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FIRM SIZE AND INNOVATION POLICY

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Abstrac

This study analysed the effect of R&D subsidies on strategic decisions taken by firms when faced by innovation. The traditional approach of evaluating the impact of these subsidies on the net figure of R&D expenditures does not enable us to establish how public financing influences decisions involving technological knowledge generation, nor the economic returns which could be derived from this process. The study analyses these effects taking into consideration the size of the firm, since it is a widely used variable in designing innovation policies. The study revealed that public funding, regardless of size, mainly stimulated investments aimed at gaining knowledge within the firm's technological domain, while it did not expand the technological knowledge frontier. The findings also show that subsidies only enhance the generation of incremental innovations in the case of small firms. The study concludes that the present approach to subsidies allocation is permitting the continuity of a certain strategic behaviour which specialises in leading the firm towards a quest for immediate results rather than constructing a sustainable competitive advantage.

Keywords: R&D Subsidies, Innovation Policy, Firm Size, Basic Research, Applied Research, Technological Development.

FIRM SIZE AND INNOVATION POLICY

1. Introduction

Following the work by Schumpeter (1942), there has been a wide-ranging debate on the differences and complimentary qualities of small and large firms in the face of innovation and technological change. According to this author, large firms have advantages in comparison with small ones when taking part in innovation activities and what is more, these advantages increase according to firm size. This hypothesis has been reviewed in various empirical studies without any definite conclusion being reached. Large and small firms do not differ just in their investments in R&D but also in the management and productivity of their innovation activity. The works of Camisón-Zornoza et al. (2004), Cohen (1995), Cohen and Levin (1989), Cohen and Kepler (1996), and also recently the work of Ahuja et al. (2008), give a review of the studies in this field.

Though no consensus has been reached in the literature analysing the relationship between firm size and innovation, results from research have led to a change in the role assigned to large and small firms in the processes of technological change and economic development. Small firms are now viewed as agents of change, giving rise to employment and technological diversity which stimulate the growth and the evolution of the industry. As a consequence of this change, new innovation policies have sprung up with a specific recognition of the firm's dimension as a key aspect in maintaining technological diversity and the industrial dynamic (Pavitt et al., 1989). Nevertheless, the design of these new policies has been made with a lack of awareness of the relationship between the variables firms size and innovation policy. The analysis of differences

between innovation activity of small and large firms has not yet reached the same degree of intensity in the literature which evaluates the impact of these policies.

Following the traditional evaluation approach described by David et al. (2000), a small group of studies analyse how some measure of public funding received –generally R&D subsidies- impinges on some variables which represent firms' innovation activity - generally private R&D expenditures-. Though these studies confirm the hypothesis that public funding has different effects on the private R&D expenditures of large and small firms, it is not clear to what extent firms gain advantage from public incentives.

Estimating the effect of subsidies on net R&D expenditures does not sufficiently capture the effect of public funding on the innovation process itself. Despite the economic justification for innovation policies stressing that they guarantee the production of technological knowledge and reduce market failures which reduce incentives to innovation (Arrow, 1962), the literature has not analysed the effect of public funding on creating technological knowledge or economic returns stemming from such knowledge. Being aware of these effects is a determining factor since the role and the importance of technological knowledge in economic activity has changed.

Firms invest less in physical capital and more in knowledge (Gopalakrishnan and Bierly, 2006). As a consequence of this change in firms' behaviour, new priorities arise for innovation policy and thus it is important for policymakers to understand how firms generate and acquire new knowledge (this is how they build up their competences) and what benefits stem from these processes (Cohendet and Meyer-Krahmer, 2001).

In this context it is reasonable to deduce that the traditional approach of evaluating innovation policies cannot be used to find out the strategic value of subsidies

technologies or to predict or anticipate its success or failure. Therefore, the policy evaluation practice must take on board the firms' strategy decisions in order to obtain information for policymakers to develop new support instruments that would enable a real contribution towards the development of the industry and the industrial dynamic. At this point, we should not forget that the process involving the distribution of public funding implies, in turn, that public agencies take decisions about what aspects of innovation activity and technological change are to be stimulated to the detriment of others (Buesa, 1994).

The aim of this study is to progress in the analysis of the effect exerted by innovation policies on the generation of technological knowledge and on the economic results that firms obtain from this knowledge. The study is limited to the area of in-house R&D activities as a measure of the inputs of the innovation process and sales of innovative products as a measure of the outputs. Adopting an input-output approach in the evaluation of these policies will make it possible to show how the innovation policy impinges on knowledge generation and productivity of R& D activities of large and small firms.

In this study the knowledge generation process is conceptualised by distinguishing between basic research activities, applied research and technological development to discover how the innovation policy affects strategic decisions for knowledge generation in the initial phases of the innovation process, where the risk of failure in the market is at its highest point. These R&D activities have a double function: (1) increasing the stock of technological knowledge which provides the basis for creating and maintaining competitive advantage and, (2) improving firms' ability to understand and absorb

external knowledge. Several authors have shown that these R&D activities provide knowledge with a different strategic value and that firms' choice with regard to these activities changes according to firm size. Existing literature tends to consider R&D activities as a homogeneous process and does not take into account either the aims of each of these activities or the importance they may have for the development and growth of firms because a minimum amount of R&D activity is necessary. For example, newly growing firms would be unable to sustain their growth unless they can expand and renew their resources base by taking part in activities such as research and development (Stam and Wennberg, 2009, Raymond and St-Pierre, 2010).

Moreover, it is widely accepted that sales of innovative products reflect economic performance of the innovation process. In this study the dichotomy between "sales of products new for the firm" and "sales of products new for the market" is used in order to determine what the effect of the innovation policy is on the degree of novelty of innovations and the growth and the competitiveness of firms. The degree of innovation novelty is the force driving economic growth and could re-form the base of competition in an industry or create new ones (Audretsch and Aldridge, 2007; Tellis and Golder, 1996). Additionally, it has important implications for firms' survival and innovation policies. The policymakers will have to determine which support instruments are effective in stimulating innovations which might give rise to a radical change in the industry and what type of firms could develop them (Dahlin and Behrens, 2005).

In this study an analysis is made of the impact of subsidies for R&D represented by the form of financial transfers of funds to firms as a measure of innovation policy. These subsidies are one of the support instruments most often used in developed countries and

have been widely studied in the literature. We analysed the effect of these subsidies over two time periods, the year when they were received and the following year, in order to obtain more accurate conclusions on the time period when the effects of these subsidies are visible. Finally, firms are classified as small, medium-sized and large, which makes it possible to identify certain patterns of behaviour and to clearly see the importance of firm size in the evaluation of innovation policies.

The study has the following structure: The second section presents the theoretical arguments that justify the assumption that firm size is an important unit of analysis for evaluating the effect of innovation policies and the hypotheses tested in the study. In the third section, details are given of the methodology used and in the fourth section the data and variables are described. The findings from the empirical analysis are discussed in the fifth section and, finally, in the sixth, the conclusions are presented.

2. Firm size and innovation policy.

In general terms innovation policies are defined as a group of activities geared to increasing the quantity and intensity of innovation activities, which include creating, adapting and adopting new, improved products, processes and services (Lundvall and Borrás 2005). In the academic literature the evaluation of the effect of these policies has become an important subject for research, even though it has evolved in the absence of a comprehensive theory of technological change including the role of governments (Metcalf and Georghiou, 1998; Nelson, 1983; Nelson and Winter, 1982; Teubal, 2002; Verspagen, 2005).

Empirical evidence has been geared to evaluating the effect of these policies in the framework of interaction between public funding and private funding of R&D. In some cases public funds replace private funds and in other cases they are complementary (David et al., 2000). Some authors have attributed this disparity in the findings to a lack of control over the process for public funding distribution (Busom, 2000; Kauko, 1996). It is widely recognised that the success of these policies depends, among other factors, upon the capacity of public agencies to distribute resources and upon the structural opportunities and restrictions provided by firms (Grande, 2001; Lipsey and Carlaw, 1998). As a result, different authors have analysed the effect of policies, taking into account variables such as sector of activity (Callejón and García-Quevedo, 2005; González and Pazó, 2008; Howe and McFetridge, 1976), location of firms (Czarnitzki and Licht, 2006; Herrera and Nieto, 2008), the structure of property (Holemans and Sleuwaegen, 1988; Howe and McFetridge, 1976) or conditions for accessing public funding (Lichtenberg, 1988). Recently, a small group of studies has used firm size as a factor for analysis. Since the theory shows that large and small firms take on innovation activities in a different manner, their needs for public funding may differ and the result of R&D subsidies may also do so.

The literature analysing the relationship between firm size and innovation policy may be categorised in two groups. The first group has taken on the task of analysing, along with other variables, the influence of firm size in distributing public funding. These studies have found that large firms are more likely to obtain subsidies than small ones (Acosta and Modrego, 2001; Arvanitis et al., 2002; Blanes and Busom, 2004; Busom, 2000; Czarnitzki and Fier, 2002; Heijs, 2003, 2005; Wallsten, 2000). Large firms have R&D departments and laboratories employing qualified staff, have information advantages

and often meet the requirements of agencies handing out public support (Czarnitzki and Fier, 2002). Nonetheless, some authors have associated the positive influence of size in distribution with distortions in the final result of the policy. Specifically, large firms can obtain subsidies for projects which they would carry out regardless of any aid from public agencies (Heijs, 2003; Wallsten, 2000) and, as a result they may be more inclined to substitute public funds for private ones. In this respect, Heijs (2003) has found that large firms tend to show more opportunist or “free-rider behaviour”.

The low participation of small firms in horizontal policies -theoretically accessible to all firms- is related to the aims of support programs. These programs are clearly directed to funding R&D projects, which impedes access to small firms with other types of innovation activities. At the same time, a self-exclusion problem has been detected. This affects small firms which do not manage to convert their innovation activities into well organised projects due to the strict concept of R&D activities as defined by public agencies (Heijs, 2005). Previous studies have shown that firms benefiting from R&D subsidies are innovative firms and only a small number of firms had undertaken R&D activities on an occasional basis or had begun these activities for the first time thanks to public funding (González et al., 2005).

The second group of studies has analysed whether the effect of the R&D subsidies changes with the size of the firm. These studies follow the traditional approach of evaluation and they analyse the influence of public funding on private R&D expenditures by large and small firms (see Table 1). Carmichael (1981) found, for example, that public funding had a greater effect on R&D expenditures in large firms than in small ones. This finding is similar to that obtained by Klette and Moen (1998),

who found a complementary effect between public funding and private funding in business units of large firms. The study by Lach (2002) analysed the effect of subsidies with no significant short-term results. However, he found that, a year after obtaining the public funding, small firms showed a significant increase of their R&D expenditures. Furthermore, in a study of the Spanish case, González et al. (2005) found a complementary effect which was greater in small firms than in large ones. Unlike previous studies, these authors obtained a minimum level of subsidies needed to take on R&D activities. Their study concluded that this level was smaller in large firms and greater in small ones (10 per cent and 40 per cent of their R&D expenditures, respectively). Finally, González and Pazó (2008) estimated the effect of subsidies on the private R&D intensity in a sample of innovative firms and found this to be higher in firms with fewer than 200 employees. This effect was also significant and positive in a second sample including innovative and non-innovative firms. One of the most important conclusions obtained from the comparative study of these two samples was that for small firms, public funding has an important role in the decision to take part in R&D activities.

(Table 1 here)

As can be seen in Table 1, the results of these studies are not conclusive. The studies not only differ in their findings, the support programs analysed, the period of time evaluated and the methodology, but also in the criteria used by the authors to subdivide the sample of firms by size. As a result, these studies are not comparable and only provide information on the effectiveness of the support programs analysed. Contemporary knowledge of the relationship between firm size and innovation policy is only useful for

the policymaker to be able to make decisions on whether to continue the support program or not but not in the case of the other aspects as design, resource distribution, stimulation of certain technologies or accumulation knowledge, among others. The traditional approach of evaluating the effect on the net amount of R&D expenditures does not adequately record the impact of public funding on strategic aspects such as the process of generating technological knowledge (inputs) nor does it enable us to determine whether firms gain economic returns from the innovation process (outputs). The literature suggests that these processes are produced in a different way in large and small firms, so finding out the differences and similarities between the behaviour of firms as a reaction to innovation policy is crucial for designing new policies to stimulate technological diversity and industrial dynamic.

In the case of technological knowledge generation (inputs), Lichtenberg (1984) argued that the final impact of innovation policy on technological progress and productive growth will depend upon how public funding impacts on the way firms distribute their R&D investments. Despite the importance of this topic, only the work by Link (1992) shows that availability of public funding makes firms alter the makeup of their in-house R&D expenditures and thus, their knowledge acquisition strategy.

Basic and applied research and experimental development activities provide firms with knowledge of different strategic value (Coccia and Rolfo, 2008). The most up-to-date understanding of the innovation process suggests that these activities do not take place in a linear fashion, since the appearance of a technology may stimulate the creation of new technological knowledge and vice versa (Kline and Rosenberg, 1986). Basic research activities enable firms to produce knowledge without a particular objective.

Applied research generates knowledge with a specific practical aim in mind and technological development is concerned with transforming this knowledge into products and services (Beesley, 2003). Investment in basic research, in general, is long term and helps to make the firm aware of the latest technological advances in the field where they provide the basis for applied research (Henard and McFadyen, 2006). On the other hand, applied research and technological development activities generate knowledge which is closer to the technological domain of the firm and its market and would not give rise to many knowledge spillovers (Roper et al., 2004). These activities are in general short-term ones and enable firms to distance themselves from their competitors (Henard and McFadyen, 2006).

In accordance with Henard and McFadyen (2005) different approaches have sprung up to explain the strategic value of investment in basic and applied research. An initial approach promotes active investments in applied research to forecast the gains of the performance and at the same time discourage investments in basic research, since the knowledge obtained from the latter makes a still uncertain contribution to commercialization (Cassiman et al., 2002). A second approach supports the idea that investments in basic research are crucial for the development of new products and are a strong determinant of the firm's productivity level (Griliches, 1986; Mansfield, 1980). Though there is no a predominant approach, recent studies point out that there could be differences in the choice made by large and small firms when they invest in these three types of R&D activities.

Large firms endeavour to have a broad knowledge base to enable them to maintain their competitive advantage. These firms invest more in in-house R&D activities (Cohendet

and Meyer-Krahmer, 2001; Veugelers, 1997) and can find in basic and applied research activities a way to increase firm's scientific knowledge base in the long-term (Rafferty, 2003). On the contrary, a characteristic of small firms is that of having a narrow knowledge base due to the limitations of resources they possess (Gopalakrishnan and Bierly, 2006). Small firms are more focused on activities providing immediate solutions to critical problems and those affecting the core areas of the business (Corsten, 1987; Santoro and Chakrabarti, 2002). Due to the scarcity of resources, small firms focus on advancing core technologies. They would invest less on technologies which are outside their core domain (Santoro and Chakrabarti, 2002) and more on technological development activities because their concern is with survival. Moreover, since small firms are more flexible and can be adapted more rapidly to external changes (Acs and Audrestsch, 1990; Damanpour, 1996), they may be more interested in technological development activities which generate knowledge that can be applied faster to the market and make profits. In the case of large firms, the technological knowledge deriving from these R&D activities may take longer to become a profitable product because more time is needed to implement the new knowledge.

Analysing the effect of public funding on how firms allot their R&D expenditures would make it possible to determine whether firms take advantage of public funding to expand their technological knowledge base or to exploit existing knowledge. In order to grow and survive, firms have to make decisions regarding their technological frontier and reshaping their resource base. Productive growth is not only achieved by adapting existing technologies but also by creating new ones. In-house R&D activities are a challenge for firms and policymakers, since these activities are expensive and risky. For this reason it is important to know how innovation policy influences the stock of

technological knowledge and the strategic behaviour of large and small firms. Thus, in this study the following hypothesis is proposed:

Hypothesis 1: R&D subsidies have effects upon the way firms distribute their R&D expenditures on basic research, applied research and technological development and this effect is different in large, medium-sized and small firms.

In the case of economic returns (outputs), the review of the literature has enabled us to conclude that, in almost every case empirical studies have estimated the effect of subsidies on private R&D expenditure without taking into consideration its effects on the outputs of the innovation process of large and small firms (see Table 1). The traditional approach for evaluating innovation policies centres on the conditions for financing R&D activities and not on the results produced by these activities.

The commercial success of subsidised projects has been analysed in studies evaluating aid programs for small firms, such as the SBIR (Small Business Innovation Research Program), an initiative of the United States government to subsidise R&D activities.

Studies evaluating the SBIR program have analysed the effect of subsidies on measures of firm performance (Archibald and Finifter, 2003; Lerner, 1999; Wallsten, 2000).

Although these studies show that subsidies have an effect on sales and employment of firms participating in this program, there is no definitive conclusion as to how great the effect is. Nonetheless, the study by Archibald and Finifter (2003) clearly shows that subsidies simultaneously affected inputs and outputs of the innovation process and that in this relationship there is influence from the firm's orientation towards commercial success. The study concludes that the quest for commercial success was achieved at the

expense of investments in basic research and the technical competence of the firm. The authors insist that the analysis of these relationships needs to be extended since there are some uses of innovation activity that may have greater strategic value than the immediate success or commercial use and one of them is the production of technological knowledge.

In this study the effect of subsidies on sales obtained from new products is analysed. A firm is considered to generate innovations when these are launched on the market. In this study, the dichotomy “sales of products new for the firm” and “sales of products new for the market” is used. The objective is determining what contribution is made by R&D subsidies to the degree of novelty of innovation. Some authors find that this classification is suitable for categorising the innovative approach of small and large firms (Mosey, 2005). In accordance with Kaufmann and Tödting (2001), the “new for the firm” category is generally associated with incremental innovations. These, if successful, could improve the firm’s competitive position in the same market. The “new for the market” category is associated with radical innovations requiring more than incremental development and having no competitor in the market. In general, the literature has not dealt with analysing how innovation policy impinges on the degree of novelty of subsidised products and, consequently, its contribution to economic growth is unknown.

Radical innovations are obtained by firms with a strong emphasis on technology and innovation since these innovations have a longer, more unpredictable life cycle and are more dependent upon the context (Ettlie et al., 1984). These innovations require a renewal and extension of the knowledge base by creating competences the firm did not

have before (Herrman et al., 2006). Whereas incremental innovations are linear, involve few resources and can include simple collaboration relationships (Keizer and Halman, 2007), these same innovations are also low-cost and can be made operative more quickly than radical innovations (Bhaskaran, 2006).

There are studies which relate the degree of innovation novelty to the nature of the ideas or knowledge on which the firm's innovation activity is based (Tödtling et al., 2009). For example, the innovation activity based on commercial information tends to be incremental in nature (Dahlin and Behrens, 2005), whereas radical innovations are based on ideas which also involve tacit knowledge, the economic value of which is uncertain and asymmetrical (Audretsch and Aldridge, 2007). What is more, radical and incremental innovations require a different management system in the firm (Keizer and Halman, 2007), as well as different requirements (Oke et al., 2007), thus firms put a different value on these types of innovations. Keizer and Halman (2007) argue that when firms focus on obtaining incremental innovations, they are worried about the impact they might have on profit levels, whereas in the case of radical innovations, firms are more concerned with the value of the firm and the impact of the technology on the market.

The literature analysing firm size and the degree of innovation novelty is scarce and not very conclusive (Oke et al., 2007). Studies have centred on the analysis of innovation outputs in large firms more than in small ones (Henderson, 1993; Oke et al., 2007; Stringer, 2000). In the case of incremental innovations, some studies conclude that large firms might obtain advantages from this type of innovation, since these innovations are constructed on existing capacities and knowledge, which is greater in these firms

(Henderson, 1993). However, other authors point out that there is a greater advantage for small firms. Thanks to their flexibility and speed in introducing innovations, small firms would gain advantages from incremental innovations in highly competitive markets (Bhaskaran, 2006). In the case of radical innovations, some authors argue that the financial success of these innovations is larger in large firms than in small ones (Paulson et al., 2007), whereas others argue that they are more easily obtained in small firms because the firm itself could be based on a radical idea (Kanter, 1985; Simon et al., 2002; Stringer, 2000).

Discovering the impact of subsidies on the degree of novelty of innovations could provide important information to policymakers for developing support measures that enable firms to gear their activity and anticipate the direction and time of entry for their innovations. As a result, in this study the following hypothesis is formulated:

Hypothesis 2: Subsidies for R&D have effects on the degree of novelty of product innovations and this effect is different in large, medium-sized and small firms.

The comparison of the hypotheses formulated in this study will make it possible to discover the direct impact of innovation policies on firms' strategic behaviour and will enable conclusions to be drawn regarding the indirect effect of these policies on knowledge-accumulation processes and competitive advantage in economies. With a more detailed knowledge of the impact of public funding, policymakers will be able to choose between a general approach in subsidy allocation, in which funds are equally available for small and large firms, or a specific approach geared to solving problems linked to these groups of firms.

3. Methodology

In this study a matching estimator was used to analyse the effect of R&D subsidies (S_i) on the firms' innovation activity (Y_i). The method specifically compares the inputs and outputs of the innovation process of firms receiving subsidies $Y_{i,s=1}$ (1) or factual state, with the results they would have obtained if they had not received them $Y_{i,s=1}$ (0) or counterfactual state. Because a firm i cannot be observed simultaneously when receiving and not receiving subsidies, the counterfactual state becomes a fundamental problem for evaluation. The matching estimator estimates the counterfactual state with information stemming from a control group made up of firms that did not receive subsidies but had a strong propensity to receive them $Y_{i,s=0}$ (0). To obtain this control group the method has to estimate, for each firm, the conditional propensity of receiving R&D subsidies (or propensity score) given a group of individual characteristics X_i . In this study we used a Probit model to estimate this propensity and analysed which conditional variables X_i influence the likelihood of obtaining subsidies (see section four).

The use of matching estimators has gained popularity in the literature that evaluates public policies because it enables the problem of distribution of aid to be borne in mind. In our case, the distribution of subsidies is not a random process because firms request subsidies and often compete for them. As a consequence, at the end of this process subsidised firms differ from those which are not. This fact produces a problem known as sample selection bias, which could skew estimates of causal effect since subsidised firms are not comparable with any other firm in the economy. The estimator reduces this bias through a process of matching between comparable units and, for this purpose

uses a proximity criterion. In this way, each subsidised firm has in the control group a firm which is as similar as possible in terms of its propensity for obtaining subsidies. We have used the bias-corrected matching estimator proposed in Abadie and Imbens (2006) to make the matching process and obtain a net figure of the effect. We have also followed the recommendations in the work by González and Pazó (2008), which shows that the effect of subsidies may be overestimated if previous R&D experience (lagged outcome) and past success in application for public funding are not taken into account. As a result, in our study the selection process of similar observations was made from within the group of firms complying with the following conditions: they had a similar propensity to obtain subsidies, they belonged to the same sector of activity and were in the same situation with regard to previous R&D expenditure, and with regard to having received subsidies or not in the previous period. Once the matching process was concluded, subsequently, the bias-corrected matching indicator obtains the causal effect as the difference between the average value of a variable of interest in the group of subsidised firms $Y_{i,s=1}(1)$ and the value of this same variable in the control group $Y_{i,s=0}(0)$. Subsidies have a positive effect if the figure for this difference is significantly higher than 0. The bias-corrected matching estimator can be represented thus:

$$\tau = \frac{1}{N_1} \sum_{i \in \Omega_1} [Y_{i,s=1}(1) - Y_{i,s=0}(0)]$$

Starting from the work of Rosenbaum and Rubin (1983), matching estimators are used in the evaluation of public policies. Dwhejia and Wahba (2002) and Abadie and Imbens (2006) carry out a thorough review of these estimators and Almus and Czarnitzki (2003) describe how they are applied to the case of innovation policy evaluation. Finally, the

study of Arvanitis and Keilbach (2002) gives a comparative description between this method and others used in evaluating these policies.

4. Data and variables

4.1 Data

The data used to carry out the research come from the Panel of Technological Innovation (PITEC). This panel was created with information from Spanish firms recorded by the Survey of Technological Innovation and R&D drawn up by the Instituto Nacional de Estadística in Spain. The panel has been created recently with the intention of having a database available which would make it possible to analyse the innovation behaviour of Spanish firms and how it evolves. Since 2003 the panel has recorded information from more than 7 200 firms belonging to two sub-populations. The first consists of firms with more than 200 employees and the second of firms which declared in-house R&D activities. The representative nature of the first subpopulation is 73% of Spanish firms and 60% in the second case.

The data used in this study covers the period between the years 2003-2005. In this study a time dependence data structure was used. Specifically, we estimated the effect of receiving subsidies the same year in which they were received (2004) and also a year later (2005). The variable S_i , that is, whether the firm received subsidies or not in 2004, acquires its determination from lagged explanatory variables X_i , in other words, values in 2003, thereby reducing endogeneity problems and also improving the quality of matching.

The final sample of firms used in the study was 4 713 firms, who replied to the survey during the three-year period. Of these firms, 1 218 received R&D subsidies from central and regional governments. We compared the hypotheses in the total sample of firms and in three subsamples by size: large firms (more than 250 employees), medium-sized firms (50-249 employees) and small firms (10-49 employees). This classification was made according to the recommendation of the European Union to facilitate comparison among countries and adjust to the reality of the Spanish production sector.

Traditionally, the literature has classified firms in two groups: firms with more than 200 employees and firms with fewer than 200 employees. Around 70% of employment in Spain is provided by small firms with fewer than 49 employees, in comparison with an average 50% in the European Union and 36% in the United States (OECD, 2007).

Although the survey records unpublished information related to the innovation activity of Spanish firms and innovation policies, it has the limitation of only indicating where the subsidies come from without giving details of the support program. As a result, the interpretation of the results of the study is very general. Furthermore, it must be pointed out that this survey is a recent one and certain variables are not available every year, which hinders the task of making a longitudinal analysis.

4. 2. Variables

The covariables vector X_i used to estimate the firms' propensity to obtain subsidies includes variables which in accordance with the literature influence this propensity (see: Acosta and Modrego, 2001; Almus and Czarnitzki, 2003; Arvanitis et al., 2002; Busom, 2000; Duguet, 2003; Wallsten, 2000; González and Pazó, 2008; González et al., 2005; Herrera and Nieto, 2008). In the first place we included variables

representative of the firm's structural characteristics. Size (log of number of employees) and age (a dummy variable indicates whether the firm is newly created or not) have been considered as indicators of the firm's experience and their capacity for obtaining resources. We also included a dummy variable which indicates whether the firm is private and national, since some authors have shown that certain support programs exclude foreign firms. Secondly, we have included indicators of the geographical location and the competitive environment. The study by Herrera and Nieto (2008) shows that the final result of subsidies changes in accordance with the location of the firm. A dummy variable took the value of 1 if the firm was located in a central region of the Spanish Innovation System (this is; Madrid, Catalonia, Basque Country and Navarre, regions accounting for 70% of the country's R&D activity) or outside of it. What is more, in this group of variables we included propensity to export (ratio between exports and sales multiplied by a hundred) and the sector of activity. In the latter case, we included three dummy variables that indicate whether the firm belongs to: a hi-tech manufacturing sector, a medium-tech manufacturing sector or a hi-tech service sector.

Below we include indicators of previous R&D experience and receipt of public funding in the past. The reason to include these two variables is as follows: for a firm with no subsidies to be a good control unit for a firm with subsidies, both firms should have behaved in similar fashion in the past. Most studies quoted in this paper have shown that previous R&D experience is a determining factor for accessing public financing. Public agencies tend to choose firms which can guarantee the technical viability of subsidised projects. Moreover, González and Pazó (2008) have shown that it is also necessary to bear in mind the persistence of the granting of subsidies. For this reason, in this study a dummy variable has been included which took the value of 1 if the firm

carried out continuous R&D activities during the 3 years prior to receiving the subsidy. We have adopted this measure of the innovation behaviour because there are a large number of indicators of the innovation activity which may be influenced by the size of the firm (e.g. patents, R&D expenditure, etc). Finally, a dummy variable took the value of 1 if the firm obtained subsidies in the previous period.

In this study we have used indicators of the inputs and outputs of the firms' innovation process to estimate the effect of subsidies on the innovation activity Y_i . As measures of the inputs, the study included the private R&D intensity (ratio between private R&D expenditure and firm turnover, multiplied by a hundred). Though this variable does not cover the whole of the firms' innovation activities, the empirical evidence indicates that the effect of subsidies is mainly reflected in the private R&D expenditure (David et al. 2000). In this study no hypothesis is formulated on this variable but it is included to compare the results with those obtained by the previous studies mentioned in Table 1. Unlike other studies, this one contains an analysis of the effect of subsidies on how firms distributed their R&D expenditures on basic research, applied research and technological development. All these variables have been defined as a percentage of total private R&D expenditure. It is certain that R&D activities do not register all aspects of the SMEs' innovation activity which a consequent underestimation of the subsidies effect. To resolve this problem in this study we have adopted an input-output approach following the reasoning of Hall et al. (2009); that is, if it is not possible to measure the innovation activity made by a firm because of the presence of latent, unobservable variables, one should look at the results of R&D investments. For this reason, we have included as a measure of output of the innovation process the ratio between sales obtained from new products and total sales of the firm multiplied by a

hundred. We have used the dichotomy “sales of products new to the firm” and “sales of products new to the market” in order to determine what the effect of subsidies is on the degree of novelty of innovations and on the economic returns.

5. Results and discussion

In this section the results of the previous analysis geared to estimating the firms' propensity to obtain R&D subsidies are presented. Table 2 shows the findings of the Probit model and the estimation of marginal effects. In the four models the dependent variable took the value of 1 if the firm received subsidies and 0 in the opposite case. In the general sample the findings indicate that recently set-up firms, belonging to hi-tech service sectors, with previous R&D experience and which have obtained public funding in the past, had the highest probability of obtaining R&D subsidies. These results are in accordance with previous studies which indicate that public funding is mainly directed to innovative firms who can guarantee that their subsidised projects will be technically viable (Acosta and Modrego, 2001; Almus and Czarnitzki, 2003; Blanes and Busom, 2004; Busom, 2000; Czarnitzki and Fier, 2002; Fernández et al., 1996; Heijjs, 2003, 2005; Wallsten, 2000). The estimates of the marginal effects show that variables with the greatest impact on this propensity were: belonging to hi-tech service sectors and obtaining public finance in the past. A change in these variables, *ceteris paribus*, would increase this propensity by 21 and 57 percentage points, respectively. These findings reflect the present situation of the Spanish production system and innovation policy. On the one hand, most R&D growth in Spain has been driven by service sector expansion, where there has been an annual 16% increase, compared to 7.9% in the industrial sector (OECD, 2007). Consequently, an interpretation can be made that a relationship exists between present R&D growth and the public funding received in this sector. On the

other, there are recent studies which have detected that it is normal for Spanish firms to receive subsidies from more than one public funding source (Herrera, 2008) and that obtaining subsidies in the past has a positive influence on obtaining public funding in the future (González and Pazó, 2008). In this respect, one of the challenges for policymakers is to coordinate the subsidies distribution and access in order to avoid the excessive dispersion of innovation policy aims and to reduce duplication of resources.

The comparative analysis by size shows that three variables produce differences in the profile of subsidised firms: the ownership, the propensity to export and the sector of activity. Unlike small firms, large and medium-sized ones are more prone to obtain subsidies if they are private firms with national capital. The literature evaluating the distribution of R&D subsidies shows that public agencies tend to exclude firms with foreign capital not just in Spain (Busom, 2000) but also in other countries (Almus and Czarnitzki, 2003). Subsidiaries of foreign firms could benefit from the R&D activities obtained in another country because there is a greater degree of centralisation of R&D activities within multinational corporations (Veugelers, 1997). The study also shows that the propensity to export significantly increases the likelihood of obtaining subsidies in groups of large firms. In Spain these firms are more likely to undertake an internationalization process and some studies show that they could have an interest in obtaining public funding, since opening up to international markets gives rise to gains which reinforce the innovation process and would allow them to compete and remain in markets (Czarnitzki and Licht, 2006; González et al., 2005; Heijs, 2005). Finally, the study detected differences with regard to the sector of activity. Small and medium-sized firms are more likely to obtain subsidies for R&D if they belong to the hi-tech service sector and this propensity grows, *ceteris paribus*, by 17 and 37 percentage points,

respectively. In the case of small firms this propensity is significantly reduced if the firm belongs to the high-to-medium tech manufacturing sector. In accordance with an OECD report (2007), the design of the innovation policy in Spain is determined to a great extent by the country's industrial structure, principally made up of SMEs in traditional sectors, with a small number of firms specialising in high technology. Thus, one of the main challenges for the policymakers is to favour the expansion of hi-tech sectors and especially to support the vast majority of small firms which see no need to carry out innovation activities, or have insufficient organising capacity to take on research and development activities.

The size differences detected offer no a priori information which would enable us to clarify as to whether we will find differences in the subsidies effect magnitude, because we have discovered that, regardless of size, there are two variables which are determining in obtaining public funding: that the firm has carried out continuous R&D activities and that it has obtained public funding in the past. The study shows that the importance of these activities grows with the size of the firm, in some cases reaching very high levels. Obtaining public finance in the past could, *ceteris paribus*, increase the likelihood of obtaining subsidies by more than 50 percentage points. Thus it is worthwhile considering that this approach in distribution reflects certain isolation from the specific needs and problems that firms have deriving from their size. Moreover, continuous support for innovative firms would only contribute to improving funding of R&D activities of firms which have shown their innovation capacity in the past, in detriment of firms which wish to set in motion innovative projects for the first time.

(Table 2 here)

In the second part of the study, devoted to determining the causal effect of subsidies on the inputs and outputs of the firms' innovation process, we have made a series of estimates to ensure the matching quality and robustness of the findings. Table 3 shows the findings of a means t-test carried out to compare the variables used in the matching process before and after the pairing. As was to be expected, before matching, the analysis shows significant differences between the group of subsidised firms and the group receiving no subsidies. After the matching, these differences between the group of subsidised firms and the control group disappear. This not only provides evidence of the quality of matching, it also shows that methodological assumptions are satisfied. When these analyses were finished, we estimated the effect of the subsidies by using the bias-corrected matching estimator proposed in Abadie and Imbens (2006). The findings are shown in Table 4.

(Table 3 here)

In the general model it is seen that subsidised firms increased their private R&D intensity compared to firms in the control group by 0.26 percentage points in the year when they received their subsidies and by 0.43 percentage points the year after. Although the magnitude of the effect is a modest one (German studies place it around 4 percentage points, see Almus and Czarnitzki 2003), Spanish firms are not replacing public funds by private ones. There is a positive balance if it is borne in mind that the variable under analysis is constructed with a R&D expenditure financed by the firm with own funds and excluding other sources of finance. These findings coincide with previous studies in the Spanish case (see: Busom, 2000; Callejón and García-Quevedo, 2005; González and Pazó, 2008; González et al., 2005; Herrera and Heijs, 2007). The

study also shows that subsidies have an influence on the way in which firms distribute their in-house R&D expenditures. In the year when firms received public funding they reduced their investment in basic research by a significant amount (-2.90 percentage points) and increased investment in applied research (3.51 percentage points) and technological development (5.01 percentage points). A year later, firms increased investment only in technological development (4.95 percentage points). These results indicate that subsidies reduce the firm's effort devoted to extending the frontier of technological knowledge (outside of the technological core domain) and stimulate the generation of knowledge that provides immediate solutions to critical problems and those affecting the core area of business (technological core domain). The study's findings also reveal that subsidies are not managing to increase innovation outputs of Spanish firms in the short term.

The study revealed differences in the effect produced by subsidies on small, medium-sized and large firms. The year in which firms received their subsidies saw no significant effect on the private R&D intensity. Nevertheless, a year later, this variable rose significantly only in the case of small and medium-sized firms (0.99 and 0.32 percentage points, respectively). In this study we used a means t-test to discover whether the effect was noticeably greater in one group of firms or another. The test indicates that there are no significant differences in the magnitude of these effects.

The results of the study accept hypothesis 1. Subsidies have an impact on the allocation firms make in their R&D expenditure and that impact changes with firm size. In the case of investments in basic research, the study shows that the effect of subsidies was negative and significant only in the case of medium-sized firms (-6.01 percentage

points). In no case did the policy of subsidies promote investment geared to extending the frontier of technological knowledge, which would allow firms to diversify risk. Nonetheless, the subsidies policy made it possible for medium-sized and small firms to increase their investments in applied research, the aim of which is to extend the knowledge base in the firm's technological domain. In the year in which the subsidies were received these investments showed a significant rise in the case of medium-sized firms (8.52 percentage points), and a year later in the case of small firms (8.52 percentage points). As can be observed, there is a substitution effect for investments in the case of medium-sized firms reducing their investments in basic research and increasing them in applied research. According to Rafferty (2003), R&D activities are related to the firm's business cycle and growth. For example, during expansion processes firms cut investment in basic research and increase investment in applied research and technological development, so that substitution effects might arise between different types of R&D, since these activities compete for resources (Henard and McFadyen, 2006). The study also shows that investments in technological development experienced a significant rise in small and large firms (9.37 percentage points and 8.43 percentage points, respectively), though there are no significant differences in the magnitude of the effect. A year later only small firms were still investing in this activity.

Table 4 also shows that subsidies had a significant effect only on the outputs of the innovation process of small firms in the year when they received subsidies. The study discovered no significant effects in large and medium-sized firms, so hypothesis 2 is proved correct. Small firms showed marked increases of 5.34 percentage points in sales of products new for the firm in comparison with those firms that did not receive subsidies. In the short term, small subsidised firms obtained economic returns from

incremental innovations of the products. Likewise, results indicate they were the only group of firms which showed a continuous increase in applied research investments and technological development, with investment higher in the latter of the two. According to some authors, small firms may easily take advantage of the knowledge gained from R&D activities and may translate it into market solutions thanks to their flexibility and easy adaptation to external changes (Gopalakrishnan and Bierly, 2006).

Though different Spanish studies have shown that in general the innovation policy tends to subsidise large firms (Acosta and Modrego, 2001; Blanes and Busom, 2004; Busom, 2000; González et al., 2005; Heijs, 2005; Herrera and Nieto, 2008) small firms are the ones showing at the same time a positive, significant effect on inputs and outputs of the innovation process. Therefore, it is worth evaluating the approach in the distribution of subsidies to bring the innovation policy nearer to the needs of this group of firms.

(Table 4 here)

6. Conclusions and policy implications

This study analysed the effect of R&D subsidies on strategic decisions taken by firms when faced by innovation. Large and small firms take on the innovation activity in a different way so their needs for public support could differ and the outcome of the policy could also be different. In fact, there are studies which analyse the impact of innovation policies bearing in mind the size of the firm and have found that R&D subsidies may increase or diminish the private R&D expenditure. Nevertheless, the evaluation approach hitherto used in these studies does not enable us to determine how

the innovation policy impinges on knowledge generation and on the productivity of small and large firms' innovation activities.

This issue turns out to be important for evaluating innovation policies since policymakers are using firm size to intervene in the firms' innovation activity, even despite the lack of consensus concerning the relationship between firm size and innovation not having been of use in designing these policies. In this study we analysed the distribution and the effect of R&D subsidies on the inputs and outputs of the innovation process in the case of small, medium-sized and large firms. Unlike other studies, we analysed the impact of R&D subsidies on firms' strategic behaviour and the decisions they made to establish a basis for their competitive advantage. We believe that with these analyses policymakers may have a better understanding of the indirect effect of the innovation policy upon the process of technological change, since traditionally, the evaluation has been made from measures of innovation which do not reflect firms' strategic behaviour. In the first place, we analysed the effect of subsidies on the R&D portfolio of the firm, because it is in the early stages of the innovation process that firms run the highest risk and make decisions on their technological knowledge frontier.

Although the literature has traditionally associated R&D activities with certain specific sectors and sizes of firms, nowadays the idea that a minimum amount of R&D is needed to construct what is called absorption capacity is gaining ground. Secondly, we analysed the impact of subsidies on economic performance and the degree of novelty of innovations.

A first part of the analysis has obliged us to bear in mind the allocation of R&D subsidies. The traditional innovation policy evaluation approach which relied on

analysis of the unidirectional relationship between innovation policy and innovation activity, has changed and a third element has been incorporated: the distribution of public funding. This distribution is not random and could skew the estimates of the final outcome of the policy. In this previous analysis, we found that there are differences in the profile of subsidised firms in the three groups. For example, large firms are more likely to be subsidised if they have private, national capital and a high propensity to export, whereas in the case of small firms the determining aspect is their belonging to the hi-tech service sector. Though the literature has provided an explanation for some of these findings, we found that a priori these differences might not be enough to explain disparities in the magnitude of the effect of subsidies on these groups of firms. The above can be deduced from the results obtained in the study, which, regardless of size, shows that firms which are more likely to be subsidised were those with previous experience of R&D and had obtained public finance in the past. The importance of these variables increases with firm size, and reaches very high levels. This study has showed that having obtained public funding in the past, *ceteris paribus*, increases the propensity to receive subsidies by more than 50 percentage points. As a result, there is a clear approach in the assignation of subsidies which does not take into account the size of the firm or the specific needs and problems stemming from this variable.

In the second part of the analysis directed to estimating the impact of subsidies, we found that the effect was only positive and significant on private R&D intensity in the case of small and medium-sized firms. Nonetheless, there are no significant differences in the magnitude of the effect between two groups. Similarly, the study also showed that subsidies have effects on the way in which firms distribute their R&D expenditures on basic research, applied research and technological development activities. All of these

activities have the objective of increasing the firm's stock of technological knowledge. On the one hand, we found that subsidies did not encourage activities geared towards expanding the technological knowledge frontier (i.e. basic research). These investments would allow firms to diversify risk and combine related technologies in a complex manner to create a sustainable competitive advantage. Moreover, the findings show that subsidies, in all cases, managed to increase investments geared to extending the knowledge base in the firm's technological domain. In the short term this would enable firms to create a distance with their competitors (i.e. applied research and technological development). Our study found three differences in firms' strategic behaviour. First of all, in the case of medium-sized firms, a substitution effect on investments was noticed: these firms reduced investments in basic research and increased them in applied research. Some authors put this phenomenon down to the firm's business cycle and that in these activities there is mutual competition for resources. In second place, the findings show that small firms were the only ones to continuously keep their investments in R&D activities and thus they increased their R&D intensity and economic performance. Thirdly, large firms only invested in technological development activities, showing that they are more interested in survival and made no investments directed to obtaining a broad base of knowledge to allow them to enjoy a sustainable competitive advantage. Though the literature has shown that large firms are more likely to be subsidised, the impact on their innovation activity was minimal in comparison with changes produced by small and medium-sized firms.

As for the R&D subsidies' effect on the innovation process outputs the study found that only small firms obtained economic returns from incremental improvements in the product. In fact these firms invested more in obtaining commercial knowledge and,

consequently, the innovations obtained were incremental in nature. The subsidy policy did not stimulate the production of radical innovations. Fernández-Ribas and Catalán (2010) have already pointed out that this effect can become a limiting factor for medium-term development, since the springing up of new industries based on destructive innovations is restricted. The research will thus have to continue and managers and policymakers will have to work on the early detection of inventions which potentially can initiate a radical change in the industry. New policies could be created based on deeper knowledge of how these innovations occur and thus support the early stages of its development.

The results of this study may have implications for policy makers if we take into account that granting aid in the past has a significant determination on obtaining public funding in the future. As a consequence of these decisions, policymakers should reflect on the role of innovation policy on the technological change process and the configuration of industry, since the present approach to subsidy distribution is permitting the continuation of a certain strategic behaviour which specialises in leading the firm towards a quest for immediate results rather than constructing a sustainable competitive advantage.

Though the study may serve as a starting point for a broader analysis of the effect of public financing on firms' strategic behaviour, it must be stressed that the data are associated with a series of limitations for research. We have used data from a particular period of time, and as a result we cannot draw definite conclusions on these effects in the long term. Probably, in some cases a more extensive time period may be needed for the effects of these subsidies to become visible in some of the variables or groups of

firms. What is more, as in the majority of research works of this type, we have been unable to analyse the impact of subsidies by taking into account the support program or the agency distributing public support. Evaluations also need to compare objectives proposed with results obtained. As a result, the evaluation presented in this paper is general and the findings have to be interpreted by taking into account the characteristics of the data used (e.g. specific characteristics of the survey) and the case study. Finally, future research will find it necessary to increase the number of variables of interest to analyse the impact of these R&D subsidies on other aspects of firms' strategic behaviour such as: acquiring outside technology, contracting human resources and organisational behaviour.

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Table 1. Studies regarding the innovation policy effect according to firm size

Author	Country	Time Period	Method	Size	Results
Carmichael (1981)	United States	1976-1978	OLS	Large firms ^a	Substitutability
				Small firms ^a	Substitutability
Klette and Moen (1998)	Norway	1982-1995	OLS FE	Large firms > 263 employees	Complementarity
				Small firms < 58 employees	Not significant
Lach (2002)	Israel	1990-1995	DID	Large firms > 300 employees	Not significant
				Small firms < 300 employees	Not significant
Gonzalez et al., (2005)	Spain	1990-1999	Tobit	Large firms > 200 employees	Complementarity
				Small firms ≤ 200 employees	Complementarity
Gonzales and Pazó (2008)	Spain	1990-1999	ME	Large firms > 200 employees	Not significant
				Small firms ≤ 200 employees	Complementarity

OLS= Ordinary least squares; FE= Fixed effects; DID= Difference in Difference estimator

GLS= General least squares; ME= Matching Estimator.

^a= Information regarding group limits according to number of employees is not available.

Table 2. Results of the Probit model estimations and marginal effects

	General Model		Small Firms		Medium sized firms		Large firms	
	Coef.	M.E	Coef.	M.E	Coef.	M.E	Coef.	M.E.
Dependent variable = 1 indicates that the firms obtained R&D subsidies								
Firm Size (log number of employees)	-0.02		-0.06		-0.04		0.08	
Newly established firm dummy t-1	0.25*	0.08*	0.20		0.49		0.34	
Domestic firm dummy t-1	0.09		-0.21		0.22*	0.05*	0.31***	0.06**
Export propensity t-1 (%)	0.00		-0.00		-0.00		0.01***	0.00***
Firm location in a central region dummy t-1 ^a	-0.02		-0.08		-0.03		0.12	
High tech manufacturing sector dummy	0.05		-0.02		0.05		0.09	
Med tech manufacturing sector dummy	-0.08		-0.22**	-0.07***	-0.10		0.16	
High tech service sector dummy	0.60***	0.20***	0.45***	0.17***	1.10***	0.37***	0.01	
I+D continua dummy t-3	0.33***	0.08***	0.25***	0.08***	0.31**	0.07***	0.45***	0.09***
Public funding dummy t-1	1.76***	0.57***	1.48***	0.51***	1.95***	0.61***	2.02***	0.62***
Number of firms		4713		1971		1543		1199
Number of subsidised firms		1218		640		344		234
Log Likelihood		-1791.83		-906.84		-497.38		-348.02
Pseudo R2		0.33		0.27		0.39		0.41
Correctly classified (%)		84.94		80.00		87.75		90.08

***significant at 1percent; ** significant at 5percent; * significant at 10 percent.

M.E.= Marginal Effects

^aFirms located in Madrid, Catalonia, Navarra and Basque Country.

Table 3. Means comparisons between subsidised firms and non-subsidised firms (before matching) and between subsidized firms and control group (after matching)

	General model			Small firms			Medium sized firms			Large firms		
	S=1 ^a	Controls ^b	S=0	S=1	Controls	S=0	S=1	Controls	S=0	S=1	Controls	S=0
Propensity score	0.30	0.30	0.16***	0.54	0.53	0.22***	0.51	0.50	0.12	0.47	0.46	0.10***
Private R&D expenditures t-1	89.57	89.73	70.38***	83.00	83.54	84.01	85.13	86.7**	75.58***	58.74	60.78	44.90***
High tech manufac. sector dummy	0.05	0.05	0.08**	0.09	0.09	0.11	0.09	0.09	0.08*	0.11	0.11	0.06***
Med tech manufac. sector dummy	0.13	0.13	0.27***	0.17	0.17	0.30***	0.24	0.24	0.30**	0.24	0.24	0.17***
High tech service sector dummy	0.5	0.5	0.02***	0.14	0.14	0.03***	0.11	0.06***	0.01***	0.03	0.03	0.01***
Public funding dummy t-1	0.33	0.33	0.17***	0.73	0.73	0.18***	0.68	0.68	0.10***	0.58	0.58	0.06***

Significances (***)significant at 1percent; ** significant at 5percent; * significant at 10 percent) indicate that the means compared differ according to the two tailed t-test.

^a S=1 indicates that the firms obtained R&D subsidies and 0 in the opposite case

^b Controls= means of firms in the control group

Table 4. Average Effect of the R&D Subsidies on the Firm's Innovation Activity

	General model		Small firms		Medium sized firms		Large firms	
	Coefficients		Coefficients		Coefficients		Coefficients	
	t	t+1	t	t+1	t	t+1	t	t+1
Inputs								
Private R&D intensity	0.26*	0.43***	0.07	0.99**	0.21	0.32**	0.01	-0.02
Basic research	-2.90**	-0.67	-1.72	-1.07	-6.01**	2.33	0.46	-0.55
Applied research	3.51*	3.03	2.28	6.12**	8.52**	0.61	-4.14	-3.57
Technological development	5.01**	4.95**	9.37***	7.64**	-1.29	-1.72	8.43*	8.02
Outputs								
% Sales of products new for firm	2.80	1.38	5.34***	3.40	-0.89	-0.92	3.69	-1.47
% Sales of products new for market	2.10	1.15	2.01	2.28	3.50	1.08	-0.37	-0.08
Number of observations	4713		1971		1543		1199	
Number of observations with subsidies	1218		640		344		234	

***significant at 1percent; ** significant at 5percent; * significant at 10 percent.