time unlit the commercialization of the new product, it is by nature more risky and less predictable and the firm could be isolated in only one technology (Perrons and Platts, 2004). Acquiring technology in the market does not results in a competitive advantage *per se* due to the technology will be available for competitors as well (Barney, 1991) and because it is a short term strategy (Kurokawa, 1997). External dependences, functional inequalities, and coordination problems are others disadvantages of the buy strategy stated in the literature (Kotabe and Helsen, 1999).

2.2. Complementarity of the innovation strategies

Actually, due to the vast technological changes, most of the products and services offered in the market need embody a specific set of technologies, each of which requires high specialized knowledge and capacities to develop, so firms can no longer hope to do everything in-house (Iansiti, 1997). Hence, the firms need the ability to draw their strategies by combining the internal and external R&D (Kurokawa, 1997), that is to say, it is need to look forward the complementarity between the two innovation strategies (Vuergelers and Cassiman, 2006). Additionally, the innovations principally occur with the combination of ideas, resources and technologies (Fey and Birkinshaw, 2005).

The absorption capacity is other concept that highlights the complementarity of the technological innovation sources. This concept stated in the literature points out that in order to take advantage of the external R&D activities, the firm must develop its absorption capacity by doing in-house R&D activities (Cohen and Levinthal, 1990). By

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[2] This statement is only valid in the cases of buying licences, know-how, and other kinds of technologies that could be adapted to the product or to the process.

developing in-house R&D, firms generate its capacities to scan and to integrate the external knowledge which are two essential abilities required for achieve the complementarity of the innovation strategies (Aurora and Gambardella, 1990).

2.3 Determinants of the innovation sourcing strategy

Above was described the advantages and disadvantages of each of the innovation strategies, and it is worth to state the next research question.

R.Q.1 *¿**Which are the divers that determinate the innovation sourcing strategies***?

In order to answer this question it is necessary to deem that due to managers consider external factors and the internal conditions of the firm in order to select the adequate strategy (Cho and Yu, 2000), and base in previous research (Veugelers and Cassiman, 1999; Leiblein *et al*., 2002; Swan and Allred, 2003; Mol, 2005), four theoretical frameworks have been consider to evaluate how internal and external firm conditions determine the innovation sourcing strategy (a) resource-based view (RBV), (b) appropriability theory, (c) contingency theory and (d) transactions cost theory.

2.4 Consequences of the innovation sourcing strategy

As it was already mentioned, several investigations have demonstrated that developing innovation activities generate a positive impact on the over all firm performance (Attaran and Grijalva, 2001; Hall and Bagchi-Sen, 2002). Nevertheless, few studies have been made in order to valuate the impact of each of the innovation strategies over the firm over all performance, and that is why it is important to stress the follow research question.

P.I.2 ¿Which one of the innovation sourcing strategies generates the greatest results in terms of new product development?

Due to the implementation of the innovation strategies has an objective the generation of competitive advantages for the firm (Fahy, 2002), it is substantial valuating the consequences of achieving one or other innovation strategies.

3. Hypothesis

3.1 Determinants of the innovation strategy

3.1.1 The size as a diver

The first stated hypothesis deals with one of the more traditional topics in the innovation literature: relationship between the size of the firm and the innovation activities (Veugelers and Cassiman, 1999). Even the RBV of the firm does not make a specific emphasis in the

size of the firm, it could be considerate as the stock of the tangible resources (Lowe and Taylor, 1998). Large firms have greatest resources to innovate internally due to the can stand more risky activities than small firms since they used to have more financial resources and more qualified personal (Tsai, 2001; Leiblein *et al.*, 2002). On the other hand, small firms have some advantages like a high degree of flexibility and a faster answer to market changes.

Acs and Audretsch (1987) consider that the relation of the innovation and firm size depend on each industry. For example, Lowe and Taylor (1998) found that innovation strategy varies depending on the firm size. In this case, small firms trended to externalize the innovation activities. In the same line, Stock *et al.* (2001), found that large firms trend to externalize less since they want to take advantage of the scale economies that they generate in the in-house R&D, marketing, and production. In the investigation realized by Veugeles and Cassiman (1999) they found that small firms restrict their innovation strategy to make or to buy R&D isolated while large firms usually combine both strategies at the same time.

There are some other investigation whit contrary results. For example, Love and Roper (2001) analysing German manufacturing firms, find that large firms are the ones who externalize the more. In the study of Munier (2006) it is observed that large firms trend to externalize the R&D activities. Swan and Allred (2003) find a negative effect of the firm size in the externalization of the R&D activities for developing product innovation. Finally Mol (2005) shows that the size is not a significant driver in the selection of the innovation strategy.

As it can be observed, there is not unison agreement of the relation between innovation and size, hence, it is worth to valuate this relationship in the Spanish firms by addressing the next hypothesis.

H1a: **The probability of selecting the *make-buy* strategy will be higher when the firm is large.**

H1b: **The probability for selecting the *buy* strategy will be higher when the firm is small.**

3.1.2 Innovation Intensity as a driver

Referring to the innovation intensity, understood as the investment in R&D activities, is argued in the literature that the higher it would be, the lower externalization of R&D activities will occur (Harrigan, 1985; Williamson, 1985). Considering that in-house R&D activities are focus to generate a long term competitive advantage (Johnson and Scholes, 1999) and that the externalization of this activities represent a short term strategy

(Kurokawa, 1997), and according to the RBV, in order generate nuclear competences which become in competences hard to imitate related to the core activities of the firm and with a long term perspective, large investments must be done (Mol, 2005). Hence, if the make strategy is the more expensive (West, 2002), firms which have a bigger innovation intensity are tend to develop the R&D activities.

H2a: **When the innovation intensity is higher, the probability for selecting the *buy* strategy will be low.**

3.1.3 The context as a driver

As it was mentioned, according to the contingency theory, firm's decisions depend on the context the firm develops. One clear example could be found in the literature review make by Becheikh *et al*. (2006) here the eighty percent of the studies analyzed found a positive relationship between the innovation activities and the industry characteristics. Referring to the market, Cesaroni (2004) found that when there is an ample technology offer in the market, firm tend to externalize the technology acquisition. As well, this ample technology offer in the market affects positively the firm decision to diversify due to the technology is able to entry in new markets.

According Noori (1990), in the industries where there are high technology changes, firms rely more in the external technology acquisition due to it would be very risky developing internal R&D when the technology change very fast. Empirical support was found by Swan and Allred (2003) who found that external acquisition technology is positively and highly related to a high competition level. Contrary, Pisano (1990) finds that in sectors where the competition is very high, external technology acquisition is preferred by firms; on the other hand in sectors with lowest levels of competition, internal R&D activities are achieved. Hence, base on the above mentioned, when firms are in high competitive sectors, internal R&D activities will be performed in order to gain a competitive advantage, but at the same time, firms will be aware about and will buy the technology available in the market.

H3a: **The *make-buy* strategy will be selected when the firm belongs to a high technology intensity sector.**

Belonging to a holding group will affect the innovation strategy decision. Considering the RBV, belonging to a holding group is an intangible resource that will moderate the innovation strategy. Birkinshaw and Hood (1998) argue that some of the advantages for being within a group is that the strategy could be grouped in technology terms. When there is a complementarity in the technologies between the firm and the group, firm could access to the group resources and it would diminish considerably the costs by developing the

internal R&D activities. In the same way, firm could experiment some economies of scale and scope, minimizing the probability that a firm externalize the R&D activities when it belongs to a holding group (Love and Roper, 2001).

H4a: **When a firm belongs to a group, the *make* strategy will have more probabilities to be selected.**

3.1.4 The appropriability as a driver

According to the appropriability theory firms could diminish or annul completely the investments in the R&D activities if the appropriability is very low and they would not receive the benefits of the innovation activities (Arrow, 1962). In this sense, the study of Veugelers and Cassiman (1999) finds that when appropriability is low, or firms are aware of its important, the probability of externalizing R&D activities will diminish. Cesaroni (2004) results points out in the same way by analyzing chemical industries in USA.

H5a: **When appropriability is high, firms will rather to internalize the R&D activities.**

3.2 Consequences of the innovation strategies

3.2.1 Results of the innovation strategies

Some studies have showed that developing external R&D activities do not reduce the innovation capacity of the firm (Kotabe and Swan, 1994; Chuang and Lin, 1999). Moreover, some studies state that developing the buy strategy have some advantages over the make one. Capon and Galzer (1987) pointed out that acquiring the technology externally is faster and easier which could allow a greatest dynamisms in the market and a better performance for the firm. Nevertheless, some authors state that acquitting the knowledge externally delays the new product development for several reasons. Fist, integrating the external knowledge whit other firm departments, generally results very difficult because knowledge is hard to interpret and to understand (Bierly and Chakrabarti, 1996). Second, the external knowledge usually presents some barriers within the firm due to the “not invented here” syndrome (Katz and Kahn, 1966).

Some other studies pointed out in the same line. Lanctot and Swan (2000) by analyzing a sample of multinational American firms found that external technology acquisition for developing new products and process affects negatively the firm performance. In same stream, Kessler *et al.* (2000) studied the process of new product development of ten American firms and found that externalization of the R&D activity in the first faces of the process, affects negatively the new product market success. Even more, the more operations are externalized during the technological development face, the more slow the innovation development will be. Finally, Fey and Birkinshaw (2005) found that hiring R&D services is

related negatively with firm performance; however, the firms that collaborate with universities presented the highest performance.

Some other investigation state that development R&D activities internally increase firm performance. Analyzing 397 Spanish firm Beineto (2007) state that is through internal R&D like radical innovations are achieved, and that external R&D activities are focus for developing incremental innovations. McPherson (1997) and Licht and Zoz (2000) found the same results. Base in the capacity absorption assumption is quite comprehensible the low performance of the external R&D activities, and under this assumption could be understood the fact that firms which performs the make and buy strategy will the advantages of both strategies and will reach the highest performance.

H7a: **Firms that develop the *buy* strategy will have a lower performance of the R&D activities.**

H7b: **Firms that combine the *make* and *buy* strategies will have a greatest performance than firms that develop isolated make or buy ones**

3.2.2 The size as a results moderator

Some researches indicate that there exist a positive relationship between the size of the firm and the innovation results. On one hand, large firms are more efficient in the R&D expenditures administration which can generate high levels of productivity (Love and Roper, 2001). Likewise, large firms are more productive in terms of innovation due to the complementarities they made in the marketing, production and manufacturing departments (Cohen, 1995). As well it is expected that large firm due to he cost dispersions within the firm will increase their innovation performance (Tsai and Wang, 2005).

Nevertheless, it was found some literature that point out in the opposite direction. Griliches (1980) and Lichtenberg and Siegel (1991) did not found any significant evidence that the innovation results increase with the firm size. Similarly Cohen and Klepper (1996) and Acs and Audretsch (1990) found in their investigations that R&D activities performance are negatively related with the firm size.

As stress in the literature, large firms tend to externalize less the R&D activities due to the scale economies that they can generate by developing in-house R&D activities, which allows them to obtain a bigger absorption capacity in which the case of combining the strategies, they could obtain better results than small firms (Aurora and Gambardella, 1990).

H8a: **Large firms will have a greatest performance of R&D activities than small firms.**

H8b: **When combining the strategies, the large firms will have a higher performance of the R&D activities than small firms.**

3.2.3 Innovation intensity as a results moderator

Even Fey and Birkinshaw (2005) found a negative relationship between the innovation intensity and innovation results when analysing English and Swedish firms, there are more the studies that find a positive relationship between these two variables. Veugelers and Cassiman (2006) find empirical support for the fact that there is a relationship between the innovation investments and its performance. The Beneito (2007) results points out in the same line. Lin and Chen (2005) argue that due to the scale economies generated by the R&D investments, the more investments in R&D activities the greatest results. One stated the above, the last hypothesis is presented.

H9c: **Innovation intensity is positively related with the performance of the R&D activities.**

4. Data and the Model

4.1 Sample

The sample was taken from the Technological Innovation Survey, which was carried out by the National Institute of Statistics from Spain. The survey was developed in 2000 and it comprehends the 1998-2000 period. The database is composed by 11778 innovative and non- innovative Spanish firms from fifty-two different industries. According to the CNAE-93 Rev. code, these industries will be reclassified in six categories, form which tow of them will be used for the analysis: manufacturing and services industries.

In order to analyze the determinants of the innovation sourcing strategy there will be considered only the innovative firms. Number of patents, new product and processes development and the R&D investment are usually the three key concepts to determinate if the firm is an innovative one. Measuring if a firm is innovative or not by considering the patents would cause some problems since the patents measure inventions rather than innovations (OECD, 1997), likewise, some inventions are never patented in order to keep them secretly. Direct investment in R&D (in-house or external) activities could not be the filter to select innovative firms since this variable will be the dependent variable in the first section and the explicative on the second and third sections of this thesis. Hence, all the firms that developed product or process innovation during the period 1998-2000 have been classified as innovative firms.

Form the manufacturing firms, only the 42,68% claimed to be innovative and only the 24,97% of the service firms are innovative. After estimating the model and cleaning the database of missing values, the final sub-samples used for the econometrical analysis are composed by 2334 and 992 manufacturing and service firms, respectively.

4.2 Determinants of the innovation strategy

4.2.1 Dependent variable

The dependent variable is composed in base of three questions in which the firm must answer if it had develop internal, or external R&D[3] and if the firm had participated in a R&D cooperation agreement. Base on these there answers the seven possible combinations were made: Make; Buy; Cooperate; Make-Buy; Make-Cooperate; Buy-Cooperate; and Make-Buy-Cooperate. However, when analysing the significant differences between the different strategies[4], it was observed that that the Cooperate strategy, and its combination, was not significantly different to the other strategies. Then the Cooperate strategy and all its combinations were aggregated to the Make-Buy strategy[5]. Then for the econometric analysis based in the multinomial logit, the dependent variable was the innovation strategies (Est_Inno) and it is a four stages variable: Make, Buy, Make-Buy and Non-R&D.

In table 1 it can be observed the descriptive statistics of the sample. Even all firms claim to be innovative there is a high percentage of them that do not have a specific budget for R&D activities, 28,02% for manufacturing firms and 26,41% for service firms. It is as well observed that the more recurrent strategy is the Make-Buy one in both samples. Even more, the percentage of firms developing this strategy is quite similar, 35,65% and 36,19% of manufacturing and service firms, respectively.

4.2.2 Independent variables

Firms were classified by size based in the number of employees four categories resulted, micro, (Mic), small, (Pequ), medium (Med) and large (Gde). For controlling the industry impact, firms were classified in base to its technology intensity. Then dichotomic variables for the technology industry were added into the model. The tow categories are high and medium-high technology (Int_Tec_A_Ma) and low and medium-low (Int_Tec_B_Mb). For the service firms the classification was made in base to the knowledge intensity proposed by (Felix, 2006). Two levels of knowledge intensity were included into the model, high (Int_Con_Alt) and low knowledge intensity

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[3] Hiring R&D services, rights of patents, licenses and know how are included in the external R&D activities. Buying machinery is not considered as an external R&D activity.

[4] Taking the technological intensity, the size and the product and process innovation, an ANOVA was developed in order to find the significant differences between the strategies.

[5] The greatest significant differences were found between the Make, Buy and Make-Buy strategies.

(Int_Con_Baj). Two dichotomic variables for controlling the innovation intensity were included in the analysis, high and medium-high (Int_Inn_A_Ma) and low and medium-low innovation intensity (Int_Inn_B_Mb). The variable for the belonging to a holding group (Gp_Emp) was included in the model. The appropiabiltiy perceived (Prot) and the received financial aids for developing innovation activities (Fina) were considered for the econometric analysis.

Tabla 1. Estrategia de Innovación por Industria

		Industria	
		Manufacturera	Servicios
No realiza I+D	Recuento	654	262
	% de sector	28.02%	26.41%
Hacer I+D	Recuento	614	130
	% de sector	26.31%	13.10%
Comprar I+D	Recuento	234	241
	% de sector	10.03%	24.29%
Hacer-Comprar I+D	Recuento	832	359
	% de sector	35.65%	36.19%
Total		2334	992

Finally, it is worth to analyse the objectives that firms pursued for achieving innovation activities as well as the obstacles perceived and the information sources used by the firms in order to develop R&D projects. The objectives considered are the cost reduction (Obj_Cost), quality improvement (Obj_Cal), sales improvement (Obj_Vent) and the social responsibility (Obj_Resp). The high cost (Obst_Cost), information lack (Obst_Inf), qualify personal lack (Obst_Pers), change resistance (Obst_Res) and the clients lack of sensibility (Obst_Nec) were the obstacles analysed in the model. As regarding for the information sources, the variables added into the model are the clients (Info_Cli), competitors (Info_Com), suppliers (Info_Pro) internal (Info_Int) and technological centres information (Info_Cent).

4.3 Consequences of the innovation strategy

4.3.1 Dependent variable

The percentage of sales due to the new or highly improved product (Vent_NP) have been widely used in the literature for measuring the performance of the R&D activities D (Cano and Cano, 2006; Veugelers and Cassiman, 2006; Wang and Chien, 2006). Some of the advantages for measuring the performance of the R&D activities by this variables is that it is not been only considered the number of inventions but all of them that have reached the market, and in this way, the all innovation process is being

evaluated. In the other hand, by measuring the R&D performance by this variable, it is being evaluated the product success since it represent the market acceptance (Cano and Cano, 2006). Even more, the OECD (1997) proposed this evaluation method for the R&D activities.

4.3.2 Independent Variables

In order to evaluate the consequences of the innovation strategies, the dependent variable used in the determinant section, will be breakdown in its four categories: Non R&D (No_ID), Make (Hacer), Buy (Comprar) and Make-Buy (Hac_Comp). These variables are included in the model as dichotomic variables in order to evaluate their impact in the sales percentage of new product. The size is included in the same way it was made in for the determinant section. The technology intensity and the knowledge intensity are again included joint to the group belonging, appropriability and the financial aids. For controlling the investment on each strategy, the variables of percentage of internal (G_ID_Int) and external (G_ID_Ext) R&D expenses were included in the model. Finally, due to the performance of R&D activities is measured in base to the sales, the variable of marketing expenses for new products (Mkt) were included in the model in order to isolate its impact.

5. Results

5.1 Determinants of the innovation strategy

In table 2 the results of the model are presented. Since a logit multinomial was used to evaluate the determinants of the innovation strategies, the marginal effects were calculated for each variable in order to asses their impact on the selection of the strategy. Each of the coefficients indicate the effects on the probability that one option (innovation strategy) will occur taking as a reference on of the options (No_ID).

The model 1) represents the replication of the Veugelers and Cassiman (1999) model, which explains the 12,47% (pseudo R2). The models 2a) and 2b) represents the models developed for the manufacturing and services firms, respectively. The model for the manufacturing firms explains the 18,01% and the model for the services firms explains a little bit more, the 14,40%.

5.1.2 The size

The results presented in table 2 bring statistical support for H1a, in which it is stated that large firms are the ones which look for complementarity in the strategies. This

support was found in the three models. In the model of Veugelers and Cassiman (1999) and on the model for services firms, it can be seen that the large firms are those ones that trend less to select the Make strategy. This behaviour was found as well in Veugelers and Cassiman (1999) investigation.

As referring to the small firms (H1b) non statistical support was found in order to indicate that these firms are the ones that most trend to externalize the R&D activities, as it was found in Lowe and Taylor (1998). Contrary, it is observed in the models 2a) and 2b) that small firms, equally to large firms, trend to combine the R&D activities.

5.1.2 The context

As it is proposed in the contingent theory, the context in which firms develop their activities affects significantly the innovation strategy decision (Donalson, 1995). When the firms belong to high technological intensity sectors -or high knowledge for services firms- looking for the complementary between the innovation strategy will be the most recurrent strategy for firms. Then there are enough statistical evidence to support hypothesis H3a.

Non statistical support was found for hypothesis H4a in which it was sated in that firms belonging to a holding group will trend to select the make strategy. However, belonging to a holding group resulted a driver for the innovation strategies since it influence positively the selection of the make-buy strategy.

5.1.3 Innovation Intensity

According the literature, the more innovation intensity, the less probability to externalize the R&D activities (Williamson, 1985), however, non statistical support was found to this statement. It was found that manufacturing firms with high innovation intensity (Int_Inn_A_Ma), have a higher probability to select the Make-Buy strategy. This aspect is quite comprehensible for one reason. If firms besides to achieve the high cost for developing internal R&D activities, have to acquire technology in the market and incurring in transaction costs, then, a bigger investment is needed to achieve both strategies at the same time. As for the service firms, the behaviour in inverted since this variable diminish the probability for combining the Make and Buy strategies. Additionally, due to the absent of significant values for the Buy strategy, hypothesis H2a must be rejected.

Tabla 2. Elección de estrategias de innovación. Modelo logit multinomial; efectos marginales.

Estrategias	Variables independientes	1) Vergeulers y Cassiman '99	2a) Emp. Manufactureras	2b) Emp. Servicios
Hacer	1. Pequ	-.0527 (.0352)	-.0243 (.0384)	-.0242 (.0343)
	2. Med	-.0270 (.0342)	.0370 (.0389)	-.0124 (.0355)
	3. Gde	-.0547* (.0322)	.0428 (.0411)	-.0735** (.0359)
	4. Int_Tec_A_Ma	.0676*** (.0218)	.0776*** (.0236)	
	5. Int_Con_Alt			.0636** (.0256)
	6. Int_Inn_A_Ma		-.0912*** (.0251)	.0215 (.0279)
	7. Obst_Cost	-.0214 (.0388)	-.0087 (.0439)	-.0016 (.0471)
	8. Obst_Res	.0225 (.0437)	.0176 (.0523)	-.0667 (.0605)
	9. Obst_Pers		-.0685 (.0711)	.0068 (.0196)
	10. Obst_Inf		.0616 (.0746)	.0494 (.0899)
	11. Obst_Nec		-.0261 (.0519)	-.0213 (.0534)
	12. Info_Int	.0268 (.0415)	.0519 (.0481)	.0086 (.0470)
	13. Info_Com	.0422 (.0404)	.0407 (.0462)	-.0797 (.0521)
	14. Info_Pro		-.0428 (.0431)	-.0189 (.0473)
	15. Info_Cli		.0596 (.043)	.0537 (.0493)
	16. Info_Cent		-.21401*** (.0483)	.0644 (.0503)
	17. Obj_Cost	-.0753** (.0359)	-.0433 (.0443)	-.0489 (.0440)
	18. Obj_Vent		.1025** (.0415)	.0559 (.0445)
	19. Obj_Resp		-.0026 (.0348)	-.0311 (.0391)
	20. Obj_Cal		-.0115 (.0521)	-.0247 (.0556)
	21. Gp_Emp		-.0021 (.0277)	.0381 (.0292)
	22. Prot	.2651*** (.0503)	.2692*** (.0541)	.1909** (.0853)
	23. Fina		-.0673*** (.0227)	-.0256 (.0285)
Comprar	1. Pequ	-.0139 (.0213)	-.0084 (.0226)	-.0659 (.04409)
	2. Med	-.0255 (.0198)	-.0074 (.0226)	.0112 (.04869)
	3. Gde	-.0426** (.0190)	-.0186 (.0237)	-.0529 (.04764)
	4. Int_Tec_A_Ma	-.0675*** (.0135)	-.0609*** (.0144)	
	5. Int_Con_Alt			-.1694*** (.0346)
	6. Int_Inn_A_Ma		-.0214 (.016)	-.0014 (.0336)
	7. Obst_Cost	-.0268 (.0254)	-.0099 (.0280)	-.0453 (.0570)
	8. Obst_Res	-.0066 (.0291)	.0032 (.0344)	.1527** (.0706)
	9. Obst_Pers		.0658 (.0444)	-.0064 (.0249)
	10. Obst_Inf		-.0608 (.0479)	-.1357 (.1136)
	11. Obst_Nec		-.0057 (.0341)	-.0025 (.0651)
	12. Info_Int	-.0422 (.0272)	-.0135 (.0306)	.0455 (.0562)
	13. Info_Com	.0057 (.0274)	.0430 (.0306)	-.0223 (.0642)
	14. Info_Pro		.0620** (.0280)	.1115* (.0584)
	15. Info_Cli		-.0533** (.0287)	.0718 (.0619)
	16. Info_Cent		-.0784** (.0333)	-.1541** (.0679)
	17. Obj_Cost	-.0051 (.0243)	.0372 (.0291)	.0056 (.0538)
	18. Obj_Vent		-.0593** (.0253)	-.0597 (.0536)
	19. Obj_Resp		-.0321 (.0221)	-.0414 (.0465)
	20. Obj_Cal		-.0206 (.0315)	-.0930 (.0651)
	21. Gp_Emp		-.0073 (.0181)	-.0328 (.034)
	22. Prot	-.1172*** (.0388)	-.0776** (.0407)	-.4436*** (.1459)
	23. Fina		-.01024 (.0149)	-.0596* (.0346)

Tabla 2. Elección de estrategias de innovación. Modelo logit multinomial; efectos marginales. (continuación)

Estrategias	Variables independientes	1) Vergeulers y Cassiman '99	2a) Emp. Manufactureras	2b) Emp. Servicios
Hac_Comp	1. Pequ	.1418*** (.0462)	.0925* (.0485)	.0762 (.0638)
	2. Med	.1930*** (.0431)	.0702 (.0465)	.0237 (.0625)
	3. Gde	.3471*** (.0383)	.1652*** (.0477)	.1919*** (.0624)
	4. Int_Tec_A_Ma	.1874*** (.0234)	.1612*** (.0257)	
	5. Int_Con_Alt			.2280*** (.0355)
	6. Int_Inn_A_Ma		.1591*** (.0268)	-.0971** (.0401)
	7. Obst_Cost	.0900** (.0419)	.0053 (.0486)	.1116 (.0681)
	8. Obst_Res	.1170** (.0462)	.0378 (.0564)	-.1181 (.0837)
	9. Obst_Pers		.0129 (.0772)	.0329 (.0291)
	10. Obst_Inf		.1273 (.0811)	.0071 (.1332)
	11. Obst_Nec		.0237 (.0566)	.0953 (.0769)
	12. Info_Int	.2424*** (.0442)	.1025* (.0526)	.0506 (.0691)
	13. Info_Com	-.0526 (.0433)	-.1644*** (.0512)	-.0949 (.0755)
	14. Info_Pro		-.0924* (.0478)	-.0712 (.0705)
	15. Info_Cli		.0931** (.0469)	.0571 (.0725)
	16. Info_Cent		.5567*** (.0479)	.2322*** (.0715)
	17. Obj_Cost	.0529 (.0387)	-.0880* (.0489)	.0949 (.0648)
	18. Obj_Vent		.0385 (.0453)	.0008 (.0658)
	19. Obj_Resp		.0433 (.0383)	.0671 (.0542)
	20. Obj_Cal		.0641 (.0571)	.1793** (.0843)
	21. Gp_Emp		.0688** (.0298)	.0124 (.0414)
	22. Prot	.4220*** (.0527)	.3079*** (.0577)	.7072*** (.1391)
	23. Fina		.1207*** (.0247)	.1787*** (.0432)
Número de observaciones		2332	2332	992
LR chi2(30)	=	760.26	1098.23	379.89
Prob > chi2	=	0.000	0.000	0.000
Pseudo R2	=	0.1247	0.1801	0.1440

* p < 0.1
** p < 0.05
*** p < 0.01
Errores estandar en paréntesis
No_ID es la base en la salida del modelo.
Las empresas micro, la intensidad tecnológica baja y la intensidad innovadora baja son las variables de referencia.

5.1.4 Appropriability

The hypotheses drawn under the appropriability theory (H5a) is partially accepted since when the appropriability is high, or the conscience of it is high, the Buy strategy will be the one which has lowest probability to be selected. However, firms will not prefer to develop the R&D activities internally, rather, they will seek for complementarity by developing the Make and Buy strategy jointly.

5.1.5 Obstacles

Results indicate that the lack of qualified personal as an obstacle to develop innovation activities, is not a driver for the selection of the innovation strategies. Nonetheless, the high costs perceived (Obst_Cost) an the change resistance (Obst_Res), evaluated in model 1) affects positively the selection of the Make-Buy strategy.

5.1.6 Objectives

As it was expected, the innovation objectives pursued by firms determinate the innovation strategy. On one hand, in the model 2a), when firms looks for the cost reduction as an innovation objective, they are less prone to select the Make-Buy strategy. Even the results are not significant, it looks that firms select the Buy strategy when they want to reduce their cost. On the other hand, in model 1) it is observed that firms will not like to develop internal R&D activities when they are looking for reduce their cost.

The sales improvement (Obj_Vent) as an innovation objective affects negatively the R&D externalization and affects positively the Make strategy for manufacturing firms, suggesting that firms looks for the pioneer advantage (Love and Roper, 2001).

5.1.7 Information sources

The results obtained are in the same line with those obtained by Veugelers and Cassiman (1999) and these results bring a wide support to the absorption capacity proposed by Cohen and Levintal (1990). First, when manufacturing firms valuate the internal information positively (Into_Int) trend to look for complementarity between the strategies. Thus, in order to take advantage of the external knowledge, they develop jointly their internal capacities in order to absorb the external knowledge. Second, when external information from technological center is high valuated, manufacturing and service firms will avoid to develop exclusively the Make or Buy strategies; rather, they will prefer to combine both strategies to take advantage efficiently of the external knowledge by developing the Make-Buy strategy.

An other information source that determinate the innovation strategy for manufacturing firms is the information coming by clients (Info_Cli). This information increases positively the probability for selecting the Make-Buy satrategy. It was found in both samples that information coming from suppliers (Info_Pro) since when firms valuate this information high, they will trend to select the Buy strategy.

Finally, the data has allowed measuring the impact of the governmental financial aids into the innovation strategy decision and it was found that this variable increase the probability for selecting the Make-Buy strategy. Taking into consideration the innovation intensity results, is comprehensible that for developing the Make-Buy strategy more investment is necessary, and it would be easily achieved if the firm receive financial aids.

5.2 Consequences of the innovation sourcing strategies

Due to the percentage of new products is the dependent variable used the measure the performance of the innovation strategies, the multiple regression was used. When developing the Cook and Weisberg test, heteroskedasdicity was find in the models 1) and 3a), then, these regressions were made using robust multiple regressions. In table 3 there are showed the results of the different models developed. Model 1) is the replica of Veugelers and Cassiman model (2006), models 2a) and 2b) are the models proposed for manufacturing and service firms, respectively. The models 3a) and 3b) were developed with a sub-sample of firms that pursued only the Make-Buy strategy.

5.2.1 Innovation strategies

The first hypothesis developed for the consequences of the innovation sourcing (H6a) indicates that developing only the Buy strategy will produce the lowest R&D results. This hypothesis is confirmed for model 1) due to the Buy strategy has the lowest impact into the R&D performance. This result is in line with those obtained by Kessler et al. (2000) and Lanctot and Swan (2000). In the models proposed in this investigation the same patron is observed for manufacturing and service firms, however, the coefficients are not significant.

As in Veugeleres and Cassiman (2006) investigation, it can be observed in the three models on table 3 that the strategy that produces the greatest positive and significant impact into R&D performance is the Make-Buy strategy. This results give support or the H6a hypothesis that there exist complementary in developing the Make and Buy strategy.

Finally, all the positive coefficients of the innovation strategy in the R&D performance, indicate that these activities (internal, external or both), have a bigger impact on performance that the reference variable (No_ID), which indicates that no mater which innovation strategy is developed by the firms, the results will be better than non developing any R&D activities.

Tabla 3. Consecuencias de la estrategia de innovación.

Var. dependiente: Porcentaje de ventas de nuevos productos o altamenente mejorados (Vent_NP)

Variables independientes	1) Vergeulers y Cassiman '06	2a) Emp. Manufactureras	2b) Emp. Servicios	3a) Hac_Comp Emp. Manufactureras	3b) Hac_Comp Emp. Servicios
1. Pequ	-5.023** (2.049)	-4.610** (1.900)	2.079 (3.087)	-11.669*** (4.366)	-0.694 (6.164)
2. Med	-6.855*** (2.011)	-6.313*** (1.887)	-3.355 (2.974)	-15.401*** (4.238)	-3.090 (6.161)
3. Gde	-8.800*** (2.121)	-7.909*** (2.064)	-6.417** (3.035)	-15.070*** (4.367)	-11.095* (6.109)
4. Hacer	10.423*** (1.163)	4.895** (2.185)	6.864 (4.700)		
5. Comprar	4.235** (2.119)	2.705 (2.159)	3.023 (2.410)		
6. Hac_Comp	10.907*** (1.568)	5.240** (2.045)	5.608* (3.174)		
7. G_ID_Int		0.061*** (0.023)	0.057 (0.046)	0.053* (0.032)	0.091* (0.054)
8. G_ID_Ext		0.052 (0.036)	-0.125*** (0.044)	0.049 (0.048)	-0.183* (0.095)
9. Mkt		6.185*** (1.303)	3.804* (2.046)	4.712** (2.014)	1.255 (3.456)
10. Int_Tec_A_Ma	3.389*** (1.244)	2.472* (1.276)		4.673** (1.986)	
11. Int_Con_Alt			4.969** (1.945)		3.366 (4.604)
12. Int_Inn_A_Ma	2.999** (1.367)	2.724** (1.346)	0.101 (2.094)	1.982 (2.439)	-2.787 (3.891)
13. Obst_Inf	1.329 (2.320)				
14. Obst_Nec	1.147 (2.554)				
15. Gp_Emp		-2.640* (1.371)	1.011 (1.957)	-0.058 (2.135)	1.028 (3.333)
16. Prot		10.712*** (2.880)	46.234*** (7.268)	2.928 (4.238)	45.762*** (8.773)
17. Fina		-0.010 (1.190)	3.201 (2.291)	-0.126 (1.933)	3.464 (3.407)
_cons	18.252*** (2.105)	17.564*** (1.645)	10.745*** (3.289)	31.089*** (4.311)	21.409*** (7.833)
Núm. de observacion	2334	2334	992	832	359
Prob > F =	0.0000	0.0000	0.0000	0.0001	0.0000
R2 =	0.0428	0.0628	0.1533	0.0432	0.1822
R2 ajust (MCO) =	0.0387	0.0571	0.1411	0.0303	0.1562

* p < 0.1

** p < 0.05

*** p < 0.01

Errores estandar (robustos para el modelo 1) y 3a)) entre paréntesis.

Las empresas micro, la int. tecnológica y de conocimiento baja y la int. innovadora baja son las variables de referencia

5.2.2. The size

Contrary to Acs and Audretch (1990) results, the firm size affects negatively the R&D activities performance. It can be observed in models 1) and 2a) on table 3 that all sizes have a negative and significant coefficient, which reveals that the results achieved by micro firms are the biggest. On the other hand, for service firms only the large firms presented a negative and significant coefficient. Therefore, the H7a hypothesis is rejected in which it was suggested that large firms will achieve the greatest results.

Models 3a) and 3b) were developed for testing H7b hypothesis in which it is stated that when combining strategies, large firms would have a better performance due to the scales economies they can generate in the R&D, production and marketing departments (Cohen, 1995). The results are consistent with those obtained in models 2a) and 2b) where large firms are the ones with the lowest R&D activities performance. Thus non statistical support exists for hypothesis H7b.

5.2.3 The context

The technology intensity, for manufacturing firms, and the knowledge intensity, pro service firms, are factors that condition the results performance of R&D activities. In all models, except in the 3b), firms that belong to a high technology, or knowledge, intensity sectors presents higher results of the R&D activities. One surprising results is the one that when belonging to a holding group, R&D performance for manufacturing firms will be negatively affected.

5.2.4 Innovation intensity

Veugelers and Cassiman (2006) found in their results that innovation intensity of the firm affects positively the R&D performance. When replying their model in the model 1), it is observed that Spanish firms also increase their R&D results when they make greater innovation investments. Nevertheless, in the rest of the models even the positive relation remains clear, the coefficient losses significant power explanation. For this reason, the stated in H8a that the more innovation intensity, the greatest results, is only valid for manufacturing firms.

5.2.5 Marketing and R&D expenses

The amount of R&D internal and external expenses affects lightly the R&D results. For manufacturing firms the R&D expenses focus on internal activities affect positively the results, while for service firms, the innovation results are negatively affected by the percentage of R&D activities focus on external activities. On the other hand, as expected, the marketing investment for new products (Mkt) has a positive and significant effect in the R&D activities performance both for manufacturing and service firms.

5.2.6 Appropriability and financial aids

More than just a determinant for the innovation strategy decision, appropriability is as well a moderator for R&D activities performance, due to the highest appropriability for innovations, the more benefits for their commercialization will be achieved (Teece, 1986). Finally, it is observed that financial aids received form government, does not affect significantly the results of the R&D activities.

6. Conclusions

This investigation has showed the importance for developing R&D activities, being internal or external ones, duet to, when developing them, the innovation results will be higher than when developing innovation by non R&D activities. However, not all the ways for developing R&D activities produces the same impact on firm performance. When combining the Make and Buy strategies, due to the complementarities between them, firms will achieved the highest results. By developing one strategy isolate, it was observed that the Buy strategy is the one that produces the lowest results for the R&D activities with respect to new products development.

It was found in the investigation that there are some factors that condition the innovation strategy decision. The industry in which firms develop their activities was found to be a driver for selecting the innovation strategy since manufacturing firms have different behaviour patron than service firms. Regarding for the manufacturing firms it was found that the size is not a driver for the innovation strategy since all firms will look for the complementarity between the strategies.

The costs are one of the main diving forces for selecting the innovation strategy in manufacturing firms. Fist, due to the positive impact of innovation intensity in the Make-Buy strategy indicates clearly that this strategy is the more investment demander.

The financial aids is other factor that gives support to this supposition since firms receiving financial aids, look for developing the Make-Buy strategy. This is very comprehensible due to that firms besides to achieve the high cost for developing internal R&D activities, have to acquire technology in the market and incurring in transaction costs, then, a bigger investment is needed to achieve both strategies at the same time. Likewise, when firms look for cost reduction as an objective of the innovation activities, they will not chose the Make-Buy strategy due to it is the more expensive one.

One important determinant for innovation strategy in manufacturing firms is that when the are looking for increase their sales, through developing new products or increasing the market share, they rather to select the in-house R&D activities, clearly indicating that developing innovation in-house it allows to generate imitation barriers and increase the pioneer advantage (Dierickx and Cool, 1989).

As regarding for the impact of the size on the service firms, it was observed that the behaviour patron in different to manufacturing firms. Only larger firm look for

complementarity of the innovation strategies. Other difference is that service firms are more susceptible to the “not invented here” syndrome.

Even there are different behaviour patron between manufacturing and service firms, there are one common factor that determinate the selection of the innovation strategy: the technology and knowledge intensity. As indicated by Pisano (1999), developing internal R&D activities allow generating competitive advantages in order to compete in the chancing markets. However, is quite difficult to innovate where the market change so fast (Noori, 1990), thus, firms that belongs to high technology or knowledge intensity sectors, firms will rather combining the Make and Buy strategy. In this way, by combining strategies, firms avoid to block themselves by focusing all the resources in the internal R&D activity which could be displace very fast in the market (Perrons and Platts, 2004).

The factors conditioning the results of the innovation activities are the innovation strategy selected, the technological and innovation intensity, firm size, the appropriability and the marketing investments for new products.

Even the Make-Buy strategy is the one that have the greatest impact into the innovation results, not all firms can profit in the same way from this strategy. Contrary to that stated by Cohen (1995), the larger the firm is, the lowest the benefits for the innovation activities will be achieved. Accordingly, due to flexibility, the entrepreneurship dynamism and the fast answer to market structure changes, small firms will take more advantage from the innovation activities.

The effect of the Buy strategy was not found to be negative as suggested by some authors ((Kessler *et al.*, 2000; Lanctot and Swan, 2000; Fey and Birkinshaw, 2005), but it is the innovation strategy that produces the lowest results measured as de new product development. This low performance could obey principally to two main factors. First, if the Buy strategy is developed isolated, then the firm does not have an absorption capacity affecting the results of the external R&D activities. Second, if the objective for externalizing the R&D activities is not developing new products, the impact of this strategy over the innovation performance in the models developed would be diminish. However, when combining the dynamisms of the external R&D strategy with the developing of a unique resource of knowledge by the internal R&D activities, synergies are made and the R&D activities results increase.

Results indicate that firm in high technology intensity industry obtain greatest results of the innovation activities. One possible explanation of this behaviour is that due to the

high competence in the sector, life-cycle time product is shorter (Perrons and Platts, 2004) and firms are forced to develop and commercialize constantly new products, increasing, in this way, the percentage of sales of new products.

Innovation intensity is a conditioning of the innovation strategy results for manufacturing firms. The investment that produces the mayor impact on the innovation results is the one made in internal R&D. That is to say, the more inversion is done, the more results will be achieved. However, some reflection should be done at this point about the efficiency of the innovation activities, since being efficiency is to do more with less. This aspect is supposed to be accomplished by service firms since the R&D results are not conditioned for the R&D investments.

Finally, a high appropriability joint with marketing investment for new products, allows firms to substantially increase the benefits of the innovation activities.

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