Innovation Strategy Selection: *make*, *buy* or both? [1]

Abstract
The aim of this work is to understand the innovation strategy selection by covering the competitive dynamics and firm behavior associated with industry characteristics, the appropriability or protection of technological capabilities and the availability and competitive strength of internally developed resources. Since the data set is longitudinal, we had the opportunity to include lagged variables improving the prospects of valid causal inference. Results indicate that firm internal resources jointly whit innovation objectives and industry competitiveness explain the innovation strategy selection.

Keywords*: innovation strategy, internal firm resources, industry characteristics.*

JEL Clasification: O32, O33

Cruz-Cázares Claudio
Claudio.cruz@uab.es
Universidad Autónoma de Barcelona
Edifici B, UAB, Campus Bellaterra. (Cerdanyola del Vallés)
Barcelona (Espanya)
Telephone: 34 93 581 1209
Fax: 34 93 581 2555

Bayona-Sáez Cristina
bayona@unavarra.es
Universidad Pública de Navarra
Edificio Departamental de los Madroños
Campus Arrosadia
31006 Pamplona
Telephone: 948 169 405
Fax: 948 169 404

García-Marco Teresa
tgmarco@unavarra.es
Universidad Pública de Navarra
Edificio Departamental de los Madroños
Campus Arrosadia
31006 Pamplona
Telephone: 948 169 405
Fax: 948 169 404

[1] The authors thank the Government of Navarra for its financial support. Cristina Bayona-Sáez thanks the Spanish Ministry of Science and Technology (SEC2007-67737-C03-02/ECON) and Teresa García-Marco thanks the Spanish Ministry of Science and Technology (SEJ2007-67895-C04-01 y SEJ2006-09401) for its financial support.

We are grateful to seminars participants of Universidad Pública de Navarra for their valuable comments. We are grateful to Mónica Cortiñas for her great help with the computer program.

Introduction

Market pressure to generate competitive advantages obliges firms to develop innovative activities in order to maintain or to increase their competitive advantage and make certain their existence and long term growth (Perrons and Plats, 2004; Stock *et al.*, 2002). Product, process, market, and organizational innovations are the four different types of innovation (OECD, 2005), considering the first two as technological innovations, in which this work is focused.

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 focused in generating new products and processes or technological improvements to the existent products and processes (OECD, 1997). Technological innovations pursued by R&D activities are increasingly being used by firms in order to gain competitive advantage and it is widely recognized that these activities are central to the success of businesses (Dwyer and Mellor, 1993). Some authors describe technological innovations as the main source of competitive advantage (Prahalad and Hamel, 1990) and a substantial part of the firm's competitive strategy (Shrivastava and Souder, 1987).

In order to achieve the R&D activities, firms must select the most adequate innovation strategy[2], which objective is to guide the firm in acquiring, developing and applying the technology in order to generate competitive advantages (Swan and Allred, 2003). Traditionally, four innovation strategies have been analyzed in the literature: *make*; *buy*; *make-buy* (Murray *et al*., 1995; Veurgelers and Cassiman, 1999; Cho and Yu, 2000; Mol, 2005) and; *cooperate* in R&D activities (Colombo and Garrone, 1996). However, this last one has usually been studied independently due to its specificity and complexity (*i.e.* Bayona-Saéz *et al.*, 2001). Following the above-mentioned, this study will focus on the *make*, *buy* and *make-buy* strategies, whose advantages and disadvantages are explained in the next section.

In this respect, due to the great importance of technological innovations and because the allocation of the limited resources of R&D is one of the most difficult decisions due to the results uncertainty and the ambiguity of the R&D investments it is worth to analyze the driving forces that affect firm innovation strategy selection.

Innovation strategy is a growing area of interest and importance, both academically and professionally, thus is considerable the amount of existent literature on the phenomenon of doing R&D *via* in-house, externalizing or combining both (*i.e.* Kurokawa, 1997; Veugelers and

[2] The mode for acquiring the technology in order to achieve R&D activities has received several names: *a)* technology strategy; *b)* innovation sourcing strategy; *c)* technology sourcing decision and; *d)* technological innovation strategy (Zahra, 1996; Veugelers and Cassiman, 1999; Lancot and Swan, 2000; Jones, 2001). For this work, the terminology considered more appropriate is the technological innovation strategy, but since the investigation will be focus on technological innovations, for simplifying the term innovation strategy will be used.

Cassimman 1999). Three focuses of potential determinants of the innovation technology decision have been followed in the literature: the competitive dynamics and firm behaviour associate with industry characteristics (Utterback, 1994); the appropriability or protection of technological capabilities (Teece, 1986) and; the availability and competitive strength of internally developed resources (Prahalad and Hamel, 1990). However, these focuses have been considered apart in most of the research uncovering some important factors.

Evaluating the internal and the external firm characteristics, this work will draw the hypotheses finding support in the resource base view (RBV), the contingency and the appropriability theories. Likewise, this research incorporates new aspects as determinants of the innovation strategy selection like the kind of innovation developed, firm age, financials aids and industry competitiveness. The methodology used for the econometric analysis is the multinomial logit model and, since the data set is longitudinal, we had the opportunity to include lagged variables improving the prospects of valid causal inference (Baum, 2006).

The remainder of the study is structured as follows. In the second part, the *make* versus *buy* strategies and their complementarities are discussed. Hypotheses are exposed in the next part. The model, sample and variables are explained in the fourth section. The fifth section provides the results of the procedures explained in section four. The last part of the study is reserved for the conclusions, contributions and implications, pointing out the limitations and future lines of research.

2. Innovation Strategies

2.1 Make vs. Buy R&D

Due to the increasing rapidness of new technologies development, some firms prefer 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 results are more predictable since the technology has been already developed and tested[3] (Kessler and Bierly, 2002). Likewise, it allows calculating the risk *a priori*, offers solution for the capacity problems, increases the speed to access 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). The *buy* strategy also allows access to new knowledge areas (Haour, 1992) through the productive networks created (Nishiguchi, 1994).

[3] 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.

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 those which will 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 until the new product commercialization (West, 2002), it is by nature more risky and less predictable and the firm could remain isolated in only one technology (Perrons and Platts, 2004). On the other hand, to a great extent, acquiring technology in the market does not result in a competitive advantage *per se* due that technology is 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 other disadvantages of the *buy* strategy stated in the literature (Kotabe and Helsen, 1999). Finally, the internal capacity to carry out internal R&D is gradually disusing through the exclusive use of external R&D.

2.2 Innovation strategies complementary

Actually, due to the vast technological changes, most of the products and services offered in the market need to 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 needed to look forward to the complementarity between the two innovation strategies (Vuergelers and Cassiman, 2006). Additionally, the innovations mainly occur through combination of ideas, resources and technologies (Fey and Birkinshaw, 2005)

One of the most important concept highlighting the complementarity of the *make* and *buy* strategies is named the *absorption capacity* (Cohen and Levinthal, 1990). This is the firm ability to recognize the value of external knowledge, to assimilate it and to apply it to commercial ends (Abecassis-Moedas and Mahmoud-Jouini, 2008). Acquisition, assimilation, transformation and exploitation are the four organizational capabilities constituting the firm *absorptive capacity* (Zahra and George, 2002). The first one refers to the capability of identifying critical external knowledge. The analysis, interpretation and understanding of the information obtained are developed through the assimilation capability. The transformation is understood as the combination of acquired knowledge with the existing knowledge within the firm. Finally, exploitation is the incorporation of the acquired or transformed knowledge in the firm routines (Abecassis-Moedas and Mahmoud-Jouini, 2008). Complementarity between the R&D strategies is highlighted since firms must achieve in-house R&D in order to generate or increment their

capabilities to scan (acquisition-assimilation) and to integrate (transformation-exploitation) the external knowledge acquired through the *buy* strategy (Arora and Gambardella, 1990). That is, a firm will not make the most of the *buy* strategy efficiently if the firm does not develop R&D activities internally (Colombo and Garrone, 1996). Furthermore, the more the knowledge gained through in-house R&D may serve to modify or improve external technological acquisitions (Veugelers and Cassiman, 1999).

3. Hypotheses

As mentioned first, the determinants of the innovation strategy will be analyzed by considering the firm internal and external conditions since these are the aspects considered by managers when selecting the adequate strategy (Cho and Yu, 2000). Following Surroca and Santamaría (2007) we call for the resource based view (RBV) to focus in the internal part. In order to analyze the external or environmental part, the contingency and appropriability theory will be used.

3.1 Internal factors

The main assumption of the RBV regarding the innovation strategy selection is that externalization of R&D activities will occur either when firms need to develop a specific set of technology in which do not have the needed resources to internalize the activity, or when particular experience is scarce or because it is not one of the firm's core activities (Mol, 2005). Firm resources could to be tangible or intangible (Barney, 1991), the first of them refers to the firm fix assets which capacity is relatively stable and durable like the factory, equipment and firm capital (Fahy, 2002). Intangible resources like knowledge or brand are unique, inimitable, and immobile, reflecting the distinctive pathways of each company (Grant, 1991). The hypotheses drawn from the RBV valuate the technological, commercial and organizational resources, considering the first as tangible and last two as intangible.

3.1.1 Technological resources

In line with Surroca and Santamaria (2007) the technological resources are approximate by the innovation intensity as and represent the R&D investment. It is argued in the literature that the higher the innovation intensity, the less externalization of R&D activities will occur (Harrigan, 1985). Considering that in-house R&D activities are pointing to generate a long term competitive advantage (Johnson and Scholes, 1999; Kurokawa, 1997), large investments must be done in order to generate nuclear competences related to the core activities of the firm and with a long term perspective and hard to imitate (Mol, 2005). Hence, if the *make* strategy is the most expensive (West, 2002), firms which have a bigger innovation intensity are prone to develop the R&D activities internally. Empirical evidence has been found in Cesaroni (2004) research, where

he observes that firms with a high innovation technology are the ones which pursued the *make* strategy. On the other hand, Beneito (2006) emphasizes that firms which develop the *make-buy* strategy have the highest innovation intensity. Following the common results of these studies we preset the first hypothesis.

H1*:* When the innovation intensity is high, the probability for selecting the *buy* strategy will be low.

3.1.2 Commercial resources

The firm internationalization level is a good proxy for measuring the commercial resources of the firm (Surroca and Santamaria, 2007). Internationalization is an issue of importance for firms that often results on vital growth, useful learning outcomes (Prashantham, 2005) and it's argued that internationalization increases the firm's market size, therefore, favouring the innovation activity (Galende and Suarez, 1999). Some studies have analyzed firm internationalization as a determinant for achieve R&D activities and have found a positive relationship (Kumar and Saqib, 1996; Molero and Buesa, 1996). Nevertheless, as far as we know, the internationalization of the firm has never been developed in the literature considering it as a determinant of the innovation strategy selection.

We believed that firms with activities abroad are prone to combine both *make* and *buy* strategies since when a firm becomes international, it gains access to foreign information and communication technologies, production methods, transportation, and international logistics, which could reduce business transactions costs with potential suppliers facilitating the *buy* strategy. Additionally, by developing in-house R&D technological advancements are achieved, increasing the competitiveness and performing disruptive innovations which are usually needed to entry in new international markets (Etflie *et al.*, 1984; Galende and De la Fuente, 2003).

H2: The greater the international activities, the greater the probability of selecting the *make-buy* strategy will be.

3.1.3 Organizational resources

The firm age is a valuable measure of organizational resources since it represents the experience and the knowledge accumulated through time and the *absorptive capacity* acquired (Galende and De la Fuente, 2003). As the commercial resources, empirical evidence point out that the organizational resources have a positive impact in firm innovativeness (Busom, 1991; Bughin and Jacques, 1994). However, none investigation has been found dealing with the firm age as a determinant of the innovation strategy selection, leading a gap in the literature that we want to fulfil. If we consider that young firms often do not have the high economical and human resources (Tsai, 2001) needed to develop the in-house R&D activities, that the *make* strategy is usually more risky and expensive (West, 2002), hence they are prone to select the *buy* strategy

since young firms look for externalizing risk for overcoming environmental uncertainties (Poon and McPherson, 2005).

H3: When firms are younger, the probability for selecting the *buy* strategy will be the highest.

3.2 External Factors

The contingencial theory stresses that firm structure varies depending on the firm context (Chandler, 1962) given that the firm is dependent on the environment since it provides the needed resources and opportunities to survive and grow (Donalson, 1995). The main assumption of the contingency theory regarding innovation strategies is that when a task is safe and predictable, centralization and formalization are appropriated, but when a task is uncertain, then, externalization, and flexibility are required (Bunrs and Stalker, 1961). Here we consider technological intensity, competition degree, belonging to a group and appropriability as the main contextual factors determining firm innovation strategy.

3.2.1 Technological intensity

Industries with a big amount of technological changes deem R&D externalization as the better option for the reason that it is not worth to trust in internal R&D when the market is changing in a high degree (Noori, 1990). Likewise, when there is large technology diversity in the market, firms are influenced to externalize R&D (Cesaroni, 2004). However, following the *absorption capacity* approach, firms need to develop in-house R&D in order to integrate efficiently the acquired technology and gain competitive advantage. To that extent, it is suggested that when technological changes are unpredictable it is needed to set up the R&D integration (Shrivastava and Souder, 1989) in order to avoid technological innovations which treat dramatically the market stability (Cooper and Schendel, 1976). Drawn from the above, next is presented the hypothesis.

H4: The *make-buy* strategy will be selected when the firm belongs to a high technological intensity sector.

3.2.3 Industry Competitiveness

Swan and Allred (2003) found that external acquisition technology is positively and highly related to a high competition level because it allows cost reduction and a quickly entrance to the market. Unlikely, Pisano (1990) argued that in sectors where the competition is very high, the *make* innovation strategy is preferred by firms in order to gain the first mover advantage. Here, we consider the two approaches very valuables. Therefore, innovative firms should not look solely for the flexibility and speed needed in high competitive industries gained through the *buy* strategy, but also should deem generating the barriers to imitation relying in the *make* strategy.

H5: The *make-buy* strategy will be selected when the firm belongs to a high competitive sector.

3.2.4 Belong to a group

Belonging to a holding group is expected to determine the innovation strategy decision. Birkinshaw and Hood (1998) argue that one advantage 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 the group resources and it would diminish considerably the transaction costs by developing the external R&D activities. In the same way, firm could experiment some economies of scale and scope, minimizing the probability that a firm internalize the R&D activities when it belongs to a holding group.

H6: When a firm belongs to a group, the *buy* strategy will have more probabilities to be selected.

3.2.4 Innovation appropriability

According to the appropriability theory, incentives to *make* or *buy* R&D activities will be conditioned by the magnitude in which the R&D results could be appropriate by the firm (Veugelers and Cassiman, 1999) depending in the commercialization firm resources and political and legal structures (Teece, 2006). That is, firms could diminish or annul completely the investments in the internal R&D activities if the appropriability level is very low and they would not receive the benefits of the innovation results (Arrow, 1962). In this sense, the study of Veugelers and Cassiman (1999) finds that when appropriability is high, or firms are aware of its importance, the probability of externalizing R&D activities will diminish. Cesaroni (2004) results points out in the same way by analyzing chemical industries in USA. He finds that firms substitute internal for external R&D when appropriability and knowledge competences are scarce in the firms.

H7: When appropriability is high, firms will prefer to achieve the *make* strategy.

3.3 Controls

3.3.1 Firm size

Controversial is the relationship between firm size and the innovation strategy selection, leaving only the chance to control the model through firm size. On one hand, following the RBV, large firms have greater resources to innovate internally due to the fact that they 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). Contrary, due to the lack of resources, following less risky activities, small firms trend to select the *buy* strategy (Lowe and Taylor, 1998; Swan and Allred, 2003). In this way, Stock *et al.* (2001), found that large firms trend to do

in-house R&D since they want to take advantage of the scale economies that they generate in the in-house R&D, marketing, and production. On the other hand, empirical studies (Love and Roper, 2001; Munier, 2006) point in the opposite row. Finally, Veugelers and Cassiman (1999) argue that small firms restrict their innovation strategy to *make* or to *buy* R&D solely while large firms usually combine both strategies at the same time.

3.3.2 Innovation Objectives

Since firm resources will be allocated depending on the firm objectives (Hamel and Prahalad, 1989), it is worth to control the product or process innovation achieved as determinants of the innovation objectives although the theoretical and empirical studies reefing to this subject is scarce. It is argued that internalizing R&D to achieve product innovation is more efficient since frequent interaction is needed between individuals who possess knowledge (Afuah, 2001). Moreover, developing in-house R&D for product innovation allows creating barriers to imitation and keeping the knowledge inside the firm (Dierickx and Cool, 1989). In this sense, Johnson and Scholes (1999) argue that when products require a design or very technological production methods, the *make* strategy is preferred due to the fact that development process is considered as the best way to acquire the core competences needed to succeed in the market. Contrary, research task such as materials tasking or process innovation are more likely to be externalized due to its uncertainty and complexity (Mowery and Rosenberg, 1989).

3.3.3 Financial aids

The effectiveness of government financial aids to R&D is really important as they attempt to encourage the innovation in order to fill in the *market failure*[4] (Arrow, 1962). As far as we know, research regarding the financial aids to R&D projects as determinant of the innovation strategy selection is scarce. The literature has traditionally focused on how R&D subsides stimulates the additional R&D spending (Branstetter and Sakakibara, 1998; Almus and Czarnitzki, 2003), and its impact on the outcomes of the innovation process (Archibald and Finifter, 2003; Bayona-Saéz and Garcia-Marco, 2007). However, it is essential to investigate whether financial aids affect firm organizational behaviour (OECD, 2006).

4. Data, variables and model

4.1 The sample

The Spanish Business Strategy Survey (henceforth ESEE) is used to perform the empirical analysis which is a firm-level panel data from 1990 to 2005 of manufacturing Spanish firms. The

[4] It is stress that *market failure* exists when private R&D investment is lower than the optimal social benefits (Klette *et al*., 2000).

survey is compiled by the Spanish Ministry of Science and Technology and the Public Enterprise Foundation (Fundación Empresa Pública—FUNEP) and it is random and stratified according the industry sector and firm size (Fariñas and Jaumandreu, 2000). Market, costumers, products, employment, trade, outcome results, corporative strategy, human resources, and technological activities, is the information available in the survey which is 16 pages long. The aim of the ESEE is to know the evolution of the characteristics and the strategies of the Spanish firms. This survey is really valuable since relative few data sets contain information at firm level over several years (Leiponen and Helfat, 2003). Furthermore, several publication have been done using the ESEE focusing on firm technological activities (*i.e.* Surroca and Santamaria 2007; Diaz-Diaz *et al.*, 2008).

The sample is an unbalanced panel since not all the firms in the panel answered during the seventeen years because some new firms were added each year and some firms cease to provide information. For our analysis we dispose of fourteen years (1992-2005) since some of the variables were included in the survey until 1991 and this year was lost when generating lagged variables. Outliers, firms with missing values and firms without a continuous period, were deleted from the panel. Non logical values (i.e percentages values over 100%) or values considerably higher than the rest of the observation of the firm were also considered as outliers. As regard to the period, a firm is allowed to have just a part of the fourteen years period if, and only if, the period the firm was surveyed is continuous for at least five years. Finally, since we considered some lagged (t-1) variables, the smallest number of observation a firm has is four. Following Fritsch and Lukas (2001) and Miotti and Sachwald (2003), innovative and non innovative firms are included in the panel in order to avoid bias in the sample.

The final sample is composed by 14,052 observations of 1,560 firms from which 362 answered during the whole panel (23.21 %). The 42.03 % of the firms are innovative, those who have achieved product and/or process innovations. It is worth noticing that not all innovative firms develop R&D activities (41.70 %) and that not all firms developing R&D activities achieve product and/or process innovations (31.15 %).

4.2 Variables

4.2.1 Dependent variable

The innovation strategy (IN_ST) is the dependent variable in the model. Four levels compose the variable: 1 = *no R&D*, 2 = *make R&D*, 3 = *buy R&D* and, 4 = *make-buy R&D*. This variable is categorical unordered and was taken directly from the data base corresponding to activities in time *t*. The different levels are, by definition, mutually exclusive. In order to assure that the *make-buy* strategy was substantially different from *make* or *buy* isolated, it was recoded from the original data following the next criteria: those firms which external R&D expenses were less than the 10% of the total R&D expenses at *t*, were recode as firms pursuing only the *make*

strategy and, the inverse was done with the internal R&D expenses. Firms which internal or external R&D expenses were larger than 10% remained within the *make-buy* strategy.

4.2.2 Independent variables

The fixed part of the model includes the following firm and contextual specific variables. As mentioned before, the innovation intensity (RDSL1), considered as a proxy of the technological firm resources, is measured as the total amount of R&D expenses divided by total sales. The variable is included in the model using the first lag (*t-1*) because we believed that the current strategy is conditioned by the preparations or planning done the year before. As regarding the commercial firm resources, the firm internationalization level is measured by the percentage of the total sales due to firm exporting activities (EXP). For measuring the organizational resources, following Surroca and Santamaría (2007), the firm age in time *t* (AGE) was used. For generating the variable, the year of firm foundation was subtracted from the current year *t*.

Regarding the external factors, originally in the ESEE, firm industry is classified in 20 different industries according to the CNAE-93 classification but in order to test H4 we reclassified industry as low, medium and high technological intensity following the Oslo Manual from OECD (1997). Hence, the industry's effect on the innovation strategy selection is operationalized by three dummies, the first one for firms belonging to a high technology intensity industry (H_TECH_IN) and the second one for medium technology intensity industry (M_TECH_IN) and the third for low technology intensity industry (L_TECH_IN). For measuring the industry competiveness we used the market dynamism (MK_D) in *t* of the first market of the firm, which could take values of 0= recessive, 0.5= stable or 1= expansive, and the number of competitors in the first market of the firm (CO_N) measured as a four level ordinal variable taking values of 1 = less than 10, 2 = from 11 to 25, 3 = more than 25 and, 4 = atomized. The variable belonging to a holding group (GROUP) is operationalized as discrete, taking value of 1 if the firm does, 0 otherwise. The last variable referring to external factors is the appropriability, which is controlled by the total patents of the firm in *t-1* (TPATL1). This variable is continuous and was generating by adding the patents achieved in Spain and the international patents.

As mentioned before, we controlled for firm size, innovation objectives and financial aids to R&D. Originally in the survey the size was measured as a six level ordinal variable in respect of the number of employees but this variable was discompose in three dummy variables for the small, medium and large firms (SM, MED, LARGE, respectively) The small ones are those representing firms with less than 50 workers, medium firms with more than 50 and less than 200 workers and finally, large firms with more than 200 workers. As mentioned, the objectives of the innovation activities are expected to influence the innovation strategy selection so we used the lagged (*t-1*) process innovation (PRIL1) and product innovation achievement (PINL1).

Table 1. Means, standard deviations and variables correlations

Variables	Mean	Std. Dev.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. INN_ST	1.662397	1.046374	1															
2. RDSL1	0.6574865	1.961135	0.3858*	1														
3. EXP	17.73972	25.04291	0.3257*	0.1695*	1													
4. AGE	2.875489	0.8621237	0.2130*	0.1114*	0.1393*	1												
5. L_TECH_IN	0.4649872		-0.2206*	-0.1809*	-0.2078*	-0.0426*	1											
6. M_TECH_IN	0.2482209		-0.0202*	-0.0784*	0.0363*	-0.0326*	**-0.5357***	1										
7. H_TECH_IN	0.2867919		0.2627*	0.2744*	0.1944*	0.0780*	**-0.5912***	-0.3644*	1									
8. MK_D	0.5460433	0.3408273	0.0952*	0.0501*	0.0641*	-0.0151	-0.1048*	0.0683*	0.0503*	1								
9. CO_N	1.83739	1.141833	-0.1834*	-0.0822*	-0.1006*	-0.1629*	0.1216*	-0.0105	-0.1241*	-0.0478*	1							
10.GROUP	0.3116994		0.3212*	0.1408*	0.3227*	0.2007*	-0.2248*	0.0490*	0.2011*	0.0811*	-0.2433*	1						
11. TPATL1	0.2798178	2.036668	0.1207*	0.1019*	0.0870*	0.0488*	-0.0311*	-0.0164	0.0500*	0.0316*	-0.0363*	0.0666*	1					
12. SM	0.5154426		-0.4205*	-0.1753*	-0.4194*	-0.3502*	0.1853*	-0.0319*	-0.1739*	-0.0702*	0.2807*	**-0.5785***	-0.0975*	1				
13. MED	0.1862368		0.0389*	0.0538*	0.0848*	0.0885*	-0.0850*	0.0383*	0.0572*	0.0024	-0.0825*	0.0921*	0.0115	-0.4934*	1			
14. LARGE	0.2983205		0.4262*	0.1457*	0.3860*	0.3073*	-0.1301*	0.0023	0.1413*	0.0746*	-0.2364*	0.5535*	0.0968*	**-0.6725***	-0.3119*	1		
15. PRIL1	0.3364646		0.2763*	0.1407*	0.1656*	0.0749*	-0.1055*	0.0137	0.1033*	0.1024*	-0.1087*	0.1623*	0.0865*	-0.2375*	0.0075	0.2530*	1	
16. PINCL1	0.2555508		0.3322*	0.2173*	0.1689*	0.0993*	-0.0869*	-0.0534*	0.1469*	0.0640*	-0.0939*	0.1253*	0.1144*	-0.1919*	0.0089	0.2021*	0.3404*	1
17. InFARDL1	0.4290805	1.443	0.3987*	0.4446*	0.2455*	0.1319*	-0.1655*	-0.0283*	0.2096*	0.0401*	-0.1051*	0.1968*	0.1177*	-0.2587*	-0.0186*	0.2984*	0.2012*	0.2033*

** Significance level at 0.05*

The last, control variable is financial aids (InFARDL1) received by the firm for developing R&D activities in *t-1*, which was generated by adding the financial aids received from the local government, from the State and from others. In order to reduce differences among firms the natural logarithm of this variable was used for the estimation. Means, correlations and standard deviations for each variable are presented in table 1[5].

5. Results

5.1 Descriptive

As mentioned before, the sample is composed by 14,052 observations of 1,560 firms in a panel of fourteen years, from which 362 answered during the whole panel (23.21 %), the rest follows different continuous patterns. Table 2 shows the descriptive of the innovation strategies by firm size. First, within the whole sample, the 64% of the observations are not developing R&D activities in time *t*. It seems there is a lineal relation between firm size and the achievement of R&D activities. As showed, there is a clear tendency that small firms trend not to develop R&D activities (87%). On the other hand, almost 40 % of medium-size firms attain R&D as well as nearly 72 % of large firms. These firms are the more involved in the *make* strategy (35.5%). Finally, the *buy* strategy is the less pursued by all firms, 5% in total. As observed in table 2, the 51% of the total sample are small firms while the 30% are large and the 20% are medium-sized firms.

Table 2. Innovation strategies vs. firm size

Innovation Strategies	Small	Medium	Large	Total
No R&D %	86.58	60.26	28.7	64.41
Make R&D %	6.94	19.11	35.9	17.85
Buy R&D %	2.79	6.27	7.47	4.83
Make-Buy R&D%	3.69	14.37	27.93	12.91
Total %	51.54	18.62	29.83	100

Table 3 presents the descriptive of the innovation strategies and the industry characteristics. High technology intensity firms are more involved in R&D activities (58%), especially in *make* (28%) while only the 34% and the 27% of medium and low technology intensity firms are developing R&D activities, respectively. We observed that the *make* strategy is the more selected for all levels for technological intensity As seen in table 3, firms in expansive market dynamism trend to develop more R&D activities than firms in stable or recessive markets (33 %). Again, the *make* strategy is the one more achieved by firms in all types of market dynamism and the *buy* one is the less pursued.

[5] As observed correlation values are low (< 0.591). Nevertheless, the correlation between large and small firms (LARGE – SM, respectively) is relatively high (0.6725). Hence, in order to evaluate the impact of this correlation the variation inflation factor (VIF) test was developed regressing each independent variable among the others. The highest VIF value was 2.35, being substantially lower than the allowed in the literature (10.0), indicating that the results are not biased due to multicolineality (Nester *et al*., 1985).

Table 3. Innovation strategies vs. Industry

	Technological Intensity			Market Dynamism		
Innovation Strategies	**Low**	**Medium**	**High**	**Recessive**	**Stable**	**Expansive**
No R&D %	76.61	66.43	42.88	67.28	68.08	55.63
Make R&D %	12.26	16.43	28.14	17.89	15.98	21.3
Buy R&D %	4.16	5.3	5.51	4.15	4.65	5.64
Make-Buy R&D%	6.96	11.84	23.47	10.68	11.29	17.43

5.2 Results

In table 4 we present the *traditional* table result where we have the *no_R&D* as the reference category in the model. In this table results are interpreted as the probability of selecting one of the innovation strategies over the reference category. This table gives us the insight of which strategy will be selected when firms decide to start achieving R&D activities. Traditionally, the determinants of the innovation strategy had been analysed until this level and therefore leaving a gap since results in table 4 failed to inform whether one of the strategies is significantly more probable to be selected over the others given X_i, *ceteris paribus*. To fulfil this gap it is needed to rerun the model changing the reference category until crossing all possibilities. These results are presented in table 5 and table 6 for *make* and *buy* as references categories, respectively.

Observe that the log-likelihood (-9717.5684) and the pseudo R2 (.3096) are the same for all models since the model is the same[6]. The only thing which varies is the significance and the sign of the coefficient when the strategies are crossed. For example, observe that the process innovation variable (PRIL1) in table 4 is positive and highly significant for all strategies. In this case, we could assume that the *make-buy* strategy would be selected over *no_R&D*, *make* and *buy* because it has the highest coefficient. However, we do not know if the difference in the coefficient between *make* and *make-buy* (which is very close) is statistical significant. Hence, the only solution to solve this problem is to see table 5 where *make* is the reference and then *make-buy vs*. *make* are crossed.

From table 4 we can see that almost all variables are positive and significant in at least one strategy indicating that all of them influence the decision to achieve R&D activities. However, negative sings indicate that those firms in low technology intensity sectors (L_TECH_I), with high number of competitors (CO_N) and/or small (SM) are less R&D active than the rest of the firms It seems that the *make-buy* strategy is selected as a starting point for developing R&D activities since coefficients in all variables are higher and significant than those for the *make* or *buy* strategy. There is just the exception of GROUP variable, which is just significant and positive for *buy*. In order to see if the *make-buy* strategy is really preferred over *make* and *buy*, for all

[6] The independent and irrelevant alternatives test (IIA) was conducted by the Small-Hsiao test. Results are available if requested to the authors.

variables, we start the analysis following the hypotheses statement by comparing results of tables 4, 5 and 6.

Results show support for H1 here we have stated that firms with high technological resources (RDSL1) are less prone to select the *buy* strategy. Due to the positives and significant sings of *make* and *make-buy* in table 6 results allow us to see that the *buy* strategy is the less prone to be selected when R&D expenditure is high. On the other hand, as observed in table 5 and 6 the high innovation intensity has a positive and significant coefficient indicating that firms with higher innovation intensity are prone to achieve the *make-buy* strategy over *make* and *buy*. The fact that firms achieving the *make-buy* have the highest R&D expenses is comprehensible since firms incur both the cost of allocating plant and equipment capacity and R&D personal as well as the transaction cost of finding, selecting and negotiating when buying technology in the market (Parmigiani, 2007).

Table 4. Multinomial logit model. No_R&D as reference

			Innovation Strategies		
		Variables	***make***	***buy***	***make-buy***
Internal Factors	*Technological resources*	**1. RDSL1**	1.0402*** (.0439)	1.0004*** (.0471)	1.0867*** (.0443)
	Commercial Resources	**2. EXP**	.0140*** (.0011)	.0066*** (.0017)	.0117*** (.0013)
	Organizational Resources	**3. AGE**	.2154*** (.0354)	.0325 (.0500)	.2468*** (.0413)
External Factors	*Technological Intensity*	**4. M_TECH_IN**	.2130*** (.0746)	.1583 (.1056)	.4151*** (.0895)
		5. H_TECH_IN	.6472*** (.0716)	.2112** (.1060)	.8457*** (.0843)
	Industry Competitiveness	**6. MK_D**	.1345 (.0845)	.2965** (.1235)	.4280*** (.0981)
		7. CO_N	-.2067*** (.0300)	-.0745* (.0414)	-.1716*** (.0358)
	Belong to a group	**8. GROUP**	.0925 (.0707)	.5075*** (.1056)	.0678 (.0807)
	Appropriability	**9. TPATL1**	.0398** (.0154)	.0517*** (.0164)	.0444*** (.0162)
Control Variables	*Size*	**10. MED**	.7666*** (.0863)	.6727*** (.1247)	1.0835*** (.1058)
		11. LARGE	1.8569*** (.0877)	1.2858*** (.1314)	2.1478*** (.1080)
	Innovation Objectives	**12. PRIL1**	0.4071*** (0.0623)	.3424*** (.0908)	0.5321*** (0.0719)
		13. PINCL1	1.1763*** (0.0663)	.5953*** (.0979)	1.2400*** (0.0752)
	Financial Aids	**14. InFARDL1**	.2867*** (.0358)	.2402*** (.0434)	0.4254*** (0.0359)
Constant		**βo**	-4.0082*** (.1450)	-4.2221*** (.2017)	-5.3228*** (0.1770)

log likelihood: -9717.5684
Pseudo R2: 0.3096
** p <.1*
*** p < .05*
**** p < .01*
n (number of observations): 14 052
Standard errors in brackets.

In this research it is confirmed that internationalization activities favour innovation development (Galende and Suarez, 1999; Filipescu *et. al*, 2009) since we observed in table 4 that firms with activities abroad achieve one or other innovation strategy. Commercial resources, measured as firm internationalization (EXP), are determineants for the innovation strategy selection. However, H2, we have stated than being international would increase the probability of selecting the *make-buy* is not supported. In table 5 we observed that the *make* strategy is preferred over the other ones since the sign is negative and significant. On the other hand, we see in table 6 that *make-buy* is preferred over externalizing R&D. This indicates that in one way or other firms need to attain in-house R&D when they want to become international firms in order to create the innovations needed to be internationalized.

Support to hypothesis 3 was found since results show that when firms have constrained organizational resources, approximated as firm age (AGE), the *buy* strategy will be preferred (table 6). Fist, in table 4 we observe that the *buy* strategy is not significant different from *no_R&D* and that *make* and *make-buy* are positive and significant, meaning that the younger the firms will not *make* or *make-buy* R&D. But if we wonder to know which strategy is preferred for older firms, we should see table 5. Here we observed that, as seen in table 4, *make* is preferred over *no_R&D* and *buy*, but there is not insight that it is preferred over *make-buy* or *vice versa*.

Contextual factor determine as well the decision to achieve R&D activities and the innovation strategy selection. Table 4 shows that firms in medium and high technology intensity sectors (M_TECH_IN, H_TECH_IN, respectively) are more involved in R&D activities than firms in low technological intensity sectors (the reference category) since the signs are positive for all strategies. In H4 we argued that due to uncertainties firms in high technology sectors would prefer combining both *make* and *buy*. This statement is corroborated since *make-buy* strategy is preferred over *no_R&D* (table 4), *make* (table 5) and *buy* (table 6) for firms in medium and high sectors. Results in table 6 indicate that for high technology sectors the *buy* strategy is the less preferred. By retaking the *absorption capacity* approach we can understand this behaviour since firm will not make the must of the *buy* strategy if they do not achieve in-house R&D activities (Cohen and Levninthal, 1990). On the other hand, there are no significant differences between *make* and *buy* for firms in medium technology intensity sectors.

H5, where we stated that firms will combine both strategies when they were part of highly competitive markets, can be supported partially since this is valid only for the market dynamism (MK_D) and not for the number of competitors (CO_N). When the market dynamism is high, firms are willing to achieve the *make-buy* over solely *make* (table 5). However, the *buy* strategy is not significant different from *make-buy* neither from *make*. When analysing the effect of number of competitors in the innovation strategy selection interesting results emerge. First, in table 4 all coefficients are negative and significant, indicating that the higher the number of competitors, the lower enrolment in R&D activities will be for all strategies. Nevertheless, when firms have to

decide in achieving one of the strategies, the *buy* one will be chosen (see negatives coefficients of *make* and *make-buy* in table 6). This firm behaviour should obeys to that mentioned by Swan and Allred (2003) who found that external acquisition will be preferred in high levels of competition because it allows cost reduction and a quickly entrance to the market.

Table 5. Multinomial logit model. Make as reference

			Innovation Strategies		
		Variables	***No_R&D***	***buy***	***make-buy***
Internal Factors	*Technological resources*	**1. RDSL1**	-1.0402***	-.0397*	.0464***
			(.0439)	(.0229)	(.0119)
	Commercial Resources	**2. EXP**	-.0140***	-.0074***	-.0023*
			(.0011)	(.0017)	(.0012)
	Organizational Resources	**3. AGE**	-.2154***	-.1828***	.0314
			(.0354)	(.0524)	(.0392)
External Factors	*Technological Intensity*	**4. M_TECH_IN**	-.2130***	-.0547	.2020**
			(.0746)	(.1140)	(.0908)
		5. H_TECH_IN	-.6472***	-.4359***	.1984**
			(.0716)	(.1089)	(.0795)
	Industry Competitiveness	**6. MK_D**	-.1345	.1619	.2935***
			(.0845)	(.1277)	(.0909)
		7. CO_N	.2067***	.1321***	.0350
			(.0300)	(.0452)	(.0361)
	Belong to a group	**8. GROUP**	-.0925	.4150***	-.0247
			(.0707)	(.1088)	(.0747)
	Appropriability	**9. TPATL1**	-.0398**	.0118	.0045
			(.0154)	(.0131)	(.0105)
Control Variables	*Size*	**10. MED**	-.7666***	-.0939	.3168***
			(.0863)	(.1360)	(.1097)
		11. LARGE	-1.8569***	-.5715***	.2909***
			(.0877)	(.1396)	(.1088)
	Innovation Objectives	**12. PRIL1**	-.4071***	-.0647	.1249*
			(.0623)	(.0937)	(.0676)
		13. PINCL1	-1.1763***	-.5809***	.0637
			(.0663)	(.0972)	(.0666)
	Financial Aids	**14. InFARDL1**	-.2867***	-.0465	.1386***
			(.0358)	(.0303)	(.0155)
Constant		**βo**	4.0082***	-.2138	-1.3145***
			(.1450)	(.2162)	(.1727)

log likelihood: -9717.5684
Pseudo R2: 0.3096
** p <.1*
*** p < .05*
**** p < .01*
n (number of observations): 14 052
Standard errors in brackets.

When seeing results in table 4 for belonging to a group (GROUP) variable there is evidence that firms select the *buy* strategy as a first step to innovate. Even more, all negative and significant values in table 6 for this variable give total support for H6, where we argued that firms belonging to a group will select the *buy* strategy instead of developing in-house R&D or combining both strategies. Note as well that firms belonging to a group do not have any preference for the *make* or *make-buy* strategies (see table 5).

The last one of the hypothesis regarding the firm external factors is H7 which states that when appropriability (TPATL1) is high firms will select the in-house R&D *versus* the other strategies since they will be able to appropriate the results (Teece, 2006) was not supported. Results does not show any support to this argument since there are no significant differences between selecting *make*, *buy* or *make-buy*. Nevertheless, when we observe the positive and significant coefficients in table 4 for this variable, results indicate that when appropriability is high, or firms achieved patents, encourage firms for developing R&D.

Table 6. Multinomial logit model. Buy as reference

			Innovation Strategies		
		Variables	***No_R&D***	***make***	***make-buy***
Internal Factors	*Technological resources*	**1. RDSL1**	-1.0004***	.0397*	.0862***
			(.0471)	(.0229)	(.0230)
	Commercial Resources	**2. EXP**	-.0066***	.0074***	.0051***
			(.0017)	(.0017)	(.0018)
	Organizational Resources	**3. AGE**	-.0325	.1828***	.2142***
			(.0500)	(.0524)	(.0558)
External Factors	*Technological Intensity*	**4. M_TECH_IN**	-.1583	.0547	.2568**
			(.1056)	(.1140)	(.1231)
		5. H_TECH_IN	-.2112**	.4359***	.6344***
			(.1060)	(.1089)	(.1162)
	Industry Competitiveness	**6. MK_D**	-.2965**	-.1619	.1315
			(.1235)	(.1277)	(.1354)
		7. CO_N	.0745*	-.1321***	-.0970**
			(.0414)	(.0452)	(.0485)
	Belong to a group	**8. GROUP**	-.5075***	-.4150***	-.4397***
			(.1056)	(.1088)	(.1144)
	Appropriability	**9. TPATL1**	-.0517***	-.0118	-.0073
			(.0164)	(.0131)	(.0138)
Control Variables	*Size*	**10. MED**	-.6727***	.0939	.4107***
			(.1247)	(.1360)	(.1476)
		11. LARGE	-1.2853***	.5715***	.8625***
			(.1314)	(.1396)	(.1517)
	Innovation Objectives	**12. PRIL1**	-.3424***	.0647	.1896*
			(.0908)	(.0937)	(.0992)
		13. PINCL1	-.5953***	.5809***	.6447***
			(.0979)	(.0972)	(.1021)
	Financial Aids	**14. InFARDL1**	-.2402***	.0465	.1851***
			(.0434)	(.0303)	(.0302)
Constant		**βo**	4.2221***	.2138	-1.1007***
			(.2017)	(.2162)	(.2354)

log likelihood: -9717.5684
Pseudo R2: 0.3096
** p <.1*
*** p < .05*
**** p < .01*
n (number of observations): 14 052
Standard errors in brackets.

Regarding the control variables analysis we found support for Tsai (2001) notes who argued that large firms would rather the *make-buy* strategy due to the physical resources they have. The positive and significant coefficients for *make-buy* in tables 4 and 6 indicate that large

(LARGE) firms in our sample trend to select this strategy over solely *make* or *buy* (table 5 and 6, respectively). Taking Stock *et al.* (2001) notes, we observe that large firms do not prefer to externalize R&D activities since they want to take advantages of the potential scale economies they have. As for the medium firms (MED) it is observed that the *make-buy* strategy is preferred over the other two strategies, but there are no significant differences between *make* or *buy*.

Table 4 shows that medium and large firms are more involved in R&D activities than small (SM) firms (the reference category) since the signs are positive for all strategies. This poorly participation of small firms in R&D activities could obey to the fact that they usually have limited in financial, human and physical resources and R&D activities are resource consuming.

Recall that we have considered prior product and/or process innovation as innovation objectives. Results show that they are determinants of the innovation strategy selection and that the strategy may vary depending on them. As expected, in table 4 the coefficients values and signs for product and process achievement are positives and significant indicating that any R&D activity is helpful for obtaining innovations. In table 5 and 6, the results show that *make-buy* is preferred over *make* or *buy* solely for achieving process innovations (PRIL1). On the other hand, there are no significant differences between *make* or *buy* for this type of innovations.

As for product innovation (PINL1) we observe that the *buy* strategy is the less pursued since it does not help in building up barriers to imitation (table 6). In table 5 we see that there are not significant differences between *make* or *make-buy* for developing product innovation. It seems that when firms externalize part of the product innovation they still have the capability to build up barriers and gain the pioneer advantage (Love and Roper, 2001).

Finally, the last control variable is the financial aids (InFARDL1) as determinants of the innovation strategy selection. All positive and significant coefficients values in table 4, show that financial aids encourage innovation since all strategies are preferred over *no_RD*. It is clear that, again, the *make-buy* strategy is preferred over *make* (table 5) and over *buy* (table 6) when firms received financial aids the year before. However, no significant differences between *make* or *buy* are showed.

6. Conclusions

As mentioned earlier, the aim of this work was to find out why do firms organize their R&D activities in different ways (*make*, *buy* or *make-buy*) and we drew the hypotheses finding support in the resource base view (RBV), the contingency and the appropriability theories in order to evaluate the internal and the external firm characteristics as determinants for the innovation strategy selection.

Due to the nature of the analysis we were able to find out that firms in low technology intensity industries, in sectors where the number of competitors is high and when they are small discourage them to be involved in R&D activities.

High technological resources, belonging to high technological intensity industries and having the main market expansive represent the firms' internal and external characteristics under which the *make-buy* strategy is preferred. Moreover, we found that this strategy is developed by large, or medium, firms who achieved product and/or process innovations and received financial aids for R&D activities. Therefore, we can conclude that the *make-buy* strategy is used for uncertain markets where technology shifts quickly and high investments are required in order to achieve the innovations needed to survive and gain competitive advantage.

On one hand, as mentioned in the literature, firms look for the complementarities of the *make* and *buy* strategies. By *making* they generate the competitive advantage (Barney, 1991) needed to exist in high competitive and technological markets, but at the same time they externalize part of the R&D activities in order increases the speed to access new technology (West, 2002) and gain the flexibility needed in these markets (Kessler and Bierly, 2002).On the other hand, it seems that trough the *absorption capacity* generated by firms when developing the *make-buy* strategy and due to the complementarity of the strategies, the innovations mainly occur through combination of ideas, resources and technologies (Fey and Birkinshaw, 2005). Even more, combining both *make* and *buy* is resource demanding and trough the financial aids received by firms seem to solve this problem.

As for the *make* strategy we found that this strategy is restricted for commercial purposes since those firms with activities abroad are prone to select the in-house R&D activities. As mentioned in the literature, it's better for firms to be innovative in order to successfully enter new markets (Filipescu et al., 2008), therefore the *make* strategy is preferred when firms decide to develop product innovations with the aim of building up barriers to imitation and gain the first mover advantage (Love and Roper, 2001).

Finally, the lack of organizational resources belonging to a holding group and a high number of competitors influence firms to totally externalize R&D activities. On the contrary, when technological and commercial resources are high and product innovations are developed the *buy* strategy is the less selected one. Under these circumstances, firms' behaviour could portray R&D externalization as a short term strategy since firms do not use it to increase their market share besides; they make low instead of high investments in order to increase their core competences (Mol, 2005). However, this strategy could be depicted as the one which gives the needed flexibility in markets with a high number of competitors. On the other hand, firms belonging to a group take advantage of the low transaction cost in order to externalize the R&D activities.

This investigation had contributed to the literature from two streams. Fist, we proposed some determinants of the innovation strategy selection never used in the literature like the kind of innovation developed, firm age, financials aids and industry competitiveness. Second, since the data set is longitudinal, we had the opportunity to include lagged variables in the MLM allowing to improve the prospects of valid causal inference (Baum, 2006).

Managerial and political implications are obtained from this study. For the first ones, managers could be aware of the main characteristics under which each innovation strategy is used, as well as the main advantage for each one. For policy makers, this study has corroborated that R&D financial support encourages firms to be involved in these activities. Moreover, we found that governmental aids fulfil the lack of resources needed to pursue the *make-buy* strategy. On the other hand, this research allowed observing that legal and political Spanish structures are working well since firms are able to protect the innovation achieved even when externalizing the R&D activities. That is, contracts for developing R&D activities are designed in certain way that the contractor guarantee the appropriability of the innovations and even patent them.

Finally, the main limitation of this study, and future research line, is the potential presence of heterogeneity in the sample since we have multiple observations for the same firms. This problem could be solved by developing a multinomial random effects model for two levels (Rabe-Hesketh *et al*., 2004). However, this model, so far, is unstable and computationally excessive and time consuming[7].

[7] For this paper we tried the model mentioned but it was extremely instable and it takes more than 30 days for estimating the results.

Bibliography

Abecassis-Moedas, C. and S.B. Mahmoud-Jouini (2008) "Absorptive capacity and source-recipient complementarity in designing new products: An empirically derived framework". *The Journal of Product Innovation Management*, 25, 473-490.

Afuah, A. (2001) "Dynamic boundaries of the firm: Are firms better off being vertically integrated in the face of a technological change?". *Academy of Management Journal*, 44 (6), 1211-1228.

Almus, M. and D. Czarnitkki (2003) "The effects of public R&D subsidies on firms' innovation activities: the case of Eastern Germany". *Journal of Business & Economic Statistics*, 21, 226-236.

Archibald, R. and D. Finifter (2003) "Evaluating the NASA small business innovation research program: preliminary evidence of trade-off between commercialisation and basic research". *Research Policy*, 32 (4), 605-619.

Arora, A. and A. Gambardella (1990) "Complementarity and external linkages: The strategies of the large firms in biotechnology". *Journal of Industrial Economics*, 38 (4), 361-379.

Arrow, K. (1962) *Economic welfare and the allocation of resources for invention*. In: R. Nelson Ed. , The Rate and Direction of Inventive Activity. Princeton University Press, Princeton, NJ, 609-626.

Barney, J.B. (1991) "Firm resources and sustained competitive advantage". *Journal of Management*, 17 (1), 99-120.

Barney, J.B. (1999) "How a firm's capabilities affect boundary decisions". *Sloan Management Review*, 40 (3), 137-145.

Baum, C. (2006) *An introduction to modern econometrics using Stata*. U.S.A Stata Press.

Bayona-Saéz, C. and T. Garcia-Marco (2007) "Assessing the effectiveness of the eureka program". *Documento de trabajo, Departamento de Gestión de Empresas UPNA*, DT/87/07.

Bayona-Saéz, C., T. Garcia-Marco and E. Huerta (2001) "Firms' motivations for cooperative R&D: An empirical analysis of Spanish firms". *Research Policy*, 30 (8), 1289-1307.

Beneito, P. (2006) "The innovative performance of in-house and contracted R&D in terms of patents and utility models". *Research Policy*, 35 (4), 502-537.

Birkinshaw, J. and N. Hood (1998) *Multinational corporate evolution and subsidiary development.* Macmillan, Basingstoke

Bughin, J. and J.M. Jacques (1994) "Managerial efficiency and the Schumpeterian link between size, market structure and innovation revisited". *Research Policy*, 23 (4), 653–659.

Burns, T. and G.M. Stalker (1961) *The management of innovation*. London: Tavistock

Busom, I. (1991) "Impacto de las ayudas públicas a las actividades de I+D de las empresas: un análisis empírico". *Economía Pública*, 11 (2), 47–65.

Branstetter, L. and M. Sakakibara (1998) "Japanese research consortia: a microeconometric analysis of industrial policy". *The Journal of Industrial Economics*, 56, 207-233.

Cesaroni, F. (2004) "Technological outsourcing and product diversification: Do markets for technology affect firms' strategies?". *Research Policy*, 33 (10), 1547-1564.

Chandler, A.D. (1962) *Strategy and structure: Chapters in the history of the American industrial enterprise*. MIT Press, Cambridge, MA.

Cho, D. and P. Yu (2000) "Influential factors in the choice of technology acquisition mode: In empirical analysis of small and medium size firms in the Korean telecommunication industry". *Technovation*, 20 (12), 691-704.

Cohen, W.M. and D. Levinthal (1990) “Absorptive capacity: A new perspective on learning and innovation”. *Administrative Science Quarterly*, 35 (1), 128-142.

Colombo, M.G. and P. Garrone (1996) “Technological cooperative agreements and firm's R & D intensity. A note on causality relations”. *Research Policy*, 25 (6), 923-932.

Cooper, A. and Schendel, D. (1976) “Strategic responses to technological threats”. *Business Horizons*, February, 1-12.

Díaz-Díaz, N.L., I. Aguiar-Díaz and P.D. Saá-Pérez (2008) “The effect of technological knowledge assets on performance: The innovative choice in Spanish firms”, *Research Policy*, 37 (9), 1515-1529.

Dierickx, I. and K. Cool (1989) “An asset stock accumulation and the sustainability of competitive advantage”. *Management Science*, 35 (12), 1504-1513.

Donalson, L. (1995) *Contingency theory*. Aldershot Darthmouth Cop.

Dosi, G. (1988) “Sources, procedures and microeconomics effects of innovation”. *Journal of economic literature*, 26 (3), 1120-1171.

Dwyer, L. and R. Mellor (1993) “Product innovation strategies and performance of Australian firms”. *Australian Journal of Management*, 18 (2), 159–180.

Etflie, I.E. W.P. Bridges and R.D. O'Keeie (1984) “Organization strategy and structural differences ior radical versus incremental innovation”. *Managemenf Science*, 30 (June): 682-695.

Fahy, J. (2002) “A resource-based analysis of sustainable competitive advantage in a global environment”. *International Business Review*, 11 (1), 57-78.

Fariñas, J.C. and J. Jaumandreu (2000). “Diez años de Encuesta sobre Estrategias Empresariales (ESEE) ”. *Economía Industrial*, 329, 29–42.

Fernández, E. (2005) *Estrategias de innovación*. España: Thomson Editores.

Fey, C.F. and J. Birkinshaw (2005) “External sources of knowledge, governance mode, and R&D Performance”. *Journal of Management*, 31 (4), 597-621

Filipescu, D.A.; A. Rialp and J. Rialp (2009): "Internationalisation and technological innovation: empirical evidence on their mutual relationship". *Advances in International Marketing*, 20, 125-154

Fritsch, M. and R. Lukas (2001) “Who cooperates on R&D? ”. *Research Policy*, 30 (2),

297-312.

Galende J. and J. De la Fuente (2003) “Internal factors determining a firm’s innovative behaviour”. *Research Policy*, 32 (5), 715-736.

Galende, J. and I. Suarez (1999) “ A resource-based analysis of the factors determining a firm’s R&D activities”. *Research Policy*, 28 (8), 891-905.

Grant, R.M. (1991) “The resource-based theory of competitive advantage: Implications for strategy formulation”. *California Management Review*, 33 (3), 114–135.

Green, W.H (2008) *Econometric Analysis*, Upper Saddle River, N.J.: Prentice Hall, cop. 6th ed.

Hamel, G. and C.K. Prahalad (1989) “Strategic intent”. *Harvard Business Review*, 64 (3), 63-78.

Haour, G. (1992) “Stretching the knowledge base of the enterprise through contract research”. *R&D Management*, 22 (2), 177-182.

Harrigan, K.R. (1985) “Vertical integration and corporate strategy”. *Academy of Management Journal*, 28 (2), 397-425.

Iansiti, M. (1997) “From technological potential to product performance: An empirical analysis”. *Research Policy*, 26 (3), 345-365.

Johnson, G. and K. Scholes (1999) *Dirección estratégica, 5ª edición*. Prentice Hall.

Kessler, E.H. and P.E. Bierly (2002) "Is faster really better? An empirical test of the implications of innovation speed". *IEEE Transactions on Engineering Management*, 49 (1), 2-12.

Klette, T.; Moen, J. and Z. Griliches (2000). "Do subsidies to commercial R&D reduce market failures? Microeconometric evaluation studies". *Research Policy*, 29 (3), 471-495.

Kotabe, M. and K. Helsen (1999) *Global marketing management*. New York: John Wiley & Sons, Inc.

Kumar, N. and M. Saqib (1996) "Firm size, opportunities for adaptation and in-house R&D activity in developing countries: the case of Indian manufacturing". *Research Policy* ,25 (5), 713–722.

Kurokawa, S. (1997) "Make-or-Buy Decisions in R&D: Small Technology Based Firms in the United States and Japan". *IEEE Transactions on Engineering Management*, 44 (2), 124-134.

Leiblein, M.J. J.J. Reuer and F. Dalsace (2002) "Do make or buy decisions matter? The influence of organizational governance on technological performance". *Strategic Management Journal*, 23 (10), 817-833.

Leiponen, A. and C.E. Helfat (2003) "Innovation objectives, knowledge sources and the benefits of breadth". Paper presented at: What do we know about innovation? conference: A conference in Honour of Keith Pavitt, Freeman Centre, University of Sussex, Brighton, U.K.

Love, J.H. and S. Roper (2001) "Outsourcing in the innovation process: Locational and strategic determinants". *Papers in Regional Science*, 80 (3), 317-336.

Lowe, J. and P. Taylor (1998) "R&D and technology purchase through licence agreements: Complementarity strategies and complementarity assets". *R&D Management*, 24 (8), 263- 278.

McFadden, D.L. (1973) *Conditional logit analysis of qualitative choice behavior*. Pages 05-142 of: Zarembka, P. (ed), Frontiers in Econometrics. New York: Academic Press.

Miotti, L. and Sachwald F (2003) "Co-operative R&D: why and with whom? An integrated framework of analysis". *Research Policy*, 32 (8), 1481-1499.

Mol, M.J. (2005) "Does being R&D intensive still discourage outsourcing? Evidence from Dutch manufacturing". *Research Policy*, 34 (4), 571-582.

Molero, J. and M. Buesa (1996) "Patterns of technological change among Spanish innovative firms: the case of the Madrid region". *Research Policy*, 25 (4), 647–663.

Mowery, D. and N. Rosenberg (1989) *Technology and the pursuit of economic growth*. Cambridge Univ. Press.

Munier, F. (2006) "Firm size, technological intensity of sector and relational competencies to innovate: Evidence from French industrial innovating firms". *Economics of Innovation and New Technology*, 15 (4/5), 493-505.

Murray, J.Y., A.R. Wildt and K. Kotabe (1995) "Global Sourcing Strategies of U.S. subsidiaries of foreign multinationals". *Management International Review*, 35 (4), 307-324.

Nester, J., W. Wasserman and M.H. Kutner (1985) *Applied Linear Statistical Models, 2nd edition*. Irwin: Homewood, IL.

Nishiguchi, T. (1994) *Strategic Industrial Sourcing: The Japanese Advantage*. Oxford University Press, Oxford.

Noori, H. (1990) *Managing the Dynamics of New Technology*. Englewood Cliffs, NJ: Prentice Hall.

Nelson, R., and S. Winter (1982) *An Evolutionary Theory of Economic Change*. Belknap Press, Cambridge, MA.

OECD (1997) *Proposed guidelines for collecting and interpreting technological innovation data: Oslo manual*. OECD, Paris (Second (revised) Edition).

OECD (2005) The measurement of scientific and technologic activities: Oslo Manual. OECD, 3rd Edition.

OECD (2006): *Government R&D funding and company behaviour*. *Measuring behavioural additionality*. OECD, 2006.

Parmigiani, A. (2007) "Why do firms both make and buy? An investigation of current sourcing. *Strategic Management Journal*, 28 (2), 285-311.

Perrons, R.K. and K. Platts (2004) "The role of clockspeed in outsourcing decision for new technologies insights from the prisoner's dilemma". *Industrial Management & Data Systems*, 104 (7), 624-632.

Pisano, G.P. (1990) "The research and development boundaries of the firm- an empirical analysis". *Administrative Science Quarterly*, 35 (1), 153-176.

Poon, J. McPherson, A. (2005) "Innovation strategies of Asian firms in then United States". *Journal of Engineering and Technology. Management*, 22, 255–273

Prahalad, C.K. and G. Hamel (1990) "The core competence of the corporation". *Harvard Business Review*, 68 (3), 79-91.

Prashantham, S. (2005) "Twoard a Knowledge-Based Conceptualisation of Internationalisation". *Journal of International Entrepreneurship*, 3 (1), 37-52.

Quinn, J.B. (2000) "Outsourcing innovation: The new engine of growth". *Sloan Management Review*, 41 (4), 13-28.

Rabe-Hesketh, S.; A. Skrondal and A. Pickles (2004) *GLLAMM Manual*. *U.C. Berkeley Division of Biostatistics Working Paper Series.* Working Paper 160.

Shrivastava, P and W.E. Souder (1987) "The strategic management of technological innovation: a review and a model". *Journal of Management Studies*, 24 (1), 25-41.

Stock, G., N.P. Greis and W.A. Fischer (2002) "Firm size and dynamic technological innovation". *Technovation*, 22 (9), 537-549.

Surroca, J. and Santamaría, L. (2007) "La cooperación tecnológica como determinante para los resultados empresariales". Cuadernos de Economía y Dirección de Empresa, 33, 31-62.

Swan, K.S. and B.B. Allred (2003) "A product and process model of the technology-sourcing decision". *Journal of Product Innovation Management*, 20 (6), 485-496.

Teece, D.J. (1986) "Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy". *Research Policy*, 15 (6), 285-315.

Teece, D.J. (2006) "Reflections on "profiting from innovation". *Research Policy*, 35 (8), 1135-1146.

Tsai, W. (2001) "Knowledge transfer in intraorganizational networks: Effects of network position and absorptive capacity on business unit innovation and performance". *Academy of Management Journal*, 44 (5), 996-1004.

Utterback, J.M. (1994) *Mastering the Dynamics of Innovation*. Boston: Harvard Business School Press.

Veugelers, R. and B. Cassiman (1999) "Make and buy in innovation strategies: Evidence from Belgian manufacturing firms". *Research Policy*, 28 (2), 63-79.

Veugelers, R. and B. Cassiman (2006) "In search of complementarity in innovation strategy: Internal R&D and external knowledge acquisition". *Management Science*, 52 (1), 68-82.

West, A. (2002) *Estrategia de Innovación*. Clásicos COTEC.