Evaluation of public subsidies oriented to firms' performance: a quasi-experimental approach*

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Abstract: Many regional governments in developed countries design programs to improve the competitiveness of local firms. In this paper, we use a quasi-experimental methodology to evaluate the effectiveness of public programs directed to increase firms' performance in Catalonia. For this purpose, we compare the performance of companies that have received public subsidies (*treated*) to that of similar companies that have not received it (*non-treated*). We use the Propensity Score Matching (PSM) methodology to construct a comparison group that is as similar as possible to the treatment group with respect to observable and non-observable characteristics, and that allows us to identify firms with the same propensity to receive public subsidies. Once we have a valid comparison group, we compare the performance of firms that effectively receive public subsidies to the performance of similar non-participant companies. We find that recipient firms, on average, have changed business practices, improved their performance and increased their value added as a direct result of public programs.

JEL: H25, H32; L25; L53
Keywords: public policy, evaluation studies, firm performance, Propensity Score Matching

1. Introduction

In recent years, there has been an increase in the number of studies oriented to analyse the impact of economic policy measures directed to increase industrial competitiveness (e.g. Roper et al., 2004; Almus and Czarnitki, 2003; Duguet, 2003; Busom, 2000). In a context of growing trade openness that generates stronger international competition, along with the need to maintain balanced public accounts and the need to reach the maximum effectiveness in the implementation of public policy measures, justifies the growing interest for this type of studies.

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In Spain, the decentralization process started in the 80's allowed regional governments to adopt their own measures for industrial promotion to tackle the peculiarities of each regional industrial structure more effectively. In the Catalan case, the industrial structure is characterized by the presence of a majority of Small and Medium Enterprises (SME, hereafter), and a high degree of productive diversification. Moreover, the Catalan industry represents around 25% of the Spanish industry and, therefore, its competitive position, as well as the impact of public interventions to promote it, is of particular interest.

In Catalonia, regional industrial policy interventions have been summarized in different plans directed to overcome some of its structural weaknesses. For instance, during the 1993-1996 there was a plan to improve the competitiveness of the Catalan industry centred in reducing regional disparities, internationalization of firms, and promoting the adoption of new technology and R&D. The results materialized in the promotion of specialized clusters, and in a growing participation of Catalan firms in international transactions of goods and services, as well as in investment inflows and outflows.

More recently, industrial policy in Catalonia has been articulated around *Catalonia's Innovation Plan 2001-2004*, which intended to reinforce the innovative capacity of Catalan firms (see Callejón and García-Quevedo, 2000). Moreover, the Spanish central government has undertaken some actions to promote local industries through the design of high-priority lines SME's such as the *SME's Consolidation and Competitiveness Plan 2001-2006* elaborated by the Spanish Ministry of Industry, transferring funds to regional governments to manage locally public programs, guaranteeing independence in procedures, resolutions and liquidations in the application of these programs.

The evaluation of these public programs to promote industrial innovation is of special interest to determine which measures (and to what extent) have been effective in the reinforcement of the competitive position of Catalan firms. Therefore, the aim of this paper is to evaluate the impact of different public subsidies adopted by the Catalan Public Agency (CIDEM, hereafter)[1] devoted to promote the competitiveness of the Catalan industry. We use the Propensity Score Matching (PSM, hereafter) and a quasi-experimental methodology to evaluate the impact of public subsidies granted on the year 2000.

For this purpose, the paper is organized as follows. Section 2 briefly describes the main public subsidies of CIDEM. Section 3 reviews the econometric technique used and the

[1] From the Catalan acronym *Centre d' Innovació i Desenvolupament Empresarial*.

underlying economic model. Section 4 deals with data and estimation issues. Section 5 presents the main results obtained. Finally, section 6 concludes.

2. Public programs oriented to firms' performance in Catalonia

The Catalan industrial policy has deeply changed orientation in the last two decades. From a policy that supported specific sectors (a *picking winners approach*), it has evolved to cover the necessity of improving the economic environment in which firms operate (see Costa and García-Quevedo, 2000) and, hence, to promote R&D activities as the source of competitiveness.

This change in the main objective of the industrial policy is in line with the European Commission (EC). In fact, the EC defends to create a managerial atmosphere that promotes new initiatives, facilitate the free development of projects in market conditions, and reinforces the factors that improve the competitive capacity of the European industry (Landabaso, 2000).

Therefore, in recent years the Catalan industrial policy measures were designed towards the improvement of the innovative capacity of firms. This new industrial policy began with the *Plan of Innovation 2001-2004* that it is framed inside the *Regional Program for Technology Transfer Strategy* of the European Commission.[2] The public subsidies we evaluate in this paper are part of this plan, which had as one of its main objectives the consolidation of a base of "talent" through appropriate initiatives of recruitment and the retention "of intelligence" (highly skilled professionals). Moreover, the aim of the plan was also to create intangible infrastructures and social capital for firms.

Public subsidies in Catalonia, as we have mentioned, are managed by CIDEM. The amount of subsidies we evaluate in this paper are around 8,6 millions of Euros (see table 1), which represents, approximately 66% of CIDEM's total budget, and around 0,03% of the Catalan industrial Gross Value Added.

Next, we briefly describe the four public subsidies (programs) we evaluate in this paper. The table 1 presents a quantitative description of these subsidies during the year 2000.[3]

[2] The new Catalan government, which took office in November 2003, has recently implemented a new plan called *Catalonia's Research and Innovation Plan 2005-2008* that is currently in operation.

[3] In table 1 there are reported the total number of applications per subsidy, the number of applications accepted; the covering ratio; the total amount invested in each subsidy, and also the average value of the subsidy obtained per firm.

QP (*Quality and Productivity*). This subsidy was designed to improve the optimization and consolidation of firms' resource management, flexibility, innovation, satisfaction of clients and personnel, and to improve impact in the environment. Moreover, it had the aim of support the firm's competitive position in the market.

ISO (*International Organization for Standardization*). The main aim of this subsidy was (and still is) to obtain the certification according to the norm ISO-9000; to achieve a more competitive product, cost reduction, and increases in quality and productivity of firms.

IPIME constituted a package of subsidies divided in four programs: Managerial Cooperation; Promotion of Services of Information; Design and Program of Nets of Intermediate Organisms of Support to Innovation. The purposes of IPIME as a whole was to increase the competitiveness of firms, promote the rendering of advanced services of managerial information; the incorporation, assimilation or application of innovative technologies and/or innovative design in small businesses. Moreover, it was directed to improve the marketing of products and the application of innovative methods of management.

CIRIT was a public subsidy oriented to promote R&D of firms in cooperation with technological centres. Therefore, these subsidies had the aim to give support to the innovation processes of firms and to increase the basic research at industrial level.

Table 1. Public subsidies given by CIDEM (Year 2000)

	Applications (a)	**Accepted applications(b)**	**Covering Ratio (%) (b)/(a)**	**Total amount (€)**	**Amount per firm (€)**
QP	37	30	81	155.032	5.168
ISO	1.248	522	42	941.185	1.803
IPIME	515	183	35	6.022.927	32.912
CIRIT	142	86	61	1.539.888	17.906
Total	1.942	821	54,75*	8.659.032	14.447*

Font: Own elaboration. * Average.

3. Methodology and model specification

The best form of evaluation of public programs is "true" experiments based on random assignments since they offer the most solid foundations to analyze the relationships of causation. In this type of experimental designs, firms are assigned at random to

"treatment and control groups". Units in each group, on average, are equivalent respect to all the shared characteristics. Due to this equivalence, it is possible to eliminate the influence of external factors that could contribute to the observed results of firms. Hence, the differences of the observed results between the two groups can be attributed exclusively to the implementation of the public program.

However, the possibility to use an experimental plan based on random assignments for the evaluation of public programs directed to firms such as those analysed in this paper, is generally not very practical for various reasons. The main problem relies on the inability of public agencies of denying a subsidy to eligible companies (i.e. selection bias). Therefore, to evaluate public programs we need to use an alternative method: a quasi-experimental method. Although this methodology also requires the comparison of the results between two groups of companies, those that received the public subsidy and those similar companies that have not been exposed to the "treatment", additional steps are followed to minimize the selection bias.[4]

To avoid this problem and to get valid results from the evaluation technique we have to be careful when building up the control group, which must be as similar as possible to the treatment group with regard to non-observables characteristics (e.g. management characteristics), as well as with regard to the rest of the economic variables (size, sector, localization, etc). Moreover, the quasi-experimental methods allow discriminating among different alternative hypotheses for the differences observed in the results from companies subjected to the treatment and the control group (non-treated firms).

The nature of the quasi-experimental method used in this paper is based on the construction of two groups of firms. First, the treatment group, firms that have received subsidies from CIDEM, for which we make use of the CIDEM database. Second, we build up a control group by means of the PSM technique (see Rubin, 1974 and 1977; and Angrist et al., 1996).[5]

[4] The selection bias arises when a group of companies differs from another in terms of the characteristics that affect the results of the program. For instance, consider a situation in which there is a type of manager prone to the adoption of measures that can improve the firm's results. It is likely that this type of manager will look for public subsidies with more intensity than those managers that are already satisfied with the current situation of their companies. As a result, the observed firms' improvements can be explained more by management differences among firms than for the services provided by public programs.

[5] See section 4 for more details on the construction of both groups of firms, and on data requirements. The propensity score is defined by Rosembaum and Rubin (1983) as the conditional probability of receiving a treatment given pre-treatment characteristics. A logit estimation (see for more details Greene, 2003) will give us the propensity scores that are also known as the Average effect of Treatment on the Treated (ATT).

The PSM is an appropriate methodology for policy evaluation because it allows to estimate a counterfactual state (what had happened in absence of public subsidies)[6] and to control the process of distribution of the public subsidies.[7] Therefore, PSM helps to reduce some of the main methodological problems of policy evaluation.

Following the literature that uses this methodology for policy evaluation (Czarnitzki and Fier, 2002; Almus and Czarnitzki, 2003; Duguet, 2003; Herrera and Heijs, 2003), we make use of PSM for the evaluation of public subsidies given by the Catalan Public Agency (CIDEM) to firms. We use PSM to build up a valid control group, that is, firms that not having received public subsidies have *a priori* the same probability to receive a subsidy than those that effectively received a subsidy. Therefore, firms in the control group have the same "propensity" than treated firms once we have controlled for all those unobserved factors that influence firms to participate in public programs.

With the treatment and the control group defined, we can use a quasi-experiment to estimate the impacts of the various public subsidies given by CIDEM (either individually or as a whole), measuring the difference in the evolution of some variable of results (for instance value added, sales or productivity) and controlling for other possible influences. This second stage is driven by an underlying economic model presented in the next section.

The economic model

Our aim is to estimate an economic model that can explain the variation of firms' results, focusing our attention on the effect of public subsidies. We use a classical model of output determination including control variables correlated with results but not with public subsidies. Therefore, when estimating the underlying variation of results, these control variables increase the possibility to capture the true impact of public subsidies in the firms' results.

For this purpose, we use a modified Cobb-Douglas production function where production (Q) is function of labour (L), capital (K) and materials (M), as well as of specific effects for each firm (F) and industry (I):

[6] Many evaluation techniques are based on regression equations that do not consider the counterfactual state of the results variables (for instance, sales or revenues), or in other words, do not compare the level of these variables in absence of subsidies with their level in presence of these public subsidies.

[7] Another problem solved by PSM is related with the distribution of subsidies: public agencies follow a process of selection of firms that can determine the results of the subsidies. Consequently, it could be a problem of endogeneity of public funds that needs to be conveniently addressed.

$$Q_i = f(L_i, K_i, M_i, F_i, I_i)\,, \tag{1}$$

subtracting materials (M) of each side of the equation, it yields:

$$V_i = Q_i - M_i = f(L_i, K_i, F_i, I_i)\,, \tag{2}$$

where V_i is the value added of firm *i*.

Since we are interested in estimating the contribution of the different public programs from CIDEM to the change in the firms' value added, we adopt a growth accounting framework. That is, taking first differences of the production function in (2) we get the following relationship:

$$\Delta_t \log V_i = \Delta_t \log L_i + \Delta_t \log K_i + F_i + I_i\,, \tag{3}$$

where value added is expressed as the change between two years: 2000 and 2002.[8] The specific effects for company and sector are assumed also fixed in the growth equation and, therefore, they are not represented in terms of a variable of change.

To control for specific effects at firm level, additional variables are included: the logarithm of the total number of workers and the logarithm of the value added both for the base year. The first variable controls for the initial firm size, while the second controls for the initial levels of competitiveness and positioning in the market. Formally, the estimated equation takes the following form:

$$\Delta_t \log V_i = \Delta_t \log L_i + \Delta_t \log K_i + \log VE_i + \log E_i + I_i + e_i\,, \tag{4}$$

where $\Delta_t \log V_i$ is the change in the logarithm of value added, $\Delta_t \log L_i$ is the change in the logarithm of the number of workers, $\Delta_t \log K_i$ is the change in the logarithm of capital, $\log VE_i$ is the logarithm of the value added in the initial year, $\log E_i$ is the logarithm of the number of workers in the initial year, I_i is a dummy variables to control the economic sector where the firm operates and, finally, e_i is an error term.

[8] The year 2000 is our initial year: when the subsidies were granted. The year 2002 is a posterior date that allows us to evaluate the impact of those public subsidies. Moreover, we have chosen the year 2002 because we do not have data for more recent years in our database (see section 4 for more details).

The last step to construct our model is to introduce the variables related with the public subsidies of CIDEM (denominated as C) to estimate their effects on the growth rate of value added of firms that effectively received the subsidy compares with those that do not received it:

$$\Delta_t \log V_i = \Delta_t \log L_i + \Delta_t \log K_i + \log VE_i + \log E_i + I_i + C_i + e_i . \quad (5)$$

C denotes dummy variables that take the value 1 if the firm received a subsidy and 0 otherwise. This specification allows us to include separately in the same equation the different public programs to evaluate which has a bigger impact in the firms' performance. As presented in section 2, the subsidies (differentiated with respect their aim) programs are Quality and Productivity (QP), ISO Certification (ISO), Competitiveness (IPIME) and Innovation (CIRIT). Therefore, the equation to estimate is:

$$\Delta_t \log V_i = \Delta_t \log L_i + \Delta_t \log K_i + \log VE_i + \log E_i + I_i + QP_i + ISO_i + IPIME_t + CIRIT_i + e_i \quad (6)$$

4. Data

The main information source used in this paper is the *Sistema Anual de Balances Ibéricos* (SABI, hereafter). This database is a fully representative sample of firms in Spain (and Portugal), which contains all the relevant information at a firm level. There is information for 838.076 Spanish firms, 182.004 of which are Catalan firms.[9]

SABI makes possible to analyze the behaviour of a very wide sample of Spanish firms, it contains information on all those variables contained in a standard balance sheet: variables that refer to the firms' results: sales (revenue from activity), value added, and the different measures of results: exploitation, financial, from ordinary activities and from extraordinary activities.

There is, also, information coming from the ratio analysis: profitability (economic and financial); financial expenses; manoeuvre margin, treasury ratios and balance ratio; ratios of solvency; indebtedness; and liquidity (of general and immediate liquidity).

[9] Available data from SABI database increases with firms' size. For small firms SABI contains less than 5% of firms from the total, although with a representation of 31,4% of the total occupation of that type of firms. Nevertheless, SABI covers 31% of firms with more than nine workers, and more than half of bigger firms (55,3%). The relevance of these figures indicates that the sample of firms recorded in SABI can be considered sufficiently representative of the population of Spanish (and Catalan) firms.

The levels at which these variables are available are multiple. We can organize the information at a territorial level, since we have the postal code of firms, which allows us to locate with great precision the firms. It is also important the sectoral disaggregation (the activity of each firm is classified according to the NACE-Rev.1[10] classification). Finally, the data on the number of employees allows us to define accurately the company size.

We have collected from SABI data for the main variables we are interested in for two points in time: when the subsidy was granted (2000) and data for the same variables in 2002 to see if there has been an significant impact of public subsidies on the main aggregates of firms.[11]

Treatment group

All the information required to construct the treatment group has been directly obtained from CIDEM. All the information needed for those firms that have applied for a public subsidy that is not recorded by CIDEM can be found in SABI. The total number of applications received by CIDEM in the year 2000 was 1.844, being 821 accepted. From these 821 firms with successful applications we have 601 in SABI database; however, we do not have all the relevant information of all of them. Therefore, we finally have 421 firms that received a public subsidy with all the relevant information in SABI. This gives us a covering ratio (treated firms with all the relevant information with respect total treated firms) of 51,3%.

Therefore, our treatment group is composed by 421 firms that received a public subsidy from CIDEM. These companies are distributed by sectors, for types of subsidy and for location. In the sectoral dimension, the classification NACE-Rev.1 is used (two digits) and includes 60 economic activities.

Control group (non-treated)

Evaluation techniques require constructing a comparison, or control, group. The construction of the control group requires an element that deserves special attention: the best comparison group should represent a faithful image of the treatment group in its main dimensions, with regard to the variables that determine its results, but also for non-observable factors like management motivation or organisational behaviour. It is in

[10] Classification of Economic Activities in the European Community.
[11] The year 2002 is the last year for which we have more information for a high proportion of firms recorded in SABI.

this context that PSM acquires special relevance, since it allows us to choose those firms that have the same propensity to receive public subsidies, given a series of characteristics of the firms, and also given (*a priori*) a certain similar behaviour of the non-observable factors.

The main data source to construct the control group has been again SABI database. Obviously, the first step to select the firms that can be considered for the control group is to eliminate all those companies that received a subsidy and all those companies that operate in economic sectors that do not present any firm in the CIDEM records (sectors where firms did not apply for a subsidy).

We have 66.763 firms' records from SABI; the dimension of our control group is of 32.011 given that there is a process of filtering all those firms not eligible for the control group.[12]

4.1 Variables to determine the propensity of requesting a public subsidy

The main aim of PSM methodology is to estimate the propensity of a given firm to obtain a public subsidy given a group of individual (economic) characteristics.[13] The variables we use to estimate this propensity have been selected following the related empiric evidence, and the available information in the SABI database.

Previous works have identified some variables that can determine the propensity to obtain a public subsidy. Structural variables such as size, economic sector or localization, seems to be important as a determinant for receiving a subsidy. Other studies have also identified as relevant the information about the competitive position of the firm, its effort and orientation in innovation, management strategy, and degree of openness of the firm (internationalization). Finally, studies based in multivariate models (see Bonnet, 2002), besides structural variables, have considered aspects such as the innovative behaviour, the characteristics of the market or the difficulties to obtain financing for innovation.

Therefore, there are three relevant groups of variables when analyzing the factors that influence the propensity of receiving a public subsidy: variables associated with firms' characteristics, market related variables, and classic productive factors.

[12] Basically for data availability reasons.
[13] These individual factors can also affect the non-observable characteristics of the firm such as a different management procedures or tendency to innovate.

A. Variables associated with firms' characteristics.

Size (**L**), proxied by the number of workers, is one of the most common variables used in the literature although there is not a clear result on the effect of this variable. Despite the existence of some public subsidies exclusively directed toward SME's, the hypothesis that public financing favours firms of smaller size it has not been confirmed by all the consulted studies (Heijs, 1999 and 2001; Arvanitis et al., 2002; and Almus and Czarnitzki, 2003). Some studies find a positive discrimination towards SME's while others point out that bigger firms have been more beneficiaries than small ones.

An equally important variable is the economic sector at which the firm operates. Previous studies indicate that public programs mainly benefit companies of highly dynamic sectors. In the Spanish case, the empirical evidence is not conclusive. On one hand, there are studies that find sectoral differences (Heijs, 1999, 2001; Busom, 2000), that is, low level of participation in public programs of firms operating in traditional sectors (or sectors with low innovative propensity), and a high participation rate by high technology firms, and firms based on R&D sectors. On the other hand, there is also evidence of the absence of these sectoral differences (see Fernández et al., 1996). We include in the PSM estimation two dummy variables to control for the economic sector at which the firm operates: high technology manufacturing (**Dht**), and high technology services (**Sht**).

Firm's age (**Years**) is calculated as the number of years the firm has been operating in the market. This variable can be interpreted, in this context, as an indicator that reflects the administration capacity, experience, and the ability to obtain external of resources (Busom, 2000; and Almus and Czarnitzki, 2003). Although it seems that the explanatory power of this variable is generally poor, in the study of Busom (2000) it turns out to be statistically significant to explain the propensity of firms to participate in public programs.[14]

Localization (**Loc**) has been taken into account in various studies. However, the results generally found do not seem to show a significant influence on the propensity to receive a public subsidy. With regard the effect of location it can be argued that in developed countries there are more instruments to support private initiative, however, these public instruments can be implemented in two different ways: either to support advanced regions (efficiency argument) or to support lagging regions (equity argument) where there is a bigger need of public intervention. In the Catalan case, these arguments can be

[14] We also include a quadratic term for the effect of age's firm on the propensity to receive a subsidy ($years^2$) to capture possible non-linearities on this relationship.

translated into a dummy variable that distinguish firms located in the municipality of Barcelona (central and advanced region in Catalonia) and the rest of the Catalan territory.

Another variable we use in this paper, commonly found in the evaluation literature, is the property structure of the firms. The main hypothesis behind this variable is that firms with a bigger share of foreign capital are less likely to apply for (and hence obtain) local subsidies. Furthermore, the bigger the percentage of shares in hand of the public sector the higher the propensity to apply for a public subsidy. These hypotheses have been confirmed for the Spanish case (see Busom; 2000). Moreover, Almus and Czarnitzki (2003) show that firms belonging to an entrepreneurship group have a higher propensity to apply for subsidies than "independent" firms. We construct an indicator of independence (**Inin**) that takes the value 1 if any shareholder has more than 25% of the total number of shares.

Few studies have quantified and analysed the role of firms' management in the propensity to request/receive a subsidy, although the literature considers it an important aspect determining the innovative behaviour of firms.[15] We make use of a diversification variable to partially proxy the management strategy. Specifically, the reasoning is that diversified firms (with a wider offer of products) can be more interested in public subsidies than specialised firms (maybe because the aim of a subsidy it is easier to coincide with the activity of a diversified company more than with the activity of a specialized firm). We use as indicator of the diversification degree of a firm its number of subsidiaries (**Nsub**).

Credit constrains can be an important determinant of the propensity to apply for a public subsidy. First, because the firm can be more prone to look for financing in the public sector if it gets difficulties in the private sector. Second, because precisely some subsidies are addressed to firms for which credit constraints are a barrier, for instance, to innovation. We proxy credit constraints with the solvency ratio (**Solv**) of the firm.

B. Market related variables

The second group of variables, which can affect the propensity of a firm to receive a public subsidy, control for the competitive atmosphere in which firms operate. Many evaluation studies do not include this type of variables given the difficulties to obtain relevant data. We analyse two aspects of the competitive atmosphere: the degree of

[15] One of the main reasons for the no inclusion of this variable is the difficulty to reflect the notion of management in a single variable.

international opening as proxy for the level of competitiveness, and the investment capacity of the firm.

Similarly to other studies (Heijs, 1999 and 2001; and Busom, 2000), we consider exports by firms as a measure of competitiveness. Firms with a high propensity to export could participate more in public programs since, for instance, R&D activity has a strategic importance to compete and to remain in the market. Additionally, the government could support them due to their potential to transfer innovations in the economy. Unfortunately, we do not have data on the value (or volume) of exports (imports); therefore, we make use of two dummy variables: one that indicates if the firm exports (**Exp**), and another that indicates if the firm imports (**Imp**).[16]

Investment capacity is related to the process of development of firms, and to the evolution of its main market.[17] Moreover, it is important to control for this variable when analysing the propensity to obtain a public subsidy: firms with higher investment capacity presumably could carry out strong investments in R&D; therefore, they do not present an evident necessity for a public subsidy. To capture this effect, it has been used the variable capital requirements (**Creq**), available in the SABI database.

C. Classic productive factors

Many of the already cited studies have indicated that are precisely the most innovative firms the ones that participate more in public programs. Unfortunately, given our database, it has not been possible to include variables related to the innovative behaviour of firms. Nevertheless, it seems clear that the classical productive factors can play a role in the determination of the competitive capacity of firms, and consequently in their results. This way, we add the capital of each firm (**K**) to the estimation of the propensity to obtain a public subsidy. Moreover, we also use the labour factor, already incorporated in the first group of variables.

Summarising, with these three groups of variables we carry out the analysis of the determinants of the propensity of receiving a public subsidy by CIDEM. Once we have the propensity scores calculated for each firm, we use a matching technique to carry out the evaluation of the different public programs of CIDEM.

[16] The lack of data on the value or the volume of exports/imports prevents us to construct, for instance, an import activity variable, which could also capture the pressure of foreign competition in the domestic market.
[17] Firms usually make strong investments in modernization and innovation during these processes.

5. Results

Given the described dataset, in this section we carry out two different empirical analyses. First, using the PSM technique we estimate the propensity to obtain a subsidy, given a set of individual characteristics that may influence firm's activities and results. Once we have settled the PSM method, we use various estimators to calculate the average treatment of the treated (ATT) to take a first look at the effects of public subsidies in firms' results. Second, we use propensity scores (PS, hereafter) to construct a valid control group, and we evaluate the impact of the different public programs directed to promote firm's performance in Catalonia.

5.1 Determinants of participation in public programs

The results of the logit estimation to calculate the PS are presented in table 3 for three different specifications (denoted by SP1, SP2 and SP3, respectively). From the group of variables considered in the previous section, some do not appear in table 3 since they have been eliminated because its presence violated the requirements imposed by the calculation of the PS (Loc, Nsub, Solv and Creq).[18]

Briefly, the variables that determine the propensity of receiving public subsidies from the Catalan Agency are stable across the three different specifications shown. The variables that result significant in all specifications are those related with firms' characteristics. First, the variables that accounts for high technology sectors: manufacturing (Dht) and services (Sht). These variables are highly significant indicating that these sectors have a greater propensity of receiving a subsidy. Second, export activity (Exp) is also significant, which indicates that firms facing external competition are more propense to be subsidised in order to transfer its technology to international markets, or just for maintaining its competitiveness both domestically and internationally. Finally, the number of years that a firm has been operating (proxy for organizational capacity and experience) is also statistically significant. In this last case, it has been also included the square years term to capture the effects of the learning curve; the results show an inverted U relationship meaning that the propensity to receive a subsidy increases in the age of the firm up to a point and then decreases.

[18] Given the balancing property requirements to construct the PS, not all specifications satisfy it. Thus, in table 3 we present the variables that satisfy these conditions. For technicalities, see Becker and Ichino (2002).

Table 3. Propensity to receive a public subsidy

	SP1		SP2		SP3	
Constant	-6.4531	***	-5.7685	***	-6.4821	***
	(-20.36)		(-26.27)		(-20.16)	
Years	0.0452	***	0.0484	***	0.0448	***
	(3.26)		(3.49)		(3.21)	
Years^2	-0.0006	***	-0.0006	***	-0.0006	***
	(-2.82)		(-2.91)		(2.78)	
VA	0.2718	***			0.2762	**
	(3.77)				(2.48)	
L	-0.1237		0.0561		-0.1485	*
	(-1.51)		(1.02)		(1.75)	
K					-0.0192	
					(-0.23)	
M			0.0863	**	0.0343	
			(2.48)		(0.80)	
Inin	0.5138	**	0.5643	**	0.5189	**
	(2.11)		(2.32)		(2.13)	
Imp	0.2527		0.2341		0.2354	
	(1.52)		(1.40)		(1.41)	
Exp	0.3281	**	0.3361	**	0.3196	**
	(2.03)		(2.08)		(1.98)	
Dht	0.6715	***	0.6973	***	0.6645	***
	(4.98)		(5.18)		(4.92)	
Sht	0.8624	***	0.9312	***	0.8974	***
	(2.99)		(3.22)		(3.09)	
Log-Likelihood	-2189.6		-2167.5		-2162.8	
Pseudo R^2	0.025		0.024		0.026	

Notes: t-statistics in parenthesis. *, ** and *** indicate statistical significance at the 90, 95 and 99 percent, respectively. Data refers to year 2000. The number of observations is 32,431. Dependent variable is 1 if the company receives a public subsidy and 0 otherwise. Estimation carried out with a logit model. Inin is 0 if the company has one or more shareholders with more than 25% of the shares. Imp is 0 if the company does not import. Exp is 0 if the company does not export. Dht is 0 if the company is not part of a high technology manufacturing sector. Sht is 0 if the company is not part of a high technology services sector. Source: Own elaboration.

From table 3 we can conclude that sectoral differences are highly significant in determining the propensity of receiving a public subsidy. This result indicates that public subsidies in general (without specifying the type of program or its origin) are mainly directed towards high technology sectors. This result confirms existent empirical evidence on the Spanish case (Heijs, 1999 and 2001; Busom, 2000), as well as studies centred in other countries (Arvantis et al., 2002; Almus and Czarnitzki, 2003; Czarnitzki and Fier 2002); all of them indicating that certain sectors (specially high-tech) participate more actively in public programs than others.

On the one hand, structural variables such as firm size and the independence indicator influence the propensity to obtain a public subsidy. On the other hand, location and the difficulty to finance managerial activities (credit constraints) do not seem to have an impact on this propensity and for this reason they do not enter in the determination of the propensities.

In relation with market-related variables, investment capacity seems to have no impact on the propensity score. Finally, concerning classic productive factors, it is found that their relevance is small, and that they are not very significant. For instance, capital (K) only enters in SP3, and it is not significant, while materials (M) is only significant in SP2.

In the case of size, proxied by the number of employees, it is not significant in the first two specifications; however, in the third specification has a negative and significant influence on the propensity. Thus, it seems that SME's receive public subsidies more frequently than big firms. This result is contrary to the one traditionally obtained with this variable for the Spanish case (Fernández et al., 1996; Heijs, 1999 and 2001; Zubiaurre, 2002) as well as in studies for other countries (Almus and Czarnitzki, 2003; Czarnitzki and Fier, 2002). In fact, a classic result is that an increase of 10% in the size of the company would imply an increase of 0,7% in the probability of participating in public programs. However, we do not consider the results obtained for size in SP3 as robust given the poor performance of this variable when changing the specification.

With the PS results, and before carrying out the regressions to evaluate the impact of the different subsidies on firms' performance, we apply various estimators associated to the PSM methodology to obtain a first approximation to the impact of public policies.[19]

5.2 The effects of public subsidies on firms' performance: a first approximation

Once we have analysed and controlled for observable differences among groups of firms, in this section we estimate the average effect of public subsidies on the growth rate of value added of recipient (treated) firms. The results are summarized in table 4 for the third specification (SP3 in table 3) presented in the previous section.[20]

For the estimation of the average effect of the treatment, an area of common support is used, which allows us to eliminate firms with poor matching. The total sample of firms

[19] For a detailed description of these estimators, see Becker and Ichino (2002).
[20] The estimators for SP1 and SP2 are presented in tables A.1 and A.2 in the appendix.

included in the analysis varies according to the proposed estimator, since by definition they are not identical, and so the size of the control group is non homogeneous. Moreover, as the requirements needed for calculating the different estimators vary, the number of firms in the treatment group also varies. Thus, the number of firms that receive a subsidy is 417 (or 416 for the Radius estimator), while the control group oscillates between 414 in the lowest case (Nearest Neighbours estimators) and 30.603 in the highest case (Stratification and Kernel estimators).

Table 4. Average effect of subsidies on firm's performance for SP3

		t-statistic		Firms	
	ATT	A	B	T	C
NNM (1)	0,017	0,7	0,606	417	414.
NNM (2)	0,011	0,436	0,439	417	414.
Radius	0,044	2,307	2,246	416	10316.
Stratification	0,056	-	3,091	417	30603.
Kernel	0,035	-	2,034	417	30603.

A – t-statistic (analytic)
B – t-statistic (bootstrapping)
T – Treated firms
C - Control firms
(1) Nearest neighbour with random selection
(2) Nearest neighbour with identical weights
Source: Own elaboration.

The average effect of public subsidies granted by the Catalan Agency is, in most of the cases, significantly different from zero. Those firms that received a subsidy (treated) observe, on average, a value added growth, in the period 2000-2002, between 3,5% and 5,6% higher than the growth rate of the value added of firms in the control group (non-treated). Table 4 shows that the parameters obtained by means of nearest neighbour estimators, NNM(1) and NNM(2), are not statistically significant, but they are significant in all the other cases.

Significant estimations show that firms receiving subsidies present value added growth rates that are 3,5% higher in the case of the Kernel estimator, 4,4% higher with the radius estimator, and 5,6% with the stratification estimator than firms that do not received a public subsidy. Therefore, it seems that the inclusion of more companies, recalling that the requirements for the construction of the control group differ according to the estimator used, increases the statistical significance of the estimators.

These results seem to be robust since the estimators obtained for the other specifications considered in table 3 to obtain the PS (SP1 and SP2 presented in tables A.1 and A.2 in the appendix) confirm the results. Effectively, nearest neighbour matching parameters are not statistically significant, but when other estimators are used, the parameters become statistically significant with a variation from 3,5% in the case of the Kernel estimator, and 5,7% for the stratification estimator in the case of SP1; and a range between 2,5% and 4,4% for the same estimators, respectively, in SP2. Moreover, the radius estimator always lies somewhere in between these two extreme points (kernel and stratification estimators).

In summary, table 4 shows that, indeed, subsidies granted by CIDEM have a positive effect on the growth of the value added of firms that received them. In this sense, it seems clear that organisational, managerial and other internal changes that are required in order to carry out successfully the projects for which they receive the subsidy make them more dynamic and more competitive, and this is manifested in a growth differential with respect to firms that do not receive subsidies. Although this result is interesting, it does not allow us to uncover what programs impact more intensively on growth differentials. For this reason, the following section presents an analysis of the impact of the different programs between the treated and the control group using a quasi-experimental methodology.

5.3 Evaluation of the different public support programs

In this section, we return to the economic model presented in section 3 to evaluate the different support programs available to Catalan firms. Even if the results of the previous section are interesting and they show that, on average, firms that receive subsidies are more dynamic, this does not allow for the identification of the programs that have a higher impact on firms' performance. Besides, when considering the total number of firms, the comparison is not restricted among firms that receive subsidy and those that, being part of the control group, are the most similar firms to be compared with, since the estimators do not discriminate by sector or by any other variable.

Therefore, a new matching has been performed. First, we have separated firms by sector and, then, inside each sector we have matched the most similar firms in the treatment and control groups according to the PS. This matching has been made in three levels:

i) 1:1 matching: a firm that receives a subsidy is matched with the most similar firm from the same sector according to the PS.

ii) 1:2 matching: for each treated firm there are the two most similar firms in the same sector.

iii) 1:5 matching: there are five control firms for each treated unit, but always from the same activity sector.

Several comments are necessary before analysing the results. First, it should be recalled that the PS was calculated for a large set of firms without discriminating by sector, size or any other variable as the type of program in which treated units participate. The only characteristic that differs among the two groups is the participation or not in a public program. Second, once we have the PS's we proceeded to do the matching as explained in the previous paragraph, but once again, the only discriminating characteristic is that matched firms are from the same sector and have the most similar PS. Hence, even if it would be optimal to discriminate by program, given that there are programs with a low number of participating firms, it would imply losing valuable information. Third, the way the three different control groups were constructed makes very difficult to exclude from the regressions the observations for non-treated firms for a program that is not being evaluated. Hence, we would have in each regression a lot more of control units than it would be desirable. The only alternative in this respect is to calculate the PS's by program and perform a single programs evaluation.

From the estimations of the PS, that expresses the propensity of a firm to participate in a public program, for the participating group and a preferably large set of non participating control firms, the "mirror" firms are determined by matching to each participant one or several no participants whose PS deviates the least.

The usual approach is to match each selected participant uniquely to a non-participant. If the matching is done well, the non-participant controls will be identical to their matched participants in all relevant respects with the single exception that the treated participate in the program and the controls do not. Here, by 'relevant respects' for matching we mean factors that are associated with program participation and with the outcome(s) of interest. Thus, this would mean that non-participants could have carried out the same projects as participant firms but with their own resources or with private (not public) financing.

Hence, since PS have been calculated with the sole condition that firms have participated in a public program without considering which one (and thus not taking into account these relevant aspects), and to avoid comparisons between equals, we

determine three different control groups of varying size to determine the threshold of similarity between treated and non-treated units. The hypothesis we formulate is that if there is no average treatment effect differential between treated and their "most" equal control group (this is, with a 1:1 matching), both groups are so equal that non-treated firms would have carried out similar projects in order to keep competitive but financed with sources other than public subsidies. This would be true only in the case that there is a significant average effect differential with larger control groups, which would be determining the real effect of the subsidies. In case that there are not average effect differentials of public subsidies between treated and the largest used control group (1:5), it would be evidence of the ineffectiveness of public programs in the promotion of firms' competitiveness.

This methodology is used for checking the robustness of the results. Hence, we carry out the regressions of the economic model presented in section 3, and summarised in equation (6) using the different control variables presented in section 4. We proceed by introducing the programs one by one in the above-mentioned equation and then, increasing the number of controls. Finally, we perform the regressions considering simultaneously the whole set of programs. The results are shown in tables 5, 6, 7 and 8. In all these tables, we observe that the change in the number of employees (ΔL), the change in the capital stock (ΔK), and the number of employees (L_{t-1}) as well as the value added (VA_{t-1}) both in the base year (2000) are highly statistically significant.

Table 5 shows that, when considering the narrow control group in which each treated firm is matched to its most similar control firm, none of the programs is significant when considered in isolation but, as table 8 shows, three of them are significant if considered together. This result comes from the methodological approach taken here. This is, we have constructed a PS from the fact that firms participate or not in public subsidies without explicitly considering the characteristics of the different programs offered by the Catalan public agency. Thus, as control groups mix in the determination of the differential effect of public subsidies, it is somehow normal that the joint consideration of the different programs throw positive results while when considered in isolation the same mix of control groups makes difficult to discriminate between true matches.

Nevertheless, as shown in tables 6 and 7, when we expand the control group to consider more than one match per firm, 1:2 and 1:5 respectively, even when considered in isolation we find that some programs are statistically significant. These programs are ISO and CIRIT that are positive and significant for both cases in the determination of the differential growth in value added for recipient firms in the period under analysis.

Table 5. Incidence of public subsidies in value added growth

	1:1 matching			
	(1)	**(2)**	**(3)**	**(4)**
Constant	1.0528 ***	1.0729 ***	1.0786 ***	1.0604 ***
	(11.73)	(11.76)	(11.83)	(11.64)
ΔL	0.5466 ***	0.5441 ***	0.5489 ***	0.5465 ***
	(16.52)	(16.41)	(16.59)	(16.51)
ΔK	0.3321 ***	0.3329 ***	0.3321 ***	0.3311 ***
	(10.39)	(10.41)	(10.40)	(10.35)
L_{t-1}	0.2849 ***	0.2874 ***	0.2835 ***	0.2847 ***
	(10.85)	(10.91)	(10.80)	(10.84)
VA_{t-1}	-0.2719 ***	-0.2787 ***	-0.2763 ***	-0.2732 ***
	(-12.21)	(-12.09)	(-12.31)	(-12.16)
Inin	-0.0350	-0.0279	-0.0408	-0.0376
	(-0.35)	(-0.28)	(-0.41)	(-0.38)
Nsub	0.0137	0.0175	0.0155	0.0146
	(1.03)	(1.31)	(1.18)	(1.10)
Loc	0.0402	0.0369	0.0386	0.0410
	(0.85)	(0.78)	(0.82)	(0.87)
Exp	0.0365	0.0387	0.0257	0.0357
	(0.58)	(0.62)	(0.41)	(0.57)
Dht	0.0261	0.0363	0.0231	0.0250
	(0.67)	(0.91)	(0.59)	(0.64)
Sht	-0.0267	-0.0103	-0.0318	-0.0189
	(-0.32)	(-0.12)	(-0.38)	(-0.23)
QP	0.0746			
	(0.68)			
ISO		0.0371		
		(1.11)		
CIRIT			0.0898	
			(1.47)	
IPIME				0.0228
				(0.40)
N	826	826	826	826
F (11, 814)	55.05	55.17	55.32	55.00
Adjusted R^2	0.418	0.419	0.420	0.418

Note: t-statistic in parenthesis. *, * * and *** indicate statistical significance at the 90, 95 and 99 percent, respectively. The dependent variable is value added growth between 2000 and 2002. Estimates carried out by means of ordinary least squares. Inin is 0 if the companies have one or more shareholders with more than 25% of the shares. Loc is 0 if the company is located outside the municipality of Barcelona. Exp is 0 if the company does not export. Dht is 0 if the company is not part of a high technology manufacturing sector. Sht is 0 if the company is not part of a high technology services sector. QP, ISO, CIRIT and IPIME are dummy variables that are 0 if the firm did not receive the subsidy. Source: Own elaboration.

These results are confirmed by the figures in table 8 when all the programs are considered simultaneously. In the second column, with a 1:2 matching, we find that ISO, CIRIT and IPIME programs are all statistically significant and with high elasticities. The same happens in the third column of the table with a 1:5 matching, but the effect and statistically significance of the IPIME program is reduced. This might be due to the fact that for that control group, other differences such as the number of

subsidiaries, location or exports are variables that discriminate, jointly with public program participation, between high value added growth firms and the rest while for the other control groups that does not happen. Thus, seems that the optimal threshold for controlling the average effects of public subsidies is the 1:2 matching. Besides, it is this specification which throws the best results when we consider the different public programs both separately and jointly.

Table 6. Incidence of public subsidies in value added growth

	1:2 matching			
	(1)	**(2)**	**(3)**	**(4)**
Constant	1.1998 ***	1.2391 ***	1.2267 ***	1.2129 ***
	(16.28)	(16.33)	(16.40)	(16.21)
ΔL	0.5628 ***	0.5593 ***	0.5646 ***	0.5622 ***
	(21.02)	(20.88)	(21.10)	(21.00)
ΔK	0.2939 ***	0.2946 ***	0.2940 ***	0.2928 ***
	(11.67)	(11.71)	(11.69)	(11.62)
L_{t-1}	0.3175 ***	0.3213 ***	0.3158 ***	0.3171 ***
	(14.32)	(14.47)	(14.25)	(14.30)
VA_{t-1}	-0.3108 ***	-0.3223 ***	-0.3155 ***	-0.3133 ***
	(-16.56)	(-16.52)	(-16.70)	(-16.55)
Inin	0.0177	0.0261	0.0071	0.0101
	(0.18)	(0.27)	(0.07)	(0.10)
Nsub	0.0194	0.0245 **	0.0213 *	0.0197
	(1.60)	(2.02)	(1.77)	(1.62)
Loc	0.0459	0.0406	0.0441	0.0478
	(1.10)	(0.97)	(1.05)	(1.14)
Exp	0.0658	0.0658	0.0502	0.0613
	(1.09)	(1.09)	(0.82)	(1.01)
Dht	0.0092	0.0235	0.0071	0.0073
	(0.29)	(0.72)	(0.22)	(0.23)
Sht	-0.0523	-0.0356	-0.0578	-0.0460
	(-0.76)	(-0.52)	(-0.85)	(-0.68)
QP	0.0871			
	(0.79)			
ISO		0.0662 **		
		(2.12)		
CIRIT			0.1207 **	
			(2.00)	
IPIME				0.0563
				(1.00)
N	1239	1239	1239	1239
F (11, 1227)	90.10	90.74	90.66	90.17
Adjusted R^2	0.442	0.443	0.443	0.442

Note: t-statistic in parenthesis. *, * * and *** indicate statistical significance at the 90, 95 and 99 percent, respectively. The dependent variable is value added growth between 2000 and 2002. Estimates carried out by means of ordinary least squares. Inin is 0 if the companies have one or more shareholders with more than 25% of the shares. Loc is 0 if the company is located outside the municipality of Barcelona. Exp is 0 if the company does not export. Dht is 0 if the company is not part of a high technology manufacturing sector. Sht is 0 if the company is not part of a high technology services sector. QP, ISO, CIRIT and IPIME are dummy variables that are 0 if the firm did not receive the subsidy. Source: Own elaboration.

Table 7. Incidence of public subsidies in value added growth

	1:5 matching			
	(1)	**(2)**	**(3)**	**(4)**
Constant	1.3538 ***	1.3861 ***	1.3704 ***	1.3625 ***
	(25.30)	(25.16)	(25.30)	(25.16)
ΔL	0.5238 ***	0.5216 ***	0.5245 ***	0.5235 ***
	(28.23)	(28.11)	(28.29)	(28.22)
ΔK	0.3219 ***	0.3226 ***	0.3221 ***	0.3214 ***
	(17.77)	(17.82)	(17.79)	(17.74)
L_{t-1}	0.3440 ***	0.3467 ***	0.3434 ***	0.3438 ***
	(21.81)	(21.95)	(21.79)	(21.80)
VA_{t-1}	-0.3495 ***	-0.3582 ***	-0.3526 ***	-0.3512 ***
	(-25.46)	(-25.26)	(-25.52)	(-25.40)
Inin	0.0418	0.0435	0.0294	0.0331
	(0.45)	(0.47)	(0.32)	(0.36)
Nsub	0.0304 ***	0.0339 ***	0.0314 ***	0.0304 ***
	(3.02)	(3.38)	(3.14)	(3.03)
Loc	0.0894 ***	0.0864 ***	0.0888 ***	0.0908 ***
	(2.81)	(2.72)	(2.80)	(2.86)
Exp	0.1837 ***	0.1811 ***	0.1731 ***	0.1798 ***
	(3.74)	(3.69)	(3.50)	(3.65)
Dht	-0.0028	0.0066	-0.0030	-0.0035
	(-0.12)	(0.29)	(-0.13)	(-0.15)
Sht	-0.0510	-0.0419	-0.0536	-0.0482
	(-1.06)	(-0.87)	(-1.11)	(-1.00)
QP	0.0670			
	(0.61)			
ISO		0.0692 **		
		(2.41)		
CIRIT			0.1123 *	
			(1.91)	
IPIME				0.0564
				(1.03)
N	2478	2478	2478	2478
F (11, 2466)	182.41	183.30	182.95	182.52
Adjusted R^2	0.446	0.447	0.446	0.446

Note: t-statistic in parenthesis. *, * * and *** indicate statistical significance at the 90, 95 and 99 percent, respectively. The dependent variable is value added growth between 2000 and 2002. Estimates carried out by means of ordinary least squares. Inin is 0 if the companies have one or more shareholders with more than 25% of the shares. Loc is 0 if the company is located outside the municipality of Barcelona. Exp is 0 if the company does not export. Dht is 0 if the company is not part of a high technology manufacturing sector. Sht is 0 if the company is not part of a high technology services sector. QP, ISO, CIRIT and IPIME are dummy variables that are 0 if the firm did not receive the subsidy. Source: Own elaboration.

The results show that variables that capture the variation in the quantities of the productive factors (K and L) are, as expected, highly significant and positively related with firms' value added growth rate. Moreover, these parameters stay constant as the number of observations increases using each time a control group with more firms.

The variables introduced in the model to control for firm specific effects, the value added and the number workers both for the initial period, are also highly significant.

Table 8. Impact of public subsidies in value added growth

	Control group		
	(1:1)	**(1:2)**	**(1:5)**
Constant	1.1809 ***	1.3524 ***	1.4370 ***
	(11.84)	(16.61)	(24.96)
ΔL	0.5430 ***	0.5576 ***	0.5212 ***
	(16.41)	(20.9)	(28.12)
ΔK	0.3333 ***	0.2941 ***	0.3227 ***
	(10.45)	(11.74)	(17.85)
L_{t-1}	0.2868 ***	0.3200 ***	0.3464 ***
	(10.92)	(14.47)	(21.96)
VA_{t-1}	-0.3033 ***	-0.3467 ***	-0.3690 ***
	(12.25)	(-16.92)	(-25.26)
Inin	-0.0465	-0.0119	0.0050
	(-0.47)	(-0.12)	(0.05)
Nsub	0.0153	0.0225 *	0.0324 ***
	(1.14)	(1.83)	(3.2)
Loc	0.0300	0.0361	0.0863 ***
	(0.64)	(0.87)	(2.72)
Exp	0.0001	0.0106	0.1523 ***
	(0.00)	(0.17)	(3.06)
Dht	0.0366	0.0248	0.0081
	(0.92)	(0.76)	(0.35)
Sht	-0.0376	-0.0583	-0.0495
	(-0.45)	(-0.85)	(-1.03)
QP	0.1490	0.1637	0.1048
	(1.32)	(1.48)	(0.96)
ISO	0.0931 **	0.1188 ***	0.0913 ***
	(2.38)	(3.49)	(3.09)
CIRIT	0.1809 ***	0.2186 ***	0.1598 ***
	(2.57)	(3.35)	(2.65)
IPIME	0.1210 *	0.1577 ***	0.1068 *
	(1.84)	(2.59)	(1.9)
N	826	1239	2478
F	44.19	73.05	145.11
Adjusted R^2	0.4429	0.449	0.4489

Note: t-statistic in parenthesis. *, * * and *** indicate statistical significance at the 90, 95 and 99 percent, respectively. The dependent variable is value added growth between 2000 and 2002. Estimates carried out by means of ordinary least squares. Inin is 0 if the companies have one or more shareholders with more than 25% of the shares. Loc is 0 if the company is located outside the municipality of Barcelona. Exp is 0 if the company does not export. Dht is 0 if the company is not part of a high technology manufacturing sector. Sht is 0 if the company is not part of a high technology services sector. QP, ISO, CIRIT and IPIME are dummy variables that are 0 if the firm did not receive the subsidy. Source: Own elaboration.

Contrary to what happens in the determination of the propensity of receiving a subsidy, the results here point out that bigger firms, according to the number of employees in the initial period, are those that grow more rapidly. However, the results also show that

firms with smaller value added in the initial period grow more quickly. This result would show that once firms have reached a high level of value added, it is more difficult to find mechanisms that allow keeping a high growth rate. In other words, firms with a low value added have more margins to increase it at higher rates that firms that have already achieved a high value added. It is necessary to make clear that the definition of value added used here refers to the increase in the value of the products of a firm, calculated as the deduction of the costs of intermediates from production value.

More specifically, the results presented in table 8 point out that the variables that define firms' characteristics as well as market related variables are not significant to explain value added growth. Only when the control group increases until a 1:5 relationship some of these variables become significant. These are the number of subsidiaries, defined as a measure of differentiation indicating that diversified firms grow faster, location, meaning that firms located in the municipality of Barcelona also grow faster, and finally exports, that indicates that exporting firms also show higher growth rates for value added. Finally, it is worth noting that the dummy variables controlling for high technology manufacturing and services sectors are not significant, signalling that there are not differential growth rates for these two groups of firms.

One result from table 8 is that most of the programs have a positive and significant impact in the growth of value added value of the firms that receive a subsidy. Hence, the table shows that, except for the Quality program, all the rest have an important role in recipient firms' results. It is the case, for example, for firms that receive subsidies to obtain the ISO certificate. Given that the objective of this program is the promotion quality and competitiveness as a mechanism for the improvement of firms' results, it is verified that indeed those units that receive a subsidy of this type become more dynamic, and this turns out in a growth differential respect to firms that do not receive such a subsidy. The same argument goes for the programs CIRIT and IPIME. In the case of the first one, it is a program for the development of R&D activities and the second has as objectives the promotion of managerial information services and deepening of managerial cooperation between firms. These results are positive and highly significant, mainly those corresponding to the R&D program. Firms that receive these subsidies and that develop R&D projects are also firms that may increase quicker their value added, improving their competitiveness and consequently their market positioning.

6. Conclusions

In this paper, we have designed an evaluation exercise to analyse the impact of some public subsidies directed to improve the performance of Catalan firms. An important element for such an evaluation exercise is that it fulfils the requirements demanded for a counterfactual design based on the construction of a control group that allows measuring accurately the effects of the subsidies.

In this sense, the proposed methodology uses the Propensity Score Matching method not only to evaluate the impact of public subsidies, but also for building up a control group formed by firms that have not received any subsidy, but that can be considered as the most similar matches to treated (recipient) firms.

From the results obtained, it should be noted that the propensity scores indicate that variables such as the age, the economic sector (especially high-tech sectors), the property structure, and the export activity of firms positively affect the propensity to receive a public subsidy (these results seem to be robust to different specifications). Using the PS in a first approximation to estimate the effects of public subsidies, we find that, in general, those firms that received a subsidy in the year 2000 observe (on average) a higher growth rate of value added between 2000 and 2002.

Moreover, in a second stage, we estimate an economic model for the treatment and control groups (created with the PS), obtaining that three of the four public programs that CIDEM manages have a positive impact on the growth rate of the value added of firms which have effectively received a public subsidy. This positive and significant impact, keeping in mind the construction of the control groups, suggests that the results are robust and that, indeed, public subsidies promote growth differentials among treated and non-treated firms.

These conclusions are based on the results of a comprehensive evaluation of different programs put forward by the Catalan Agency for the promotion of firms using a quasi-experimental design. This rigorous approach yields credible estimates of program impacts. However, in the absence of random experiments, causality can always be questioned, particularly because of potential selection bias. While the construction of the comparison group and specification of the model used in this evaluation helps to minimize potential bias, future efforts need to address this problem in greater detail. Explicit modelling of the selection process using longitudinal data need further efforts by researchers interested in measuring program impacts.

Finally, quantitative analysis is only one approach to estimate the impacts of public programs. Statistical techniques should be combined with qualitative research to yield better insights into program dynamics as well as provide a more solid foundation for conclusions concerning program effectiveness.

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Appendix

Table A1. Average effect of subsidies on firm's performance for SP1

	ATT	t-statistic		Firms	
		A	B	T	C
NNM (1)	0.011	0.446	0.434	421	420
NNM (2)	0.002	0.070	0.081	421	420
Radius	0.045	2.388	2.297	420	11089
Stratification	0.057	-	2.527	421	31309
Kernel	0.035	-	1.946	421	31309

A – t-statistic (analytic)
B – t-statistic (bootstrapping)
T – Treated firms
C - Control firms
(1) Nearest neighbour with random selection
(2) Nearest neighbour with identical weights
Source: Own elaboration.

Table A2. Average effect of subsidies on firm's performance for SP2

	ATT	t-statistic		Firms	
		A	B	T	C
NNM (1)	-0.007	-0.257	-0.274	417	417
NNM (2)	-0.005	-0.196	-0.230	417	417
Radius	0.034	1.695	1.907	415	11237
Stratification	0.044	2.346	2.137	417	30704
Kernel	0.025	-	1.344	417	30704

A – t-statistic (analytic)
B – t-statistic (bootstrapping)
T – Treated firms
C - Control firms
(1) Nearest neighbour with random selection
(2) Nearest neighbour with identical weights
Source: Own elaboration.