

University Spin-Off's Seed Capital: An Empirical Study from Demand Perspectives

Abstract: This study aims to enrich our knowledge of the influences of capabilities and social networks of entrepreneurial teams have on the engagement of external supporters in seed investments by exploring academic entrepreneurial teams. This paper explores capabilities and social networks of entrepreneurial teams in Spanish university spin-offs using quantitative data analysis. Basing upon resource-based view theory of Barney (1991) to study capabilities of the entrepreneurial teams, the research employ entrepreneurial technology, strategy, human capital, organizational viability, and commercial resources (Vohora et al., 2004). To study social networks of entrepreneurial teams, this study employs the conceptual model of Hoang and Antoncic (2003) to study the characteristics of social networks. The results from an examination of the sample of 181 Spanish university spin-offs demonstrate that by exploiting social networks an entrepreneurial team can shape its capabilities, which in turn improve its ability to access external seed investments. Thus, the paper has implications for universities in training and policy development to support spin-off's activity, especially to build entrepreneurial teams with capabilities to pitch to the focused seed capital providers. This study addresses a fundamental question to contribute to the theory-based understanding of university spin-offs: What make financial supporters engage in seed investments?

Keywords: University spin-offs; entrepreneurial teams; resource-based view; social networks; seed capital

Introduction

Early-stage finance, including primary and second round of funding, is a major issue of university entrepreneurship activities to develop inventions or know-how into practical applications (Lindstrom and Olofsson, 2001). The imperfections of capital market caused by the uncertainty of investment returns, the asymmetric information between entrepreneurs and potential investors and the lack of collateral create financial constraints and funding gaps for university spin-offs (Carpenter and Petersen, 2002). While such financial constraints were studied by numerous scholars, none of extant literatures has studied the factors that influence the decision of external supporters to engage in seed investments. Given the difficulties in accessing external financial resources to commercialise new opportunities, a determination of the factors underlying supporters' willingness to make seed investments is important for entrepreneurs, researchers and policy makers.

According to Vohora et al. (2004), university spin-offs can have similar characteristics to other new ventures, but they face a fundamentally different set of challenges due to the context in which they are created. Those authors have indicated that academic entrepreneurial teams have inadequate internal capabilities and limited assets. The academic entrepreneurial teams originate from a non-commercial environment where sophisticated technical capabilities are valued and fostered; often at the expense of commercial knowledge that could help facilitate the exploitation of ideas (Clarysse and Moray, 2004). A university spin-off is therefore characterised by highly innovative products/services that are new and unique to the market (Heirman and Clarysse, 2004). However, the performance of these spin-offs is comparatively poor compared to other new ventures because the entrepreneurial team have to deal with complex tasks in unfamiliar and uncertain business environments (Shane, 2004) which are exacerbated by their limited industrial

experience and/or access to non-technical networks (Cooper and Daily, 1997). Thus, the capabilities and social networks of entrepreneurial teams are reflected in the prevalent insights from financial supporters who constantly consider those factors as important funding criteria (Meseri and Maital, 2001).

Since university spin-off study is a relatively recent subject that has come under investigation, this paper will address some fundamental questions to contribute to the theory-based understanding of spin-off process: Which capabilities of entrepreneurial teams influence the engagement of seed investments in university spin-offs? Which dimensions of social networks of entrepreneurial teams accelerate the engagement of seed investments in university spin-offs? To study the capabilities of an academic entrepreneurial team, this study will employ resource-based view (Barney, 1991), which emphasized the internal idiosyncratic capabilities and explained how a firm utilizes the available capabilities to be successful. The capabilities of an entrepreneurial team known as internal capabilities comprise entrepreneurial technology, strategy, human capital, organizational viability and commercial resources (Vohora *et al.*, 2004). Besides these internal capabilities, the quality of a team's social networks, external resources, in the entrepreneurial process are also important (Shane, 2004; Vohora *et al.*, 2004). A social network includes single nodes (actors) and linkages between these nodes (dyads), and provides "a sum of actual and potential resources embedded within, available through, and derived from the networks of relationships possessed by individual social units" (Nahapiet and Ghoshal, 1998). To answer those research questions and strengthen the theoretical and empirical foundation of university spin-off studies, this study examines the engagements of external financial supporters in seed investments of university spin-offs under the impact of the capabilities and social networks of entrepreneurial teams. The results presented are based upon a sample of 181 Spanish university spin-offs based in 35 universities across all regions of Spain; each spin-off was created and developed by an entrepreneurial team and responses were obtained from the members of the teams. The findings indicate that the capabilities of entrepreneurial teams affect the decisions of financial supporters to engage in seed investments. Additionally, the social networks of entrepreneurial teams indirectly influence the decisions of financial supporters through their impact on the capabilities of entrepreneurial teams.

Theoretical development

The nature of seed capital

The early-stage financial needs of university spin-offs develop through three phases: Seed, start-up and early-growth (Lindstrom and Olofsson, 2001). In the university spin-off model from studies of Shane (2004) and Vohora *et al.* (2004), seed capital is to support the research activities and develop the initial business concept before a real product or company established. The start-up finance is needed for early organizing efforts in business registration to create a legal entity. The early-growth finance is needed for the initial product development and market entry. It is suggested that while good fundraising is perceived to assist entrepreneurs to be more commercially productive than others (Powers and McDougall, 2005), undercapitalization can be one of the consistent causes of failures not only in the stage of foundation but also in the growth period of a new venture (Rosman and O'Neill, 1993). Thus, entrepreneurial teams must choose to explore suitable financial sources within the capital market depending upon the growth goals, the nature of ownership and the sector of spin-offs (Riding *et al.*, 2012).

Lindstrom and Olofsson (2001) suggested that while these financial sources are available, how to access them has become a key challenge for entrepreneurial teams because of the effects of capital market imperfections. Carpenter and Petersen (2002) indicated three reasons for these effects. First, the low probability of financial success and the high failure rate of university spin-offs generate the uncertainty of investment returns discouraging the investment decisions of investors. Second, a university spin-off per se has a limited collateral value because it has a little salvage value in the event of failure. Third, the information asymmetry, entrepreneurial teams and investors unequally access to the information about the spin-offs, makes potential backers have sceptics about the true value of university spin-offs (Certo, 2003). In fact, entrepreneurial teams possess more inside information about the intentions, planned activities and value of spin-offs than investors (Prasad *et al.*, 2000); this asymmetric information can lead to the rejection of good investment opportunities or underinvestment (Myers and Majluf, 1984). Information asymmetry not only influences the ability of an entrepreneurial team to access to financial sources but also importantly determine firm's capital structure (Fama and French, 2005). Because the ultimate purpose is to maximize the benefit, investments are likely to be undertaken when financial providers can see the value of university spin-offs and mitigate the risks (Cumming and Johan, 2008). Thus, to surmount the effects of capital market imperfections, this paper proposes that entrepreneurial teams could provide relevant information signalling that university spin-offs have wealth creating potential to attract more financial supporters.

Resources of entrepreneurial teams

The economic theory of entrepreneurship mostly emphasises the entrepreneurial function as the roles of a single person reflecting on his/her decision making, preferences, beliefs and actions. Although this research approach has long been appreciated, the notion that new ventures are more likely to be created by founders plural, is increasingly recognised (Gartner and Vesper, 1994). Recent research has demonstrated that entrepreneurial teams have become a more popular mode of a new business development (Lasch *et al.*, 2007). This has led researchers to investigate the contributions of entrepreneurial teams to the development of new ventures (Cooper and Daily, 1997).

Social networks of entrepreneurial teams

The quality of an entrepreneurial team's social networks, external resources, in the entrepreneurial process is an important element in fundraising process of a university spin-off (Shane, 2004; Vohora *et al.*, 2004). This study divides the network into three components structure, governance and content as suggested by Amit and Zott (2001) and Hoang and Antoncic (2003). Network structure refers to the properties of connections and personal configurations of relationships among actors (Burt, 1987; Granovetter, 1973); network governance is defined as mechanisms that govern the relationships among actors, the legal forms of actors and the incentives for participations within networks; content within a network refers to exchanging resources (Amit and Zott, 2001).

Nofsinger and Wang (2011) argued that entrepreneurial teams at early stages do not belong to professional networks in capital markets (e.g. networks for IPOs and SEOs pricing and distribution, co-underwrite offering networks, venture capitalist networks, etc.), and thus may rely on their social networks. Many scholars have proved that social ties provide a potential mechanism to reduce the information asymmetry between potential investors and entrepreneurial

teams (Freiburg and Grichnik, 2012; Uzzi, 1996). Financial providers can reduce the information asymmetry regarding to the intentions and planned activities of the teams and the value of university spin-offs through contingency (incentive) contracts and monitors (Granovetter, 2005). The asymmetric information can be alleviated via signals (Certo, 2003) conveyed by the knowledgeable parties or/and through screening activity which seeks for additional information from uninformed parties (Carpentier *et al.*, 2010). Social relationships allow potential investors to obtain private information about the talents and tendencies of members of entrepreneurial teams (Nofsinger and Wang, 2011), and resolve some moral hazard issues (Shane and Cable, 2002). By associating with well-regarded individuals and organizations, entrepreneurial teams are able to increase their reputation determined by the information about past performance of the members of entrepreneurial teams to attract and convince more investors of their business projects (Podolny, 1994). Social networks also leverage the trust between entrepreneurial teams and financial providers (Kautonen *et al.*, 2010) eventually positively influence the investment decisions. Thus, this research hypothesizes that entrepreneurial teams can use their social networks to improve the ability to access external financial resources for seed capital.

H1: The social networks of entrepreneurial teams leverage the pitch for seed capital from external resources of university spin-offs

Capabilities of entrepreneurial teams

Vohora *et al.* (2004) characterised the capability construct as encompassing entrepreneurial technology, organisational viabilities, human capital, entrepreneurial strategy, and commercial resource and this will be replicated in this paper. A capability that supports entrepreneurial technology is identified as an outcome of research that has the potential to be commercialized due to its limited imitability (Gallini and Wright, 1990) or its ability to create significant scale, range of application or value (McGrath, 1997). Organizational viability refers to internal systems that create institutional routines (Nelson and Winter, 1982) that originate from internal communication (Krueger Jr, 2000), formal control mechanisms defined as institutionalized rules, missions and regulations that create desirable patterns of behaviours (Covin and Slevin, 1991), and organizational support (Leonard-Barton, 1992) refers to the provision of appropriate training and reward structures (Zahra, 1993). The human capital refers to the levels of education and experience available within the management team (Alvarez and Busenitz, 2001; McKelvie and Davidsson, 2009). Proactiveness, innovativeness, risk-taking and competitive aggressiveness (Dess *et al.*, 1997; Lumpkin and Dess, 1996) constitute the entrepreneurial strategy-making of a founding team. A firm's commercial resources are represented by the quality of bespoke relationships with customers (Nadherny, 1998; Powell and DentMicallef, 1997), these trusting and value enhancing relationships require complex coordination and communication skills to create and maintain (Hall, 1993).

Entrepreneurial teams have the capacities to exploit the links with industrial sectors to support the development of commercial (Dubini and Aldrich, 1991), management and leadership expertise (Kitagawa and Robertson, 2012; Rothschild and Darr, 2005). The teams can also utilise co-operative links with university staff to access the latest knowledge and technology which reduces development costs (Markman *et al.*, 2005) in the creation of innovative products (Lockett and Wright, 2005). The greater the density of these links (i.e. the level of interconnectedness) the more opportunity an entrepreneurial team will have to access the resource available within a network (Newbert and Tornikoski, 2013). Interconnectedness is often

a function of an actor's position within the network and entrepreneurial teams that occupy a central position within a network would expect to have more opportunity to explore and access the resources more efficiently and effectively (Stam and Elfring, 2008).

Antecedent activity often leads to reciprocal arrangements within networks that enable the entrepreneurial team to access critical resources through cooperative arrangements that have been established over time (Messick *et al.*, 1983; Witt, 2004). As these relationships develop trust is enhanced between the entrepreneurial teams and their networks enabling them to bypass expensive search activity by utilising the network to reduce risk and limit the need for expensive due diligence when accessing key resources (Jones *et al.*, 1997). Reciprocity and trust increase the reputation of an entrepreneurial team over time and this characteristic creates greater breadth and depth of interactions with the network. In essence the mechanisms that govern networks when collectively combined enhance the competitive advantages that an entrepreneurial team can access from their networks (Witt, 2004).

The process of mobilizing resources from external sources is a vital task in the entrepreneurial process (Aldrich and Martinez, 2001), and it has been suggested that entrepreneurial teams may access critical resources at below-market cost thanks to their relationships with resource gatekeepers (Hite, 2005; Larson and Starr, 1993; Newbert and Tornikoski, 2013). The types and quality of such resources characterise the content of networks (Amit and Zott, 2001). Resource types can be tangible or intangible in nature and include ideas, strategic advice (Deakins, 1996; Floyd and Wooldridge, 1999; Yli-Renko *et al.*, 2001), access to financial providers (Kitagawa and Robertson, 2012; Rothschild and Darr, 2005), technology (Lockett and Wright, 2005), appropriate staff (Davidsson and Honig, 2003; Rothaermel and Deeds, 2006; Tolstoy and Agndal, 2010) and emotional support (Bruderl and Preisendorfer, 1998; Gimeno *et al.*, 1997). In the case of spin-offs the social capital of a university can often confer security and scientific credibility that enables access to resource gatekeepers (Newbert and Tornikoski, 2013). Moreover where university incubators are employed, spin-offs will be able to take advantage of internal and external networks previously developed and fostered that can provide access to important information and resource (Kitagawa and Robertson, 2012; Patton and Marlow, 2011; Zucker *et al.*, 2002). The value of networks to a spin-off depends upon the collective activities of the entrepreneurial team and university support mechanisms to identify, acquire and exploit appropriate relationships (Chandler and Lyon, 2009).

For the reasons identified, this paper proposes that the social networks of entrepreneurial teams, developed in conjunction with university support, can provide an important contribution to the resource and knowledge acquisitions of entrepreneurial teams.

H2: An entrepreneurial team can exploit its social networks to improve capabilities which in turn increase the probability of pitch for seed capital from external resources of a university spin-off.

In general, potential investors trend to look for the signal of future success from university spin-offs when making investment decisions (Meseri and Maital, 2001; Wiltbank *et al.*, 2009). Each investor has different scales and ratings of a spin-off's abilities basing upon technology, market and management stage (Douglas and Shepherd, 2002), or the business, risk/returns ratio and time to exit (Wiltbank *et al.*, 2009). Additionally, studying early stage fundraising, other scholars have found that investment decisions depend on the investor's perception of management skills,

business model, potential market, growth perspective (Mason and Harrison, 2004), shortcut heuristic (Maxwell *et al.*, 2011) and the presentation of entrepreneurial teams (Clark, 2008). Moreover, the investors also require the presence of well-balanced teams with sufficient business capabilities as an important criterion of their funding decisions (Muzyka *et al.*, 1996). Taking the entrepreneurial teams as the unit of analysis, this study proposes the stage of team's capabilities as an unobservable element signalling the value of a university spin-off. Although investors and entrepreneurial teams, each has different perception of potential for success to evaluate and move forward (Douglas and Shepherd, 2002), this study proposes that the capabilities of founding teams, the hidden value of university spin-offs, positively determine the pitch for seed capital from external resources of university spin-offs.

H3: The capabilities of entrepreneurial teams influence the pitch for seed capital from external resources of university spin-offs.

Methodology

Sample

This study draws the sample from 69 Spanish universities, each has an office for the transfer of research results (OTRI), located in 17 autonomous communities. The OTRIs were created by public or private universities within the first Spanish National Plan of R&D 1988-1999 to enhance the relationships between academic institutions and industry. OTRI's engage in a wide range of R&D activities but only 35 are involved in the creation and development of spin-offs. OTRIs are embedded in the sector and are the best source of fine-grained information about university spin-offs in Spain. It was through their offices that a dataset was developed of those spin-offs, created by teams, which included at least one academic member from a university. These criteria produced a dataset of 862 spin-offs that were subsequently surveyed using a web-based instrument; this survey resulted in 181 responses, 21 per cent of research population. All respondents were members of an entrepreneurial team and have a position on the executive board of the spin-off. The spin-offs are in various sectors: 33.8% in information, computing and telecommunications, 16.1% in engineering and consultancy, 15.3% in medicine and health, 15% in agriculture and biotechnology, 8.9% energy and environment, 4.3% in aeronautics and automotive, 3.4% in electronic, and 3.2% in other industries. The majority of spin-offs, 98%, were created after 2003 inside a university incubator; the actual breakdown is: 20% in 2009, 16% in 2010, 14% in 2006, 13% in 2008 and 2007, 7% in 2005, 5% in 2011 and 2004, and 7% in 2003 or earlier. The entrepreneurial teams of these university spin-offs used seed capital funded by one or more resources: 52% from personal, friends, or family, 19% from government grants, 7% from banks, 7% from university grants, 5% from business angles, 4% from strategic partners, and 3% from venture capitalists. This study constructs a binary variable to measure whether external financial resources (i.e. government grants, banks, business angles, strategic partners and venture capitalists) involve in providing seed capital for a university spin-off.

Construct measurements

To ensure the content validity of measurements, questions employ a seven-point Likert scale using constructs from existing entrepreneurship and management studies (Antoncic and Hisrich, 2001; Tsai and Ghoshal, 1998).

Entrepreneurial capabilities

The capability construct is derived from previous research (Antoncic and Hisrich, 2001; Lumpkin and Dess, 2001; McGrath, 1997) and employs measures for technology, organizational viability, human capital, strategy, and the commercial resource of entrepreneurial teams. In terms of technology, respondents answered six questions about the ease of imitation, scope, continuity, and the market signals of their technology (McGrath, 1997). To measure the organizational viability, measurements were adapted from studies of Leonard-Barton (1992), Zahra (1993) and Antoncic and Hisrich (2001) to construct five questions that relate to internal communication mechanisms, formal control mechanisms and organizational support within entrepreneurial teams during the creation period. Human capital was subject to a four-item measurement tool, adopted from the studies of Alvarez and Busenitz (2001) and McKelvie and Davidsson (2009), that evaluates the industrial, managerial knowledge, and work and entrepreneurial experience of the founders. The strategy measurement employed questions that investigated levels of innovation, proactiveness, risk-taking, and competitive aggressiveness among the entrepreneurial team (Lumpkin and Dess, 2001). Finally, four questions based on the customer relationship, staff's technology training, and process design were used to measure the commercial resource available within entrepreneurial teams (Nadherny, 1998; Powell and DentMicallef, 1997).

Social networks

By adapting prior research, eight social network measurements were constructed in the areas of ties, density, centrality, reputation, reciprocity, trust, information quality, and diversity. The strength of an entrepreneurial-team's ties was measured by constructs that look at the willingness to engage in discussions with reference to social, political, and family matters (Parks and Floyd, 1996). The density of a network was measured by a three-item scale evaluating interactions within networks (Marsden, 1993). Centrality was based on the measurements of Rowley (1997) that evaluate the location of actors within information flows using four questions that focus on how respondents communicate with others within networks. To measure the quality of information within social networks five questions, developed by O'Reilly III (1982), were employed which evaluate the accuracy, relevance, reliability, specificity, and timeliness of information. The availability of business relevant data was used to measure the diversity of information within networks; broken down into market data, product and process design data, marketing know-how, and packaging design or technology data (Gupta and Govindarajan, 2000). Furthermore, trust was measured by four questions which require respondents to self-report on how trustworthy they are perceived by other members within networks (Tsai and Ghoshal, 1998). By adapting the studies of Uzzi (1996) and Shane and Stuart (2002), a four-item measurement to evaluate the founder's reputation was constructed to obtain the views of other participants within networks. Reciprocity was measured by four questions that refer to the level of support received, accumulation of favours, and the fairness contained in the relationships among members (Miller and Kean, 1997).

Control Variables

To ensure that one person from the entrepreneurial team worked or was a student at a university, a binary code was used one for at least one founder in the team, at the creation time, and zero for no member. To manipulate for the potential negative effect on the performance of a spin-off

created outside a universities' incubator, this study will include a dummy variable coded one if spin-offs created inside the parent incubators and zero otherwise.

Validity and reliability

To reduce common method bias, previously validated measurements were employed (Spector, 1987) and a pilot test on five spin-offs from the university of Granada was undertaken to help fine tune the survey instrument. There is a potential error generated by the use of self-reporting from respondents especially as many of the measures are complex in nature and require post-hoc assessment. To reduce this issue, Harman's one-factor test was employed on all variables and the results suggest that the relationships among entrepreneurial capabilities and social networks are unlikely to be caused by common method bias in this study. Furthermore, to avoid measurement errors, the study conducted proper survey measures and used a construct validation test (the empirical indicators actually measure the construct) for validity (convergent and discriminant) and reliability.

To assess convergent validity, the extent to which the indicators of measurement converge to a high proportion of variances in common, this study examines construct loadings and average variance extracted. The study constructs the EFA of eleven factors: tie, reputation, reciprocity, trust, information quality, information diversity, technology, organizational viability, human capital, strategy, and commercial resource. The results revealed that all standardized loadings estimates are higher than 0.5 (Appendix A). Moreover, all indexes of average variance extracted (AVE), the amount of construct variance relative to measurement error, are greater than 0.5 (Appendix B) suggesting adequate convergent validity.

Discriminant validity (i.e., unidimensionality) is to test whether a construct is truly distinct from other constructs. The results revealed that all AVE estimates are larger than the corresponding squared interconstruct correlation estimates (SIC) (Appendix B) inferring discriminant validity of the hypothesized structure is supported by our data.

This study computes the composite reliability, analogous to Cronbach's alpha, of all factors by the formula of Fornell and Larcker (1981). Most factors revealed sufficient composite reliabilities (above 0.70) except the reputation factor (0.644) (Appendix A). However, according to Hatcher (1994), the cut-off level of 0.6 is acceptable for a new conceptual variable. Moreover, construct reliabilities of all variables are greater than 0.7 (Appendix B), the measurements of this research, thus, are reliable.

Results

Firstly, exploratory factor analysis (EFA) is used to construct the research indicators. The results from the EFA of the network and capability measurements revealed that item loadings were mostly significant (over 0.5) (Appendix A); where they were not, in the case of the factors relating to trust, information quality, information diversity and strategy, they were removed. Secondly, by using all items identified from the EFA, the average scores of all factors of social networks and capabilities of entrepreneurial teams were estimated before testing the research hypotheses.

The results from a logit model analysis (Table 1) reveals that both organizational viability and strategy significantly negative (-0.025, $p < 0.05$) and positive influences (0.221, $p < 0.01$) the

probability of using external seed capital. In other words, the hypothesis 3 in which the capabilities of entrepreneurial teams influences the pitch for external seed capital is partially accepted. However, the results also show that the networks of entrepreneurial teams do not have direct effect on the probability of using external seed capital leading to a rejection of hypothesis 1 (Model 1 & 2). However, results from correlations matrix (Appendix C) show that both organizational viability and strategy variables significantly relate to other variables. Thus, those factors are proposed to have indirect effects on the pitch for external seed capital or contributions as moderator components. The result (Model 2) shows that only the commercial resources of entrepreneurial teams elevate (0.18, $p < 0.05$) the influence of strategy has on the pitch for external seed capital.

Table 1: Empirical results

	External Seed Capital		Organizational Viability		Strategy	
	Model 1 ^a	Model 2 ^a	Model 3	Model 4	Model 5	Model 6
Organizational Viability	-.205*	-.24**				
Strategy	.221**	.30***				
Reputation			.19**	.162*	.15*	.167**
Information Diversity			.246***	.282***	.167*	.201**
Entrepreneurial Technology			.234***	.295***	.392***	.373***
Human Capital					.159*	.145*
<i>Commercial x Strategy</i>		.18*				
<i>Commercial Resources x Human Capital</i>						-.174**
<i>Commercial Res. x Entre. Technology</i>				.201**		
<i>Tie x Information Diversity</i>				.133*		.145*
<i>Infor. Quality x Entre. Technology</i>				-.177**		
<i>Trust x Information Diversity</i>						-.198**
<i>Reciprocity x Information Diversity</i>						.177*
University Incubator		.013		.011		.011
R ²	.045	.074	.176	.258	.296	.39
Adjusted R ²	.036	.058	.162	.233	.280	.361
F value	4.331*	4.725**	12.59***	10.1***	18.5***	13.7***

* $p < .05$, ** $p < 0.01$, *** $p < 0.001$

^a Logit model

To understand the influences of social networks have on the capabilities of entrepreneurial teams, this study estimate the regression models of organizational viability and strategy. The results from model 4 (table 1) show that the reputation of entrepreneurs (0.162, $p < 0.05$), the diversity of information within networks (0.282, $p < 0.001$), and the technology of the entrepreneurial teams (0.295, $p < 0.001$) significantly positive influence their organizational viability. Meanwhile the commercial resources of entrepreneurial teams (0.201, $p < 0.01$) and the

quality of information within networks (-0.177, $p < 0.05$) significantly leverage the influence of technology has on organizational viability. The strength of ties also significantly influences the relationship between technology and organizational viability (0.133, $p < 0.5$). The model 6 shows that the strategy of entrepreneurial teams is significantly influenced by the reputation (0.167, $p < 0.01$), entrepreneurial technology (0.373, $p < 0.001$), human capital (0.145, $p < 0.05$) of entrepreneurial teams, and the diversity of information within networks (0.201, $p < 0.01$) (table 1). The influences of entrepreneurial technology have on strategy of entrepreneurial teams are significantly moderated by the strength of ties (0.145, $p < 0.05$), trust (0.198, $p < 0.01$), and reciprocity (0.177, $p < 0.05$) within the networks. Thus, social networks of an entrepreneurial team partially contribute to the development of its capabilities meaning that hypothesis 2 is partially supported.

Discussion

This paper investigates the impact on the seed capital of university spin-offs as a consequence of the capabilities and social networks exhibited by entrepreneurial teams associated with their creation prior to incorporation. The research is distinctive in its focus upon university spin-offs and the use of entrepreneurial teams as the unit of analysis; previous literature has focused upon new ventures in general (Carayannis *et al.*, 2000; Dimov and Murray, 2008), on the impact of the characteristics of entrepreneurs (Carayannis *et al.*, 1997), and on macroeconomic factors (Murray, 1999). This research posited that the capabilities and social networks of an entrepreneurial team would be related to the ease of the team to access external seed capital resources. The results indicate that a founding team is likely to improve its capabilities by exploiting its own social networks and that these improved capabilities can help a spin-off improve its pitch for external seed capital. While there was no evidence of a significant direct relationship between the social networks of an entrepreneurial team and its pitch for seed capital the results find support for a moderated role of social networks in leveraging the relationships between capabilities of an entrepreneurial team and external seed capital. As a consequence this paper demonstrates that the entrepreneurial teams of university spin-offs significantly influence the pitch for external capital; identifying a need to pay more attention to the entrepreneurial team and the process by which they build capabilities and networks in the 'creation' phase.

The empirical tests show that a university spin-off's external seed capital can be obtained by having a good strategy of its entrepreneurial team. This finding is partially supported by evidence from the study of Rea (1989) which indicated that the success of a seed capital negotiation is associated with the market opportunities, business plan and completeness of entrepreneurial teams. As such this paper argues that it is in the interest of those involved in university spin-offs to enhance the capabilities and of the entrepreneurial team during the 'creation' phase and that this should be a clear purpose of a university technology transfer office or incubation facility. While a great deal of work in this area is already undertaken it is important for such agencies to facilitate an understanding of, and improvement in, commercial skill sets through greater interaction with business through joint CPD programmes, internships and secondments.

The role of networks in enhancing an entrepreneurial team's capabilities has been well documented in the literature relating to new ventures. For example, Chen (2003) and Tsai-Lung (2005) suggest that a new venture's relationship with various actors; consultants, universities, and other companies, support the acquisition of technological knowledge. In addition, Yli-Renko

et al. (2001) have indicated that, by exploiting business experience and market knowledge embedded in social networks, founders can enhance capabilities which support the commercialisation of products or services. Therefore, this paper indicates that, like other new ventures, entrepreneurial teams involved in university spin-offs can exploit social networks to improve their entrepreneurial strategy. Acknowledging this evidence, it is recommended that universities and policymakers develop and facilitate the development of social networks that integrate academia, entrepreneurs, industry experts, the public sector, and investors. Thus, creating forums to share knowledge and experience, and discuss, identify and exploit solutions for the challenges faced by spin-offs with limited experience or market legitimacy.

By embedding resource-based view and social network theory into university entrepreneurship studies this paper broadens the contexts in which this relevant theory can be applied. The current resource-based entrepreneurship studies have mostly focused on the capabilities of the spin-offs, but this paper has highlighted the important role of an entrepreneurial team's capabilities as a key resource. The strategy of an entrepreneurial team makes an important contribution to the success of pitch for seed capital. In part, this is achieved by exploiting the benefits of social networks which, over time, enhance the capabilities of entrepreneurial teams. Thus, this paper contributes to university entrepreneurship theory by identifying factors and processes that underpin the successful creation and development of university spin-offs. The model developed to predict the success of pitch for seed capital of university spin-offs before significant capital has been expended substantially benefits the members of an entrepreneurial team, supporters, resource suppliers, researchers, and public and university policy.

In particular, it has been suggested that early stage firm founders are often reluctant to admit the need to expand their capabilities and/or are uncertain about how best to acquire such capabilities (Baker and Nelson, 2005); this often leads to entrepreneurial capacity being constrained (Hughes *et al.*, 2007). This research suggests that the entrepreneurial teams of university spin-offs do have limited capabilities and networks which can be supplemented by university support. The results from our model suggest that key capability that requires enhancement is an entrepreneurial strategy.

Conclusion

This paper explores academic entrepreneurial teams to enrich our knowledge of the impact of capabilities and social networks of entrepreneurial teams have on the engagement of external supporters in seed investments. Resource-based view theory was employed to evaluate the capabilities of entrepreneurial teams and the conceptual model of Hoang and Antoncic (2003) to scrutinize the characteristics of social networks. The results from an examination of the sample of 181 Spanish university spin-offs demonstrate that by exploiting social networks an entrepreneurial team can shape its capabilities, which in turn improve its ability to access external seed investments.

While the findings from the study are robust, it is acknowledged that there are areas within the research process that could impinge upon the validity and reliability of the work. This study's sample size was restricted because of the limitation on the number of spin-offs from Spanish universities; nevertheless, this sample reflects 21% of all spin-offs in Spain between 2003 and 2010. The survey is also based upon a non-random sample as respondents were selected on the basis of their potential to provide the level of detail which could enhance our understanding of

the phenomena based upon the judgement of OTRI officers in Spain. In addition, the data was collected using an internet survey which has the potential to be misinterpreted but these issues were carefully explored during the pilot phase of the empirical work. It is also possible that respondents to the survey may exhibit a certain cognitive bias based on post-hoc rationalisation; they were asked to comment on the constructs of entrepreneurial capabilities and social networks of founding teams at the 'creation' phase, but were making these evaluations some time into the spin-off's development.

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APPENDIX A: Factor Loading

Reliving this spin-off's creation phase, evaluating these statements about relationships between your team and individuals, who you received advice or information related to process of your firm's incorporation, and among them, and evaluating these statements about what the founding team possessed (1: Not true...7: Very true).

Measures		Loadings	Cronbach's Alpha
Ties	We would share personal matters with them	0.804	0.840
	We might discuss family matters with them	0.918	
	We might ask them for advice about private matter	0.885	
Reputation	We generated a lot of enthusiasm	0.787	0.644
	We persevered until the task is finished	0.750	
	We liked to play with ideas	0.766	
Reciprocity	People were generally pair in dealings with us	0.776	0.805
	People were willing to do us a favour if asked	0.733	
	We did favours for each other from time to time	0.817	
	People patronized my business	0.900	

Trust			0.879
	We were dependable by these people	0.863	
	People would say that we are sincere	0.888	
	They would trust us with personal information about themselves	0.822	
	They would say that we are trustworthy	0.894	
Information Quality (<i>information used to be exchanged</i>)			0.926
	Their information was usually accurate	0.895	
	Their information was relevant	0.909	
	Their information was specific	0.887	
	Information from them was often	0.846	
	I quickly received their information	0.852	
Information Diversity (<i>information used to be exchanged</i>)			0.922
	Market data	0.812	
	Product design	0.874	
	Process design	0.863	
	Marketing know-how	0.853	
	Packaging design/technology	0.848	
	Management system and practices	0.838	
Entrepreneurial Technology			0.847
	Our products might replace numerous existing one	0.843	
	Might replace other technologies in the industry	0.784	
	Potential to generate large economic returns	0.821	
	A platform for variety of commercial applications	0.706	
	Developed products with considerable demand in market	0.808	
Organizational Viability			0.794
	Team's members were encouraged to improve working method	0.793	
	Team's members had power to make decisions	0.740	
	Rewards and reinforcement were used	0.824	
	Individuals had time to incubate innovative ideas	0.674	
	Training in working techniques and attitudes was major emphasis	0.668	
Human Capital			0.829
	Good business management knowledge	0.737	
	Good industrial experience	0.710	
	Good entrepreneurial experience	0.792	
Strategy			0.758
	Strong emphasis on R&D, technological leadership, and innovation	0.746	
	The first to introduce new products and services, administrative technologies, etc...	0.708	
	Strong tendency to be ahead of other competitors in introducing novel ideals and products	0.803	
	The team was very aggressive and intensely competitive	0.653	
Commercial Resource			0.737
	Good plan to redesign management process	0.823	
	Good plan to redesign marketing and sales process	0.860	
	Improving company processes as a key of our business plan	0.747	

APPENDIX B: Reliability and validity tests

	Construct Reliability (CR)	Average Variance Extracted (AVE)	Squared Interconstruct Correlation (SIC)
Social Network			
Ties	0.9033	0.7575	0.01;0.15;0.09;
Reputation	0.8116	0.5895	0.18;0.28;0.06;
Reciprocity	0.8827	0.6542	0.06;0.03;0.001;
Trust	0.9238	0.7521	0.32;0.53;0.19;
Information Quality	0.9439	0.7711	0.13;0.10;0.25
Information Diversity	0.9390	0.7195	
Capabilities			
Entrepreneurial Technology	0.8946	0.6301	0.085;0.03;
Organizational Viability	0.8591	0.5512	0.21;0.14;
Human Capital	0.7909	0.5582	0.04;0.24;
Strategy	0.8190	0.5322	0.06;0.08;
Commercial Resource	0.9364	0.6583	0.05;0.22