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Does public financial support to innovation increase innovation and productivity? An Impact Evaluation

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Abstract

The aim of this paper is to contribute to the scarce empirical literature that evaluates the effects of public financial support to innovation on innovation innovation and productivity in services. We apply propensity score matching techniques to analyze the impact of public financial support to innovation in Uruguayan firms. We use two waves of innovation surveys that allow us to distinguish between manufacturing and service sector firms. The results indicate that there is no crowding-out effect of private innovation investment by public funds, and that public financial support seems to increase private innovation expenditure effort, particularly in manufacturing. Financial support also induces increase in R&D expenditure and innovative sales, being these effects larger for services. Public funds do not significantly stimulate private expenditures of firms that would carry out innovation activities in the absence of financial support. Probably due to the short time period in which the evaluation was conducted, we found little evidence of an effect on applications for patents and productivity. [1]

JEL CODES: O31,O32, O38, C21
Keywords: Public Financial Support to Innovation, Innovation, Productivity, Policy Evaluation.

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1. Introduction

The need for public support to innovation and particularly, public financial support, rest mainly on the assumption that innovation is a non-rival good (i.e. that can be used by multiple firms) that cannot be fully protected because its output is, basically, knowledge (i.e. the knowledge of how to produce new or improved goods or services) and most of it is tacit knowledge (i.e. not codified). Therefore firms cannot appropriate fully the return to innovation investment. In other words, we have a problem of positive externalities of innovation. This generates a gap between the social return of innovation and the private return of innovation, having as a consequence that the firm will underinvest in innovation activities with respect to the social optimum.

As pointed out by Hall and Lerner (2010) there is some evidence that points out that imitations are not free, and that they can cost between 50% and 75% of the original R&D investment. This can mitigate the above mentioned externality problem, but in any case the problem still persist since the returns are not fully appropriated by the original investor. Moreover, this available evidence is for manufacturing; we can think that the problem is more important for service innovations where innovations rely less on codified knowledge (that can be more easily protected) and presumably, where the costs of imitating are smaller.

But the case for public financial support goes beyond the externality problem mentioned above. Even assuming that this problem can be solved, for example, with some intellectual property protection instrument, there are other characteristics of the innovation investment that justifies public financial support. For instance, returns to innovation investment are highly uncertain and the asymmetric information that exists between the innovator and the investor could be greater than in other type of investment, leading to important moral hazard and adverse selection problems.[2] Therefore, credit constraints and high cost of credit is likely to affect the level of innovation investment and consequently the innovation output. The intangibility characteristic of services and the non-technological and more ad-hoc characteristic of many service innovations could make these problems even worse.

These theoretical considerations have stimulated public intervention in different countries with the objective of increasing innovation investment, innovation and productivity in services. But so far the evidence of the positive (or otherwise) impact of these interventions in the service sector is almost unavailable.

So far, most of the available empirical literature has focused its attention on public financial support policies to research and development (R&D) activities and their impact on R&D expenditure in the manufacturing sector. As pointed out by Hall and Lerner (2010) the focus on R&D instead of the broader concept of innovation investment is largely due to reasons of data availability and measurement. In addition, most of the available studies are for OECD or European countries, and we are lacking evidence for less developed countries.

Our paper aims to contribute in helping fill some of these gaps, through an impact evaluation of public financial support to innovation using quasi-experimental methods and innovation survey data from Uruguay, that allow us to distinguish between manufacturing and service sector firms. More specifically, the paper contributes to the literature in at least three ways. First, it presents an impact evaluation of public financial support to innovation on innovation expenditure and productivity, and hence the analysis is extended beyond the R&D context. Second, we analyze the possible heterogeneity of impacts on services *vis a vis* manufacturing. Finally, our paper adds to the scarce evidence available for developing countries.

Our findings show the absence of a crowding out effect, either full or partial, between public and private innovation expenditure, though the presence of subsidies hardly stimulates private innovation spending of firms engaged in innovation activities in any case. Moreover, firms that had received financial support increase R&D expenditure relative to those that did not received. We found similar effects in the services and manufacturing sectors. While there is no crowding effect in any of the two sectors, we found that public financial support stimulates innovation expenditure. There are no effects on productivity, probably due to the short time period in which the evaluation was conducted, but financially supporting the firms has a positive effect on the share of innovative sales.

[2] Given that the innovator has more information about the project than the investor, it can use this advantage to increase his profit in detriment of the investor.

The paper is organized as follows. Next section discusses briefly the available evidence on the impact of public financial support to innovation. Section 3 describes the empirical strategy and data. Section 4 presents the main results. Finally, section 5 concludes.

2. Public financial support and innovation: the available evidence

Most of the available evidence focuses its attention on developed countries, does not have the focus on services firms and use mostly R&D expenditure as the outcome variable. David et al. (2000) carry out an extensive survey of this literature, finding substitution effects between public and private R&D in one-third of the studies analyzed. More recent studies have focused (mostly) on matching methodologies to evaluate the crowding out effects. Along these lines, different studies have found that public financial support stimulates privately financed R&D, so that the crowding out hypothesis is rejected. Examples are Almus and Czarnitzki (2003) who use data from a survey of German manufacturing firms; Duguet (2004) who uses a pool of French R&D-performing firms; and Gonzalez and Paso (2008) who use a sample of Spanish firms to evaluate the effect of subsidies. As for the service sector, Czarnitzki and Fier (2002) by studying a panel of German service firms found that financial support stimulated private expenditure on innovative activities. However, as far as we know there are no studies that allow direct comparison of the impact that a certain policy imposes on the service and manufacturing sectors.

As for evidence regarding the policy impact on innovation output (rather than on R&D and innovation efforts, which are inputs for innovation), Aerts and Czarnitzki (2004) found no significant effects of public support for innovation on patent applications from a survey of Flemish firms; while Czarnitzki and Hussinger (2004) found that the impact was positive on this variable for a set of German manufacturing firms and Czarnitzki et al. (2011) found a positive impact on the number of new products introduced by manufacturing Canadian firms.
Evidence on the impact on firm performance, particularly productivity, is scarcer and indirect. Czarnitzki et al. (2011) found that the impact was not significant on firms' profitability. Wallsten (2000) found no significant impact on employment for American high-tech small firms, this may owe to the fact that such policy effects often do not arise until after several years after policy implementation, so that they may not be observed throughout the short periods of analysis. On a different note, Lokshin and Mohnen (2013) found for Dutch firms that fiscal incentives had a positive impact on wages of R&D workers.

The available evidence of the effects of public financial support on innovation is sparse for emerging and developing countries. Few examples can be found in Hall and Maffioli (2008), Lopez and Tan (2010), or Crespi et al. (2012).

Hall and Maffioli (2008) synthesized the results of a series of impact evaluations of Technology Development Funds (TDFs) in Argentina, Brazil, Chile and Panama. The authors evaluated the impact on TDFs recipient firms using data from innovation and industrial surveys. They found that TDFs do not crowd out R&D from private sources and that they have a positive impact on the intensity of R&D. Also, although low-cost credit had a more positive effect than matching grants on R&D projects—suggesting that different types of financing impact firms differently—matching grants were more effective for new innovators. The authors also found that participating in a TDF results in a more proactive attitude toward innovation strategy for firms. Although Argentina and Brazil were not included in this part of the study, using a firm's willingness to engage with external financing and knowledge sources as proxies for innovation strategy shifts, the authors found that TDFs have a positive effect on innovation. Conversely, participation in a TDF did not positively affect patent grants or new product sales, which were used as measures of innovative output, although the authors note rightly that the time frame may have been too short to observe the full effects of TDF participation on this regard. Evidence concerning the potential impacts on firm performance was not uniform: TDF participation was found to positively impact firm growth but not firm productivity. The authors argue that this can also be due to the short time period in which the evaluations were conducted, and that additional impact evaluations based on longer panel data are needed to shed some light on long-run effects.

López-Acevedo and Tan (2010) provide an evaluation of small and medium enterprises credit programs in Mexico, Chile, Colombia and Peru. The authors found positive gains in labor productivity, sales and employment in Chile, and higher value added, sales, export and employment in Mexico. In Colombia, the results suggest positive effects on exports, investment in R&D and total factor productivity. Finally, in Peru the findings show significant positive effects on sales and profits. Confirming the findings of Hall and Maffioli

(2008), López-Acevedo and Tan (2010) note that some of the estimated impacts on firm's performance do not materialize until after several years.

Crespi et al. (2012) evaluate the effects of financial incentives for R&D (matching grants and contingent loans), given by Colciencias in Colombia, on firm's beneficiaries economic performance. With a dataset that allows the authors to look at long term effects, the authors find significant impact on firm performance of public funding from Colciencias. More precisely, the authors found that introduction of new products and labor productivity increased around 12% and 15% respectively, with these effects becoming more significant between three to five years after the firms started being treated.

In appendix A we summarize the results of 26 evaluations.

3. Empirical strategy and data

3.1 Empirical strategy

The objective of this paper is to estimate the impact of public financial support on some firm's outcome variables (innovation investment, innovation, productivity). As it is well known the main problem to perform such evaluation is that we cannot observe what would happen with treated firm's outcomes variables in case they wouldn't get public financial support, i.e. the counterfactual. Therefore, we have to find a suitable "proxy" for the counterfactual. Of course, the firms that didn't get public financial support are clear candidates to form a comparison group (or control group). The problem here is that it is possible that these firms didn't get the public financial support because they have some characteristics that also affect the outcome variables. For example, it could me more difficult for small firms to get public financial support, and we know that the size of firms affect innovation. Therefore if we compare the innovation performance of the firms that got support with that of the firms that didn't get support, we will find that the supported firms innovate more, but this could be simply because they are bigger, and not as a consequence of the public financial support program.

Luckily, under some assumptions we can circumvent this problem. The strategy followed here was to use propensity score matching (PSM) methods.[3] In what follows we will explain briefly the rationale behind it and make explicit some methodological decisions taken.

The main parameter of interest in this paper is:

$$\tau_{\text{ATT}} = E[Y(1)|\text{D} = 1] - E[Y(0)|\text{D} = 1],$$

where τ_{ATT} is the average treatment effect on the treated, $E[Y(1)|\text{D} = 1]$ is the mean value of the outcome variable $Y(1)$ (for example innovation investment) given that the firms received public financial support, and $E[Y(0)|\text{D} = 1]$ is the counterfactual, i.e. the expected value of outcome variables, $Y(0)$, for the firms in the treatment group in case they haven't received public financial support (of course this can never be observed). D=1 means that the firm belongs to the treatment group. Unfortunately, we do not observe the latter.

What we can observe is $E[Y(0)|\text{D} = 0]$, the mean of the innovation investment for firms that do not belong to the treatment group ($\text{D} = 0$) and did not receive treatment. But of course $E[Y(0)|\text{D} = 0]$ must not need to be equal to $E[Y(0)|\text{D} = 1]$ and therefore when using the former as a proxy for the latter we can be introducing a bias in our estimation. Note that,

$$\tau_{\text{ATT}} = E[Y(1)|\text{D} = 1] - E[Y(0)|\text{D} = 1] - E[Y(0)|\text{D} = 0] + E[Y(0)|\text{D} = 0],$$

and therefore

$$E[Y(1)|\text{D} = 1] - E[Y(0)|\text{D} = 0] = \tau_{\text{ATT}} + bias,$$

where$bias \equiv E[Y(0)|\text{D} = 1] - E[Y(0)|\text{D} = 0]$.

[3] See Caliendo and Kipeinig (2008) and Crespi et al. (2011) for a very intuitive presentation of these methods.

As said before, if firms with some especial characteristics tend to be selected in the treatment group and these characteristics affect outcomes, then we will have a bias. On the contrary if the assignment to both groups is completely random we should not be concerned with the existence of this bias. But because this condition normally does not hold in the case of innovation survey data we have to do something else.

Under the assumption that the differences between the treated and the control group comes from observable characteristics (e.g. firms' size, capital and knowledge intensity, etc.), that are not affected by the treatment, we can proceed to find firms that are similar on these characteristics in both groups and compare them. One possible identification assumption is to assume that given a set of observable covariates X which are not affected by treatment, potential outcomes are independent of treatment assignment (unconfoundness or conditional independence assumption, CIA).

This implies that selection into the treatment is only based on observable variables, X, for what we can control for. Usually, X is of high dimension. Hence, to deal with this dimensionality problem we can balance propensity scores. We can use the Xs to estimate the probability of being selected for treatment P(D=1| X)=P(X) (using a probit or logit model in the case of binary treatment) and then use this probability for finding similar firms in both groups (treated and control groups).

The PSM estimator for average treatment effect on the treated is:

$$\tau_{\mathrm{ATT}}^{\mathrm{PSM}} = E[Y(1)|\mathrm{D}=1, \mathrm{P(X)}] - E[Y(0)|\mathrm{D}=0, \mathrm{P(X)}].$$

Under the assumption of conditional (on the propensity score, $\mathrm{P(X)}$) independence of outcome variables with respect to treatment, this estimator is unbiased.

An additional important condition to be able to use PSM, besides CIA, is that we must have enough treated and control firms on the common support. More formally we need: $0 < P(\mathrm{D}=1|\mathrm{X}) < 1$. This condition ensures that firms with the same values of X have a positive probability of being both participants and non-participants, and we avoid predicting perfectly if a firm belongs to control or treatment group.

The matching algorithm used in this work is the Nearest Neighbor Matching (NNM) with replacement, using a caliper of 20 percent of the standard deviation as suggested in the literature. We use oversampling, taking advantage of the big number of potential controls in our sample. In particular for each treated firm we find the 5 nearest neighbors (matching partners) and compare them with the treated firm.

Our vector of variables X is composed of six variables plus 2-digit sectoral dummies: firm size (proxy by the number of employees at the beginning of the period), foreign owned (if foreign capital is greater than 10% of firm's capital in the current period), patent (if the firm obtained a patent in the period, we use this variable as proxy for the innovation performance of the firm in the past), capital intensity (defined as K/L at the beginning of the period, where K is capital and L the number of employees) and firm's age. We can argue reasonably that these variables are not affected by the treatment.

We combine the propensity score matching with Mahalanobis metric matching over size and the sectorial dummies. Hence, a treated firm is matched with the closest control firm of the same sector, and similar size using the distance defined by the Mahalanobis distance.

3.2 Data

We apply the above methodology to evaluate the effect of financial support granted to Uruguayan service and manufacturing firms during the period 2004-2009. For this purpose we make use of two waves of Innovation Surveys (IS): 2004-2006 and 2007-2009.

The IS data is collected in parallel with the Economic Activity Survey (EAS); same sample and statistical framework. All the firms with more than 49 workers are of mandatory inclusion. Units with 20 to 49 employees and with fewer than 19 workers are selected using simple random sampling within each economic sector at ISIC 2-digit level up to 2005. Since then, random strata are defined for units with fewer than 50 workers within each economic sector at ISIC 4-digit level.

We matched both IS with the 2004 and 2007 EAS because we needed information on the size of the firm at the beginning of the period, capital (fixed assets), and productivity. In order to avoid endogeneity problems associated to the variables size, capital and productivity, we use these variables at the beginning of the period of the survey. All the other variables used in the empirical exercise come from the IS. When matching with the EAS some firms are lost because of sampling problems.

In order to reduce the loss of observations we use an imputation procedure, in order to recover the information for the missing variables at the beginning of the period for those firms that are not in the EAS. The imputation procedure is based on a regression between log(size(t-1)) against the age of the firm, and sectoral dummies. We use this regression to predict size in (t-1) for the missing observations. The same is done for the capital stock, and productivity. Note that the technique uses the information available at the beginning of the period of the survey, not at the end of period to avoid causal effects interacting. In any case, as a robustness check we present the results with the reduced sample, i.e. without the imputation procedure.

For the service sector, the final number of included firms in the IS is 1868; 885 from the first survey, and 983 from the second one. For the manufacturing sector, the final number of included firms is 1727; 816 for 2004-2006 survey, and 911 for the second one.

The treatment variable is: financial support. We consider a firm to be financially supported if it has received some financial support from the Public Sector[4] in the period of reference. In first instance, we evaluate the effect of financial support on innovation expenditure (IE) effort, i.e. expenditure on innovation over sales. Total innovation expenditure comprises investment in design, installation of machinery, industrial engineering, embodied and disembodied technology, marketing, and training. We are able to distinguish between total and private firms' innovation investment. Then, we analyze the effect of financial support on R&D expenditure (both internal and external) over sales, share of innovative sales, patents applied for, and productivity. Productivity is defined as the logarithm of sales over total employment.

Table 1 bellow reports the number of firms in each sector, divided in KIBS (knowledge intensive business services) and traditional services, and high-tech and low-tech manufacturing sectors. Manufacturing sector firms tend to invest more in innovation activities than the service sector. The High-Tech sector is the sector that innovates most, followed by the KIBS sector. The third column of the table shows the manufacturing bias of innovation policies. While more than 4% of the manufacturing firms have received public financial support in the period 2004-2009, only 2% in the service sector obtained financial support.

Table 1. Firms with innovation activities and financial support. Period 2004-2009.

	Obs	% with Inn activities	% with financial support
Services	1868	38.5	2.1
KIBS	628	42.0	1.9
Traditional	1240	36.7	2.3
Manufacturing	1727	42.3	4.2
High-tech	399	52.4	5.8
Low-tech	1328	39.3	3.7

Note*: Author's calculations based on the 2004-2006 and 2007-2009 IS.*

Table 2 reports the innovation effort (IE/sales) for firms with and without financial support. On average firms from the manufacturing sector invest more in innovation activities than firms from the service sector. One fact to highlight is that the private effort of firms with financial support (column 2) is notably higher than the effort of firms without financial support and with innovation activities (column 4) in the manufacturing sector. On average, the difference is 0.9 percentage points, being even higher in the High-tech sector (1,77pp). On the contrary, in the service sector the private effort of those that received financial support is lower than those firms

[4] The survey includes information regarding financial support received from the Public Sector (excluding public firms from the definition of public sector).

that undertook innovation activities without financial support; on average, 0.7 percentage points lower. This is driven by traditional services firms, while KIBS present a higher private effort.

This raw data can lead to us to the conclusion that a crowding out effect could exist in the service sector, while not in the manufacturing sector. Our empirical strategy will try to disentangle if this is an effect derived from the fact that public financial support tend to be directed to firms that tend to invest more in the manufacturing sector, while to firms that show a poor performance in innovation in the service sector. This will be done by comparing firms with similar probability of obtaining financial support.

Table 2. Innovation effort in firms with and without financial support (in %). Averages for period 2004-2009

	Innovation effort			
	With		Without	
	Total	Private	All	IE>0
Services	6.37	3.62	1.61	4.33
KIBS	9.77	6.93	1.75	4.28
Traditional	4.91	2.21	1.54	4.35
Manufacturing	7.50	5.05	1.66	4.16
High-tech	6.27	5.07	1.64	3.30
Low-tech	8.08	5.04	1.67	4.50

Note: Author's calculations based on the 2004-2006 and 2007-2009 IS

Finally, table 3 presents the mean of the selected matching variables of the control and treatment group by sector. Firms tend to be larger in the treatment group than in the control group. At the same time, in the treatment group firms tend to have obtained more patents than in the control group. Firms in the treatment group tend to be more located in Montevideo (the capital of the country), belong to networks, and to have more stores, while with respect to age and ownership status there are no clear differences.

Table 3. Mean comparison of financially supported firms and non-supported firms on selected controls

	Services		**KIBS**		**Traditional**	
	With	Without	With	Without	With	Without
Size (log employees) (t-1)	4.48	3.85	4.11	3.87	4.64	3.84
Foreign owned	7.5%	10.4%	16.7%	13.8%	3.6%	8.7%
Age (years)	23.9	18.3	11.6	13.7	29.4	20.7
Obtained patent	5.0%	1.2%	8.3%	1.3%	3.6%	1.2%
Network	30.0%	19.9%	50.0%	18.3%	21.4%	20.6%
Group	15.0%	15.6%	16.7%	16.2%	14.3%	15.3%
Stores	4.7	3.9	1.6	1.4	6.0	5.1
In Montevideo	85.0%	74.3%	100.0%	87.2%	78.6%	67.8%
	Manufacturing		**High-tech**		**Low-tech**	
	With	Without	With	Without	With	Without
Size (log employees) (t-1)	4.24	3.80	4.09	3.56	4.30	3.87
Foreign owned	9.7%	11.5%	8.7%	17.3%	10.2%	9.9%
Age (years)	32.29	25.56	35.96	28.01	30.57	24.84
Obtained patent	2.8%	2.7%	0.0%	3.2%	4.1%	2.5%
Network	16.7%	7.9%	17.4%	10.1%	16.3%	7.2%
Group	18.1%	13.2%	8.7%	16.0%	22.4%	12.4%
Stores	1.85	1.74	1.57	1.60	1.98	1.79
In Montevideo	83.3%	78.0%	91.3%	87.0%	79.6%	75.4%

***Note**: Author's calculations based on the 2004-2006 and 2007-2009 IS.*

4. Results

We will present results for the complete sample of firms, that is, manufacturing and service sector firms together. The main idea of the strategy, in order to reduce endogeneity issues, is to match observations, according to their pre-treatment behavior. For this reason, we choose to work with the size of the firms at the beginning of the period of reference of the IS: (t-1), capital per worker at t-1, and productivity at t-1.

In the next section, we present results dividing the sample in manufacturing and service sector. We employ two different groups of observations to select the controls for the average treatment effects on the treated estimator: first of all, the full sample which includes observations with and without innovation expenditures; and in second place we restrict the sample to observations with innovation activities. In the first case, we take into account the potential effect of financial support on the inducement to undertake innovation activities. In the second case, we evaluate the stimulus of financial support on the effort considering that all supported firms would have performed innovation activities in the absence of support.

4.1 Complete sample results

In the first stage we investigate factors that influence the probability of receiving public financial support. The dependent variable takes the value one if the firm has got public funding, and zero in the other case. Table 4 displays marginal effects after Probit estimation. The first column takes all firms as the possible control group, while in the second column the sample is restricted to only firms that reported positive innovation expenditure.

Table 4. Estimation of the propensity score

	(1) All firms	(2) Only innovative firms
Size	0.0408***	0.0663*
	(0.0147)	(0.0374)
Size^2	-0.00292*	-0.00499
	(0.00160)	(0.00396)
Foreign owned	-0.0163***	-0.0405***
	(0.00588)	(0.0156)
Age	-0.000182	-0.000475
	(0.000287)	(0.000693)
Age^2	2.54e-06	6.49e-06
	(2.66e-06)	(6.22e-06)
Obtained Patent	0.0129	-0.00653
	(0.0222)	(0.0327)
K_L	-0.000361	-6.85e-05
	(0.00252)	(0.00532)
Productivity t-1	0.00315	-0.00434
	(0.00362)	(0.00898)
Network	0.0123	0.00562
	(0.00891)	(0.0173)
Group	0.000225	-0.00245
	(0.00818)	(0.0193)
Stores	-6.75e-05	-0.000243
	(0.000152)	(0.000452)
Montevideo	0.00814	0.0181
	(0.00638)	(0.0163)
Industry dummies	yes	yes
Observations	2,914	1,382
Log likelihood	-423.1	-356.4

Notes: Standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

The vector of explanatory variables includes firm characteristics that may influence the probability of getting public funds. We included the size of the firm in a quadratic form, measured as the logarithm of the number of employees in t-1, age (proxy for experience), a dummy variable for foreign owned (when more than 10% is foreign owned), capital intensity (measured as fixed assets per worker) and productivity at t-1. We also, include a dummy indicating if the firm has obtained patents in the period of reference (as a proxy of past innovation effort), if belong to a network, or to a group of firms, if it is located in Montevideo, the number of stores of the firm and the age and its quadratic form. The dummy for obtained patents tries to control for the persistence in innovation, since obtaining a patent is a long process; the obtained patent is probably consequence of past innovations. Finally, we included 33 sectoral dummies (at 2-digit level).

Results show that the most important determinant of the probability of receiving public funds is size. The larger the size of the firm, the larger the probability of receiving public funds. On the contrary, being foreign owned decreases the probability of receiving public funds for innovation. These are the only two significant variables (with the exception of some sectoral dummies).

According to our empirical strategy the matching is done using the calculated propensity score. Hence, some important assumptions need to be validated. The first is to check the common support or overlap condition. With this purpose we can perform a visual analysis of the density distribution of the propensity score in both groups.

Figure 1. Propensity score of treated and potencial controls considering all firms (left panel) and only firms with positive innovation expenditure (right panel)

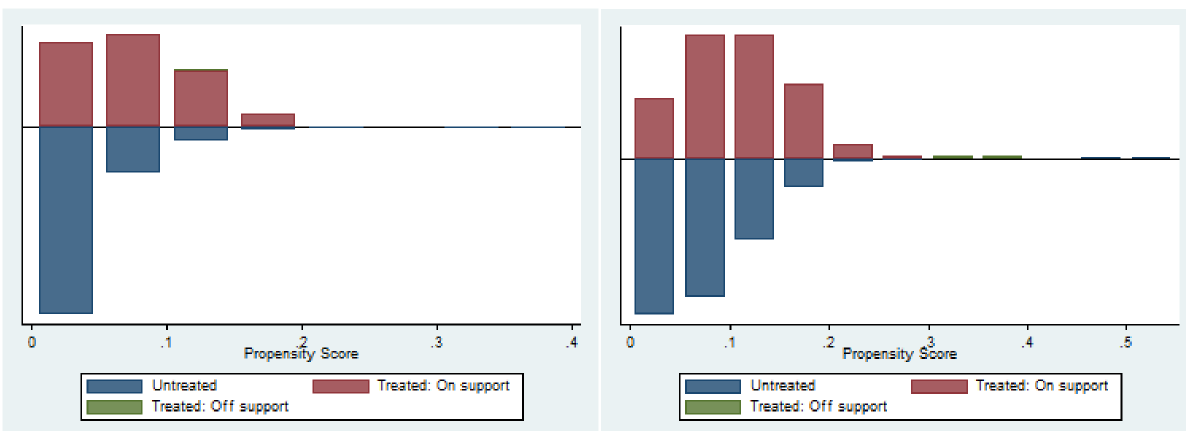

Figure 1 shows the calculated propensity score by treated and untreated group. Observations in the control group are more left skewed than the treatment group. But a comparison of the minima and maxima of propensity scored leads to the conclusion that significant overlap is achieved. When taken into account firms with positive innovation expenditure there are some firms that are off common support. We restrict the estimation to the region of common support of the propensity scores.

Finally, since we do not condition on all covariates but on the propensity score, it has to be checked if the matching procedure is able to balance the distribution of the relevant variables in both the control and treatment group.

Table 6 shows that the treated group appears to be different from the potential control groups in some relevant variables before the matching. But similarity between treated and controls is achieved after the matching. As can be seen in table 6 the differences were significantly reduced and are not statistically significant.

Table 6. Mean comparison of financially supported firms and non-supported firms on selected variables before and after the matching

		All firms in the potencial control						Potential control with positive IE					
		Mean			%reduct	t-test		Mean			%reduct	t-test	
Variable		Treated	Control	%bias	bias	t	p>t	Treated	Control	%bias	bias	t	p>t
Size	Unmatched	4.34	3.84	46.2		4.69	0.00	4.34	4.08	23.4		2.27	0.02
	Matched	4.35	4.28	6.5	85.9	0.52	0.61	4.37	4.28	7.7	66.8	0.61	0.54
Foreign	Unmatched	0.090	0.107	-5.8		-0.58	0.56	0.09	0.16	-20.7		-1.90	0.06
owned	Matched	0.091	0.146	-18.6	-221	-1.26	0.21	0.09	0.18	-25.3	-22	-1.77	0.08
Age	Unmatched	29.342	21.816	33.7		3.90	0.00	29.15	24.80	18.6		1.98	0.05
	Matched	29.491	27.513	8.8	73.7	0.64	0.52	29.51	28.05	6.3	66.4	0.45	0.65
Patent	Unmatched	0.04	0.02	11.5		1.43	0.15	0.04	0.04	0.3		0.03	0.98
obtained	Matched	0.04	0.03	6	47.5	0.41	0.69	0.04	0.04	-0.5	-50.5	-0.03	0.98
K/L	Unmatched	0.634	0.620	1		0.08	0.94	0.64	0.73	-5.1		-0.40	0.69
	Matched	0.639	0.686	-3.3	-236.6	-0.34	0.73	0.65	0.80	-8.3	-62.7	-0.93	0.35
Productivity t-1	Unmatched	13.738	13.361	36.1		3.59	0.00	13.74	13.67	6.5		0.63	0.53
	Matched	13.746	13.739	0.7	98	0.05	0.96	13.75	13.91	-15.5	-138	-1.18	0.24
Network	Unmatched	0.21	0.16	12		1.31	0.19	0.20	0.22	-5.6		-0.55	0.58
	Matched	0.209	0.141	17.6	-46.6	1.32	0.19	0.206	0.195	2.5	54.3	0.19	0.85
Group	Unmatched	0.171	0.147	6.6		0.70	0.48	0.165	0.200	-8.9		-0.87	0.39
	Matched	0.173	0.169	1	85.4	0.07	0.95	0.168	0.221	-13.7	-54.4	-0.96	0.34
Stores	Unmatched	2.883	2.781	0.5		0.04	0.97	2.917	3.982	-3.9		-0.29	0.77
	Matched	2.90	2.27	3.3	-518.4	0.80	0.42	2.94	2.24	2.6	34.2	0.89	0.38
In Montevideo	Unmatched	0.847	0.757	22.6		2.18	0.03	0.853	0.796	15.1		1.44	0.15
	Matched	0.845	0.783	15.7	30.8	1.17	0.24	0.850	0.783	17.8	-18	1.26	0.21

Table 7 reports the results for the average treatment effect of the treated, considering as performing variables the investment expenditure, private innovation effort and, the share of R&D in innovation expenditure, the share of innovative sales, the application for patent, and the (log) productivity.

Table 7. Effects from financial support

Dep variable	(1) IE effort	(2) Private IE effort	(3) R&D 1/	(4) Innovative sales 2/	(5) Applied for Patents 3/	(6) Productivity
ATT	4.492***	1.922**	8.242***	14.63***	0.0268	0.123
	(1.230)	(0.850)	(2.643)	(4.306)	(0.0263)	(0.0990)
Treated group	110	110	110	110	110	110
Off support	1	1	1	1	1	1
Potential control group	2,803	2,803	2,803	2,803	2,803	2,803

Notes: 1/ Share of innovation expenditure that is R&D, 2/ Share of sales due to innovation.
*Bootstrapped standard errors in parentheses. 100 replications *** p<0.01, ** p<0.05, * p<0.1*

Results show that financial support has a stimulating effect on both private and total innovation expenditure. Financial supported firms invest 4.5% more of their sales in innovation than non-supported firms. This result indicates that not only no crowding-out effect exists, but also that firms invest more from their private budget.

Financially supported firms spend 8% more of the innovation expenditure in R&D than non-treated firm. This result was expected since usually financial support is directed to R&D. Remember that this sample includes all potential firms in the control group, i.e. firms could also have zero innovation expenditure. Hence, this result can be interpreted as public financial support having inducement effects on innovation activities.

Receiving financial support increases significantly the share of innovative sales relative to firms in the control group.

Finally, receiving financial support has no statistically significant effect on productivity. This result is not surprising since we are looking at very short time horizon, and effects on productivity can appear significantly later. Probably for the same reason, results show that there is no statistical effect on the application for patents in the current period.

Table 8 presents the results when we take into account only firms with positive investment expenditure.

Results show now that financial support has no stimulating effect on private investment. This result indicates that no crowding-out effect exists. Firms add the amount of subsidies to their private investment, not substituting private investment by public funds, but also not increasing their private innovation investment. Results show that financially supported firms make larger R&D investment. On the other hand, there are no significant effects on the share of innovative sales, applications for patents, and productivity.

Table 8. Effects from financial support. Firms with positive IE.

	(1)	(2)	(3)	(4)	(5)	(6)
	IE effort	Private effort	R&D 1/	Innovative sales 2/	Applied for Patents	Productivity
ATT	2.531**	-0.107	5.427*	6.436	0.00561	-0.0151
	(1.055)	(0.937)	(3.005)	(3.928)	(0.0250)	(0.100)
Treated group	107	107	107	107	107	107
Off support	2	2	2	2	2	2
Potential control group	1,273	1,273	1,273	1,273	1,273	1,273

Notes: 1/ Share of innovation expenditure that is R&D, 2/ Share of sales due to innovation.
*Bootstrapped standard errors in parentheses. 100 replications *** p<0.01, ** p<0.05, * p<0.1*

To check the robustness of our results we use the same methodology, but without doing the imputation procedure. Now the treatment group is formed by 80 firms, while with the imputation procedure we had 109 firms. Results in tables B.1 and B.2 of appendix B indicate that results are robust to the imputation procedure. Quantitative results are very similar, with the exception of the results for R&D. The impact is smaller when the imputation procedure is not considered.

To summarize, the results lead to the conclusion that there is no crowding-out effect of private funds by public funds, and that public financing in Uruguay seems to induce some increase in private innovation effort, R&D and innovation expenditure. Also has positive effects on the sales derived from innovation. But public funds do not significantly stimulate private expenditures of firms that would carry out innovation activities in the absence of subsidies. Finally, probably due to the short time period in which the evaluation was conducted, there are no effects on applied patents and productivity. In what follows we will distinguish between service and manufacturing sectors.

4.2 Services and Manufacturing sectors results

Because of the existing heterogeneites between service and manufacturing firms, and therefore the different impact that financial support could have in both sectors, in this section, we present results for the manufacturing and service sector, separately.

In table 10 the marginal effects of the probability of receiving public financial support are reported. Size is still a very important determinant in the service sector, while less so in the manufacturing sector. When restricting the sample to firms that show positive innovation expenditure, size becomes statistically insignificant. In the manufacturing sector, being foreign owned affects negatively the probability of being financially supported, while no other variable seems to have statistically significant effects on the probability, except some of the sectoral dummies.

Table 9. Estimation of the propensity score

	Services		**Manufacturing**	
	(1)	(2)	(3)	(4)
Control group	All	IE>0	ALL	IE>0
Size	0.00801***	0.0175***	0.0194***	0.0116
	(0.00212)	(0.00629)	(0.00682)	(0.0124)
Foreign owned	-0.00714	-0.0249	-0.0357**	-0.0545**
	(0.00674)	(0.0190)	(0.0144)	(0.0270)
Age	-0.000133	-0.000621	-4.91e-05	0.000109
	(0.000282)	(0.000816)	(0.000701)	(0.00119)
Age^2	9.31e-07	4.29e-06	4.08e-06	5.32e-06
	(2.37e-06)	(6.38e-06)	(7.02e-06)	(1.16e-05)
Obtained Patent	0.0243	0.0204	-0.00501	-0.0408
	(0.0338)	(0.0515)	(0.0365)	(0.0408)
K_L	3.34e-05	2.85e-05	-0.00756	-0.00822
	(0.000974)	(0.00262)	(0.00873)	(0.0138)
Productivity t-1	0.00326	0.00427	0.00385	-0.0158
	(0.00313)	(0.00862)	(0.00897)	(0.0172)
Network	0.00576	-0.00558	0.0298	0.0209
	(0.00732)	(0.0168)	(0.0253)	(0.0335)
Group	-0.00492	-0.0150	0.0110	0.0209
	(0.00631)	(0.0185)	(0.0222)	(0.0372)
Stores	-7.17e-05	-0.000261	-0.00238	-0.00335
	(0.000121)	(0.000425)	(0.00339)	(0.00563)
Montevideo	0.00954*	0.0267	0.00308	0.00826
	(0.00557)	(0.0167)	(0.0176)	(0.0291)
Industry dummies	yes	yes	yes	yes
Observations	1,758	684	1,156	698
Log likelihood	-167.1	-135.1	-255.6	-218.9

Standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

In tables B.1 and B.2 and figures B.1 and B.2 in the appendix we report the balance test for the covariates for treatment and control groups, and the estimated propensity score to check for common support. The results are satisfactory; showing that after the matching the mean of the covariates in the control and treatment group cannot be rejected to be equal in the sample. Also, the analysis of the estimated propensity scores leads to the conclusion that significant overlap is achieved.

Table 10 shows the effects of financial support on the financially supported firms in the service and manufacturing sector. Results show that financial support has a stimulating effect on both private and total investment expenditure, in the manufacturing sector. Financially supported firms invest 2% more of their sales in innovation than non-supported firms. This result indicates that not only no crowding-out effect exists, but also that financial support increases the private innovation investment. On the contrary, in the service sector the mean of private IE effort is positive but not significantly different from zero, while the total investment is higher in the treated firms. This also signals that there is no crowding out effect; instead firms add the amount of the support to their private investment. This let us conclude that in none of two sectors there is crowding-out effects, and that for the manufacturing sector there is evidence of a positive effect on the private investment as well.

R&D investment as a proportion of innovation expenditure is higher in treated firms, both in the service and manufacturing sectors. Innovative sales are higher in financially supported firms than in non-treated firms, in both manufacturing and service sector. This effect is larger in the service sector than in the manufacturing sector (where is 9%), amounting to 20% higher innovative sales than non-financially supported firms in the service sector. Productivity is higher in financially supported firms relative non-treated firms in the service sector, while in the manufacturing sector this effect is negative but not statically significant. The first result is unexpected given the short period in which the evaluation is performed. Finally, there are no significant effects on applied patents.

Table 10. Financial support effects on supported firms

	(1)	(2)	(3)	(4)	(5)	(6)
Dep variable	IE effort	Private IE effort	R&D 1/	Innovative sales 2/	Applied for Patents	Productivity
Service sector	4.370**	1.490	8.753*	20.73***	0.0632	0.366**
	(1.815)	(1.223)	(4.969)	(7.287)	(0.0487)	(0.178)
Treated group	38	38	38	38	38	38
Off support	1	1	1	1	1	1
Potential control group	1,758	1,758	1,776	1,775	1,777	1,778
Manufacturing sector	4.402**	1.951*	6.704**	9.924*	-0.0139	-0.0102
	(1.999)	(1.159)	(3.303)	(5.240)	(0.0224)	(0.110)
Treated group	72	72	72	72	72	72
Off support	0	0	0	0	0	0
Potential control group	1,156	1,156	1,157	1,156	1,158	1,159

Notes: 1/ Share of innovation expenditure that is R&D, 2/ Share of sales due to innovation.
*Bootstrapped standard errors in parentheses. 100 replications *** p<0.01, ** p<0.05, * p<0.1*

When restricting the sample to firms with positive innovation expenditure (table 11), the mean difference in private effort between treated and control is not statistically significant in both sectors. This means that there is no crowding-out effects of public financial support. Also is there no stimulating effect, neither in the total innovation expenditure, R&D expenditure as a proportion of innovation expenditure, applied patents or private effort. Also, the effects on innovative sales and productivity are not significant.

Table 11. Financial support effects on supported firms if IE>0

	(1)	(2)	(3)	(4)	(5)	(6)
	IE effort	Private effort	R&D 1/	Innovative sales 2/	Applied for Patents	Productivity
Service sector	2.866	-0.0910	4.364	6.341	0.0288	0.230
	(1.908)	(1.227)	(5.793)	(8.986)	(0.0615)	(0.174)
Treated group	38	38	38	38	38	38
Off support	0	0	0	0	0	0
Potential control group	684	684	684	684	684	684
Manufacturing sector	3.005	0.501	3.912	4.585	-0.0435	0.00676
	(1.899)	(1.287)	(3.662)	(4.955)	(0.0333)	(0.125)
Treated group	69	69	69	69	69	69
Off support	2	2	2	2	2	2
Potential control group	698	698	698	698	698	698

***Notes**: 1/ Share of innovation expenditure that is R&D, 2/ Share of sales due to innovation.*
*Bootstrapped standard errors in parentheses. 100 replications *** p<0.01, ** p<0.05, * p<0.1*

To summarize, when analyzing the differential impact of financial support in the service and manufacturing sector, the results lead to the conclusion that there is no crowding-out effect of private funds by public funds in any of the two sectors, but there are no effects on firms that would carry out innovation activities in any case.

5. Conclusions

This paper evaluates the impact of public financial support on innovation using quasi-experimental methods and innovation survey data from Uruguay for the manufacturing and service sectors.

This paper contributes to the literature in three ways. First, it presents an impact evaluation of public financial support to innovation on innovation expenditure. Therefore the analysis is extended beyond the R&D context. Second, we analyze the possible heterogeneity of impacts on services and manufacturing. Finally, the evaluation is for a middle income developing Latin American country, where the empirical evidence is scarce.

Results lead to the conclusion that there is no crowding-out effect of private funds by public funds, and that public financing in Uruguay seems to induce some increase in private innovation effort. Moreover, financial support induces some increase in R&D expenditure as a proportion of innovation expenditure and in innovative sales. But public funds do not significantly stimulate private expenditures of firms that would carry out innovation activities in the absence of financial support.

When analyzing the differential impact of financial support in the service and manufacturing sector, the results lead to the conclusion that there is no crowding-out effect of private funds by public funds in any of the two sectors and there is a crowding in effect on manufacturing firms. The positive impact of public funding on R&D and innovative sales is bigger in the service sector. An unexpected (given the short run evaluation that we are conducting) positive effect of public funding on productivity was fund in the case of services.

When the control group is restricted to firms that innovate the above mentioned positive effects vanish. This implies that the positive effects are probably coming from an inducement effect, i.e. firms are induced to innovate thanks to the public funding.

The previous results call for a re-thinking in terms of public innovation policy. On one hand, there is evidence of the bias towards manufacturing firms in terms of public financial support. But results show that the positive effects could be even bigger for services firms. This result raises the question of how public funds are and should be targeted to the service sector.

Finally, more research is needed in the area of relative effectiveness of different instruments of support for innovation. This could help in focusing instruments where they have biggest impact.

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Appendix A

Table A.1. Summary of the available evidence

Author(s)	Country	Policy measure	Outcome variable(s) and impact	Data source	Method
Aerts and Czarnitzki (2004)	Belgium (Flanders)	Financialsupport	R&D expenditure (net of subsidy): + Patent applications: n.s.	Innovation survey (CIS3: 1998-2000) linked to other data resources on patents and financial statements. *Unit of analysis:* manufacturing, computer services, R&D services and business-related services firms.	Non-parametric matching
Almus and Czarnitzki (2003)	Germany (Eastern)	All public R&D schemes	R&D expenditure (net of subsidy): +	Innovation panel (1995, 97, 99). *Unit of analysis:*manufacturing firms.	Non-parametric matching
Avellar	Brazil	Fiscal incentives	R&D expenditure (net of subsidy): + Expenditure on innovative activities (net of subsidy): +	Innovation survey (2006-08). *Unit of analysis:* all firms.	Non-parametric matching
		Financial support	R&D expenditure (net of subsidy): + Expenditure on innovative activities (net of subsidy): +		
Bloom, Griffith and Van Reenen (2002)	Australia, Canada, France, Germany, Italy, Spain, United Kingdom and USA	Fiscal incentives	R&D expenditure: +	Panel with tax information from national sources and R&D expenditure at the country level from OECD database (1979-1997). *Unit of analysis:*national manufacturing sectors.	Instrumental variables with fixed effects
Busom (2000)	Spain	Financial support	R&D expenditure (net of subsidy): + R&D personnel: +	Innovation survey (1988) *Unit of analysis:* all firms.	Heckman's selection model
Crespi, Maffioli and Melendez (2011)	Colombia	Financial support and promotion of research alliances	Productinnnovation: + Labor productivity: +	Industrial, innovation and administrative panel (1995-2007). *Unit of analysis:* manufacturing firms.	Fixed effects
Czarnitzki (2002)	Germany	Financial support	R&D expenditure: +	Innovation panel (1994, 96, 98), database with credit information from a credit rating agency and patenting activity from the national	Tobit model

				patent office. *Unit of analysis:* manufacturing SME's.	
Czarnitzki and Fier (2002)	Germany	Financial support	Expenditure on innovative activities (net of subsidy): +	Innovation panel (1997, 99) *Unit of analysis:* service firms.	Non-parametric matching
Czarnitzki, Hanel and Rosa (2011)	Canada	Fiscal incentives	Number of new products: + Sales of new products: + Profitability: n.s. Domestic market share: n.s. International market share: n.s. Allowed keeping up with competitors: n.s.	Innovation survey (1999). *Unit of analysis:* manufacturing firms.	Non-parametric matching
Czarnitzki and Hussinger (2004)	Germany	Financial support	R&D expenditure (net of subsidy): + Patent applications: +	Innovation panel, public information on R&D funding, database with credit information from a credit rating agency and patenting activity from the national patent office. *Unit of analysis:* manufacturing firms.	Non-parametric matching to estimate the policy effect on R&D expenditure and probit model to estimate the effect of R&D on patent application.
Duguet (2004)	France	Financial support	R&D expenditure (net of subsidy): +	R&D surveys and fiscal information on firms (1985-97). *Unit of analysis:* all firms.	Non-parametric matching
González, Jaumandreu and Pazó (2005)	Spain	Financial support	Decision to invest on R&D: + R&D expenditure (net of subsidy): +	Entrepreneurial panel (1990-1999). *Unit of analysis:* manufacturing firms.	Tobit model
González and Pazó (2008)	Spain	Financial support	R&D expenditure (net of subsidy): +	Entrepreneurial panel (1990-1999). *Unit of analysis:* manufacturing firms.	Non-parametric matching
Gorg and Strobl (2007)	Ireland	Financial support	R&D expenditure (net of subsidy): n.s.	Entrepreneurial panel and public database on R&D grants (1999-2002). *Unit of analysis:* manufacturing firms.	Difference in differences with non-parametric matching.
Hall (1993)	USA	Fiscal incentives	R&D expenditure (net of subsidy): +	Entrepreneurial panel (1980-91). *Unit of analysis:* manufacturing firms.	Instrumental variables.
Hall and Maffioli (2008)	Argentina (1994-2001)	Financial support	R&D expenditure (net of subsidy): +	Innovation panel (1995-2001). *Unit of analysis:* all firms.	Instrumental variables with fixed effects.
	Argentina		R&D expenditure:	Innovation panel (2002-04).	Difference in

	(2001-04)		+ Sales of new products: n.s. Sales growth: n.s. Employment growth: n.s. Exports growth: n.s. Productivity growth: n.s.	*Unit of analysis:* all firms.	differences with non-parametric matching.
	Brazil (1996-2003)		R&D expenditure (net of subsidy): +	Innovation panel (1997-2003). *Unit of analysis:* all firms.	Differences with non-parametric matching.
			Patents: n.s. Employment growth: + Sales growth: + Productivity growth: n.s.		Difference in differences with non-parametric matching.
	Brazil (1999-2003)		R&D expenditure (net of subsidy): +	Innovation panel (1999-2003). *Unit of analysis:* all firms.	Differences with non-parametric matching.
			Patents: + Employment growth: n.s. Sales growth: n.s. Productivity growth: n.s.		Difference in differences with non-parametric matching.
	Chile (1998-2002)		R&D expenditure: n.s. Patents: n.s. New products: n.s. Sales growth: n.s. Employment growth: n.s. Exports growth: n.s. Productivity growth: n.s.	Innovation panel (1999-2001). *Unit of analysis:* all firms.	Difference in differences with non-parametric matching.
			Product innovation: n.s. Process innovation: n.s. Financial access: n.s. Training and organization activities: n.s. Use of external knowledge: +		Differences with non-parametric matching.

	Panama (2000-03)		R&D expenditure: + Sales growth: n.s. Productivity growth: + Exports growth: n.s. Sales of new products: +	Innovation panel (2001-03). *Unit of analysis:* all firms.	Fixed effects with non-parametric matching.
			Product innovation: + Process innovation: + Financial access: + Training and organization activities: n.s. Use of external knowledge: +		Differences with non-parametric matching.
Hujer and Radic (2005)	Germany	All public R&D schemes	New products: + New or improved products: n.s.	Entrepreneurial panel (1999-2000). *Unit of analysis:* all firms.	Probit model
			New products: + New or improved products: +		Non-parametric matching
			New products: n.s. New or improved products: -		Simultaneous two-equation probit model
			New products: n.s. New or improved products: n.s.		Difference in differences
Hussinger (2003)	Germany	Financial support	R&D expenditure (net of subsidy): +	Innovation panel, public information on R&D funding and patent application, and database with credit information from a credit rating agency. *Unit of analysis:* manufacturing firms.	Heckman's selection model and semi-parametric two-step selection models
Klette and Moen (2012)	Norway	Financial support	R&D expenditure: +	Innovation panel (1982-1995). *Unit of analysis:* high-tech firms.	Fixed effects regression
Lach (2002)	Israel	Financial support	R&D expenditure (net of subsidy) : n.s.	Innovation panel (1990-95). *Unit of analysis:* manufacturing firms.	Difference in differences
Lokshin and Mohnen (2013)	Netherlands	Fiscal incentives	Wages of R&D workers: +	Innovation panel and census data on production (1997-2004).	Instrumental variables

				Unit of analysis: all firms.	
Loof and Heshmati (2005)	Sweden	Financial support	R&D expenditure (net of subsidy): +	Innovation survey (CIS3: 1998-2000). *Unit of analysis:* all firms.	Non-parametric matching
Lopez-Acevedo and Tan (2010)	Mexico	Different programs supporting innovation in SME's	Sales: + Employment: + Wages: n.s.	Industrial panel linked to program participation information (1994-2005) *Unit of analysis:* SME's	Fixed effects with non-parametric matching
	Chile		Product or process innovation: + Probability of investing in R&D: + Implementation of quality control systems: + Provision of training for employees: + Sales: - Labor: + Productivity: -	Innovation and entrepreneurial panel (1992-2006) *Unit of analysis:* SME's	Difference in differences with non-parametric matching.
	Colombia		Sales: + Employment: + Wages: + Exports: n.s.	Innovation and entrepreneurial panel linked to administrative tax information (1992-2006) *Unit of analysis:* SME's	Fixed effects with non-parametric matching
	Peru		Profits: + Sales: +	Industrial panel linked to program participation information (1994-2005) *Unit of analysis:* SME's	Fixed effects with non-parametric matching
Ozcelik and Taymaz (2008)	Turkey	Financial support	R&D expenditure (net of subsidy): +	Innovation panel, entrepreneurial panel and database with information on R&D support (1993-2001). *Unit of analysis:* all firms.	Random effects Tobit, fixed effects regression and dynamic models.
Suetens (2002)	Belgium (Flanders)	Financial support	R&D personnel: n.s.	Innovation panel and annual national accounts database (1992-99) *Unit of analysis:* all firms.	Instrumental variables with fixed effects
Wallsten (2000)	USA	Financial support	R&D expenditure (net of subsidy): n.s. Employment: n.s.	Financial reports (1990-92). *Unit of analysis:* small high-tech firms.	Instrumental variables

Note: n.s.=not significant effect at the 5% level, + = positive effect found.

Appendix B

Table B.1. Effects from financial support. Sample without imputed observations

Dep variable	(1) IE effort	(2) Private effort	(3) Innovative sales	(4) R&D	(5) Patents	(6) Productivity
ATT	4.534***	2.134**	15.23***	5.032*	0.0154	-0.0263
	(1.489)	(1.027)	(4.672)	(3.015)	(0.0312)	(0.130)
Treated group	78	78	78	78	78	78
Off support	2	2	2	2	2	2
Potential control group	1861	1861	1861	1861	1861	1861

(2) Share of sales due to innovation. (3) Share of innovation expenditure that is R&D. (4) Applied for patents.

*Bootstrapped standard errors in parentheses. 100 replications *** p<0.01, ** p<0.05, * p<0.1*

Table B.2. Effects from financial support using sample with IE>0. Sample without imputed observations

	(1) IE effort	(2) Private effort	(3) Innovative sales	(4) R&D	(5) Patents	(6) Productivity
ATT	3.335**	0.903	6.690	2.511	0.00281	-0.0981
	(1.508)	(1.111)	(5.721)	(3.516)	(0.0357)	(0.119)
Treated group	77	77	77	77	77	77
Off support	2	2	2	2	2	2
Potential control group	918	918	918	918	918	918

(2) Share of sales due to innovation. (3) Share of innovation expenditure that is R&D. (4) Applied for patents.

*Bootstrapped standard errors in parentheses. 100 replications *** p<0.01, ** p<0.05, * p<0.1*

Appendix C

Table C.1. Mean comparison of supported firms, non-supported firms on selected controls in the service sector

	Unmatched	Mean			%reduc	t-test		Mean			%reduc	t-test	
Variable	Matched	Treated	Control	%bias	bias	t	p>t	Treated	Control	%bias	bias	t	p>t
Size	Unmatched	4.69	3.70	63.7		4.4	0	4.74	4.18	35.3		2.30	0.02
	Matched	4.57	4.44	8.5	86.6	0.38	0.704	4.62	4.48	8.7	75.2	0.39	0.70
Foreign	Unmatched	0.08	0.09	-6.2		-0.37	0.714	0.08	0.15	-21.1		-1.14	0.33
owned	Matched	0.08	0.10	-9	-46.9	-0.38	0.708	0.08	0.16	-23.8	-12.7	-0.98	0.35
Age	Unmatched	23.90	18.25	24.9		1.89	0.058	23.95	20.64	13.8		0.94	0.51
	Matched	24.34	18.75	24.7	1.1	1.02	0.31	24.41	20.64	15.7	-13.7	0.66	0.38
Patent	Unmatched	0.05	0.01	22.6		2.2	0.028	0.05	0.03	12.5		0.88	0.97
obtained	Matched	0.05	0.03	11.2	50.4	0.41	0.681	0.05	0.05	1	91.8	0.04	0.97
K/L	Unmatched	0.84	0.65	11.7		0.58	0.565	0.86	0.74	5.2		0.24	0.81
	Matched	0.86	0.79	4.1	64.5	0.18	0.861	0.88	0.63	10.9	-110.7	0.98	0.33
Productivity t-1	Unmatched	13.39	13.10	25.5		1.73	0.084	13.40	13.31	8.2		0.53	0.60
	Matched	13.41	13.29	10.4	59.3	0.44	0.665	13.42	13.42	-0.4	94.7	-0.02	0.99
Network	Unmatched	0.28	0.20	19.4		1.28	0.2	0.26	0.30	-8.9		-0.52	0.60
	Matched	0.29	0.21	18.8	2.9	0.8	0.429	0.27	0.25	4.8	46	0.21	0.84
Group	Unmatched	0.15	0.14	3.3		0.21	0.833	0.16	0.20	-12		-0.69	0.49
	Matched	0.16	0.13	8.8	-164.8	0.38	0.702	0.16	0.20	-8.9	26	-0.37	0.70
Stores	Unmatched	4.79	3.39	5.7		0.27	0.791	4.89	6.07	-3		-0.14	0.89
	Matched	4.89	2.95	7.9	-39.2	0.95	0.344	5.00	3.22	4.6	-51.1	0.83	0.41
In Montevideo	Unmatched	0.8718	0.7353	34.7		1.92	0.055	0.8947	0.7988	26.7		1.45	0.15
	Matched	0.8684	0.8022	16.8	51.5	0.76	0.447	0.8919	0.8382	15	44	0.66	0.51

Table C.2. Mean comparison of supported firms, non-supported firms on selected controls in the manufacturing sector

	Unmatched	Mean			%reduc	t-test		Mean			%reduc	t-test
Variable	Matched	Treated	Control	%bias	bias	t	p>t	Treated	Control	%bias	bias	p>t
Size	Unmatched	4.22	3.81	36.6		2.83	0.006	4.22	4.12	8.9		0.69
	Matched	4.22	4.21	1.3	96.5	0.08	0.773	4.26	4.29	-2.9	67.6	-0.18
Foreign	Unmatched	0.10	0.13	-9.8		-0.77	0.651	0.10	0.18	-22.4		-1.64
owned	Matched	0.10	0.17	-21.5	-119.3	-1.2	0.841	0.10	0.19	-25.9	-15.6	-1.45
Age	Unmatched	32.29	27.48	21.8		1.9	0.973	31.93	29.09	12.5		1.03
	Matched	32.29	28.01	19.4	11.1	1.19	0.635	32.57	28.84	16.4	-31.2	0.97
Patent	Unmatched	0.03	0.03	0.6		0.05	0.008	0.03	0.04	-8.8		-0.65
obtained	Matched	0.03	0.04	-7.8	-1149	-0.42	0.721	0.03	0.05	-12.1	-37.2	-0.66
K/L	Unmatched	0.52	0.59	-6.7		-0.43	0.401	0.53	0.72	-17.7		-1.13
	Matched	0.52	0.66	-12.9	-94.3	-0.81	0.422	0.54	0.73	-17.6	0.5	-0.95
Productivity t-1	Unmatched	13.93	13.78	16.2		1.2	0.444	13.92	14.05	-15.3		-1.15
	Matched	13.93	13.90	2.5	84.6	0.15	0.787	13.94	14.05	-12.4	19.1	-0.70
Network	Unmatched	0.17	0.10	19.7		1.81	0.001	0.17	0.14	7		0.58
	Matched	0.17	0.12	14.1	28.7	0.81	0.964	0.17	0.16	4.3	37.8	0.24
Group	Unmatched	0.18	0.15	6.8		0.58	0.058	0.17	0.19	-6.6		-0.52
	Matched	0.18	0.17	1.8	74	0.1	0.684	0.17	0.20	-5.9	10.6	-0.33
Stores	Unmatched	1.85	1.81	1.9		0.12	0.958	1.86	1.83	1.7		0.11
	Matched	1.85	1.76	4.3	-130	0.25	0.654	1.87	1.61	13.7	-717.3	1.14
In Montevideo		0.8333	0.7915	10.7		0.85		0.831	0.7927	9.8		0.76
		0.8333	0.7913	10.7	-0.5	0.64		0.8261	0.8	6.7	31.9	0.38

Figure C.1. Propensity score of treated and potencial controls considering all firms (left panel) and only observations with positive innovation expenditure (right panel). Service sector

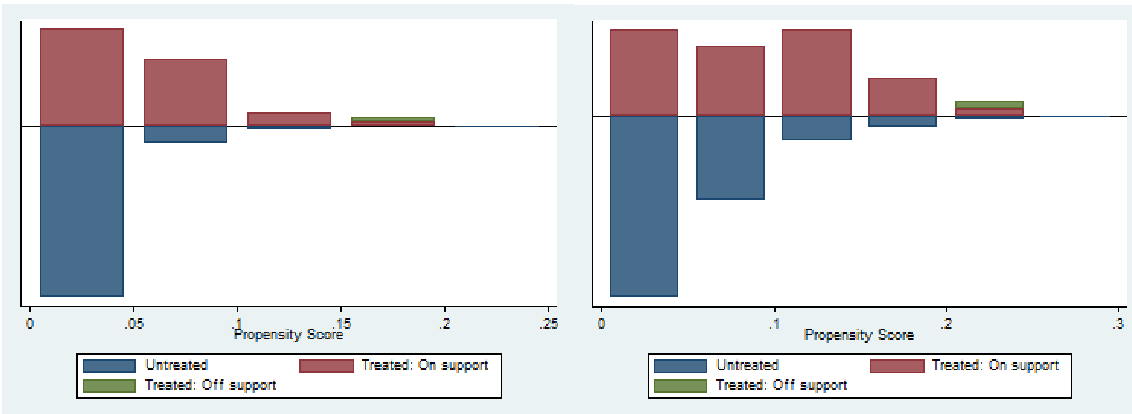
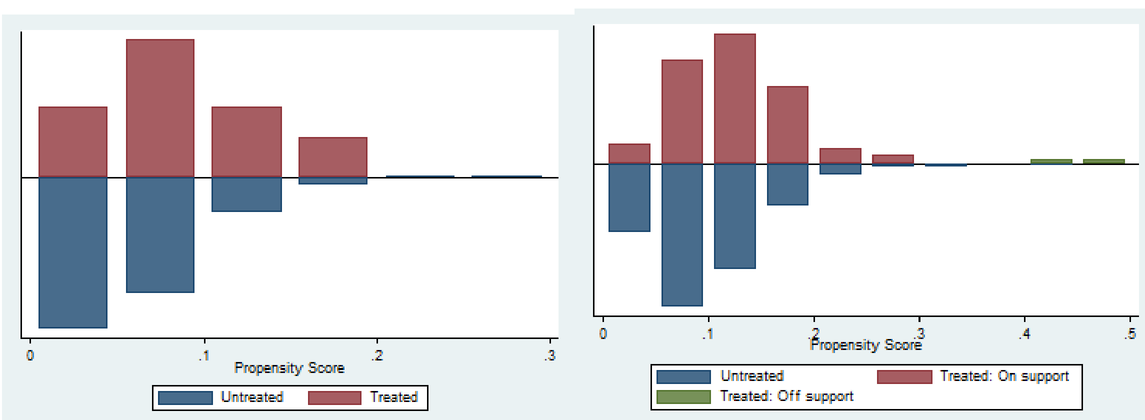


Figure C.2. Propensity score of treated and potencial controls considering all firms (left panel) and only observations with positive innovation expenditure (right panel). Manufacturing sector



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