PLAYING THE INNOVATION SUBSIDY GAME: EXPERIENCE, CLUSTERS, CONSULTANCY, AND NETWORKING IN REGIONAL INNOVATION SUPPORT

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ABSTRACT

Government support to promote firm-level innovation is seen as a crucial factor for economic growth. This support is frequently channeled through firm-level subsidies. Despite their relevance within the policy portfolio, there is an open academic debate on whether subsidies are effective for innovation. This is by no means related to a potential inadequacy of subsidies, but because the mechanisms of assignment may be unsatisfactory. We argue that this may be the case when subsidies are awarded to larger firms with a solid international and innovative trajectory or to those that know how to "play the system," rather than to the most deserving firms and projects. To test whether this is the case, we use data from 17,866 applicants for innovation subsidies managed by the Valencian Institute of Competitiveness. We find that firms with specific knowledge accrued through previous submissions, public funding and grant consultancy or cluster location, are the main beneficiaries of public innovation support, generally at the expense of more promising candidates that lack the know-how to navigate a complex and often flawed process. This inertia gets policy-makers stuck in a sub-optimal assignment system that should be deeply reconsidered.

Keywords: clusters, networks, innovation policy, consultancy services, previous subsidy experience

1. INTRODUCTION: PLAYING THE SUBSIDY GAME

Fostering innovation is increasingly a key element in long-term development policy strategies. However, in spite of increasing attempts to encourage innovation production, it often remains elusive. Many policies targeting the generation of innovation —such as some R&D policies— have delivered subpar results, meaning that the quest for more efficient innovation policies remains center stage (Conte *et al.* 2009).

Delivering more efficient policies implies adequately targeting the actors behind innovation, that is, *who* is driving innovation. However, most innovation policies continue to focus on the *whats* and the *hows* rather than on the *whos*, meaning that the key players in the innovation process —firms— are often forgotten (Busom *et al.* 2017). And whenever the focus has been put on firms, it has been mainly concerned with the characteristics of individual firms, rather than with issues related to how a firm's history, its trajectory, and, especially, its capacity to link to the outside world affect its probability to innovate and its ability to attract innovation support and subsidies.[1]

This relative neglect of how networking with the outside world affects innovation happens at a time when more and more innovation policies are being concentrated on the firm. Firms are being targeted by public subsidies, aimed at bringing innovation to the fore and accelerating the process of change and transformation within them. However, the capacity of firms to innovate often depends not just on their individual characteristics, but also on their talent to establish links with other economic actors within and outside their main place of operations (Fitjar and Rodríguez-Pose 2015). This more territorial and firm-level approach is increasingly gaining ground (McCann and Ortega-Argilés 2013). It fundamentally targets individual firms, rather than the whole raft of actors and organizations —from customers, competitors and suppliers to research centers, universities and consultants— that participate at ground level in the knowledge generation process. In particular, specific firms that know how to "play the system" often emerge as the main beneficiaries of innovation subsidies. By contrast, other firms that for whatever reason are less frequently engaged with the policy processes lose out. This regardless of their contribution to embedding firms in local —mostly through clusters— or external networks. Hence, although most innovation systems literature regards this type of embeddedness in networks as an important factor for the success of innovation policies (e.g. Feldman & Kelley 2006; Broekel et al. 2015), little empirical evidence actually supports it.

Driven by the open academic debate about the effectiveness of subsidy allocation processes and their subsequent additionality effect on innovation (González *et al.* 2005, Dimos and Pugh 2016), this research focuses on procedures to allocate innovation subsidies. It aims to identify which kind of firms and local networks are most relevant in this process. In particular, and extending previous studies (e.g., Tanayama 2007, Aschhoff 2010, Crespi and Antonelli 2012, Pereira and Suárez 2018), this research evaluates how the subsidy history of firms as well as their links with local public funding consultants and foreign counterparts, influence their success in obtaining innovation subsidies. In doing so, our paper addresses the issue of why many innovation subsidy programs do not achieve the expected results. We will argue that it is not because subsidies per se are an inadequate tool to promote innovation, but because they are often allocated to firms and projects that know how to "play the game", that is, they know how

[1] Aschhoff (2010) and Busom et al. (2017) are the main exceptions.

to deal with the dynamics of the application process rather than being those that have the best prospects of innovation.

We hypothesize that firms with more experience in the dynamics of the policy application process and its requirements —whether through their direct previous experience in obtaining subsidies (Crespi and Antonelli 2012) or indirectly, by engaging a specialized consultant— have more chances of obtaining public resources (Agogué *et al.* 2017). In contrast, firms with more limited know-how of the process have less chances of receiving subsidies, even if they are more deserving, unless they convey clear signals to policy makers in terms of size, innovation or international trajectory (Aschhoff 2010, Dimos and Pugh 2016).

Most research has tried to clarify this effect of innovation policies, by focusing on the well-known debate on the substituting-complementary effect of R&D subsidies on private R&D investments (David *et al.* 2000, Zúñiga-Vicente *et al.* 2014, Huergo and Moreno 2017). In this research, we try to contribute by continuing the debate about the effect of R&D subsidies but from a different perspective. More specifically, we focus on the dynamics of the assignment procedure, dealing with who receives the subsidies and the underlying rationale behind subsidy allocation decisions. We assume that these assignments require a deep knowledge about the process, opting for firms that already know the system or firms that are more likely to innovate based on pre-established characteristics, whether through private or government supported R&D (Dimos and Pugh 2016).

Secondly, we add to existing knowledge by focusing on the role that specialized consultants play in this process (Bellini and Landabaso 2007, Laranja *et al.* 2008).These public funding consultants have broad experience in obtaining subsidies for their clients, meaning that they act as a kind of bridge, exchanging information and knowledge between the different applicants and policy makers. While innovation scholars have long recognized that consultants are crucial for the learning and dissemination of knowledge through intermediation (Aslesen and Isaksen 2007), their broader role in subsidy allocation remains overlooked. In a certain way, relying on specialized consultants helps firms improve the quality of the proposals, while also making the soliciting firm more aware of the dynamics of the process that underlies the programs (Agogué *et al.* 2017, Russo *et al.* 2018). On the flip side, firms located at the fringe of the network of consultants and their applicants, often lack relevant information when applying for subsidies. In this context, international partnerships become a source of knowledge to develop high quality and novel proposals that may help these candidates to overcome certain informational gaps on key aspects of the allocation process.

The Valencia region represents an excellent case for observing the potential mismatches between allocation processes and expected additionality in a firm's R&D efforts or innovation results. A recent technical report based on the Regional Innovation Scoreboard, highlights the weakness of its firms' expenditure on R&D compared to the strength of its public R&D expenditures and innovation support within the Spanish context (REDITT, 2019). We draw on a micro-level dataset including 17,866 applicants for R&D and non-R&D innovation support programs, managed by the Valencian Institute of Competitiveness —Instituto Valenciano de la Competitividad (IVACE). This detailed data set allowed us to build a network of applicant firms based on the number of consultants shared.[2] By examining the two types of subsidies simultaneously, we follow

[2] In search of fluency and to avoid any misunderstanding, from now on, we just refer to this consultant-based structure as the applicant network or simply the network.

recent claims on the importance of investigating both polices (Paraskevopoulou 2012, Chen *et al.* 2018). Our findings corroborate the need of a more holistic consideration of the applicant, in which firm characteristics should be complemented with aspects such as previous experience, prestige, and networking with consultants, but also on local and international scales. These characteristics are also expected to shape a firm's likelihood of accessing innovation funding.

After presenting the theoretical framework about the role of consultants and the resulting network in section 2.1., section 2.2 develops the theoretical expectations dealing with the above-mentioned aspects. In section 3 we describe the methodological issues, statistical approach and the main findings. Section 4 discusses the conclusions and implications of the study. Finally, section 5 presents the main limitations of the approach adopted and suggests avenues for future research.

2. THEORETICAL FRAMEWORK

2.1 Consultants, networks and the subsidy allocation system

Governments consider innovation as a means to achieve higher and sustainable growth rates, while firms find it a way to improve their competitiveness (McCann and Ortega-Argilés 2013). Nevertheless, innovation projects that benefit society may not be developed by firms due to undesirable market externalities (Dimos and Pugh 2016). The imperfect appropriability of knowledge drives the probability of firms investing in innovation below the social optimum, as they attempt to avoid undesirable leakages to other firms (Falk 2007, Gelabert *et al.* 2009). Moreover, firms, especially SMEs, often lack the resources, capacity, time, and know-how to accelerate the process of innovation. The high level of uncertainty involved in most innovation projects, along with the inherent coordination and communication costs of innovation (Gök and Edler 2012) often limit SMEs desire to undertake innovation, regardless of whether they are using their own funds or other private funding (Aschhoff 2010, Dimos and Pugh 2016).

R&D subsidies are designed as a policy instrument to complement internal R&D investments and overcome the innovation deficit of many SMEs. They also aim to raise innovation to socially desirable levels. In this sense, abundant research has tried to identify the incentive programs that stimulate —rather than simply compensate— firms' R&D spending (David *et al.* 2000, Zúñiga-Vicente *et al.* 2014, Huergo and Moreno 2017). But in order to deliver efficient innovation, many governments require additional know-how to establish well-funded and transparent programs. However, it is often the case that many of these programs fail in their objectives of simplicity and transparency. They frequently turn out to be quite complex for applicants, meaning that requests for public funding for innovation end up being intricate and multifaceted administrative processes. Along with the technical knowledge that is needed to succeed in their innovation process, firms applying for subsidies need to develop specific expertise about what are often cumbersome bureaucratic procedures and learn "how to play the system", if they want to be granted subsidies.

Firms bidding for innovation support, as a consequence, increasingly resort to consultants to reduce the time constraints and the coordination and complexity costs of preparing a project proposal. These public funding and grant consultants provide specialized services and expertise and provide assistance to confront the challenges linked to the initial development of the innovation project and the subsequent application for public support (Agogué *et al.* 2017). Subsidy consultants advise and assist firms during the entire subsidy process, mitigating the costs of difficult-to-navigate regulations or fund lobbying (Bouwen 2009). They also connect candidates with external valuable experiences of other applicants (Howells 2006). They undertake a brokerage role, exchanging information and knowledge about different practices and proposals through networks and help firms in the development of successful projects (Huergo and Moreno 2017).

The presence of specialized consultants is also helpful from the perspective of regional governments. This is important in a decentralized country, like Spain, where innovation policy-making is arduous because of the need for institutional coordination, multi-level governance mechanisms, or the presence of financial constraints (Sanz-Menéndez and Cruz-Castro 2005, Cruz-Castro *et al.* 2017). Consultants assist regional governments in the design and implementation of innovation policies through exchanges of experiences, either formally or informally (Laranja *et al.* 2008). They cooperate in different tasks to configure the right innovation policy framework at a lower cost: identifying firm profiles, establishing areas of intervention, developing awareness campaigns, or disseminating calls among a roster of suitable applicants (Bellini and Landabaso 2007).

As a consequence, the involvement of specialized consultants in policy design and implementation makes them a cost-saving solution when it comes to choosing firms and projects that would adjust to the parameters of the support program. In their interviews with potential applicants, consultants ask them about their main managerial or technological challenges, suggesting public funding programs that may be suitable for them (Russo *et al.* 2018). During the detailed evaluation of the proposals, governments may find it easier to consider proposals co-developed between candidates and these grant consultants. The experience and fine-grained information these consultants have often lead to proposals adapted to both the firms' requirements and the standards of delivery expected by the policy-makers (Russo *et al.* 2018).

Moreover, governments assigning innovation subsidies tend to follow a "cherry-picking" strategy (Dimos and Pugh 2016), searching for those firms that can undertake the project, even without public support. Consultancy support often acts as a signal of the quality of the proposal and the candidate; increasing the confidence placed in them as opposed to other plausible alternatives not endorsed by the consultants. By pre-focusing on those firms tightly related to skilful consultants familiarized with system, policy-makers partially transfer the selection costs to consultants.

While this system of evaluation based on the intermediation of the consultants may have clear advantages for both firms and governments, it often leads to situations where firms engaging with grant consultants end up receiving the most public resources (Kauffeld-Monz and Fritsch 2013, Russo *et al.* 2018), frequently to the detriment of what could be considered as more deserving firms. Firms that already have experience in the process and adept at navigating its particularities would also end up receiving more and repeated public funding (Tanayama 2007, Aschhoff 2010). But those firms that lack both indirect experience through consultants or direct experience in obtaining subsidies, would have less possibilities of participating in these programs. However, the role of consultants during the policy design is also not exempt of risks. They may advocate for a complex allocation system, whose application cost may discard promising projects and foster less innovative proposals that cover the sunk costs or create a "parasitic" consultancy market around public innovation funding.

2.2 Hypothesis development

2.2.1 Direct learning, cumulative experiences and innovation support

The allocation of public funds for innovation shows high rates of persistence across different countries (Tanayama 2007, Aschhoff 2010, Crespi and Antonelli 2012, Pereira and Suárez 2018). When it comes to getting subsidies from innovation promotion programs, there are firms that do not participate in the programs because they are unlikely to innovate or, at the other extreme, they are highly innovative, but they do not need public support or do not have the time and information to engage with it (Huergo and Trenado 2010). Focusing on applicant firms, it is possible to identify firms that systematically apply for and obtain the subsidies from others that only occasionally participate in these programs and generally fail.

The repetitive public funding of certain firms is a consequence of a non-ergodic and discretionary assignment process, where history matters (Crespi and Antonelli 2012). One of the key sources of funding persistence is accumulated reputation. The underlying rationale is that decision-makers and selection committees are influenced by previous assignments based on the scientific and technological prestige of the candidates, rather than by the potential of the innovation projects (Arora and Gambardella 1997). Such process, which bias successive allocation of subsidies towards well-known candidates in a sort of 'picking winners' strategy (Dimos and Pugh 2016), implicitly considers previous assignments as a reliable signal of quality.

Along with reputation asymmetries, the persistence in the allocation of innovation subsidies may be caused by a firm's knowledge on the assignment process (Antonelli and Crespi 2013). A firm's recurrent engagement in subsidy requests and awards provides experiences to efficiently develop successful proposals, due to the increasing awareness about the key contents and requirements of each funding program (Aschhoff 2010), increasing its incentives to apply (Blanes and Busom 2004). This expertise on the dynamics of the process and system rules tends to accrue over time, leading to competence building and path dependence. Based on that, we propose the following hypothesis:

H_1: *Specific knowledge and reputation accrued through previous applications increases the likelihood of a firm's success rate in obtaining public funding.*

2.2.2 Indirect learning, networks and innovation support

Many candidates rely on public funding and grant consultants to deal with the system and submit proposals more efficiently (Bellini and Landabaso 2007). These consultants assist applicants in the areas of searching public funding opportunities, developing the best possible case by aligning the project to the program goals and writing what the funding source wants to read, or even managing the entire application process (Russo *et al.* 2018). To some extent, consulting firms are likely to spread the knowledge acquired from other experiences among their clients and apply strategies that seem to work for one firm to another (Cross and Sproull 2004).

Candidates may also rely on these indirect sources to shore up their knowledge and reputation, enhancing the efficiency of their new submissions. For firms with either a solid reputation or accumulated knowledge on the dynamics of subsidy allocation, consultants represent a smart solution for accelerating the identification of alternative funding sources or the co-development of new proposals at a moderate cost (cost-saving strategy). Also, consultants can prevent unsuccessful applicants from abandoning, by providing in-depth knowledge of the system and lobbying capacity. They also encourage the participation on firms that have never played the subsidy-application game due to lack of time or resources. Consultants' involvement in policy design facilitates the targeting of these unusual applicants with a high probability of being funded and make them recurrent candidates.

To maximize funding opportunities each firm should select the right consultant. Considering the role of consultants in transmitting and exchanging specific knowledge between participants, their embeddedness in the network of actors involved in the allocation system becomes crucial to identifying the most suitable consultant. Centrality reflects to what extent an applicant is indirectly linked to other candidates, and it is represented by the number of the ties the firm has (Wasserman and Faust 1994). The more candidates the firm is connected to, whether directly or indirectly, the greater the access to new valuable information on how to efficiently apply for subsidies. By connecting to a consultant, the firm is involved in a particular network where it retrieves knowledge from other applicants, who are clients of the consultant. A firm connected with one or more consultants that count on a considerable number of customers, has privileged access to a significant amount of experiences on proposal design, funding opportunities, deadlines, characteristics of the applications that have more chances of succeeding, or how to reorganize submissions for improving the proposal, among others (Powell *et al.* 1996, Phelps *et al.* 2012). Consequently, the larger the consultant's portfolio of clients, the greater the access to other experiences within the system.[3]

Moreover, consultants holding a solid status and powerful position, due to their large number of clients, are frequently invited to intervene in policy design and obtain the preferential knowledge and the privileged institutional support necessary to succeed (Powell *et al.* 1996, Stam and Elfring 2008). This relevant position can be reinforced by other governmental actions. Policy-makers may inadvertently rely on the evaluation of some key consultants as they have broad experience in evaluating proposals, thereby transferring part of the selection costs.

Although our theoretical expectation rests on the positive effect of a firm's centrality on the applicant's success, the relationship may not be linear. In this sense, too little centrality engenders limited effects because it implies scarce indirect access to alternative sources of information about the allocation system, reputation and lobbying. At the other extreme, too much centrality may become harmful and present diminishing results (McFadyen and Cannella 2004, Rotolo and Petruzzelli 2013), due to cost and conflicts (Podolny and Baron 1997, Ahuja and Katila 2004), the limited resources available to absorb and apply incoming knowledge from very different sources (McFadyen and Cannella (2004), or the high number of proposals managed by large consultants that reduces the quality of the knowledge transfers and lobbying capacity (Tether *et al.* 2001). Thus, the higher the firm's centrality, the better the application results of a firm up to a certain threshold, from which the positive effects become negative when the embeddedness with many other candidates through large consultancy services, either increases costs or diminishes the value of the consultants' contribution. Considering these arguments, we establish that:

H_2: *Centrality in the network will positively influence a firm's success rate in obtaining public funding for medium levels of centrality, and this effect will diminish as the centrality increases or declines.*

[3] Firms may hire the services of one or more consultants depending on factors such as the number of different proposals submitted each year. So, firm's centrality in the network and the number of consultant's clients may differ.

2.2.3 Clusters, knowledge spill-overs and innovation support

A plethora of empirical evidence shows how knowledge spill-overs, harnessed as flows of knowledge between firms in the same industry, allow cluster firms to outperform competitors (Malmberg and Maskell 2002). In this vein, firms in clusters will be more likely to participate and obtain awards in innovation support programs compared to firms located outside. The knowledge advantages make cluster firms more likely to develop and submit excellent proposals for R&D programs. Moreover, the existence of local innovation agents reinforces the dissemination of knowledge about funding calls and program schemes, which will make firms more inclined to submit their application (Broekel *et al.* 2015).

Policy-makers may also opt for innovation projects from firms in clusters, whose returns are more likely to be retained in the territory (Roper *et al.* 2004). Inside clusters, firms receiving R&D subsidies have more opportunities for knowledge creation and innovation (Audretsch and Feldman 1996, Gertler 2003, Bathelt *et al.* 2004). The internal dynamics of the cluster, based on physical proximity, shared trust, and common beliefs (Boschma and ter Wal 2007, Giuliani 2013, Balland *et al.* 2016), not only reinforce the effect of R&D subsidies on individual innovation, but also the development of collaboration agreements between innovative firms in the cluster (Caloffi *et al.* 2018). As a consequence, regional policy makers supporting R&D applicants from a cluster can leverage the R&D investment by indirectly promoting local knowledge diffusion (Nishimura and Okamuro 2011) and the competitiveness of the cluster. Considering that, we propose that:

H_3: *Belonging to a cluster increases the firms' success rate in obtaining a subsidy.*

2.2.4 International operations, learning and innovation support

Relationships with geographically distant actors give access to knowledge unlike that which is locally available (Fitjar and Rodríguez-Pose 2011, Bathelt and Li 2014). Internationalization provides opportunities to connect with these new repositories of knowledge (Salomon and Jin 2010, Kauffeld-Monz and Fritsch 2013, Farole and Winkler 2014) through learning-by-doing interactions with foreign organizations, converting firms into solid innovators (Alcacer and Oxley 2014). While international buyers help to improve existing products and provide technical or operational assistance, connections within host countries facilitate access to expertise from the local labor force, exchanges of technical information, and foreign input acquisitions, among others (Xu and Wang 1999, Salomon and Jin 2010, Damijan and Kostevc 2015, Gonchar and Kuznetsov 2018).

Several studies suggest the distinct role of local and distant collaboration, compensating distant collaborations for the lack of local ones (see Coombs *et al.* 2009, Whittington *et al.* 2009). Firms scarcely connected to other cluster organizations increasingly depend on distant relationships to learn and acquire knowledge, balancing their impoverished engagement within the local knowledge network (Fontes 2005, Rees 2005). Considering network centrality as an indicator of the access to local knowledge, it is reasonable to assume that applicants with low levels of network centrality will mostly rely on geographically distant linkages (i.e., international relationships) to create high quality projects whose intrinsic innovativeness makes it less necessary to play the system. As a consequence, it is reasonable to assume that governments would support firms that have this international experience, as it can be considered a signpost of their stronger capacity for undertaking and exploiting successful innovation projects. From this discussion we derive the following hypothesis:

H4: *Applicants with low levels of network centrality will have to rely on geographically distant linkages to develop innovative proposals*.

3. METHODOLOGY

3.1. Data description

Innovation-related programs in Spain are highly decentralized. In the Valencia region, these policy actions are mainly implemented by the Valencian Institute of Competitiveness —Instituto Valenciano de la Competitividad (IVACE).[4] Created as a public entity, its mission is managing the industrial policy of the regional government and promoting the competitiveness of the industry by providing funding and advice to regional companies in aspects like innovation or internationalization. Of the 100 million euros budgeted for 2018, IVACE supported the development of innovation projects with over 61 million euros through a combination of several instruments (grants, subsidies or subsidized loans). Throughout this paper, only innovation-related subsidy lines have been considered (see Table 1 for program overview).

< Insert Table 1 about here>

The dataset used in the empirical analysis combines three different sources. IVACE internal files provide information on the project proposal, the applicant firm, and the funding decision of all the business sector submissions for innovation subsidies. The Iberian Balance Sheet Analysis System (Sistema de Análisis de Balances Ibéricos, SABI), an archive developed by Bureau van Djik, provides structural and financial data for Spanish companies. The World Intellectual Property Organization (WIPO) PatentScope database contains 58 million patent documents including 3 million published international patent applications from Patent Cooperation Treaty and a wide range of other countries including the European Patent Office, USPTO, and Japan.

The final dataset comprises 17,866 observations obtained by merging the above sources. It includes information on 24,947 projects between 2004 and 2014.[5] Each observation represents a particular firm during a particular year. The average number of firms asking for funding in any given year was 2,552. 25.9% submitted proposals to R&D programs and 66.9% asked for support in non-R&D programs. 7.1% applied to both types of support initiatives. About 77% of the firms had less than 50 employees and 10% were in high or medium knowledge industries. 9% of the firms were located in pre-identified industrial clusters (Boix and Galletto 2006), while 8% belonged to the peripheral counties of the region.

3.2 Building the applicants knowledge network

The data obtained from IVACE internal files reports that 45.3% of the candidates used consultants to help them with their application. In order to create the applicant network to test our expectations, we must convert the relationship that each firm establishes with one or more consultants, that is, the applicant-consultant linkages, into a network of

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[4] IVACE has its roots in the Valencian Institute for Small and Medium Industry- Instituto de la Pequeña y Mediana Industria Valenciana (IMPIVA), founded in 1984.

[5] Differences between the number of observations and projects are due to the existence of multiple applications by some candidates in the same year.

applicants linked by edges of shared consultants. This process is a standard practice in social network analysis (i.e., Nyhan and Montgomery 2015). We represent a two-mode network of i=1,…,n firms and j= 1,…,m consultants as a nxm adjacency matrix, where binary edges indicate whether the firm i hired the services of a consultant j. The existence of a relationship between firm i and consultant j is represented in the matrix as Aij= 1; Aij=0 otherwise.

To convert this two-mode network (applicant-consultant linkages) into a one-mode network of firms (applicant-applicant linkages) that linked via consultant edges, we multiply the adjacency matrix A by its transpose (AA^T) which generates a nxn applicant adjacency matrix W. In W, each edge between two different firms demonstrates the existence of a shared consultant. Essentially, the edge represents the extent to which an applicant accesses knowledge from other applicants with a common consultant. The more customers the consultant or consultants the firm has, the higher the number of knowledge sources the firm can access. By using this approach, the rationale assumed is that a firm will be more likely to obtain knowledge as the number of contacts it has increases.

3.3 Statistical analysis

The empirical analysis has two stages. First, we focus on locational and firm-level factors that explain the success rate of the applicants. In the second stage, we explore to what extent this success rate increasingly relies on geographically distant knowledge, for firms showing lower embeddedness in the network.

3.3.1 Variable descriptions

For the two stages, our dependent variable is the natural log of the success rate of an applicant "i" in the year "t" (ASR_{it}).[6] The funding authority selects the projects that will be subsidized and decides the percentage of the project that will be financed. As each firm may present different projects to both R&D and non R&D support lines, the applicant's success rate will be measured as the percentage of the projects submitted and positively resolved for each firm and year in our data frame. Submission success indicates that the project was positively evaluated and harnessed financial support.

Regarding the variables of interest, according to Social Network Analysis (SNA), degree centrality measures (hypothesis 2 and 3) the number of direct relations of every firm and positively relates them to knowledge retrieval. Once we have created the applicant-applicant network, based on the relationships that each applicant has with one or more shared consultants, we computed the centrality indicator for each firm i and year t using the formula:

$$C_i = \sum_{j:j\neq i} y_{i,j}$$

As the degree distribution depends on the network size, we standardized the degree value to make the indicator comparable across all years (*Degree*). The standardized degree was obtained by dividing the degree by the maximum possible value $n – 1$.

$$\tilde{C_i} = \frac{C_i}{C_{max}} = \frac{C_i}{n-1}$$

[6] In the regression specification, while the success rate can sometimes be 0, the dependent variable is the natural log of one plus the success rate of the firm in each year. This operationalization of the dependent variable has the limitation that we add an arbitrary constant to (i.e., 1) to the original success rate.

Within the Valencia region, the most relevant geographical agglomerations of firms have been recognized as industrial clusters or districts. Boix and Galletto (2006) and Boix and Trullén (2011), applying the well-known Italian methodology designed by ISTAT,[7] identify the following clusters in the region: the ceramic tile cluster, the furniture cluster, the Toy Valley cluster, the natural stone cluster, the foodstuff cluster and the Vinalopó footwear cluster. Location and sector data (NACE codes) were applied to determine in-cluster and out-cluster firms. In line with previous research (e.g., Molina-Morales 2001, Belso-Martinez 2006), we use a dummy variable labelled *Cluster* which takes the value 1 if the firm of the specific industry "*i*" was located within the cluster boundaries in the year "*t*", 0 otherwise. For instance, we assign value 1 to a firm classified in NACE group 19 and located in any of the cities that comprise the Vinalopó footwear cluster.

Regarding the subsidy-related variables, in order to test whether previous experience with the IVACE's programs exerts significant effects (hypothesis 1), the variable *ISP Experience* was created. Similarly to Tanayama (2007) or Antonelli and Crespi (2013), the variable takes value 1 if the firm "*i*" asked for support in any of the programs considered in our research before year "*t*", 0 otherwise. Previous research frequently uses patents as a proxy to capture a firm's capacity to create knowledge (Czarnitzki and Licht 2006, Aschhoff 2010, Cantner and Kösters 2012). In this vein, our variable *Patent* accounts for the technological knowledge stock and for innovative past practices and success. If a firm "*i*" registered one or more patents since its creation when submitting the proposal in year "*t*", this dummy variable is coded as 1, otherwise 0 (see Busom and Fernández-Ribas 2008, or Huergo and Moreno 2017 for a similar operationalization).

Additional variables are included to account for other possible sources of heterogeneity. All variables will be computed for each firm "*i*" and year "*t*" in our data frame. Firm's size is a relevant variable when explaining the participation and support in R&D and non-R&D programs, although its expected sign is uncertain (Huergo and Trenado 2010). In our paper, the variable *Size* is a measure designed as an ordinal variable with four levels based on the number of employees: micro-enterprises (less than 10 employees); small- (10 to 49 employees); medium-sized (50-249); and large- (more than 249) firms. The same relevant but inconclusive effect holds for the firm's age (Huergo and Trenado 2010). So, the variable *Age*, operationalized as the number of years since inception, is included in our model.

<Insert Table 2 about here>

Previous research suggests that award patterns differ across sectors (specially across low-tech and high-tech industries) and these differences reflect agency goals (Blanes and Busom 2004, Huergo and Trenado 2010). Accordingly, the dummy variable *Sector*, taking a value 1 for medium-high and high-tech industries and 0 otherwise, captures the knowledge intensity of the industry (Aschhoff 2010). International operations have been proven to explain resource allocation. For instance, firms exhibiting export orientation are more likely to be funded because policy-makers are inclined to subsidize projects that strengthen a firm's competitiveness through foreign knowledge or that show high potential on an international scale (Almus and Czarnitzki 2003, Blanes and Busom 2004, Tanayama 2007). Following previous research (Czarnitzki and Licht 2006, Aschhoff

[7] Using the ISTAT methodology, SMEs' local manufacturing systems are determined based on inter-municipality commuting and occupation data.

2010, Antonelli and Crespi 2013) we also included the dummy variable *International Operations* (Hypothesis 4) with a value of 1 if the firm exports and/or imports during the previous year (period *t-1*) and 0 otherwise.

Finally, innovation subsidies influence the persistence of a firm's innovation activities during the economic crisis (García-Vega and López 2010, Busom and Vélez-Ospina 2017). We control for the influence of the economic crisis by including the dummy variable *Economic Crisis,* indicating whether the firm applied for support before 2008 (value 1) or after 2008 (value 0). The basic descriptive statistics and Pearson's correlation for all variables are presented in Table 2. Detailed analysis of the data discarded the possibility of the existence of multicollinearity. Correlations did not exceed (0.70) and the Variance Inflation Factors (VIF) in the regression equations remained below 5, far below the cut-off of 10 proposed in the literature (Hair *et al.* 1998).

3.3.2 Results

Table 3 shows the results of the regression analysis. Model 1 includes only the control variables to allow us to observe changes in the explanatory power of the models when more variables are added. As expected, firm level characteristics had a positive effect on innovation (p-value < .01). The probability of being funded is higher for firms with a lengthy trajectory, larger size, involved in international operations, and a previous track record in patents and innovation.

Model 2 is the base model. It contains all the control variables and our first variable of interest, *ISP experience* (H_1). Consistently with our first hypothesis, we observe that previous experience with either R&D or non-R&D support programs increases the likelihood that the firm will secure public financial support (p-value<.01). Surprisingly, the statistical relevance of the previous success in innovation projects (Patents) diminishes up to p-value<.1. This outcome is robust to more restrictive operationalization of the variable ISP experience that just considers experience in one specific support program.

Models 3, 4 and 5 comprise three new specific terms to separately test hypotheses 2 and 3. The variable degree in Model 3 allows us to evaluate the influence of centrality on the success rate. Model 4 adds a quadratic term $degree^2$ to test for the inverted U-Shaped relationship between degree and the dependent variable (H_2), while the variable cluster evaluates the locational effects in Model 5 (H_3).

<Insert Table 3 about here>

In Model 3, the variable degree has a positive and significant effect (p-value < .01). This implies that being in a central position within the applicant network fosters access to valuable knowledge and increases the probability of being funded by public institutions. The quadratic term in Model 4 shows a negative and significant effect (p-value<*.01*), corroborating our second theoretical prediction related with centrality (H_2). Either the lack or the excess of centrality in the applicant network generates constraints for the development of successful submission. Model 5 tests for the positive effects derived from colocation in clusters. The significant effect observed for the cluster variable (p-value<*.01*) validates our third hypothesis (H_3), suggesting the relevance of colocation and knowledge spill-overs for the development of successful candidatures.[8]

The remaining theoretical argument asserts that firms exhibiting lower levels of network connectivity rely more heavily on non-local (foreign) sources of knowledge and vice versa (H_4). To test this prediction, we run three linear models including all predictors at different levels of the degree variable. Model 1 in Table 3 just includes the subset of cases with low values of degree centrality (degree< .05). International operations —capturing the influence of non-local linkages— shows a strong positive effect on the probability of being awarded a subsidy (p-value<.01). However, as subsets of firms with a higher degree are selected (see Model 2 and Model 3 in Table 3), the B value becomes negative and loses its statistical relevance. Hence, we corroborate our fourth theoretical expectation (H_4).[9]

<Insert Table 4 about here>

Regarding the controls included in the different models, our results are in line with most empirical literature. The size of the observed companies, their age or the knowledge stock and previous innovation success enhance the probability of access to public innovation subsidies across the different models in Table 3. Since large, experienced firms characterized by innovation competences are more likely to be awarded public funding, it seems that policy makers apparently select solid applicants to guarantee the viability of the supported projects. The industry classified according to the technological scope in which the firm operates has a positive significant effect, reflecting the technological opportunities and appropriability conditions of high and medium high sectors (Ortega-Argilés *et al.* 2005, Huergo and Moreno 2017). As could be anticipated, the negative value of the dummy *Economic Crisis* confirms the effect of the global recession on innovation practices and public budget.

4. DISCUSSION AND CONCLUSIONS

Empirical and theoretical developments emphasize the need for more efficient innovation policies (McCann and Ortega-Argilés 2013). Frequently, the complex process that underlies the allocation of grants is at the heart of the lack of additionality in terms of internal R&D or innovation performance. This paper fits within this research line by delving into the procedure that explains the access to innovation grants in the Valencia region.

Particularly, we do so by analyzing the determinants of the allocation of innovation subsidies (Blanes and Busom 2004, Heijs 2005, Czarnitzki and Licht 2006, Huergo and Trenado 2010, Hautam *et al.* 2011, Huergo and Moreno 2017, among others). Our pioneering analysis on the role of subsidies consultants shows the value of their advice

[8] In a robustness test, we re-estimate Model 5 in Table 3 with alternative operationalizations of some variables. Patent are substituted by Number of Patents (ln) or Patents by firm size (sqrt). ISP experience in non-innovation programs (training, start up, ...) and ISP experience based on successful applications were applied instead of the initial ISP experience configuration. Finally, we split International operations into Import and Export binary variables. The results remain similar regardless of the proxy used. These results are available in the appendix of supplementary material.

[9] In an unreported robustness test (available upon request), we evaluate whether differentiating import and exports produce different success rates at any degree level. Again, the results remain solid.

and assistance during the entire subsidy process. However, although consultants mitigate application costs or help to fund lobbying (Bouwen 2009), our results also reveal certain grey areas.

Regarding our hypotheses, firms that applied for support in the recent past are more likely to be funded. Innovation subsidy allocation appears to be a path dependent process, in which history and expectations greatly matter in determining the eventual outcome. This outcome is in line with the scarce pre-published literature (Tanayama 2007, Aschhoff 2010, Crespi and Antonelli 2012, Pereira and Suárez 2018). It may be the case that prestige (Arora and Gambardella 1997) and, particularly, specific knowledge accumulation (Antonelli and Crespi 2013) coalesce to produce inertia in allocation processes.

Alongside firms' characteristics and direct experience obtained by previous submissions, our research also incorporated the role that relationships with consultants play in the dynamics of the assignment procedure, measured by the indirect access to other applicants. The more central the applicant is in this network, the greater number of indirect connections generated through one or more consultants. The reduction of application costs thanks to external assistance increases the application activity, while expert knowledge from external repositories helps enhance the potential of the project submitted. However, also in this sphere, networking is not exempt of costs and risks. At moderate levels, networks help improve the chances of funding success by increasing the application activity, thanks to the reduction of the application costs firms face and the enhancement of the quality of the proposal. Once a certain level of connectivity is reached, further networking efforts do not significantly reduce application costs, increase knowledge redundancies, or foster standardization and replication of proposals. Consequently, in line with network literature (McFadyen and Cannella 2004, Rotolo and Petruzzelli 2013), the costs associated with the creation and management of linkages may overcome their benefits, leading to a progressive decreasing contribution of inter-organizational relationships.

What makes our results different from extant work is the particular characteristics of our relational architecture. Our applicant network built with consultant-applicant data, endorses the crucial role of external advisers as disseminators of effective knowledge and practices (McKenna 2001). Apparently, applying knowledge and strategies accrued in previous experiences to other firms, leads to an optimal threshold of applicants in the network for whom the need for standardization and sporadic interactions reduces knowledge exchanges and fosters replication of proposals. Once consultants achieve this optimum level of connections, the relative quality of applications and success rates decline. This outstanding outcome goes a step forward by questioning traditional paradigms that systematically assume the direct benefits of consultant support (Cross and Sproull 2004).

Even when controlling for their embeddedness in territorialized networks, firms in clusters are more prone to receive public funds for their innovation project than their counterparts located outside of clusters. So, colocation provides a "premium" not only for innovation, but also for public fund-raising (Broekel *et al.* 2015). In line with the scarce empirical evidence (Feldman and Kelley 2006, Tanayama 2009), we observe that public agencies put more emphasis on encouraging firms and projects with higher potential for knowledge spillovers. On the one hand, the solid learning and knowledge diffusion mechanisms characterizing clusters guide policy makers towards supporting firms and projects in these areas. On the other hand, our cluster variable may also capture the underlying influence of local innovation agents. Their research excellence and experience in applying for financial resources also helps explain why agencies opt for subsidizing projects in clusters.

Dealing with the role that international experience plays, we have observed that international activities have a substituting role in the network, following previous studies (Coombs *et al.* 2009, Whittington *et al.* 2009). Firms weakly connected to the applicant network of the region need to access geographical distant knowledge in order to create successful submissions.

Leaving aside our hypotheses, all the determinants included in the analysis affect the award rate in line with most previous research (Almus and Czarnitzki 2003, Blanes and Busom 2004, Tanayama 2007, Aschhoff 2010). The existence of a positive effect of age and size in successfully harnessing public funding is noticeable. This outcome confirms that larger firms with solid trajectories are more likely to be supported, and apparently discards the disincentivising effect that the higher opportunity cost for larger firms may have (Tanayama 2007). Complementing previous research mainly focused on exports, international operations are tightly related to the success rate. Being an exporter or/and an importer possibly contributes to gaining practice in dealing with bureaucratic formalisms which, in turn, raises the probability of success (Huergo and Trenado 2010). Since the medium-high technology sector dummy positively affects the probability of being awarded a subsidy, we can confirm that the distribution policy of public agencies favours firms that guarantee the viability of the subsidised project.

5. IMPLICATIONS AND LIMITATIONS

The difficulty of monitoring policy implementation has traditionally explained the limited attention paid by the literature to subsidy allocation processes. In this sense, we have focused on the influence exerted by subsidy history and linkages and how local public funding consultants play a key role in increasing the chances of obtaining subsidies. Thanks to the access to experience in the dynamics of the process, applicants can directly or indirectly reinforce their knowledge and reputation in the subsidy allocation system, thereby increasing their success rates.

Managers and entrepreneurs may draw up important guidelines for the design of relational structures and the use of networks when the firm aims to access public innovation funds. Taking into account the results of this research, firms can follow two main alternative strategies to successfully secure the subsidy. Firstly, they can invest in developing cooperative links with consultants that have the right level of connections. For firms with a solid reputation or accumulated knowledge in the dynamics of subsidy allocation, consultants represent a smart solution for accelerating the identification of alternative programs or funding sources, or the co-development of new proposals. However, most of their value does not only rely on their ability to play the system, but in being an efficient cost-saving strategy. However, care should be taken when selecting the most appropriate consultant. While less experienced or connected consultants may not give sufficient and appropriate knowledge, large consultants can generate inertia and replication. Also, these firms should be aware that colocation in clusters provides advantages in terms of public support for innovation. Factors like anchoring the potential benefits derived from innovation funding in a given territory or the existence of support organizations provides a "premium" on a firm’s access to innovation grants. However, this does not mean that cluster location automatically grants public funding, as other factors at the firm level also determine the agency’s decision.

Secondly, as an alternative to the development of applicant networks through consultants, firms searching for a subsidy can rely on their international experience as a source of valuable knowledge and reputation. This alternative strategy allows firms to use this experience to produce high-quality projects whose intrinsic innovativeness makes it less necessary to play the system. Moreover, by avoiding central positions in the network and in the cluster, they reduce the problems of inertia and replication.

From the policy maker's perspective, the influential indicators observed are the size, the technical capability, and the foreign market possibilities that are associated with a firm's global competitiveness. In line with previous empirical findings on a national scale (see Huergo and Trenado 2010), this apparently indicates that program leaders promote regional champions by selecting the best projects in terms of their technological and economic potential. Systematically resorting to this strategy enlarges the asymmetries between the innovation leaders and less innovative firms. So, policy makers need to design suitable mechanisms to correct this inertia, as it may have serious implications for a balanced economic evolution in any given territory. Moreover, firms tend to work in areas that are well funded and where awarded firms concentrate. This may lead to a type of inertia which curbs the possibility of renewal and disrupts innovation.

In other cases, and regardless of the efforts and quality of the project, lack of recognition or an inadequate knowledge of the system by the candidate will limit their chances of securing public funding. This often demotivates and prevents applicants from persevering, which reduces the pool of talent bidding for public funding. Grant consultants may increase the involvement of unsuccessful applicants by providing the right tools for success, knowledge of the system, and lobbying capacity. Furthermore, consultants may also encourage innovators who have never played the innovation subsidy game because they lack the time or the necessary resources. The accumulated experiences of these advisers allow the identification and support of suitable firms, sharing the submission costs and benefits of innovative proposals that would smooth the way towards increasing the candidate pool and guaranteeing a rise in the rates of success of new candidates.

This research has some limitations that open avenues for future research. Although most of the variables are statistically significant in accordance with previous literature, the explanatory power of our models is modest. This is probably linked to the need of operationalizing certain variables in a more sophisticated way or to the absence of explanatory variables related to project aspects, which strongly help explain the dynamics involved in applications and awards (Huergo and Trenado 2010). In this vein, although patents are frequently used to measure innovation, many firms do not protect their novelties using legal tools due to reasons such as cost-saving (Holgersson 2013). The multi-sector sample population of our data base are small firms in which the use of complementary indicators prevails (creation of products, processes or business strategies) to circumvent this limitation (Murphy *et al.* 2016).

Furthermore, we assume that no particular threshold of international operations is necessary to benefit from distant knowledge. Undoubtedly, the degree of exporting and/or importing, or even the establishment of foreign subsidiaries may provide additional insights. However, accessing such data is not only hard, but would also substantially restrict our database, hamper the statistical analysis, or introduce other types of bias. The structure of our network implies that knowledge between applicants flows through consultants. Joint applications or other cooperation mechanisms would open opportunities to include knowledge exchanges between firms. However, the profile of the programs and the structure of our dataset prevents us from developing this line of analysis or verifying whether consultants are really channels to this specialized knowledge. Finally, recent research raises questions about complementarities and crowding-out effects between policy tools (Huergo and Moreno 2017). Considering that only subsidies are included in our analysis, future research should pay particular attention to these issues. Deeper analysis of the inter-industry differences and similarities would provide insights to develop more "tailor-made" solutions.

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Table 1. Overview of the R&D programs and non-R&D programs

Program	Support Line	Description	Project profile	Target
CHEQUE GESTION	Non-R&D	To promote innovation in Valencian SMEs in the technological field, through the acquisition of knowledge. To foster a cultural change, making them aware of the value of incorporating external knowledge in their innovation processes.	Technological diagnosis of the firm's capacity for technological innovation. Technological applications and assistance for the development and implementation of solutions derived from the previous diagnosis.	SMEs
CHEQUE INNOVACION	Non-R&D	To boost the competitiveness of SMEs through strategic projects, promoting innovative actions that increase knowledge, the dissemination of new techniques and key global competitiveness factors.	It finances the contracting of advanced technologies related to products and processes, environmental sustainability, logistics, biotechnology and communication.	SMEs
EXPANDE	R&D	To increase the capacity of companies to undertake R&D activities by facilitating the hiring of highly-qualified employees.	Recruitment of highly-qualified employees by SMEs or large companies to exclusively carry out internal R&D activities.	All firms
GESTA	Non-R&D	To encourage the participation of SMEs in the development of key technological solutions for the industrial progress and competitiveness of the region in line with the technological challenges of the region.	Critical research for the acquisition of new knowledge useful for the creation or considerable improvement of products or processes. Materialization of research results (prototypes or pilot projects). Routine modifications are excluded.	SMEs
INNOEMPRESA	Non-R&D	Support for innovation in small and medium-sized enterprises. The program is structured into actions such as organizational innovation or advanced management.	Innovation related to the use and exploitation of ICT. The result must be systematically reproducible and a substantial improvement with respect to the current European state and entail some risk.	SMEs
I+D PYMESs	R&D	Development of R&D projects carried out by SMEs within the objective of boosting and promoting R&D activities led by companies and supporting the creation of innovative companies.	Planned research for the acquisition of new knowledge and skills which lead to a substantial improvement of existing products and processes. Recombination and application of existing knowledge to drawing up plans for new or improved products or processes.	SMEs
I+D GRANDES EMPRESAS	R&D	To improve the technological capacities of firms, supporting the generation of scientific or technical knowledge to obtain products or processes of a higher technological level and to adapt their offer to global demands.	Industrial research to acquire new knowledge and skills. includes the creation of complex systems for research. Experimental development through the acquisition and use of existing scientific knowledge, with a view to the production of new or significantly modified products or processes.	Large firms

Source: http://www.ivace.es and authors' elaboration

Table 2. Summary of descriptive statistics and correlations

	Mean	Sd	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
ASR (1)	3,269	1,895	1										
Age (2)	15,240	12,556	***,069	1									
Size (3)	1,88	,901	***,094	***,384	1								
International operations (4)	,407	,491	***,107	***,306	***,333	1							
Patents (5)	,053	,224	***,060	***,207	***,156	***,179	1						
Sector (6)	,060	,240	***,052	***,021	***,061	***,101	***,106	1					
Support program (7)	,259	,438	***,083	-,006	***,151	***,108	***,071	***,171	1				
Economic Crisis (8)	,703	,458	***-,137	***,098	***,029	***,053	***,026	-,007	,005	1			
ISP experience (9)	,360	,481	***,262	***,143	***,159	***,211	***,120	***,082	***,210	***,145	1		
Degree (10)	0,154	,033	***,063	***,071	-,003	***,062	,005	***-,068	***-,145	***-,063	***,089	1	
Cluster (11)	,090	,281	***,080	***,155	***,077	***,163	***,066	***-,079	***-,041	***-,065	***,114	***,269	1

Significance level: ***<.01; **<.05; *<.1

Table 3. Regression results. Dependent variable: Applicant Success Rate

	Model 1 B(sig.)	**Model 2** B(sig.)	**Model 3** B(sig.)	**Model 4** B(sig.)	**Model 5** B(sig.)
Age	***,006	***,004	***,003	***,003	***,003
Size	***,090	***,062	**,064	***,064	*,064
International	***,288	***,146	***,140	***,138	***,138
Patent	***,239	*,112	*,114	*,116	*,116
ISP experience		***1,046	***1,032	***1,025	***1,025
Degree			***1,672	***4,317	***4,317
Degree ^{2}				*-20,704	*-20,704
Cluster					***,222
Intercept	***Yes	***Yes	***Yes	***Yes	***Yes
Sector	***Yes	***Yes	***Yes	***Yes	***Yes
Economic Crisis	***Yes	***Yes	***Yes	***Yes	***Yes
Support program	***Yes	***Yes	***Yes	***Yes	***Yes
F-Statistic (sig.)	***114,955	***264,235	***236,876	***214,036	***214,036
R^2	,043	,106	,107	,107	,107
N	17866	17866	17866	17866	17866

Significance level: ***<.01; **<.05; *<.1

Table 4. Regression results. Dependent variable: Applicant Success Rate

	Model 1 B(sig.)	**Model 2** B(sig.)	**Model 3** B(sig.)
Age	,002	***.006	*,006
Size	*.037	***.123	***.151
International Operations	***.164	.059	-.073
Patent	*.138	-.040	.100
ISP experience	***1.040	***.953	***.785
Cluster	***.311	**.165	**.153
Intercept	***Yes	***Yes	***Yes
Sector	***Yes	Yes	Yes
Economic Crisis	***Yes	***Yes	Yes
Support program	***Yes	**Yes	Yes
F-Statistic (sig.)	***173.138	***52,359	***21,054
R^2	.101	.107	.089
N	13907	3958	1955
Degree values	=<.01	>.01	>.05

Significance level: ***<.01; **<.05; *<.1