From the lab to the stock market? The characteristics and impact of university-oriented seed funds in Europe

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From the Lab to the Stock Market?

The Characteristics and Impact of University-Oriented Seed Funds in Europe[1]

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Abstract

This work investigates the role of university and PRO-oriented seed funds (USFs)—VC funds with an explicit mission to make investments in academic spin-offs and support technology transfer—as instruments for addressing funding gaps and facilitating the commercialization of academic technologies. We first offer an overview of USFs in Europe, highlighting their heterogeneity and principal characteristics. Second, we exploit a unique data set of 1,497 start-ups (including 733 USF-backed start-ups and another 764 start-ups backed by other VC funds) to analyze how USF-backed companies perform in terms of exit rates, staging, and syndication levels when compared with non-USF-backed companies. Empirical evidence suggests that USF-backed companies perform better in staging and syndication but worse in exit rates. Moreover, our analyses show that, within the group of USF-backed companies, the ones that can attract more follow-on funding and investors are those financed by USFs that are internally managed by a universities/PROs and are linked to universities with high scientific rankings.

1.   Introduction

In Europe over the past decade, several actors have invested significant resources toward the creation of a large array of knowledge transfer activities available to universities and public research organizations (PROs) for the commercialization of their technologies. University-generated inventions are typically undeveloped in nature and often at the frontier of scientific advancements (Jensen & Thursby, 2001; Colyvas et al., 2002). Considerable risks are associated with their validation, industrialization, and commercialization. As a consequence, sophisticated investors such as venture capitalists (VCs) might be reluctant to invest in this type of enterprise due to elevated transaction costs, significant asymmetric information in the early stages, and high risks related to the uncertainty of project outcomes (Murray, 1998; Murray, 2007). This situation is likely to generate a *funding gap*, a lack of adequate private funding sources to support technology transfer (TT) activities and academic spin-offs (ASOs) (Lockett & Wright, 2005).

To address this critical issue—one that might severely limit the success of technology transfer activities—national governments and regional authorities in many countries have implemented public policy measures to provide financial support or stimulate the involvement of VCs in ASOs (Myers, 1984; Murray, 1998; Wright et al., 2006; Clarysse et al., 2007; Brander et al., 2008; Knockaert et al. 2010). Similarly, universities and PROs are increasingly partnering with diverse investors to create innovative financial and incubating instruments, such as university seed funds, proof-of-concept funds, university incubators, and technology accelerators (Gulbranson & Audretsch, 2008; Mian, 2011; Rasmussen & Sørheim, 2012). In this context, an important topic that requires in-depth investigation is how financial investors can contribute to the support of technology transfer activities and what public intervention can do as a catalyst to accelerate this process.

In our investigation, we address this issue by focusing on the role played by university and PRO-oriented seed funds (hereafter referred to as USFs), defined as seed and early-stage VC funds with the explicit purpose of making investments in university and PRO spin-offs. These financial instruments have the goal of addressing and alleviating the funding gap, thus enhancing technology transfer and the commercialization of university and public research results. Despite the importance that USFs can have in the achievement of this "third mission" of universities and the increasing presence of USFs in various countries, they still represent a relatively new and under-researched phenomenon in academic literature on entrepreneurial finance and technology transfer. Most existing studies on this issue are based merely on anecdotal evidence or on the analysis of a few case studies in a limited number of countries (Lerner, 2009; Jacob et al., 2003; Rasmussen, 2008; Rasmussen & Rice, 2012).

In this regard, the purpose and contribution of our work is threefold. First, we define the concept of USFs and map their presence across European countries for a comprehensive overview of how far this gap funding mechanism has spread. Second, we provide original data on the key characteristics of USFs, highlighting their existing heterogeneity. USFs may differ in terms of governance structure and level of integration with an academic institution (i.e., funds that are managed internally by universities/PROs vs. those that are managed externally), supporting institutions (i.e., universities, governments, regional authorities, and foundations), and investment strategies (i.e., exclusive investment focus on university spin-offs/regions/technological fields). Finally, we conduct regression analyses to assess the impact of USFs on their supported start-ups, determining whether some of the above-mentioned dimensions have an impact on the ultimate success rates of investee companies. As researchers have done in previous studies on the performance of VC funds (e.g., Lerner, 1999; Cumming, 2006; Cumming et al., 2008), we focus on the level of analysis of portfolio companies and measure their success in terms of exit performance (i.e., their likelihood of reaching an initial

public offering—IPO—or a trade sale) and their ability to attract additional funding through staging and syndication processes. We compare our sample of USF-backed companies with a control group of new ventures backed by other VC funds, controlling for a series of factors to reduce unobserved heterogeneity at the fund, company, and environmental levels. In addition, we investigate whether the success rate of the investee companies is influenced by specific characteristics of the USFs, such as: (1) the type of governance arrangement with universities/PROs (i.e., differentiating between USFs that are internally managed by a university/PRO and those that are externally managed by other public or private actors); (2) the scientific reputation of the university with which the USF is linked; (3) the size of the fund; (4) the investment strategy of the fund.

We perform our empirical analyses on a final sample of 1,497 portfolio companies, including 733 start-ups funded by 73 different European USFs and a control group of 764 start-ups backed by other seed funds (i.e., non-USFs) established over the period 1990–2012. Our principal results indicate that USF-backed companies are less likely to obtain a positive exit through an IPO or acquisition than are non-USF-backed companies. In point of fact, the former seem to be more able to attract additional financing through staging and syndication. When we investigate the USFs' characteristics, our findings suggest that a better performance in terms of staging and syndication is registered when USFs are internally managed by universities/PROs, when they are linked to universities with high scientific rankings, and when they are characterized by a larger initial scale.

The rest of this article is organized as follows. Section 2 provides (a) a review of literature, with the aim of explaining the importance of the available sources of funding for technology transfer activities when a funding gap exists, and (b) the set of studies analyzing USFs as a specific mechanism for addressing funding gaps. Section 3 describes sample and data sources, along with the results of our process of mapping USFs across Europe. Finally, in

Section 4 we present the results of the econometric analyses. We conclude by discussing our findings and their implications and by suggesting possible lines of further research.

2.   Background Literature

2.1.   Financing Technology Transfer Activities: Critical Issues and Existing Evidence

Over the past thirty years, the transfer to the market of technological knowledge developed within universities has attracted dramatically increased attention. This situation is a natural stage in the evolution of the modern university, which has economic development as one of its goals (generally referred to as a "third mission"), in addition to the more traditional mandates of education and research (Rothaermel et al., 2007; D'Este & Perkmann, 2011; Van Looy et al., 2011). A constantly increasing stream of research in economics and management has given extensive attention to the relevance of technology transfer activities for innovation development and economic growth (Mustar, 2002; Hulsink et al., 2008; Wright & Filatotchev, 2008). Several works have analyzed, for example, the size and the evolution of technology transfer activities (OECD, 2008); the impact of legislation reforms governing university technology transfer (Baldini et al., 2006; Mowery & Sampat, 2005; Geuna & Rossi, 2011); the organizational structures, incentive systems, and capabilities required to enhance the commercialization of university research (Wright et al. 2006; Conti & Gaule, 2011); and the different channels through which university-generated knowledge spreads to industry and society, such as through licensing (Jensen & Thursby, 2001; Mowery et al., 2001 Powers & Mcdougall, 2005), spinoffs (Nerkar & Shane, 2003; Markman et al., 2005), and collaborative R & D projects (Nerkar & Shane, 2003; Markman et al., 2005).

However, an aspect that is still relatively neglected in literature has to do with the involvement of financial investors in technology transfer and the types of financial instruments that can be leveraged to ease the establishment of technology transfer activities. Literature on

innovation financing, in particular, has largely ignored the issues related to technology transfer, with the exception of a limited number of studies that have assessed the provision of equity capital by VC firms to ASOs (Shane & Stuart, 2002; Wright et al., 2006). It is well known that new technology-based firms—especially those operating in seed and early stages—typically face significant constraints in accessing equity financing by VC firms due to the high level of risk and information asymmetries (Lockett et al., 2002; Munari & Toschi, 2010). This type of funding gap can be especially significant for ASOs (Shane, 2004; Wright et al., 2006), for several reasons. As discussed by Tassey (2005), the "risk spike" occurs when a project moves from basic scientific research into technological research. In this phase, the technical and market risks are extremely high. As a consequence, the scale and cost of the due diligence process by investors may be disproportionately great when investing in ASOs. This situation arises from the exceptional information demands involved, due to the newness and complexity of both the technology and the markets for the commercialization of related products. The basic and embryonic nature of the technology developed by ASOs also requires a scientific knowledge base for the evaluation of business proposals, which investors often do not have (Wright et al., 2006). In the case of ASOs, this situation exacerbates the problems of information asymmetries in the relationship between the venture and the external investors (Lockett et al., 2002; Salmenkaita & Salo, 2002). In addition, the typical composition of the entrepreneurial team of ASOs could create some problems in attracting VC investors. Because academic start-ups emerge in a noncommercial and noncompetitive environment such as that of a university or research institution, their major characteristic is generally "not investor ready" (Rasmussen & Sørheim, 2012). The strong research orientation and the lack of the commercial experience of the founding academic team critical for introducing new technologies into the market could discourage VCs from investing in this type of venture (Lockett et al. 2002; Moray & Clarysse, 2005; Hsu, 2007). These barriers and challenges are

likely to create a funding gap between the spin-offs stemming from university labs and potential investors supporting their development. External actors with the explicit aim of increasing the success rate for technology transfer and commercialization can address the concerns, thereby increasing the economic and social impact of transfer activities (Rasmussen & Rice, 2012).

To bring a solution to the funding gap issue, technology transfer mechanisms have been implemented in numerous countries, often with publicly supported models such as proof-of-concept programs (Audretsch & Lehmann, 2005; Rasmussen, 2008; Rasmussen & Rice, 2012), science parks (Löfsten & Lindelöf, 2002; Siegel et al. 2003; Phan et al., 2005), and incubators (Mian 1996; Colombo & Delmastro, 2002; Bruneel et al., 2012; Soetanto & Jack, 2011). Among these mechanisms, we devote specific attention to university seed funds, whose mission is to provide financial support to ASOs, typically in the form of equity investments, to facilitate the development of university technologies and to promote their potential for commercialization.

2.2. University and PRO-Oriented Seed Funds as a Response to the Funding Gap

University and PRO-oriented seed funds (USFs) can be defined as seed and early-stage VC funds that have a deliberate and explicit mission of making investments in university and PRO start-ups to support technology transfer and the commercialization of university and public research endeavors. The first pioneering experiences of this type of instrument can be traced to the United States. According to Lerner (2005), the birth of the VC industry had its roots in the American Research and Development (ARD) fund, designed to focus on technology-based spin-offs from the Massachusetts Institute of Technology. Several similar initiatives followed (Lerner, 2005). A recent report estimates that in 2011 there were approximately 70 research universities in the United States that had established internal funding programs, in addition to

several state-based technology and start-up funding programs that partnered with local universities to support technology transfer activities (Rasmussen et al., 2006; Luukkonen et al., 2013). In regard to the European landscape, Wright et al. (2006) provide several examples of university seed funds established in different countries, making a distinction between 100% publicly owned funds (e.g., Twinning Growth Fund and Biopartner in the Netherlands, the Danish Growth Fund in Denmark, Fond de Co-investissiment des Jeunes in France, and the Sitra fund in Finland) and public-private partnerships (e.g., University Challenge Funds in the UK and University Seed Funds in Belgium). The University Challenge Fund (UCF) program of the United Kingdom is likely one of the first examples in Europe of the establishment of a pool of seed capital funds to encourage the exploitation of scientific discoveries in universities (Mustar & Wright, 2010; Wright et al., 2008). The program's funding was established in 1998 by the Department of Trade and Industry (DTI), Wellcome Trust, and Gatsby and Host University, with the objective of fostering a spirit of entrepreneurship and providing universities with access to seed funds for taking projects from the lab bench out into the commercial world. The program originally was composed of 19 USFs and provided early-stage funding to create university spin-off companies, with an initial funding of £45 million in 1999 and a second round of funding amounting to £15 million in 2001. In similar efforts, other countries have promoted the establishment of USFs with a specific mission of supporting university start-ups and technology transfer—such as Belgium (Wright et al., 2008), France (Mustar & Wright, 2010), Norway (Rasmussen & Rice, 2012), Italy (Clarysse et al., 2007), Canada (Rasmussen, 2008), and Sweden (Jacob et al., 2003).

Despite the importance that USFs can have for universities in achieving the third mission, they still represent a relatively new and under-researched phenomenon in literature on financial entrepreneurship and technology transfer. Most of the existing evidence of this phenomenon is based on few case studies, such as that of Lerner (2009), which analyzes the

empirical evidence from pioneering USFs in the United States: Boston University's venture capital subsidiary and the ARCH initiative of the University of Chicago. Lerner points out the risks of the creation of these instruments by academic institutions or governments, particularly in regard to crowding out independent VCs, leveraging on a limited deal flow, and backing unsustainable companies.

Another study along this line is the one by Jacob et al. (2003), which analyzes the Swedish context through the experience of Chalmers University of Technology. This institution established Innovationskapital in 1999 as a venture capital company partly owned by Chalmers, with the purpose of providing a bottom-up view of the transformation from a traditional university to an entrepreneurial one. The main difficulties in creating the entrepreneurial university can be summarized in terms of the organization of the infrastructure and the integration of the entrepreneurship function with the primary tasks of research and education. More recently, Rasmussen (2008) has reviewed the Canadian support structure at the federal level, describing the most important initiatives undertaken to build capabilities and develop a commercialization culture at Canadian research institutions, along with the initiatives supporting the commercialization of university research. The Rasmussen study focuses principally on the experience of the University of British Columbia. The main factors highlighted for the success of a bottom-up approach supporting research commercialization projects are as follows: (1) the provision of direct resources for commercialization projects and for developing professional expertise in technology transfer in the university sector, (2) the encouragement of innovation in project design, and (3) the development of close cooperation between commercializing organizations.

Besides qualitative studies such as these, to the best of our knowledge, the only two quantitative studies centered on the analysis of university seed funds are represented by a work by Nightingale et al. (2009) and a recent article by Croce et al. (2013) on a sample of USFs in

the United States and Europe. The former analyzes 782 companies backed by 6 public-private VC projects in the United Kingdom—including the University Challenge Fund scheme—and compares them with an untreated, matched control group of other new ventures. The findings show that these programs have had a positive impact on firm performance when compared with the matched control sample, but the size of their impact remains modest. The recipients of UCF funding, versus those of other public-private funding ventures, seem to be characterized in this study by a higher likelihood to be acquired, a higher likelihood to fail, and a lower average number of follow-on funding rounds.

The study by Croce et al. (2013) analyzes 26 USFs, 15 of which registered in the EU and 11 in the United States. The researchers focus on "pure" USFs, defined as funds directly managed by the target universities that invest (or co-invest with other investors) in the equity capital of portfolio companies. This study provides a basis for understanding the characteristics of USFs (in terms of target industries and investment stages of portfolio companies and the types of co-investors involved in the deals) and their ultimate performance, measured in terms of exit rates through IPOs of portfolio companies. However, the study refers to a strict definition of USF, based on data collected from a single source (e.g., the Thomson One database), and it does not take into consideration the high level of heterogeneity characterizing this type of financial mechanism along a series of dimensions, such as the type of affiliation, investment focus, and internal structure of the fund. Moreover, it considers a single dimension of performance—the exit rates through IPOs of portfolio companies—ignoring other important objectives of such funds.

Thus, more research is needed in this emerging and important area to better understand how to design and implement this type of financing instrument and improve its success rates.

Along those lines, we contribute to the existing literature in various ways. First, we make a comprehensive mapping of the USF landscape in Europe, using a variety of data

sources. This task is particularly complex because of the lack of a precise definition and a unique label for identifying these funds. However, the comprehensive overview in itself represents an important starting point for understanding the nature of USFs and deriving policy suggestions for supporting the technology transfer process. Secondly, we recognize the strong heterogeneity that characterizes this type of tool, and we take this issue into consideration in our empirical investigation. For example, as suggested by the literature review and confirmed by our data, "pure" USFs, in which universities promote and manage their own funds, represent only a minor part of the USF landscape. Different configurations of funds also exist, characterized by varying levels of institution involvement and investment strategies. Therefore, our intent is first to identify relevant structural dimensions for the design and implementation of university seed funds and then to analyze whether and how these different dimensions impact the success rates of the investee companies. We try to understand in greater depth which specific factors are critical in determining the success of these funds, by taking as the level of analysis that of portfolio companies—as several other researchers in the realm of VC financing have done (Lerner, 1999; Cumming, 2006; Cumming et al., 2008).

We investigate the performance of portfolio companies by looking at three different measures of success that have been widely used in VC literature: (a) their final exit in terms of an IPO or a merger and acquisition (M&A), (b) their ability to attract additional funding through a greater number of investment rounds (e.g., staging), and (c) a greater involvement of other investors (e.g., syndication).

Finally, we will assess these measures of performance for USFs along two distinct parameters. On the one hand, we are interested in understanding whether the level of effectiveness of the USFs is different from that of other seed funds that do not have a specific mission of investing in academic spin-offs and promoting technology transfer. On the other hand, in the specific case of USFs, we are particularly interested in exploring the influence on

the success rates of investee companies of four important characteristics that clearly emerge from literature and from our mapping exercise (see Section 3.2): (a) the type of governance arrangements of USFs, differentiating between internally managed and externally managed USFs; (b) the scientific reputation of the universities with which USFs are affiliated or collaborate (by considering the position of such universities in the international rankings of scientific productivity); (c) the size of the USF, considering the amount of capital initially committed to the fund; and (d) the investment strategy of the USF, considering whether or not it focuses on specific technological fields or geographic areas.

3. Methodology

3.1. Data Sources and Sample

The first challenge of our research was to identify USFs established in different European countries. To accomplish this task, we adopted a broad definition of USFs. We defined them as seed and early-stage funds that have a deliberate and explicit mission to make investments in academic and PRO spin-offs to support technology transfer and the commercialization of both university and public research results. This definition contains three building blocks that specify the nature of the university and PRO seed funds: (a) a focus on new companies rather than on individual researchers, projects, research teams, or patents (this dimension helps to differentiate PROs from other instruments such as proof-of-concept funds, IP funds, and other public grants); (b) a deliberate and declared mission of investing in university and PRO spin-offs and supporting the technology transfer process (this characteristic distinguishes these funds from other early-stage and seed VC funds generically investing in new high-tech ventures); and (c) a focus on the initial stages of investment (seed and early stages of a new company).

In keeping with this definition for identifying USFs activated in Europe, we took various steps. We started our data collection by using the private equity module of the Thomson One database (formerly known as VentureXpert), selecting those funds resulting in the subcategory "venture capital" (thus excluding buyouts) and included in the category "University Development Program." In this grouping, Thomson One classifies those programs established by a university or college to make private equity investments in spin-offs and start-ups. However, we noticed that the definition of "University Development Program" adopted by Thomson One was rather narrow and did not allow us to have a complete picture of the wide variety of USFs existing in Europe. Thomson One included only 19 European "pure USFs" (i.e., internally managed by a university technology transfer office—TTO—or TT company) in this category.

As a second step, we redefined and augmented our sample through desk research on the web, using a set of predefined key words.[2] We included in our sample only those VC funds that declared on their official websites an explicit mission to support technology transfer from universities and PROs and/or the establishment of formalized links with universities/PROs. As a third step, we conducted 41 qualitative interviews with technology transfer experts (i.e., TTO managers, researchers, and VC managers) from 22 European countries for the purpose of determining the exact USF population to include in our study. Each interview lasted around an hour and a half. In addition to other questions about the TT landscape in the interviewee's country, we specifically asked him or her to name the USFs and university proof-of-concept programs available in that country. Finally, we administered an online survey to managers of TTOs of 663 European universities, and responses were completed by 145 TTOs in 28 European countries. The responses included information on the university-oriented seed

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[2] In our web searches, we used key words such as "university seed fund," "university challenge fund," "university accelerator fund," "seed funds and academic spin-offs," and "seed fund and university." We also used Google Translate to translate the key words and conduct the web searches in the different European languages.

funding schemes managed by a particular university or existing in a particular country, if these were available. To our knowledge, this research effort represents the broadest and most complete one conducted so far to map gap funding schemes available in Europe.

Through this search strategy, we were able to identify a further 121 USFs operating in Europe (in addition to those already classified in Thomson One). We were able to find information through Thomson One for 54 of them, where they were labeled under different categories in the database.

Then we used Thomson One to collect data on both the funds and their portfolio companies. Thus, our final sample consists of 73 USFs established in European countries since 1990 and their 733 related portfolio companies.

Finally, to compare USFs with other seed funds that do not have a specific mission of supporting academic spin-offs, we constructed a matched control group of other seed funds (hereafter referred to as non-USF seed funds) with their associated portfolio companies. We assembled the control group by extracting data from Thomson One and selecting those VC funds created over the period of analysis (i.e., 1999–2012), in the same European countries and focused on seed-stage investments. We also retrieved data both at the fund and investee company levels for non-USF funds.

After these steps, our sample consists of a total of 1,497 portfolio companies, among which 733 are USF-backed companies, whereas 764 are included in the control group of non-USF-backed companies.

3.2. A Closer Look at Our Sample: The Characteristics of University and PRO-Oriented Seed Funds in Europe

Analysis of our data set reveals some interesting patterns that characterize the array of USFs in Europe. It is clear that this category of gap funding instruments is highly heterogeneous along

several dimensions, such as the governance and management structure of the fund, the size of the fund and the type of funding provided, and the focus of investments. The following explanation summarizes the main characteristics of these emerging patterns, that we investigate in more detail in the empirical analyses reported later.

Governance and management. A primary characteristic for classifying USFs is related to the relationships existing between the fund and the universities (and/or PROs), particularly in regard to the organization responsible for managing the fund. A clear distinction has to be made between funds *internally managed* by the university/PRO and funds *externally managed* by private investor groups or by national or regional public agencies responsible for innovation and technology transfer. In the internally managed group, we have included funds managed directly by the university/PRO technology transfer offices or by comparable units (such as university/PRO-controlled companies in charge of technology transfer activities). Here, typically the university also provides part of the initial capital injection into the fund, although in most cases this investment is complemented by other funding from (most frequently) public sources or from private and other sources. Examples of USFs included in this category are Imperial Innovation Fund of Imperial College in the United Kingdom, the Baekeland Fonds of the University of Ghent in Belgium, Inserm Transfert in France, and Fraunhofer Ventures of Fraunhofer Institute in Germany. In the vast majority of cases, internally managed USFs tend to be associated with a single university or PRO, but we also found a few cases in which they are jointly managed by two or more universities, in an effort to attain critical mass in terms of both managing units and underlying deal flow. Examples are the Wyern Seed Fund in the United Kingdom, established as a joint venture between the University of Southampton and the University of Bristol, and KTH Chalmers Fund in Sweden, established to support new ventures of Chalmers University and KTH University. In contrast, externally managed funds are managed by external private investors or public agencies, often in collaboration with one

or more partner universities/PROs. In this category, we also included seed funds in which the universities (or the PROs) are financially involved as limited partners although they are not directly involved in the active management of the venture. This is the case with the QBIC Fund in Belgium (involving Ghent University, Vrije Universiteit Brussel, and the University of Antwerp), managed by QBIC Venture Partners, and the Cascade Fund in the United Kingdom (involving the universities of Surrey, Brunel, Reading, Sussex, and Royal Holloway). We also included here funds that have established formal or informal collaborations with universities and PROs even though these do not involve a direct injection of capital by the research institutions. This is the case, for example, of the Portuguese fund Portugal Ventures, the TT Seed Fund promoted by TT Venture in Italy, and the Austrian UniVenture Fund. In our sample, 22% of USFs are internally managed by universities, whereas the remaining 78% are managed by other, external participants. This early and interesting empirical result of our study suggests that the category of "pure USFs" represents only a minor fraction of seed funds oriented toward universities/PROs established in Europe, with the largest majority encompassing hybrid and looser governance structures.

Fund size and type of funding. An important structural dimension to characterize USFs relates to fund size. According to the data we collected for our sample, USFs in Europe tend to be characterized, on average, by a small initial size. According to the data provided by Thomson One for the available cases, USFs in our sample have, on average, a mean value of 29.42 million Euro, with a median value of 16.50 million Euro. If we look at the subsample of USFs internally managed by universities/PROs, we notice that they tend to be characterized by a smaller scale, given that their size, according to Thomson One data, has a mean value of around 10.60 million Euros (see Table 4). These observations suggest that a relatively small initial investment is generally required to activate this type of funding instruments, as compared to other type of seed and early stage financial instruments. USFs use equity investment as the

predominant vehicle to invest in startups. In almost all cases included in our sample we found this type of financial support provided by USFs to investee companies. We found only a few exceptions adopting hybrid forms of investment, such as a mix of pre-seed grants and equity investments, as in the case of some of the early University Challenge Funds established in the United Kindgdom, or a mix between equity investment and loans.

Investment focus and strategy. Another important dimension for differentiating USFs is related to their investment strategies. In this respect, it is possible to identify different approaches in terms of the focus of investments by type of company, technological or industrial sector, or geographic area. The first dimension of analysis separates those USFs that deliberately invest only in university and PRO spin-offs (or translational funding programs that invest only in projects generated by universities/PROs) from those that, in addition to university and PRO spin-offs, also invest in other types of new ventures. The vast majority of internally managed USFs are included in the former category, whereas externally managed USFs tend to have a broader focus of investment in this respect. Another important dimension of analysis with respect to the investment strategy of the fund has to do with targeting (or not) by technology sector or geographic area. Previous literature on venture capital has associated both dimensions with the success rates of VC funds (Cressy et al., 2007; Gompers & Lerner, 2009). As to geographical specialization, when USFs are created to support the commercialization of technologies developed within specific universities, it is therefore normal that they tend to invest primarily in the region in which the institution is located. Furthermore, they are often sponsored and promoted by regional innovation or development agencies, so it is not surprising in such cases to find geographical constraints on investments.

Table 1 reports some significant examples of European USFs, revealing ways in which they differ with respect to the dimensions just described.

Table 1: Examples of USFs in Europe

Fund Name	Country	Governance	Universities involved	Investment Focus
Gemma Frisius KU Leuven NV	BELGIUM	Internally managed	KU Leuven	start-ups in the region of Leuven
Sopartec SA	BELGIUM	Externally managed	Université catholique de Louvain, Cliniques Universitaires Saint-Luc, de Duve Institute	life sciences, electronics, new materials
Genopole 1er Jour	FRANCE	Externally managed	Université Évry Val d'Essonne	biotechnology in the Ile-de-France
EMBL Ventures	GERMANY	Internally managed	EMBL, University of Heidelberg	biotechnology, life sciences, medical technology
TT Venture	ITALY	Externally managed	University of Florence, University of Trieste	clean techs, agro-food, life sciences, new materials
Thuja Capital BV	NETHERLANDS	Internally managed	University Medical Center Utrecht	medical life sciences
Portugal Venture	PORTUGAL	Externally managed		Lisbon and Oporto areas
Innova31	SPAIN	Externally managed	Universitat Politècnica de Catalunya	telecommunication, information technology, biotechnology, internet, electronics, chemical
Karolinska Development Fund	SWEDEN	Internally managed	Karolinska Institute	biotechnology, medical technology
Iceni Seed Corn	UK	Externally managed	University of East Anglia, University of Essex, John Innes Centre, Sainsbury Laboratory, Institute of Food Research, Plant Bioscience Ltd.	
Imperial Innovation Fund	UK	Internally managed	Imperial College London	high-tech, healthcare
White Rose Technology Seed Fund	UK	Internally managed	University of Leeds, University of Sheffield, University of York	

In the next section, our purpose is twofold. First, we will present in more detail the variables used in the empirical analyses. Next, we test empirically whether the characteristics abovementioned correlate with the success rates of the companies in which USFs invest. From a policy perspective, this is an important step in understanding better how to design and manage these instruments to foster the technology transfer and the growth of the firms involved.

3.3. Variables and Measures

Dependent Variables

Following the procedure of previous research on the performance of VC funds (i.e., Lerner, 1999; Cumming, 2006; Cumming et al*.,* 2008), we focus on the level of analysis of portfolio companies. As other researchers have done in existing literature, we measure the companies' success in terms of exit performance (i.e., the likelihood of reaching an IPO or trade sale) and their ability to attract further funding through staging and syndication processes. These outcomes are compared with those of a control group of new ventures backed by other VC funds (e.g. Cressy et al., 2007; Cumming, 2006; Gompers et al., 2009).

Positive exit. This outcome is a dichotomous variable equal to 1 if the investee company has exited through an IPO or M&A as of December 2012, and 0 if not (source: Thomson One). In literature, this kind of performance measure is used at both the fund level (e.g., Hochberg et al., 2007; Cressy et al., 2012) and the company level (e.g., Cumming and MacIntosh, 2003; Neus and Walz, 2005; Gompers et al. 2009 Cumming 2006). This rationale is based on the fact that VCs can earn a capital gain from their investments only if they exit through an IPO or the sale to another company.

Staging. This count variable indicates the number of rounds of VC funding obtained by each company, as of December 2012 (source: Thomson One). A fundamental goal of USFs is to provide support and monitoring to university or PRO start-ups so that they can reach a development stage at which they are able to attract further funding to strengthen their growth. USFs, therefore, should act as a catalyst in encouraging follow-on funding by other qualified private VC investors. We adopt the staging variable to measure the achievement of the specific objective of attracting further financing.

Syndication. This count variable indicates, for each company, the total number of VC investors involved in the different financing rounds over time, as of December 2012 (source: Thomson

One). Similar to the staging variable, the syndication variable signals the achievement of a specific objective of USFs—that of attracting additional external investors for portfolio companies.

Explanatory Variables

We adopt as our main explanatory variables the principal characteristics we discussed in the previous section.

USF backed. This characteristic is a dichotomous variable that takes a value of 1 if the investee company has received financing from a USF fund, and 0 otherwise (source: Thomson One).

Internally managed USF fund. This dichotomous variable takes a value of 1 if the investee company has received financing from a USF that is internally managed by a university/PRO, and 0 otherwise (source: search of the fund websites, triangulated with interviews of experts in the field and a survey of TTO managers).

Rank50 (or Rank100). This dummy variable is equal to 1 if the USF investing in the company is affiliated or formally collaborates with universities included in the top 50 (or in the top 100) Leiden Ranking of research universities, and 0 otherwise (source: Leiden Ranking). The Leiden Ranking measures the scientific performance of 500 major universities worldwide using a set of bibliometric indicators based on Web of Science–indexed publications from the period. We used the 2011–2012 edition of the Leiden Ranking to set up the variable.

Technology-focused USF. This dummy variable takes a value of 1 if the USF has an investment focus on a limited number of technological sectors (e.g., specialist funds), and 0 if not (e.g., generalist funds) (source: search of the fund websites).

Regionally focused USF. This dummy variable takes a value of 1 if the USF has an investment focus on a specific geographical area (e.g., a particular province or region), and 0 if not (source: search of the fund websites).

Control Variables

We controlled for a series of variables at the company, fund, and environmental levels that may impact the ultimate performance of portfolio companies (e.g., Croce et al., 2013; Hsu, 2007).

Company age. An ordinal variable, expressed in years, indicates the age of the company at the year of the first founding round, as of December 2012 (source: Thomson One).

Fund Size. This variable indicates the initial size of the USF, for USF-backed companies, and the size of the lead VC investor, for the control group. Fund size is expressed in million of euros (source: Thomson One).

Bubble years. This dichotomous variable takes a value of 1 if the first VC investment obtained by the investee company occurred in 1999 or 2000 (source: Thomson One). It is included to differentiate such companies that were funded in a "boom" stage of development for VC markets.

National VC investments: For each company, this variable indicates the average amount of VC investments that occurred in the period 1980–2012 in the corresponding country (source: Eurostat). We use this variable to capture the munificence of the VC environment in the country in the period of interest of the study.

MSCI. This acronym stands for the Morgan Stanley Capital International Index equity return for the UK in the first-round investment year, to capture the favorableness of the capital market in that specific period (source: Datastream).

Technological-sector dummies. This term refers to the dummy variables associated with each technological sector in which the start-ups operate. We follow the classifications given by Thomson One: (a) Medical and Health, (b) Biotechnology, (c) Communication and Media, (d) Computer Hardware, (e) Computer Software and Service, (f) Internet Specific, (g) Consumer Related, (h) Industrial-Energy, (i) Semiconductors and Other Electronics, and (j) Other Products (source: Thomson One).

Table 2 lists all the variables with their definitions. Table A.1 displays their descriptive statistics and their pairwise correlation.

Table 2: Definitions of the Main Variables

Variable	Description
Exit	Dichotomous variable that takes a value of 1 if the investee company has exited through an IPO or acquisition as of December 2012, 0 otherwise (source: Thomson One).
Staging	Number of staged investment rounds obtained by the company as of December 2012 (source: Thomson One).
Syndication	Number of syndicated investors involved in the company, for all of the financing rounds, as of December 2012 (source: Thomson One).
USF-backed company	Dichotomous variable that takes a value of 1 if the investee company has received financing from an USF, 0 otherwise (source: Thomson One and search of the fund websites).
Fund size	Indicates the size of the fund (in million Euro) (source: Thomson One).
Company age	The age of the company at the date of the first funding round, expressed in years, on December 2012 (source: Thomson One).
MSCI	Morgan Stanley Capital International Index equity return for the UK in the first-round investment year (source: Datastream).
National VC investments	Overall amount of VC investments in the country in which the investee company operates, over the period 1980–2012 (source: Eurostat).
Bubble	Dichotomous variable that takes a value of 1 if the first investment round obtained by the investee company is in 1999 or 2000 (source: Thomson One).
Internally managed USF	Dichotomous variable that takes a value of 1 if the investee company has received financing from a USF that is internally managed by a university/PRO, and 0 otherwise (source: search of the fund websites).
Rank50	Dummy variable equal to 1 if the USF investing in the company has a collaboration with universities in the top 50 Leiden Ranking of research universities, 0 otherwise (source: Leiden Ranking).
Rank100	Dummy variable equal to 1 if USF investing in the company has a collaboration with universities in the top 100 Leiden Ranking of research universities, 0 otherwise (source: Leiden Ranking).
Technology-focused fund	Dummy variable that takes a value of 1 if the mission of the USF is investing in specific technological sectors (e.g., specialist funds), and 0 if not (e.g., generalist funds) (source: search of the fund websites).
Regionally focused fund	Dummy variable that takes a value of 1 if the mission of the USF is investing in a specific geographical area (e.g., a province or region), and 0 if not (source: search of the fund websites).

4. Results

We divide our results into two main parts. In the first part, we focus on the characteristics of USFs. Here, we show a series of descriptive statistics to shed light on the heterogeneity existing between USFs and non-USFs, as well as within the category of USFs. In the second part, the

focus is on the success rate of the investee companies. Along this line, we estimate the correlation between USFs and the main features differentiated in the previous section and the probability that the investee company will attain a successful exit.

4.1. Descriptive Statistics

In Table 3, we compare USFs with non-USFs. From our descriptive statistics in terms of exit, syndication, staging, and fund size, we notice that there is a statistical difference between the two groups. More precisely, USFs have a higher number of follow-on investments (i.e., syndication: mean USF = 1.95; mean non-USF = 1.08, p < .000) and are involved in investments with a higher level of staging (mean USF = 2.35; mean non-USF = 1.71, p < .000). At the same time, USFs are smaller in terms of size (mean USF = 21.98; mean non-USF = 56.94, p < .000), and they are involved in a smaller number of trade sales (mean USF = 0.13; mean non-USF = 0.25, p < .001). Furthermore, comparing the characteristics of a subsample of USFs (n = 734)—distinguishing them between internally managed and externally managed (Table 4)—we observe that internally managed funds are generally involved in investments with more co-investors (i.e., syndication: mean internally managed = 2.13; mean externally managed = 1.89, p < .10). Finally, the descriptive analyses show that externally managed USFs are statistically larger in terms of size (mean internally managed = 10.60 million Euro; mean externally managed = 25.35 million Euro, p < .001) and are more technologically specialized and more geographically focused (mean internally managed = 0.60; mean externally managed = 0.73, p < .001).

Table 3: Comparison of USF and Non-USF

	N	USFs	Non-USFs	Std	t-test	p-value
Exit	1498	0.13	0.25	0.40	5.64	***
Syndication	1498	1.95	1.08	1.15	–15.98	***
Staging	1498	2.35	1.71	0.43	–4.52	***
Fund size	1498	21.98	56.94	47.58	15.23	***

(*** p < 0.01, ** p < 0.05, * p < 0.1)

Table 4: Comparison of Types of USFs

	N	USF Internally Managed	USF Externally Managed	Std	t-test	p-value
Exit	734	0.13	0.14	0.34	0.42	
Syndication	734	2.13	1.89	1.48	−1.87	*
Staging	734	2.15	2.00	1.58	−1.12	
Fund size (million Euro)	734	10.60	25.35	24.19	7.18	***
Technology focused	734	0.32	0.45	0.49	3.01	***
Geographically focused	734	0.60	0.73	0.46	3.26	***

(*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$)

4.2. Econometric Estimations

In line with Cumming (2006) and Cumming and Johan (2009), we formulate two different econometric models: first, a logit model for binary-coded variables (i.e., positive exit, acquisition); second, a negative binomial to estimate staging and syndication to deal with dependent count variables. In Table 5, we report our estimates where the main independent variable is USF-backed companies (i.e., we compare investee companies backed by USFs with non-USFs).

The first specification (5.1) estimates, for each company, the probability of achieving a positive exit through an IPO or a trade sale as of December 2012. The results suggest that USF-backed companies are less likely than the control group to reach a positive exit ($p < .001$). In other words, all other factors being equal, companies financed by USFs are on average less successful in generating exits from IPOs or M&As for their investors. If we turn to staging and syndication (specifications 5.2 and 5.3, respectively), empirical evidence suggests that the variable "USF-backed company" produces a positive effect on both the probability of syndication and the staging (in both cases the significance is at 1%). In this set of regressions, control variables such as the age of the company and the level of national VC investments have a statistically significant and positive effect on the exit rates.

Table 5: Estimates of Performance of USF-Backed Companies vs. Non-USF-Backed Companies

	Exit (5.1)	Staging (5.2)	Syndication (5.3)
USF-backed company	−0.062***	0.213***	0.543***

	(0.023)	(0.044)	(0.051)
Fund size	0.000***	0.002***	−0.000
	(0.000)	(0.000)	(0.001)
Company age	0.021***	0.022***	−0.002
	(0.002)	(0.004)	(0.005)
National VC investments	1.101**	2.623***	−1.990**
	(0.479)	(0.922)	(1.010)
Bubble years	0.019	0.028	−0.044
	(0.027)	(0.054)	(0.064)
MSCI index	0.031	0.222***	−0.033
	(0.042)	(0.082)	(0.086)
Technology-sector dummies	YES	YES	YES
Constant		0.278	0.794***
		(0.190)	(0.164)
Observations	1,497	1,497	1,497
Log likelihood	−657.860	−2362.200	−2007.163
Chi-square	150.330	112.498	229.307

(Standard errors in parentheses: *** p < 0.01, ** p < 0.05, * p < 0.1)
Note: For the logit model, we display marginal effects computed at the discrete change from 0 to 1 for dummy variables and at the mean for continuous variables

In Tables 6 and 7, we run additional estimates limited exclusively to the subsample of USFs, to investigate in detail whether some of their main characteristics might affect the positive exit and the acquisition of an investee company, the number of co-investors, and the maximum number of rounds financed. In Table 6, the main explanatory variable is "internally managed fund," indicating whether the investee company is financed by a USF directly managed by universities or PROs. Empirical evidence shows that being financed by an internally managed USF is not significantly correlated with the probability that the firm will exit positively from the market (specification 6.1) and have a higher number of rounds financed (6.2). In contrast, specification 6.3 suggests that the variable "internally managed fund" is positively and significantly associated with syndication (p < .05). In these models, the variable capturing a technology-focused investment strategy by the USF does not have a statistically significant effect, whereas the characteristic of geographical focus has a statistically significant influence on the likelihood of syndication. The control variable "company age", on the other hand, is positively associated with exit and staging

Table 6: Estimates of Performance of USF-Backed Companies: Internally vs. Externally Managed

	Exit (6.1)	Staging (6.2)	Syndication (6.3)
Internally managed fund	−0.012	0.042	0.211***
	(0.029)	(0.069)	(0.067)
Technology-focused fund	0.033	0.081	0.078
	(0.027)	(0.061)	(0.060)
Geographically focused fund	0.027	−0.037	0.152**
	(0.026)	(0.062)	(0.064)
Fund size	−0.000*	0.000	0.001**
	(0.000)	(0.001)	(0.001)
Company age	0.015***	0.026***	0.001
	(0.003)	(0.007)	(0.007)
National VC investment	0.322	0.850	−3.803***
	(0.648)	(1.452)	(1.424)
MSCI	0.008	0.290**	−0.071
	(0.049)	(0.114)	(0.105)
Bubble	0.070	0.060	−0.108
	(0.050)	(0.095)	(0.101)
Technology-sectors dummies	YES	YES	YES
Constant		0.497**	1.150***
		(0.226)	(0.194)
Observations	733	733	733
Log likelihood	−271.109	−1229.384	−1186.307
Chi-square	34.440	36.749	57.556

(Standard errors in parentheses: *** p < 0.01, ** p < 0.05, * p < 0.1)
Note: For the logit model, we display marginal effects computed at the discrete change from 0 to 1 for dummy variables and at the mean for continuous variables.

In the analysis of Table 7, the main explanatory variables are "Rank100" and "Rank50," which capture the scientific ranking of the universities with which USFs are associated. The results generally suggest that the receipt of funding from USFs is associated with universities with a high scientific ranking (the dummy variables "Rank50" and "Rank100" measure the inclusion of the university in the first 50 and 100 universities of the Leiden Ranking) and has a statistically significant effect on our dependent variables. More precisely, in line with previous results, a company's receipt of financing from USFs negatively influences the probability of exiting the market (models 7.1 and 7.2, $p < .05$), but the higher the ranking, the higher the probability of exiting (see the coefficients). Similarly, in specification 7.4, the variable "Rank50" explains significantly the variance of a higher number of staging at the 5% level (whereas Rank100 is not statistically significant). Finally, both variables "Rank100" and "Rank50" have a statistically significant positive effect on syndication (specifications 7.5 and 7.6, $p < .05$ and $p < .10$). Also in this case, a geographically-focused investment strategy has a

positive and statistically significant effect on syndication, but only in Model 7.5. The variable Fund Size has a statistically positive effect in all regression models presented in Table 7.

Table 7: Estimates of Performance of USF-Backed Companies: The Quality of Affiliated Universities

	Exit (7.1)	Exit (7.2)	Staging (7.3)	Staging (7.4)	Syndication (7.5)	Syndication (7.6)
Rank100	−0.523**		0.074		0.101**	
	(0.263)		(0.061)		(0.061)	
Rank50		−0.285**		0.131**		0.121*
		(0.274)		(0.065)		(0.066)
Technology-focused fund	0.257	0.310	0.095	0.098	0.104*	0.095
	(0.245)	(0.244)	(0.062)	(0.061)	(0.061)	(0.061)
Geographically focused fund	0.316	0.385	−0.040	−0.069	0.128**	0.105
	(0.263)	(0.267)	(0.061)	(0.063)	(0.064)	(0.065)
Fund size	0.002**	0.002**	0.000*	0.000*	0.001*	0.001*
	(0.005)	(0.005)	(0.001)	(0.001)	(0.001)	(0.001)
Company age	0.129***	0.129***	0.026***	0.025***	0.002	0.001
	(0.027)	(0.027)	(0.007)	(0.007)	(0.007)	(0.007)
National VC investment	2.772	1.582	0.760	0.815	−3.449**	−3.208**
	(6.011)	(5.980)	(1.444)	(1.434)	(1.422)	(1.412)
MSCI	0.057	0.054	−0.000	0.287**	−0.069	−0.067
	(0.468)	(0.467)	(0.001)	(0.113)	(0.105)	(0.105)
Bubble	0.604*	0.538	0.047	0.049	−0.132	−0.120
	(0.338)	(0.334)	(0.095)	(0.095)	(0.102)	(0.101)
Industry dummies	YES	YES	YES	YES	YES	YES
Constant	−4.727***	−4.823***	0.490**	0.513**	1.146***	1.169***
	(1.211)	(1.212)	(0.226)	(0.226)	(0.195)	(0.195)
Observations	733	733	733	733	733	733
Log likelihood	−266.140	−267.643	−1228.829	−1227.577	−1189.137	−1189.920
Chi-square	39.436	36.431	37.859	40.363	51.896	50.331

(Standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$)

Note: For the logit model, we display marginal effects computed at the discrete change from 0 to 1 for dummy variables and at the mean for continuous variables.

5.   Discussion and Conclusions

In this work, we contributed to the definition of the concept of university- and PRO-oriented seed funds as important financial instruments addressing the funding gap, a problem that severely limits the growth prospects of university spin-offs and the effectiveness of technology transfer from universities to the industry. This topic is particularly relevant not only in light of the problems faced by ASOs in accessing VC financing due to information asymmetry and uncertainty-related issues, but also for the challenges associated with the development of an

effective supporting structure for the commercialization of early-stage technologies developed within the university. Investors dedicated to backing new firms spawned from these institutions with the goal of generating more wealth for the university also have to take into consideration the challenges that these university-affiliated funds have to face. As discussed in Lerner (2005), there are several pitfalls that can severely restrict the ability of such instruments to add value. With these problems in mind, academic research should pay particular attention to the design and structure of the USFs and the context in which they are developed.

For this reason, we first mapped the landscape of USFs available in Europe by triangulating several data sources, such as commercial databases, web searches, interviews with experts, and surveys of TTOs. Our analyses permit us to identify several characteristics that differentiate the structure and investment strategies of USFs, such as the governance of the fund, the size, the scientific reputation of the universities with which they are linked, and the technological and geographical focus of the investments. In our regressions, we tried to determine whether these characteristics actually influence the success rates of investee companies in terms of exit rates, staging, and syndication patterns. We also compared the success rates of companies backed by USFs with those of a control group of companies backed by other seed funds from the same countries.

The results of the regression analyses show that companies backed by USFs tend to experience a lower likelihood of achieving a positive exit for the VC investor through an IPO or a trade sale. This result can be explained by the embryonic nature of university and PRO-generated start-ups, which are typically the focus of this type of program. The delicate and troublesome transition from the scientific to the commercial environment typically takes place through a long and risky process. From the point of view of the USF investor, the process, in turn, is likely to reduce the possibility of obtaining an exit from the investment over a short period. However, this preliminary evidence should be considered together with other, positive

insights emerging from our findings as to the capacity of USF instruments promoting growth in the investee companies, thanks to attracting follow-on funding and the involvement of other external investors. Our findings indeed show that USF-backed companies tend to present higher staging and syndication levels than do their counterparts.

Additional interesting insights emerge from our findings regarding USF characteristics, which have profound policy implications for the design and implementation of such financial instruments. On the one hand, our findings demonstrate a superior impact of internally managed USFs when compared with externally managed ones, considering their respective staging and syndication rates. This circumstance depends in part on the fact that a large percentage of the universities that have established internal seed funding programs are among the most scientifically advanced in Europe. Along with that aspect, however, internally managed USFs can benefit in principle from other idiosyncratic advantages, provided that the USFs are adequately sized and managed. Among the latter advantages is the possibility of maintaining closer access and more frequent interaction with researchers and academic entrepreneurs, so as to enhance their ability to support and add value to investee companies. Proximity between the academic entrepreneurial team, the TTO staff and the financial investors is thus an important factor for nurturing the commercialization of academic technologies.

According to our estimates, moreover, the size and quality of the research base upon which the USF is built is another important precondition for delivering effective results by means of this type of financial instrument. The availability of high-quality science at the university or in the subject region is thus an important precondition for the success of such financial instruments, guaranteeing a steady stream of high-potential companies and the possibility of developing a diversified portfolio of high-quality companies in which to invest. Another interesting finding emerging from our analyses relates to the positive and statistically significant impact of the size of the USF on the ultimate success rates of investee companies.

It appears certain that a minimally efficient scale is required for this type of instrument and that excessive fragmentation of resources should be avoided in this area. The effectiveness of subscale USFs can be limited for several reasons: the high incidence of fixed costs (such as management fees) on the amount of capital available for investments; the limited ability to alleviate project risks by diversifying investments across projects; the risks of distribute the funds too thinly across investee startups and the consequent limited ability to provide follow-on financing in a successful startup. All such characteristics may reduce the risk-propensity of small-scale VCs, thus limiting their involvement in addressing the funding gap for university and PRO startups.

Additional research and evidence are required to overcome the limitations presented in the current study. First of all, it appears to be important to adopt more precise performance measures for assessing the ultimate impact of university/PRO funds. An interesting extension of our work could be to consider typical measures of turnover or employment growth—or profitability levels related to portfolio companies—to assess the influence of USF funding vis-à-vis funding obtained through other types of VC funds. Another important research avenue would be to conduct further in-depth cases studies related to university and PRO-oriented seed funds, to understand in greater detail their design, organization, and management—in particular the types of relationships existing between university TTOs and research departments and the support activities offered to university researchers. We believe, however, that our study makes some important contributions both for researchers interested in the emerging area of gap funding instruments and for university managers and policy makers involved in guiding the design and implementation of innovative funding policies for the enhancement of third mission activities by universities.

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APPENDIX. Table A.1: Descriptive Statistics and Correlation Matrix

	Variable	N	Mean	S.D.	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Positive exit	1497	0.192	0.394	0	1	1														
2	Staging	1497	1.864	1.44	1	8	0.08	1													
3	Syndication	1497	1.406	1.142	0.125	8	0.01	0.16	1												
4	USF backed	1497	0.49	0.5	0	1	–0.15	0.12	0.38	1											
5	Internally managed fund	733	0.229	0.421	0	1	–0.01	0.04	0.05	0.54	1										
6	Rank50	733	0.182	0.43	0	1	–0.01	0.07	0.24	0.45	0.63	1									
7	Rank100	733	0.148	0.417	0	1	–0.01	0.07	0.21	0.47	0.16	0.15	1								
8	Company age	1497	9.687	4.616	0	30	0.28	0.12	–0.09	–0.13	0.03	0.01	0.04	1							
9	Fund size	1497	50.791	57.994	0.033	550	0.15	0	–0.22	–0.48	–0.21	–0.02	0.11	0.09	1						
10	MSCI index	1497	–0.003	0.243	–0.658	0.299	0.02	0.08	0.02	0.06	0.02	–0.03	0.06	0.03	–0.07	1					
11	VC disposal	1497	0.055	0.022	0.004	0.108	0.02	0.1	0.01	0.27	0.22	–0.16	0.05	–0.04	–0.07	0.02	1				
12	Bubble	1497	0.158	0.365	0	1	0.06	0.01	–0.1	–0.19	0.00	0.02	0.03	0.11	0.13	–0.06	–0.07	1			
13	Technology-sector company	1497	4.66	0.886	1	8	–0.04	–0.02	–0.03	0.06	0.01	0.02	0.00	–0.02	–0.02	–0.01	0.08	–0.05	1		
14	Technology-focused fund	733	0.415	0.493	0	1	0.03	0.03	0.13	0.18	–0.11	0.29	0.03	–0.12	0.16	0	–0.3	–0.04	–0.07	1	
15	Regionally focused fund	733	0.701	0.458	0	1	0.04	–0.02	0.1	0.23	–0.12	0.08	0.01	–0.05	–0.15	0.05	0.11	–0.01	–0.07	0.11	1