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DIPARTIMENTO DI SCIENZE ECONOMICHE E SOCIALI

Public Support to Innovation Strategies

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Abstract

This study investigates whether the receipt of public R&D funding determines firm's R&D strategy selection. Using the Community Innovation Survey (CIS) dataset including more than 3000 Italian manufacturing companies, we adopt a multinomial logit model after controlling for sample selection and endogeneity issues which arise when dealing with CIS data. The main finding is that public R&D funding influences whether firms select the *make*, the *buy* or the *make&buy* strategy and in particular firms, after receiving public support, prefer the composite strategy rather than the single strategies. This result turns out to be good news given that government support, correcting for the market failures which characterize the combined strategy, favors the strategy which seems to enhance a positive synergy between in house R&D and external sourcing.

Keywords: Public Funding, R&D strategies, CIS Survey.

JEL: G32, O31, D21

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1 Introduction

In recent years, policymakers in Europe have tried to increase R&D funding in order to reduce the structural differences in R&D business expenditure between Europe and its main competitors, namely Japan and the United States. In particular, the European Commission[1] has set an R&D investment objective for the '2020 European Strategy' at 3% of GDP. Given this goal, support of business R&D remains a major element of innovation policy across European countries. New R&D funding programs and tax incentives for business R&D have been introduced in a number of countries[2].

The main economic rationale for these objectives and public support for private R&D, is the common belief that R&D specificities generate numerous market failures leading to a suboptimal equilibrium and private under-investment in R&D. Such developments have placed a higher priority on evaluating the effectiveness of government R&D support programs.

The main focus of the academic literature[3] on this topic has been in detecting how much additional R&D is performed as a result of government support focusing on R&D input levels (mainly R&D expenditure), but also on the outcome of the innovation process and more recently analyzing the influence of public funding on innovation behavior (OECD, 2006) trying to answers questions such as 'Did the firm improve the management of its R&D activities?', 'Did the firm collaborate more with partners?', 'Were different types of R&D conducted?'.

In this paper we relate to the third stream of the literature focusing on whether public funding influences the R&D strategy selection, assuming three possible strategies, namely in house

[1] See European Commission [2002]

[2] OECD [2006]

[3] See García-Quevedo [2004], Zúñiga-Vicente et al. [2014], Hall et al. [2015] and the literature therein.

R&D (*make*), outsourced R&D (*buy*) or the combination of both (*make&buy*). We are not the first to investigate this issue (see Cruz-Cázares et al., 2013 and Afcha and López, 2014) and in particular we are not the first to find that, after receiving public support, firms prefer the composite strategy rather than the single strategies. What we try to give in this paper is some insight on why this is the case focusing on the different market failures that each strategic choice implies.

Using a unique dataset of Italian companies, which combines the information of the Community Innovation Survey – CIS – (referring year 2010) with balance sheet data on companies characteristics (year 2010, AIDA Bureau van Dijk), we adopt a multinomial logit model after controlling for sample selection and endogeneity issues.

The Italian case is relevant in the international comparison because Italian firms are usually characterized by a low level of innovation activities (Hall et al., 2009). In Italy, only large firms assign a high priority to formal R&D activities (internal R&D) while SMEs resort mostly to external R&D, in the form of intermediate and capital goods. In this context, it becomes particularly interesting understanding what strategy public funding mostly incentives.

The paper is organized as follows. Sections 2 and 3 review the relationships between market failures and public funding and strategies. In Section 4 we describe some relevant facts revealed by the data, we describe variables and methodology issue. The results are discussed in Section 5 and the main conclusions are summarized in the final section.

2 Public Funding and Market failures

The traditional justification for public funding to support business R&D is based on the presence of market failures in

the production and dissemination of knowledge. These failures are thought to prevent the Pareto efficient allocation of R&D resources through market forces and to undermine private incentives to invest in R&D (European Commission, 2002).

The uncertainty of R&D activities (Carpenter and Petersen, 2002) and the strategic nature of R&D, which might restrain managers from revealing the features of their R&D projects to prevent their disclosure to competitors (Bhattacharya and Ritter, 1983), lead to asymmetric information problems, such as adverse selection and moral hazard (Jensen and Meckling, 1976) that might discourage external investors (Himmelberg and Petersen, 1994, Brown et al., 2012 and Hall et al., 2015).

These circumstances can lead to higher cost of external finance due to requirements of a risk premium, or even to the possibility of credit rationing.

Government intervention in private R&D investment can be useful to overcome the financial constraints due to capital market imperfections (Hall, 2002, Takalo and Tanayama, 2010). The empirical evidence is, in general, consistent with the view that financial constraints may deter successful R&D projects (Czarnitzki, 2006) and that public R&D subsidies appear as a public policy instrument aimed at offsetting the negative effect of financial constraints on private R&D activities (Blanes and Busom, 2004, Hyytinen and Toivanen, 2005 and Ali-Yrkkö, 2005).

The second market failure relates to the externalities in the generation of knowledge which are related to the problem of appropriability of research results (Aghion and Jaravel, 2015). If firms cannot fully capitalize the value of their discoveries and prevent competitors or users from benefiting from spillovers, they will invest in R&D less than would be socially optimal (see Nelson, 1959).

Economists generally agree that, on balance, market failures will lead markets mechanisms to fail to provide the socially opti-

mal level and direction of R&D activity (Montmartin and Massard, 2014). In this sense, public support is justified to restore the socially desirable level of business R&D. Governments may influence the firms' incentives to engage in R&D and innovation through a variety of financial and fiscal measures. In this paper we are going to consider direct subsidies, which have the advantage of allowing the policy maker to retain control over the kind of research conducted and direct it to those fields where the gap between private and social rates of return is the greatest and appropriability problems are largest.

Market failures do not affect all types of R&D strategies to the same extent. We discuss this issue in the next paragraph, in which we consider three different types of R&D strategies: a pure *make* strategy, characterized by in-house R&D activities, a pure *buy* strategy, which mainly involves the acquisition of technologically advanced machinery and equipment and to a lesser extent licensing, R&D contracts and outsourcing activities, and finally a composite strategy (*make&buy*), which involves both internal R&D activities and external search[4].

3 Strategies and market failures

Firms competing in global markets face the challenges and opportunities of change in market and technologies. Given the less certain returns and shorter life cycles, management of risky sunk R&D expenditures has become even more of overriding importance for the survival of the firm. The way in which firms determine their boundaries both in terms of production (Parmigiani, 2007) and in terms of innovative strategies (Cassiman and

[4]In this paper we do not intend to account for the formal collaborations with external entities which are usually discussed in the open innovation literature even though external search and collaborations are often considered within the same framework (Teece, 1986).

Veugelers, 2006, Hagedoorn and Wang, 2012) is a complex issue. In this paper we focus on the organization of R&D investment along the internal (*make*) versus external (*buy*) sourcing dimension.

The *make* strategy facilitates the information flow within the R&D department, it allows an objective valuation of real innovation needs and constitutes a unique source of knowledge, with economies of scale being enhanced, transaction costs evaded and barriers to imitation constructed (Contractor and Lorange, 1988). Nevertheless, the *make* strategy is risky because the results of the R&D project are less predictable and the firm could remain isolated in one specific technology if the R&D department is not flexible (Perrons and Platts, 2004).

The *buy* strategy is more reliable and results are more predictable, it allows access to new knowledge areas through the productive networks created (Kessler et al., 2000). On the other hand, buying implies considerable costs of negotiating and enforcing contracts (Narula, 2001), the firm that buys only obtains a little amount of the codified results and not total accumulated knowledge and there is also a substantial risk of opportunistic behavior. External dependencies, functional inequalities, and coordination problems are further factors affecting the *buy* strategy (Kotable and Helsen, 1999).

The theoretical literature, drawing on transaction costs economics (Williamson, 1988) and property rights theory (Grossman and Hart, 1986), traditionally considers the choice between internal development (*make*) and external sourcing (*buy*) as substitutes. The theoretical framework to explain R&D outsourcing stresses the advantage of tapping existing often more specialized knowledge if available. However, technology outsourcing may create considerable transaction costs, ex ante, in terms of search and negotiation costs, and ex post to execute and enforce contracts. Transaction cost economics clearly predicts under what

conditions a firm should internalize the R&D process, i.e. when high asset specificity, high uncertainty, high frequency of transactions are at place (Mol, 2005).

Moreover according to Teece [1986] and Malerba and Orsenigo [1993] the incentive of integrating the R&D activities within the firm could also be driven by the aim of reducing the spillover of information. In a regime of low appropriability there is the risk that the contracting partner won't perform according to the innovator's perception of what the contract requires and there is the added danger that the partner may imitate the innovator's technology and attempt to compete with the innovator (Teece, 1986).

Finally, the resource based view literature focuses on how firms' strategic choices depend on firm-specific capabilities (Barney, 1999). Vicente-Lorente [2001] stresses that the choice between internalizing or outsourcing R&D activities (or the combination of the two) depends on the degree of specificity and opaqueness of the assets involved. In addition assets characteristics play an important role in the theory of capital structure because the costs of both financial distress and liquidation depend on the nature of a firm's assets (Williamson, 1988). The specificity and opaqueness of a firm's asset, which favors the choice of internalizing R&D activities within the firm (Vicente-Lorente, 2001), contribute at increasing the idiosyncratic risk of the firm's project, which can have a profound impact on the lenders' decision to supply finance if they feel they cannot reliably asses the firm's quality on the basis of the perceived value of their innovative activities (Avery et al., 1998 and Carpenter and Petersen, 2002). This process will result in higher costs for finance to compensate for this risk. The nature of R&D projects in general exacerbate moral hazard problem to the extent that no market for external capital might even exist (Hall, 2002), but given the different idiosyncratic risk implied by a *make* strategy rather

than a *buy* strategy it is reasonable to suggest that the level of asymmetric information between firms and lenders is higher for the first strategy rather than the second one (Vicente-Lorente, 2001).[5]

To summarize, while a fully integrated R&D investment strategy (*make*) avoids transaction costs and disclosure of important information it cannot avoid information asymmetries and moral hazard problems towards external borrowers. On the other extreme a fully outsourced strategy (*buy*) avoids information asymmetry and disclosure of important information but it is characterized by higher transaction costs.

If the literature on the substitution between the *make* and the *buy* strategies implies that the two strategies are incompatible, according to the literature on complementarity, the winner strategy should be the composite one. By investing in the build up of 'absorptive capacity' (Cohen and Levinthal, 1990) through in-house R&D, companies may increase their ability to generate future innovations by being able to exploit the opportunities that scientific and technological advances create (Arora and Gambardella, 1994 and Veugelers, 1997). The open innovation literature also stresses this point (Chesbrough, 2003, West et al., 2014). Organizations need to align their internal processes to the external environment: they need to configure their firm to enable successful absorption of knowledge from external sources (see Laursen and Salter, 2014 and Cassiman and Veugelers, 2002).

Empirically there has been some evidence on the effect of complementarities in stimulating innovative performance (see e.g., Cassiman and Veugelers, 2006, Lokshin et al., 2008, Cruz-Cázares et al., 2013), but also evidence of substitutability or absence

[5] A firm that chooses to buy technology in the form of technologically advanced machinery, for example, can use the asset as collateral and collateral assets appear to reduce agency costs of debt.

of complementarity (Hagedoorn and Wang, 2012, Laursen and Salter, 2014).

In this paper we claim that the reason why there might be a substitution effect between the two strategies relates to the fact that those market failures that were present in the single R&D strategies are also present in the composite strategy, even if to a lesser extent.[6]

A combined strategy imposes greater managerial effort to find suitable partners, agree on contracts and coordinate joint efforts (transaction costs). In order to access external knowledge organizations have to reveal some part of their own knowledge to external actors, they thus need to protect their own firm's knowledge from being copied by competitors (risk of information spillover).[7] Finally asymmetric information between the firm and the external borrowers is partially present also in this context.

To conclude, on the one hand external search can provide ideas and resources that help firms gain and exploit innovative opportunities, on the other innovation search is not costless. It can be time consuming, expensive and laborious. It appears that there are moments or tipping points after which openness can negatively affect innovative performance (Laursen and Salter, 2006). The advantages of the combination of in-house R&D with external acquisition (absorptive capacity) might not fully compensate the market failures that are still present in the combined strategy.

If public subsidies correct the market failures of the combined strategy, it should be the case that the complementarity between *make&buy* holds promoting a greater innovative performance. In the rest of the paper we will test empirically what R&D strategy

[6]R&D capability enhanced through in-house R&D can decrease the transaction costs of external sourcing (Arora and Gambardella, 1994), broadly cooperating with external parties can help to cut or reduce innovation costs (Chesbrough, 2003).

[7]See Laursen and Salter, 2014 and Cassiman and Veugelers, 2002.

public funding supports in the context of the Italian manufacturing sector.

4 Data, Methodology and Variables

4.1 Data Sources

The empirical analysis has been carried out using cross-sectional firm-level data drawn from the seventh Italian Community Innovation Survey[8] (CIS2010) conducted over a three-year period (2008-2010) and balance sheet data extracted from the AIDA dataset, by Bureau van Dijk[9].

Linking CIS data with accounting information from administrative sources allows for the use of a wider set of economic indicators typically not considered in the innovation survey microdata.[10] Balance sheet data provides information, on an annual basis, mainly on firms structural characteristics related to size, capital structure, profitability. The Community Innovation Survey (CIS) is directed to manufacturing and services firms with more than 10 employees and collects data on product and process innovation, on the resources allocated to the innovation activities (namely R&D expenditure), but also information on public support to innovation, cooperation activities and the obstacles to innovation. We have restricted the analysis to units belonging to the manufacturing sector with observable expenditure on both

[8]This is a firm level survey, compiled every 4 years in all EU member states and some non-EU countries

[9]The AIDA (Analisi Informatizzata delle Aziende) database is the Italian counterpart of the European Amadeus database, distributed by Bureau van Dijk, and contains balance sheet information on about one million companies in Italy.

[10]The dataset is the result of a collaboration between the Italian National Institute of Statistics (Istat, Regional Office for Lombardy) and the Università Cattolica del Sacro Cuore (UCSC). More information may be found in ISTAT and Università Cattolica del Sacro Cuore [2014].

internal and external R&D activities, leaving us with a sample of 3717 firms.

4.2 Empirical strategy

The structure of the CIS questionnaire and our research question, aiming at revealing whether public funding influence a firm's innovation strategy, lead to the adoption of an empirical procedure based on three different steps, each of them focused on addressing specific econometric issues such as sample selection, as well as the endogeneity of some of the adopted regressors.

An important characteristic of the CIS questionnaire is that it requires companies to declare their innovative inputs and to provide other information, including the one concerning funding, on their innovative activities only if they have introduced innovation outputs (process and/or product innovation), or started innovative projects (then abandoned or still to be completed).

A first problem coming from the structure of the dataset is then related to sample selection, that is information on innovative investments is recorded only for a sample of 2156 innovative companies, here defined as the sub-sample of companies having invested in innovative activities (regardless of whether they had already generated an innovative output or had instead been abandoned or still-to-be-completed).

The second problem, coming from the variable choice, is the endogeneity issue due to a potential reverse causality between subsidy assignment and strategy decision.

In order to solve the aforementioned problems we follow a procedure consisting in the estimation of three specific equations.

The first equation, which we refer to as *Innovation Selection Equation*, explains a firm's probability to innovate. The dependent variable is a dummy one (*Innovation*) which takes value 1 if the firm is an innovative one (i.e. it had started innovative projects – then abandoned or still to be completed – or

introduced innovation outputs) and 0 otherwise. The *Innovation Selection Equation* represents the starting point of our empirical analysis. In fact, in order to take into account the sample selection associated with the exclusion of non innovative companies, a preliminary step of the treatment selection model consists in a standard Heckman procedure. The inverse Mills ratio, namely λ, is then computed on the basis of the following probit model:

$$Innovation_i = \begin{cases} 1 & \text{if} \quad Innovation_i^* = \mathbf{x}'_{1i}\boldsymbol{\beta}_1 + \mathbf{z}'_{1i}\boldsymbol{\gamma}_1 + \varepsilon_{1i} > 0 \\ 0 & \text{if} \quad Innovation_i^* = \mathbf{x}'_{1i}\boldsymbol{\beta}_1 + \mathbf{z}'_{1i}\boldsymbol{\gamma}_1 + \varepsilon_{1i} \leq 0 \end{cases} \tag{1}$$

where $Innovation^*$ is the latent variable underlying the binary outcome we observe; $\mathbf{x}_1$ summarizes a set of control variables; $\mathbf{z}_1$ represents the set of exogenous explanatory factors specific for this equation and ε_{1i} is the usual error term.

The inverse Mills ratio computed at this stage will then augment all the equations of the stages that follow. Moreover, since public funding is precisely referred to the innovation realized over the period under consideration[11], innovation turns out to be explained by public funding and not vice versa. In this way, the problem of endogeneity due to reverse causality between the two variables is avoided.

The second stage of our model, which we refer to as *Funding Selection Equation*, consists in the estimation of the probability of receiving public funds by a simple probit model. This selection equation has as a dependent variable a dummy variable, *Funding*, equal to 1 if a given innovative firm has received some kind of financial support to innovation during the 3 years preceding the survey, and equal to 0 otherwise.[12] The fact that the

[11]Specifically, in the CIS questionnaire firms answer to the following question: "Has your enterprise received any kind of public support for innovation-related activities in the last 3 years?"

[12]As reported before, in the CIS questionnaire firms were asked to answer the following question 'Has your enterprise received any kind of public sup-

variable refers to the 3 years preceding the time of the survey (year 2010) greatly mitigates the obvious limitations due to the cross-sectional nature of our dataset.
The probit model we estimate is the following:

$$Funding_i = \begin{cases} 1 & \text{if} \quad Funding_i^* = \mathbf{x}'_{2i}\boldsymbol{\beta}_2 + \mathbf{z}'_{2i}\boldsymbol{\gamma}_2 + \lambda_i\delta + \varepsilon_{2i} > 0 \\ 0 & \text{if} \quad Funding_i^* = \mathbf{x}'_{2i}\boldsymbol{\beta}_2 + \mathbf{z}'_{2i}\boldsymbol{\gamma}_2 + \lambda_i\delta + \varepsilon_{2i} \leq 0 \end{cases} \tag{2}$$

where $Funding^*$ is the latent variable underlying the binary outcome we observe (1 for subsidized firms and 0 for unsubsidized); $\mathbf{x}_2$ is a set of control variables; $\mathbf{z}_2$ summarize a set of exogenous explanatory factors specific for the *Funding* equation and that represent instrumental variables for that equation; λ is the inverse Mills ratio obtained in step 1 while ε_{2i} is the error term.

In the last step of the procedure, which we refer to as *Outcome Equation*, the fitted values of Equation (2), namely $Funding_{score}$, are inserted in the *Strategy* equation in order to solve the reverse causality problem between the two variables ('Is the strategy's choice determined by the receipt of funding or does the public support depend on the strategy-specific decisions?'). Given the three types of strategies commonly defined in the literature (*make*, *buy* and *make&buy*) and explained in detail in Section 3, we define a categorical ordered dependent variable (the *Strategy* variable) which assumes value 0 in the case the firm pursued a *make&buy* strategy during the period of analysis, value 1 if the business engaged only in internal R&D and value 2 if the firm conducted only extra muros R&D activities. Being the depen-

port for innovation-related activities in the last 3 years?'. Note that only financial support is to be considered (i.e. contributions in capital or interest accounts, facilitated funding, tax credits and fiscal bonuses) and it is not possible to distinguish between different forms of support. Moreover, there is a lack of information about both the amount received by each firm and the specific innovative input (or output) the government's programs aimed at supporting.

dent variable a categorical one, the following multinomial probit model is used[13]

$$Strategy_i = \gamma Funding_{score} + \mathbf{x}'_{3i}\boldsymbol{\beta}_3 + \lambda_i\delta + \varepsilon_{3i} \qquad (3)$$

where $Funding_{score}$ are the fitted values of Equation (2), $\mathbf{x}_3$ are controls and ε_{3i} is the error term.

4.3 The variables

In the first stage of our model we estimate an *Innovation Selection Equation* through a probit regression.

Regarding the determinants of *Innovation* it has been widely recognized in the empirical literature that firm size, sectors and location play a major role (see Cohen, 2010 for a review). On the other hand, given that innovation is often associated with risks and costly investments in knowledge and technology, both internal financial resources and access to external capital are possible determinants of a firm's innovation activity (Czarnitzki, 2006). Therefore we consider some firms characteristics which may in principle be relevant controls for all three equations of our empirical model, in particular *firm size*, measured as the log of employment, *profitability*, measured as the return on investments, given that firms' profits might in fact be used as a source of internal financing, some indicators of firms' financial conditions in particular the *liquidity ratio*, current assets on current liabilities, *the cost of debt*, the effective rate that a company pays on its current debt and *leverage*, measured as total debt on total assets,

[13]We also try to implement an ordered probit model by ordering the *Strategy* categories in a meaningful way on the basis of the relevance of the market failures that each of them implies. Nevertheless, the model violates the proportional odds assumption, verified by the Brant test. Results are available upon request.

regional and sectoral dummies[14].

In addition the empirical literature suggests that global competition can spur innovation through the concept of 'learning by exporting' (see Salomon and Shaver, 2005) and that young (see for example Huergo and Jaumandreu, 2004) and fast growing firms are more likely to be innovative (Catozzella and Vivarelli, 2014). We thus consider *exports*, measured as an extensive margin, *firm's growth*, measured by the rate of growth of employees and *age*, computed as the log difference between the current year and the constituent year, but also the occurrence of other forms of innovation, in particular *organizational innovation*, i.e. new agreements with other parties, and *marketing innovation*, i.e. new pricing policies, which according to the literature are seen as complementary to the main innovative activities (Bresnahan et al., 2002, Piva et al., 2005); the percentage of *skilled labor* and the firms' perceived *obstacles to innovation*, which can derive either from the lack of financial possibilities (both internal or external to the firm) or from the lack of skilled human capital, which is regarded to reflect a firm's capacity to absorb, assimilate and develop new knowledge and technology (Cohen and Levinthal, 1990, Machin and Van Reenen, 1998, Jones, 2009).

In the second stage of our model we estimate a *Funding Selection Equation* through a probit regression.

The main determinants of the probability of receiving public funding can be driven on one side from the public administration incentives of supporting firms whose projects have a higher probability of success and on the other side on the firms' incentives in a costs/benefits framework of applying for public funding [Blanes and Busom, 2004]. Firms position in international markets, group affiliation, size, the perceived importance of in-

[14]We consider the following Italian regions: North East, North West, Center and South. We consider the technological sectors according to the Pavitt classification divided into high, medium-high, medium-low and low

formation and cooperation can on one hand influence the firm's propensity to participate in public programs [González and Pazó, 2008], but at the same time these characteristics could be a signal for public administrations of the firms' ability to transform innovation into successful products [Blanes and Busom, 2004]. In particular, firms with more market power could be facing lower application costs as they are more experienced in dealing with bureaucracy than their peers, firm's ownership could be an indicator of the ease of access to external capital markets, possibly meaning a better knowledge of the public aid system or, on the contrary, it could also mean that foreign-owned companies may benefit from R&D developed in their home country and have no incentive in applying for public funding, large firms might have the organizational resources to face bureaucracy and paperwork inherent to public funding application. Along this line we consider the following variables: *ownership*, which indicates whether the firm has national or international headquarters, *belonging to a group*, the firms' perceived importance of information coming from other firms, clients, suppliers (*market information*) or from universities, research centers (*basic information*), *demand pull R&D* and lastly firm's cooperation activities, considering *external cooperation*, *horizontal cooperation* and *vertical cooperation*.

Finally, in the third stage of our model we estimate the *Outcome Equation* through a multinomial probit regression. The choice of conducting R&D activities internally or externally mainly depends on three different variables. The first is technological cooperation which could play a major role in enhancing the complementarity between the *make* and the *buy* strategies, given that it enables firms to internalize spillovers, assimilate new knowledge fields embedded in the core competencies of other firms and/or reduce costs relative to pure market-based transactions (see Cassiman and Veugelers, 1999, Spithoven and Teirlinck, 2015). The second important indicator that might enhance both the selec-

tion of R&D internally or to combine the two strategies together is qualified human resources with capabilities to adapt external knowledge and to fulfill internal requirements of the firm. Recruited qualified personnel reinforce internal capabilities in order to develop R&D activities and exchange and incorporate information from external firms or institutions in the future (see Beneito, 2003, Afcha, 2012). Thirdly financial costs, which are seen as the main obstacle to develop R&D activities, might be different with respect to the selected strategy. The financial barrier should diminish in the case of external R&D activities as its cost is in general lower than internal R&D costs (see Beneito, 2003, Love and Roper, 2002). Given these lines of reasoning we introduce the following variables: *external cooperation*, *horizontal cooperation*, *vertical cooperation*, *demand pull R&D*, *skilled labor* and *obstacles to innovation*, together with the firms' characteristics common to all equations previously described[15].

4.4 Descriptive Statistics

A preliminary, descriptive comparison of the sub-samples of innovative firms (having received public funding or not and/or following a specific innovative strategy) is provided below (Table 1), showing the quantitative (unconditional) effect that the subsidy produces on the choice of the innovation strategy, namely *make*, *buy* and *make&buy*.

Then, the mean differences in the three innovation strategies between supported and non-supported firms are computed. These differences, which provide us with preliminary estimates of the effects generated by the subsidy, are reported in the last two columns of Table 1, together with the corresponding two-sample t-tests and their significance. In spite of the negative impact of

[15]Note that formal definitions of all the variables are provided in Appendix A.

Table 1: Descriptive statistics

	Sample means			Mean differences	
	All firms	Non-supported	Supported	Difference	%Difference
Number of obs.	*2156*	*1360*	*796*		
Make	0.133	0.143	0.117	−0.026∗ (0.015)	−18.096
Buy	0.186	0.224	0.119	−0.105∗∗∗(0.016)	−46.783
Make&Buy	0.681	0.633	0.764	0.131∗∗∗(0.020)	20.650

¯ Difference: mean($Supported$)-mean($Non\_Supported$); %Difference: mean($Supported$)-mean($Non\_Supported$) in percentage terms. In the case of Make, Buy and Make&Buy variables we also report a two sample proportion test.
¯ In brackets: standard errors; * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

the subsidy on both *make* and *buy* strategies, a positive (and strongly significant) effect emerges when the *make&buy* strategy is considered, shrinking by almost 21 percentage points from the non-supported to the supported sub-sample.

However, it should be noted that these descriptive statistics do not control for the possibility that the impacts of the subsidy over the strategies may be driven either by selection biases or by ex ante sources of firm heterogeneity. The econometric results in the next Section will test whether these impacts of funding on innovative strategies persist once we have checked for the selection bias affecting our analysis (i.e. the selection of the 2156 innovative firms from the total 3717 surveyed) as well as for the role that the exogenous factors can play in differentiating the two sub-samples of supported and non-supported firms.

Tables 5 and 6 in Appendix A provide some descriptive statistic for all independent variables used in our model equations ordered by innovation strategy and funding.

The total sample of firms surveyed (3717 firms) are on average 20 years old (equal to 3 in logarithmic terms) with 60 employees and are characterized by a very low dimensional growth. A large part of firms, 72,4%, export its products on foreign markets while only a small proportion, 34,7%, is part of a business group. Regarding the technological level of the firms, the most part have a low level of technological change according to the Pavitt's taxonomy (medium low 32%, low low 43%) and are lo-

cated in the Northern Italy (72%). Among the innovative firms, almost a 37% benefited from public financial support for innovation related activities.

Table 2 once again considers all independent variables but it presents their differences between supported and non supported firms (divided by strategies) together with the corresponding two-sample t-tests and their significance. Differences on firm's characteristics between supported and non supported firms are more evident among firms with mixed strategies than among firms with pure innovation (external or internal) strategies. In general, firms performing simultaneously internal and external R&D that receive public support are those showing less favorable characteristics in order to adopt innovative activities. These firms are mostly located in the South, they are younger, with little experience in their market (characterized by a low level of technology), smaller with some difficulty to export, to cooperate and to enter in a group. Supported firms following this strategy are also those recruiting a smaller number of personnel with a university degree (skilled labour).

On the contrary, in the group of pure-internal innovation strategy, firms receiving public support are bigger, perceiving minor constraints both internal and external and more aware about the importance of market and basic information.

Finally, supported firms performing pure-external R&D are mostly located in the Centre, but with a non Italian headquarter, characterized by a medium-low level of technology and generally financially constrained.

5 Results

The model presented in the previous section is here estimated in order to properly test and measure the impact of the subsidy on the innovative strategy which emerged from the preliminary

Table 2: List of variables and statistics by strategy and by funding.

	Make				Buy				Make&Buy			
	All firms		Mean differences supported vs. non-supported		All firms		Mean differences supported vs. non-supported		All firms		Mean differences supported vs. non-supported	
Number of observations	*287*		*93*	*194*	*400*		*95*	*305*	*1469*		*608*	*861*
(%)			*(32.40)*	*(67.60)*			*(23.75)*	*(76.25)*			*(41.39)*	*(58.61)*
Variables	**mean**	**std.err.**	**mean**	**std.err.**	**mean**	**std.err.**	**mean**	**std.err.**	**mean**	**std.err.**	**mean**	**std.err.**
Age	2.964	(0.777)	−0.087***	(0.098)	2.866	(0.696)	−0.138*	(0.082)	3.051	(0.747)	−0.118***	(0.039)
Firm Growth	-0.044	(0.252)	0.03	(0.026)	0.020	(0.267)	0.008	(0.024)	0.014	(0.396)	0.029	(0.020)
Organizational Innovation	0.206	(0.405)	−0.034	(0.051)	0.165	(0.372)	−0.060	(0.044)	0.318	0.466)	−0.081***	(0.025)
Marketing Innovation	0.139	(0.347)	−0.015	(0.044)	0.120	(0.325)	−0.050	(0.042)	0.236	(0.424)	−0.008	(0.022)
Firm Size	4.377	(1.450)	0.467***	(0.181)	3.597	(1.051)	−0.027	(0.124)	4.700	(1.498)	−0.569***	(0.078)
Export	0.902	(0.297)	0.017	(0.038)	0.670	(0.471)	0.009	(0.055)	0.880	(0.326)	−0.074***	(0.016)
Skilled Labour	1.962	(1.439)	0.263	(0.181)	1.218	(1.304)	0.009	(0.153)	2.135	(1.424)	−0.357***	(0.075)
Internal Financial Constr	0.261	(0.440)	−0.100*	(0.055)	0.235	(0.425)	0.004	(0.050)	0.215	(0.411)	0.011	(0.022)
External Financial Constr	0.286	(0.453)	−0.105**	(0.057)	0.220	(0.415)	0.095**	(0.044)	0.236	(0.424)	0.020	(0.022)
Skill Constr	0.070	(0.255)	−0.024	(0.032)	0.083	(0.275)	−0.012	(0.032)	0.071	(0.258)	0.018	(0.013)
Liquidity ratio	1.461	(0.795)	−0.105	(0.089)	1.462	(0.861)	0.176**	(0.081)	1.501	(0.819)	0.007	(0.043)
Cost of Debt	0.032	(0.019)	0.002	(0.002)	0.028	(0.019)	−0.002	(0.002)	0.029	(0.019)	−0.0001	(0.001)
Leverage	0.621	(0.205)	0.001	(0.026)	0.610	(0.209)	−0.012	(0.025)	0.601	(0.195)	0.013	(0.010)
Roi	0.256	(0.581)	−0.055	(0.068)	0.326	(0.613)	0.025	(0.072)	0.207	(0.435)	0.006	(0.023)
External Co	0.108	(0.311)	0.047	(0.042)	0.018	(0.131)	−0.005	(0.015)	0.241	(0.428)	−0.217***	(0.023)
Horizontal Co	0.063	(0.243)	0.050	(0.034)	0.025	(0.156)	0.005	(0.018)	0.161	(0.368)	−0.123***	(0.020)
Vertical Co	0.073	(0.261)	0.035	(0.035)	0.018	(0.131)	−0.009	(0.013)	0.201	(0.401)	−0.153***	(0.022)
Demand Pull	8.122	(2.586)	0.345	(0.326)	7.175	(2.800)	−0.350	(0.329)	8.946	(2.284)	−0.421***	(0.121)
Group	0.456	(0.499)	0.104*	(0.063)	0.220	(0.415)	0.068	(0.049)	0.494	(0.500)	−0.094***	(0.026)
Ownership	0.854	(0.354)	−0.038	(0.045)	0.950	(0.218)	−0.052***	(0.017)	0.859	(0.348)	0.001	(0.018)
Market info	1.413	(0.634)	0.177**	(0.079)	1.278	(0.587)	−0.099	(0.077)	1.693	(0.607)	−0.088***	(0.032)
Basic info	0.724	(0.539)	0.117*	(0.068)	0.545	(0.514)	−0.106	(0.066)	0.980	(0.628)	−0.273***	(0.032)
High	0.024	(0.155)	−0.004	(0.020)	0.040	(0.196)	−0.003	(0.023)	0.075	(0.263)	−0.049***	(0.015)
Medium high	0.268	(0.444)	0.064	(0.056)	0.120	(0.325)	−0.022	(0.038)	0.305	(0.461)	−0.103***	(0.025)
Medium low	0.286	(0.453)	−0.041	(0.057)	0.300	(0.459)	0.159***	(0.048)	0.266	(0.442)	0.072***	(0.023)
Low low	0.422	(0.495)	−0.019	(0.062)	0.540	(0.499)	−0.134**	(0.058)	0.354	(0.478)	0.079***	(0.025)
North West	0.425	(0.495)	0.055	(0.062)	0.343	(0.475)	0.021	(0.056)	0.382	(0.486)	−0.016	(0.026)
North East	0.387	(0.488)	−0.063	(0.062)	0.325	(0.469)	−0.098*	(0.055)	0.408	(0.492)	−0.028	(0.026)
Centre	0.122	(0.328)	0.042	(0.041)	0.155	(0.362)	0.079**	(0.037)	0.113	(0.317)	0.010	(0.017)
South	0.066	(0.249)	−0.034	(0.029)	0.178	(0.383)	−0.002	(0.045)	0.097	(0.297)	0.034**	(0.015)

¯ Mean difference: mean($Supported$)-mean($Non\_Supported$).
¯ * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

descriptive evidence reported in Table 1. In particular, previously illustrated sequential steps had been performed in order to estimate our model. Firstly, the sample selection of 2156 firms out of the 3717 surveyed firms has been taken into account by a standard Heckman procedure. The first column of Table 3 reports the results from the corresponding probit selection equation generating the inverse Mills ratio (λ) which is included in all the following steps. As the table shows (and not surprisingly), large, fast-growing, skill-intensive and exporting firms are more likely to be innovative. By the same token, a clearer perception of internal and external obstacles to innovation is also significantly correlated with the actual innovative effort. Finally, *organizational innovation* and *marketing innovation*) are confirmed to be complementary to innovation activities positively affecting the occurrence of technological innovation.

Results from the second step of the estimation show the determinants of the subsidy concession (Table 3, column (2)). As expected firm size has a positive sign given that, on one hand public administrations might prefer to support large firms as they believe in the success of their projects, on the other firm dimension and consequently better organizational resources might be a useful tool for public funding applications.

Moreover cooperation with external parties as well as the perceived importance of information coming from universities and research centers (*basic info*) are positively correlated with the probability of receiving funding given that these factors can influence the propensity to participate in public programs. At the same time, it is more likely that firms that share these characteristics receive more funding because they are more willing to undertake successful innovation projects thanks to the exploitation of external information and cooperation.

Finally the Italian ownership of the firm positively impacts on the probability of receiving funding while on the contrary,

being part of a group seems to be an obstacle to receiving public support.

Looking at the last two columns of Table 3 public funding emerges to be a factor that determines the firm's choice of R&D strategies, i.e. whether it opts for in-house R&D, outsourced R&D or a combination of the two. Public funding negatively impacts on the single strategies with respect to the composite one (and this is also confirmed by the single probit model estimations reported in Table 4).

In other words, public R&D funding influences whether firms select the *make*, *buy* or *make&buy* strategy and in particular firms, after receiving public support, prefer the composite strategy rather than the single strategies. This result turns out to be good news given that government support, correcting for the market failures which characterize the combined strategy as outlined in Section 3, favors the strategy which in the literature is found to enhance a positive synergy between in house R&D and external sourcing. Regarding the other controls, as expected large, skill-intensive, exporting firms are more likely to prefer conducting R&D activities internally. Interestingly the results on cooperations show that while external cooperation increases the probability of choosing a *make* strategy rather than a composite one, vertical cooperation seems to play an important role for the selection of a *make&buy* strategy.

Table 3: Estimation results.

	(1) *Probit*		(2) *Probit*		(3) *Multinomial (Make&Buy=0)*		(4)	
Variables	**Innovation**		**Funding**		**Make**		**Buy**	
	coeff	**std.err**	**coeff**	**std.err**	**coeff**	**std.err**	**coeff**	**std.err**
lambda_inn			0.152	(0.162)	1.163***	(0.292)	0.905***	(0.264)
Funding_score					−3.700***	(0.890)	−3.400***	(0.953)
Age	−0.010	(0.033)						
Firm Size	0.143***	(0.021)	0.113***	(0.028)	0.110**	(0.052)	−0.091*	(0.051)
Firm Growth	0.219***	(0.072)						
Export	0.524***	(0.054)	0.162	(0.104)	0.820***	(0.192)	0.012	(0.165)
Skilled Labour	0.105***	(0.019)	0.024	(0.025)	0.112***	(0.043)	−0.075*	(0.044)
Internal Financial Constr	−0.214***	(0.064)	0.035	(0.083)	−0.007	(0.135)	−0.044	(0.141)
External Financial Constr	0.306***	(0.065)	−0.092	(0.084)	0.175	(0.138)	−0.207	(0.148)
Skill Constr	0.064	(0.082)	−0.186	(0.115)	−0.150	(0.195)	0.009	(0.193)
Organizational Innovation	0.674***	(0.069)						
Marketing Innovation	0.540***	(0.075)						
Liquidity ratio	−0.046	(0.035)	−0.080*	(0.046)	−0.119	(0.084)	−0.252	(0.086)
Cost of Debt	2.278*	(1.242)	0.637	(1.614)	6.358**	(2.665)	−0.744	(2.852)
Leverage	−0.053	(0.154)	−0.212	(0.192)	−0.252	(0.350)	−0.635*	(0.339)
Roi	−0.071*	(0.041)	0.040	(0.060)	0.148	(0.104)	0.168**	(0.088)
External Co			0.393***	(0.106)	0.501**	(0.251)	−0.329	(0.342)
Horizontal Co			0.083	(0.107)	−0.104	(0.213)	0.092	(0.282)
Vertical Co			0.039	(0.112)	−0.381*	(0.221)	−0.597**	(0.302)
Demand Pull			0.016	(0.013)	−0.047**	(0.022)	−0.115***	(0.021)
Group			−0.171**	(0.078)				
Ownership			0.198**	(0.098)				
Market info			0.018	(0.054)				
Basic info			0.223***	(0.055)				
High	–		–		–		–	
Medium High	−0.014	(0.134)	−0.113	(0.131)	0.567**	(0.281)	−0.459*	(0.265)
Medium Low	−0.405***	(0.130)	−0.422***	(0.138)	0.058	(0.309)	−0.692***	(0.287)
Low low	−0.300**	(0.130)	−0.245**	(0.134)	0.380	(0.292)	−0.265	(0.263)
North-West	–		–		–		–	
North-East	0.081	(0.053)	0.054	(0.066)	−0.049	(0.113)	−0.062	(0.115)
Centre	−0.127*	(0.072)	−0.113	(0.094)	−0.213	(0.165)	0.055	(0.161)
South	−0.223***	(0.074)	−0.164	(0.105)	−0.610***	(0.191)	0.138	(0.170)
const.	−0.722***	(0.235)	−1.159***	(0.353)	−1.778***	(0.661)	2.214***	(0.600)
Pseudo R^2	0.184		0.076					
Obs.number	3717		2156		2156			

Probit coefficients for Innovation equation and Public Funding equation. Mutinomial coefficients for Make and Buy equations (Make&Buy strategy=0). Standard errors in parentheses.

* Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 4: Probit estimation results on single strategies.

Dependent Variable	**Make**		**Buy**		**Make&Buy**	
	coeff	**std.err**	**coeff**	**std.err**	**coeff**	**std.err**
lambda_inn	0.633***	(0.211)	0.484**	(0.189)	−0.823***	(0.167)
Funding_score	−2.259***	(0.640)	−1.899***	(0.687)	2.679***	(0.561)
Firm Size	0.096***	(0.037)	−0.089**	(0.037)	−0.018	(0.032)
Export	0.656***	(0.142)	−0.154	(0.117)	−0.224**	(0.106)
Skilled Labour	0.101***	(0.031)	−0.075**	(0.032)	−0.011	(0.027)
Internal Financial Constr	0.012	(0.096)	−0.035	(0.101)	0.026	(0.086)
External Financial Constr	0.162	(0.099)	−0.185*	(0.106)	0.016	(0.088)
Skill Constr	−0.113	(0.141)	0.037	(0.138)	0.055	(0.119)
Liquidity ratio	−0.043	(0.060)	−0.170***	(0.063)	0.139***	(0.051)
Cost of Debt	4.827***	(1.881)	−1.784	(2.039)	−2.499	(1.738)
Leverage	−0.065	(0.252)	−0.443*	(0.245)	0.316	(0.210)
Roi	0.067	(0.075)	0.096	(0.064)	−0.108*	(0.059)
External Co	0.352*	(0.184)	−0.337	(0.250)	−0.187	(0.168)
Horizontal Co	−0.107	(0.155)	0.084	(0.207)	0.030	(0.140)
Vertical Co	−0.253	(0.163)	−0.398*	(0.224)	0.312**	(0.144)
Demand Pull	−0.008	(0.016)	−0.077***	(0.015)	0.062***	(0.013)
High	–		–		–	
Medium High	0.495**	(0.206)	−0.440**	(0.192)	−0.073	(0.155)
Medium Low	0.183	(0.226)	−0.529**	(0.208)	0.241	(0.173)
Low low	0.331	(0.215)	−0.262	(0.190)	−0.047	(0.159)
North-West	–		–		–	
North-East	−0.021	(0.081)	−0.032	(0.083)	0.043	(0.070)
Centre	−0.181	(0.118)	0.080	(0.116)	0.060	(0.101)
South	−0.490***	(0.139)	0.206*	(0.121)	0.130	(0.107)
const.	−2.130***	(0.478)	1.2637***	(0.434)	−0.611	(0.379)
Pseudo R^2	0.051		0.206		0.136	
Obs.number	2156					

Probit coefficients.
* Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

6 Concluding Remarks

A large number of empirical studies in the last five decades have investigated the effectiveness of public subsidies on private R&D spending. In general, academics and policymakers agree about the desirability of subsidizing private R&D activities. The market failure argument resting on the 'public good' nature of R&D, which deters full appropriation and leads the level of private R&D below the socially optimal level, drives this agreement. Furthermore, capital market imperfections leading to financial constraints on risky projects, also contribute to reducing private R&D investment below the socially optimal level [Hall, 2002]. Public subsidies are thus used as policy instruments to fill the gap between the private and the socially optimal levels of R&D investment. Accordingly, many empirical studies aim at assessing the causal effect of public subsidies on private R&D investment.

Drawing on the standard evaluation literature mainly aimed at estimating the additional effect of subsidies on either firms' innovative inputs or outputs only, this paper has tried to move one step further, drawing a bridge between economic studies, focused on public funds used to overcome market failures, and the economics of the firm, mainly focused on the way to identify firms' boundaries.

In particular, using the seventh Italian Community Innovation Survey combined with balance sheet data, we measure the impact of public funding on firm innovation strategy, the latter distinguished in 'in house R&D' (*make*), outsourced R&D (*buy*) or the combination of both (*make*&*buy*). The important finding from this study is that public funding for R&D is not only a factor influencing firms' decisions to undertake R&D activities, but it is also a factor that determines the firm's R&D strategic choice. In particular firms, after receiving public support, prefer

the composite strategy rather than the single strategies.

Interestingly the combined strategy, on the negative side, encloses all the market failures which characterize the single strategies (i.e. information asymmetries towards external borrowers typical of *make* and high transaction costs and information disclosure typical of *buy*), on the positive side it incorporates the complementarity between the *make* and the *buy* strategies. In other words external R&D can provide ideas and resources that may help the firm to conduct better in house R&D (absorptive capacity literature).

In this light, the fact that public funding is aimed at supporting the combined strategy turns out to be good news given that government support, correcting for the market failures which characterize the combined strategy, leaves the latter only with its positive aspect, i.e. the positive synergy between internal and external R&D.

The cross sectional nature of our dataset is an important limitation to be overcome by further studies using longitudinal data. Furthermore, the lack of information about the magnitude and typology of the received subsidy calls for a better design of the CIS questionnaire. Finally, our results are obviously dependent on the specificities and weaknesses characterizing Italian manufacturing firms and should be compared with studies conducted in other countries.

Having said that, we can suggest that public support in Italy is correctly addressed to promote the most promising R&D strategy.

A List of variables and Descriptive Statistics

Variables	Description
Innovation	dummy variable=1 if the firm is an innovative one
Funding	dummy variable=1 if the firm has received some kind of financial support to innovation
Make	dummy variable=1 if the business engaged only in internal R&D during the period
Buy	dummy variable=1 if the firm has conducted only extra muros R&D activities during the period
Make&Buy	dummy variable=1 if the firm has conducted both R&D activities during the period
Age[1]	log(current year - constituent year)
Firm Growth[1]	rate of growth of employees
Organizational Innovation[1]	dummy variable=1 new agreements, joint ventures, partnerships with other firms or public institutions
Marketing Innovation[1]	dummy variable=1 new pricing policies
Firm Size[1,2,3]	log of firm's employment
Export[1,2,3]	dummy variable=1 if the firm engages in export activity
Skilled Labour[1,2,3]	percentage of skilled labour(university degree)
Internal Financial Constr[1,2,3]	dummy variable=1 if the firm declared a high perception of financial obstacles within the firm
External Financial Constr[1,2,3]	dummy variable=1 if the firm declared a high perception of financial obstacles outside the firm
Skill Constr[1,2,3]	dummy variable=1 if the firm declared a high perception of lack of skilled human capital
Liquidity ratio[1,2,3]	current assets on current liabilities
Cost of Debt[1,2,3]	Effective rate that a company pays on its current debt: financial charges on debt
Leverage[1,2,3]	Amount of debt used to finance a firm's assets
Roi[1,2,3]	Return on Investment index
Regions[1,2,3]	North West, North East, Center, South (Italian macro regions defined by ISTAT)
Sectors[1,2,3]	High, Medium High, Medium Low, Low (Pavitt's taxonomy)
External Co[2,3]	dummy variable=1 if the firm has conducted some cooperation with external parties
Horizontal Co[2,3]	dummy variable=1 if the firm has conducted some cooperation with other firms in the group or competitors
Vertical Co[2,3]	dummy variable=1 if the firm has conducted some cooperation with clients and/or suppliers
Demand pull R&D[2,3]	relevance of demand related to range of products, market share and product quality in the firm's innovation decision (it takes values from 0 to 12)
Group[2]	dummy variable =1 if belonging to a group
Ownership[2]	dummy variable =1 if the headquarters are in Italy
Market info[2]	average importance of information coming from the firm, clients and suppliers
Basic info[2]	average importance of information coming from the universities, research centers ect.
lambda_inn[2,3]	inverse Mills ratio coming from the selection equation on innovation
Funding_score[3]	fitted values of Public Funding obtained from the equation on Public Funding

Table Notes: (1) refers to the presence of the variable in the selection equation (Innovation), (2) in Public Funding and (3) in Strategies.

Table 5: List of variables and statistics. All firms and all innovative firms.

	All firms of the sample		All innovative firms					
			All firms		Supported		Non Supported	
Number of observations	*3717*		*2156*		*796*		*1360*	
(%)					*(36,92)*		*(63,08)*	
Variables	**mean**	**std.err.**	**mean**	**std.err.**	**mean**	**std.err.**	**mean**	**std.err.**
Age	2,960	(0,751)	3,005	(0,745)	3,077	(0,711)	2,963	(0,761)
Firm Size	4,092	(1,425)	4,453	(1,480)	4,825	(1,555)	4,235	(1,389)
Firm Growth	0,000	(0,354)	0,007	(0,359)	-0,003	(0,296)	0,014	(0,391)
Organizational Innovation	0,188	(0,391)	0,275	(0,446)	0,325	(0,469)	0,245	(0,430)
Marketing Innovation	0,143	(0,350)	0,201	(0,401)	0,217	(0,413)	0,192	(0,394)
Export	0,724	(0,447)	0,844	(0,363)	0,891	(0,312)	0,816	(0,387)
Skilled Labour	1,599	(1,451)	1,942	(1,447)	2,185	(1,444)	1,799	(1,430)
Internal Financial Constr	0,251	(0,433)	0,225	(0,418)	0,210	(0,407)	0,234	(0,423)
External Financial Constr	0,229	(0,420)	0,239	(0,427)	0,214	(0,410)	0,254	(0,436)
Skill Constr	0,075	(0,263)	0,073	(0,261)	0,062	(0,241)	0,080	(0,272)
Liquidity ratio	1,507	(0,851)	1,489	(0,824)	1,465	(0,762)	1,503	(0,858)
Cost of Debt	0,029	(0,019)	0,029	(0,019)	0,030	(0,019)	0,029	(0,019)
leverage	0,606	(0,203)	0,605	(0,199)	0,600	(0,192)	0,609	(0,203)
Roi	0,288	(0,578)	0,236	(0,495)	0,218	(0,443)	0,246	(0,524)
External Co	0,105	(0,307)	0,182	(0,386)	0,300	(0,459)	0,113	(0,316)
Horizontal Co	0,071	(0,257)	0,123	(0,328)	0,192	(0,394)	0,082	(0,275)
Vertical Co	0,087	(0,282)	0,150	(0,357)	0,235	(0,424)	0,101	(0,301)
Demand Pull	–	–	8,507	(2,524)	8,886	(2,394)	8,286	(2,573)
Group	0,347	(0,476)	0,438	(0,496)	0,501	(0,500)	0,401	(0,490)
Ownership	0,903	(0,297)	0,875	(0,331)	0,871	(0,336)	0,878	(0,327)
Market info	–	–	1,579	(0,630)	1,673	(0,643)	1,523	(0,617)
Basic info	–	–	0,865	(0,622)	1,039	(0,646)	0,763	(0,584)
High	0,045	(0,207)	0,062	(0,241)	0,087	(0,282)	0,047	(0,212)
Medium high	0,202	(0,402)	0,266	(0,442)	0,332	(0,471)	0,227	(0,419)
Medium low	0,323	(0,468)	0,275	(0,447)	0,222	(0,416)	0,306	(0,461)
Low low	0,430	(0,495)	0,397	(0,489)	0,359	(0,480)	0,420	(0,494)
North-West	0,362	(0,481)	0,380	(0,486)	0,392	(0,488)	0,374	(0,484)
North-East	0,359	(0,480)	0,390	(0,488)	0,412	(0,493)	0,376	(0,485)
Centre	0,139	(0,346)	0,122	(0,327)	0,111	(0,314)	0,129	(0,335)
South	0,140	(0,347)	0,108	(0,311)	0,085	(0,280)	0,121	(0,327)

Table 6: List of variables and statistics. By strategy.

	Make						Buy						Make and Buy					
	All firms		**Supported**		**Non Supported**		**All firms**		**Supported**		**Non Supported**		**All firms**		**Supported**		**Non Supported**	
Number of observations	*287*		*93*		*194*		*400*		*95*		*305*		*1469*		*608*		*861*	
(%)			*(32,40)*		*(67,60)*				*(23,75)*		*(76,25)*				*(41,39)*		*(58,61)*	
Variables	**mean**	**std.err.**	**mean**	**std.err.**	**mean**	**std.err.**	**mean**	**std.err.**	**mean**	**std.err.**	**mean**	**std.err.**	**mean**	**std.err.**	**mean**	**std.err.**	**mean**	**std.err.**
Age	2,964	(0,777)	2,905	(0,805)	2,992	(0,763)	2,866	(0,696)	2,833	(0,718)	2,971	(0,613)	3,051	(0,747)	3,002	(0,771)	3,120	(0,706)
Firm Growth	-0,044	(0,252)	-0,024	(0,150)	-0,053	(0,288)	0,020	(0,267)	0,022	(0,290)	0,014	(0,173)	0,014	(0,396)	0,026	(0,438)	-0,003	(0,326)
Organizational Innovation	0,206	(0,405)	0,183	(0,389)	0,216	(0,413)	0,165	(0,372)	0,151	(0,358)	0,211	(0,410)	0,318	(0,466)	0,285	(0,451)	0,365	(0,482)
Marketing Innovation	0,139	(0,347)	0,129	(0,337)	0,144	(0,352)	0,120	(0,325)	0,108	(0,311)	0,158	(0,367)	0,236	(0,424)	0,232	(0,423)	0,240	(0,428)
Firm Size	4,377	(1,450)	4,693	(1,543)	4,226	(1,382)	3,597	(1,051)	3,591	(1,029)	3,618	(1,123)	4,700	(1,498)	4,465	(1,430)	5,034	(1,529)
Export	0,902	(0,297)	0,914	(0,282)	0,897	(0,305)	0,670	(0,471)	0,672	(0,470)	0,663	(0,475)	0,880	(0,326)	0,849	(0,358)	0,923	(0,267)
Skilled Labour	1,962	(1,439)	2,140	(1,380)	1,876	(1,463)	1,218	(1,304)	1,220	(1,316)	1,211	(1,271)	2,135	(1,424)	1,987	(1,409)	2,344	(1,421)
Internal Financial Constr	0,261	(0,440)	0,194	(0,397)	0,294	(0,457)	0,235	(0,425)	0,236	(0,425)	0,232	(0,424)	0,215	(0,411)	0,220	(0,414)	0,209	(0,407)
External Financial Constr	0,286	(0,453)	0,215	(0,413)	0,320	(0,468)	0,220	(0,415)	0,243	(0,429)	0,147	(0,356)	0,236	(0,424)	0,244	(0,430)	0,224	(0,417)
Skill Constr	0,070	(0,255)	0,054	(0,227)	0,077	(0,268)	0,083	(0,275)	0,085	(0,280)	0,074	(0,263)	0,071	(0,258)	0,079	(0,270)	0,061	(0,239)
Liquidity ratio	1,461	(0,795)	1,390	(0,604)	1,495	(0,872)	1,462	(0,861)	1,503	(0,926)	1,328	(0,593)	1,501	(0,819)	1,504	(0,831)	1,497	(0,804)
Cost of Debt	0,032	(0,019)	0,033	(0,021)	0,031	(0,019)	0,028	(0,019)	0,028	(0,019)	0,030	(0,019)	0,029	(0,019)	0,029	(0,019)	0,029	(0,019)
leverage	0,621	(0,205)	0,622	(0,186)	0,621	(0,214)	0,610	(0,209)	0,607	(0,213)	0,619	(0,194)	0,601	(0,195)	0,607	(0,197)	0,594	(0,192)
Roi	0,256	(0,581)	0,219	(0,493)	0,274	(0,619)	0,326	(0,613)	0,332	(0,613)	0,307	(0,617)	0,207	(0,435)	0,210	(0,459)	0,203	(0,399)
External Co	0,108	(0,311)	0,140	(0,349)	0,093	(0,291)	0,018	(0,131)	0,016	(0,127)	0,021	(0,144)	0,241	(0,428)	0,151	(0,358)	0,368	(0,483)
Horizontal Co	0,063	(0,243)	0,097	(0,297)	0,046	(0,211)	0,025	(0,156)	0,026	(0,160)	0,021	(0,144)	0,161	(0,368)	0,110	(0,313)	0,234	(0,423)
Vertical Co	0,073	(0,261)	0,097	(0,297)	0,062	(0,242)	0,018	(0,131)	0,020	(0,139)	0,011	(0,103)	0,201	(0,401)	0,138	(0,345)	0,291	(0,455)
Demand Pull	8,122	(2,586)	8,355	(2,632)	8,010	(2,563)	7,175	(2,800)	7,092	(2,797)	7,442	(2,808)	8,946	(2,284)	8,771	(2,337)	9,192	(2,184)
Group	0,456	(0,499)	0,527	(0,502)	0,423	(0,495)	0,220	(0,415)	0,236	(0,425)	0,168	(0,376)	0,494	(0,500)	0,455	(0,498)	0,549	(0,498)
Ownership	0,854	(0,354)	0,828	(0,379)	0,866	(0,342)	0,950	(0,218)	0,938	(0,242)	0,989	(0,103)	0,859	(0,348)	0,859	(0,348)	0,859	(0,349)
Market info	1,413	(0,634)	1,532	(0,640)	1,356	(0,625)	1,278	(0,587)	1,254	(0,553)	1,353	(0,681)	1,693	(0,607)	1,656	(0,596)	1,745	(0,619)
Basic info	0,724	(0,539)	0,803	(0,551)	0,686	(0,531)	0,545	(0,514)	0,520	(0,488)	0,626	(0,585)	0,980	(0,628)	0,867	(0,598)	1,140	(0,634)
High	0,024	(0,155)	0,022	(0,146)	0,026	(0,159)	0,040	(0,196)	0,039	(0,195)	0,042	(0,202)	0,075	(0,263)	0,055	(0,227)	0,104	(0,305)
Medium high	0,268	(0,444)	0,312	(0,466)	0,247	(0,433)	0,120	(0,325)	0,115	(0,319)	0,137	(0,346)	0,305	(0,461)	0,262	(0,440)	0,365	(0,482)
Medium low	0,286	(0,453)	0,258	(0,440)	0,299	(0,459)	0,300	(0,459)	0,338	(0,474)	0,179	(0,385)	0,266	(0,442)	0,296	(0,457)	0,224	(0,417)
Low low	0,422	(0,495)	0,409	(0,494)	0,428	(0,496)	0,540	(0,499)	0,508	(0,501)	0,642	(0,482)	0,354	(0,478)	0,387	(0,487)	0,308	(0,462)
North-West	0,425	(0,495)	0,462	(0,501)	0,407	(0,493)	0,343	(0,475)	0,348	(0,477)	0,326	(0,471)	0,382	(0,486)	0,375	(0,484)	0,391	(0,488)
North-East	0,387	(0,488)	0,344	(0,478)	0,407	(0,493)	0,325	(0,469)	0,302	(0,460)	0,400	(0,492)	0,408	(0,492)	0,396	(0,489)	0,424	(0,495)
Centre	0,122	(0,328)	0,151	(0,360)	0,108	(0,311)	0,155	(0,362)	0,174	(0,380)	0,095	(0,294)	0,113	(0,317)	0,117	(0,322)	0,107	(0,309)
South	0,066	(0,249)	0,043	(0,204)	0,077	(0,268)	0,178	(0,383)	0,177	(0,382)	0,179	(0,385)	0,097	(0,297)	0,111	(0,315)	0,077	(0,267)

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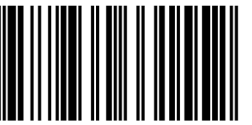
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