

# Early-stage Fundraising of University Spin-offs: A Study through Demand-site Perspectives

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University spin-offs have increasingly received attention from academia, governments, and policymakers. However, the limited number of studies in understanding of the contribution made by the capabilities and social networks of a founding team to its fundraising ability still remains, especially within university spin-off context. Employing resource-based view theory and social networks approach, this paper enriches the knowledge of how a founding team exploits its social networks and capabilities to signal the value of a university spin-off. Capabilities are analysed through a set of constructs, technology, strategy, human capital, organizational viability, and commercial resource that have been derived from previous literatures. The contribution made by social networks is evaluated using three dimensions, structure, governance and content that form the construct of relationships within a network. Based on data from 181 university spin-offs in Spain, this paper empirically demonstrates that by exploiting social networks a founding team can improve its capabilities, which in turn enhance its fundraising ability.

**Keywords:** University spin-offs; fundraising; founding teams; resource-based view; social networks

## Introduction

University spin-offs have increasingly received attention from academia, governments, and policymakers in studying financing policies (Wonglimpiyarat, 2006, 2013), venture capital investment decision making (Aouni et al., 2013), the roles of venture capitalist in the development of new ventures (Paik and Woo, 2013), and the contributions of entrepreneur's social capital to the fundraising activities (Ozmel et al., 2013). However, it is still recognised that early-stage fundraising is a major issue of university spin-offs to develop their inventions and knowledge into practical applications (Lindstrom and Olofsson, 2001; Widding et al., 2009). 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). Thus, studying the financing activities of the university spin-offs requires more attention from both research and policy makers. In their theoretical review, Rasmussen and Sørheim (2012) found that previous studies emphasise the roles of financial supporters for funding in both early-stage and later stages of development of new ventures. However, most of current research studying the early-stage fundraising of new ventures (included spin-offs) has been oriented towards supply side (the investors) (Lindstrom and Olofsson, 2001) despite the fact that the issues from the demand sides (Murray, 1999) significantly impact the business development, which eventually determents investment returns. Thus, the first distinction between this study and others is it focuses on demand-side perspectives, particularly, the founding teams of university of spin-offs. It is due to new ventures are more likely to be created by founders plural, rather than singular (Gartner and Vesper, 1994), and that entrepreneurial teams are at the heart of any new venture have emerged (Cooper and Daily, 1997). Founding teams have become more popular and important modes of new business development (Kamm et al., 1990; Watson et al., 2003; Chandler et al., 2005; Cooney, 2005; Lasch et al., 2007); their importance also is

reflected in the prevalent insights from investors who constantly consider the quality of teams as an important funding criterion (Roure and Keeley, 1990; Zacharakis and Meyer, 1998; Meseri and Maital, 2001).

This study is also distinct from others by focussing on the early-stage fundraising of university spin-offs, which face a fundamentally deferent set of challenges due to the context in which they were created (Vohora et al., 2004a). A university spin-off is characterised by highly innovative products/services that are new and unique to the market (Heirman and Clarysse, 2004). However, performance of these spin-offs is comparatively poor compared to other new ventures because founding teams 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). It leads to the fact that there is a sceptic from investors about the success of spin-offs (Clarysse and Moray, 2004). To offset these limitations the university sector will often provide ideas with commercial potential a supportive incubation period within their host institution (Clarysse and Moray, 2004) that creates an artificial time lag between idea generation and company formation. The time lag not only creates an opportunity to fine tune the idea but also to change the structure and composition of the founding team before incorporation (Vanaelst et al., 2006). Changes to the structure are often necessary because typically the technological founders exhibit less commitment to the commercialisation of the idea, have lower growth aspirations (Clarysse and Moray, 2004; Vanaelst et al., 2006) and view themselves more as part-time entrepreneurs (Müller, 2010). The time lag therefore allows an opportunity to balance the founding team of the university spin-off through the introduction of individuals with more commercial experience, particularly in the market segments targeted by the spin-off (Vohora et al., 2004b; Filatotchev et al., 2006; Wennberg et al., 2011; Visintin and Pittino, 2014).

Finally, this paper is distinctive compared with others by studying the unobservable elements (i.e. the capabilities and social networks of founding teams) signalling the value of university spin-offs. In particular, the paper, inspired by the idea of focusing on demand-side perspectives, will examine empirically some fundamental questions to contribute to the theory-based understanding of the early-stage fundraising of university spin-offs: How can a founding team exploit its social networks to signal the value of a university spin-off to improve the chance of obtaining early-stage funds? How can a founding team use its capabilities to signal the value of a university spin-off to improve the chance of obtaining early-stage funds? To address these questions and strengthen the theoretical and empirical foundation of university spin-off studies, the paper adopts a resource-based view to measure the capabilities of founding teams under the perspectives of entrepreneurial technology, strategy, human capital, organizational viability, and commercial resources, and social capital theory to analyse the networks of founding teams through three dimensions: structure, governance and content. These characteristics will be analysed against the returning and new investments of university spin-offs. Moreover, signalling theory will be employed to develop and test a theoretical framework linking the early-stage fundraising of university spin-offs to both capabilities and social networks of the founding 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 a founding team and responses were obtained from the members of founding teams. The findings indicate that the capabilities of founding teams affect the early-stage fundraising of university spin-offs, but fail to demonstrate the relationships between early-stage fundraising and the social networks of founding teams.

### **Early-stage fundraising and financial market imperfections**

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 process model from studies of Shane (2004) and Vohora et al. (2004a), the seed capital is typically provided by the host institution or public funding sources to support the research activities and develop the initial business concept. 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. However, this paper solely considers early-stage fundraising as the financing activities of spin-offs to fulfil the early-growth financial needs. 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 new ventures (Rosman and O'Neill, 1993). Thus, founding teams must choose to explore suitable financial sources within the capital market depending upon the growth goals, the nature of ownership, firm size, and sector of the spin-offs (Riding et al., 2012).

Financial supporters in early-stage are classified into existing investors (returning investors) who provided seed capital to create university spin-offs and potential investors (new investors) whose may invest to spin-offs in the future (Cooper et al., 1994; Greene and Brown, 1997; Harrison and Mason, 2000; Shane, 2004). Lindstrom and Olofsson (2001) suggested that while these financial sources are available, how to access them has become a key challenge for early-stage spin-offs 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 that affect the investment decisions of the investors. Second, the university spin-offs, in themselves, have the limited collateral value because they have little salvage values in the event of failure. Third, it is difficult for financial providers to evaluate and frequently embody new knowledge because of the information asymmetry between university spin-offs and potential investors. Founding teams and investors unequally access to the information about the spin-offs leading to the absence of perfect information (Certo, 2003). In fact, founding teams possess more inside information about the true intentions, planned activities, and value of the firms than outside investors (Amit et al., 1990; 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 a new venture 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 (Cable and Shane, 1997; Cumming and Johan, 2008). Thus, to surmount the effects of capital market imperfections, this paper proposes that founding teams could provide relevant information signalling that university spin-offs have wealth creating potential to attract more financial supporters.

### **Social networks of founding teams**

The quality of a founding 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., 2004a). A social network includes single nodes (actors) and linkages between these nodes (dyads), and is "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). The analysis divides the network into three components structure, governance, and content as suggested by Amit and Zott (2001) and Hoang and Antoncic (2003). Network structure has referred to the properties of connections and personal configurations of relationships among actors (Granovetter, 1973; Burt, 1987). The absence and presence of network ties, network configurations,

and network morphology are the most important facets of the structural dimension (Tichy et al., 1979) and these facets describe the pattern of relationships as density, connectivity, and hierarchy (Amit and Zott, 2001). Network governance is defined as mechanisms that govern the relationships among actors, the legal forms of actors, and the incentives for participations within networks. These mechanisms based upon power, influence, reputation, relationship reciprocity, and trust support the network sustainability more than legal enforcement (Amit and Zott, 2001). Content within a network refers to exchanging resources (Amit and Zott, 2001); such resources can be ideas, information, and advice (Smeltzer et al., 1991) or more esoteric, emotional support for entrepreneurs willing to take risks increasing their persistence to remain in business (Gimeno et al., 1997; Bruderl and Preisendorfer, 1998).

Founding teams have the capacity to exploit links with industrial sectors to support the development of commercial (Dubini and Aldrich, 1991), management and leadership expertise (Rothschild and Darr, 2005; Kitagawa and Robertson, 2012). It 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 a founding team will have to access the resource available within the network (Newbert and Tornikoski, 2013). Interconnectedness is often a function of an actor's position within the network and founding 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 founding 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 founding 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 a founding 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 a founding 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 founding teams may access critical resources at below-market cost thanks to their relationships with resource gatekeepers (Larson and Starr, 1993; Hite, 2005; 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 (Rothschild and Darr, 2005; Kitagawa and Robertson, 2012), technology (Lockett and Wright, 2005), appropriate staff (Davidsson and Honig, 2003; Rothaermel and Deeds, 2006; Tolstoy and Agndal, 2010) and emotional support (Gimeno et al., 1997; Bruderl and Preisendorfer, 1998). 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 (Zucker et al., 2002; Patton and Marlow, 2011; Kitagawa and Robertson, 2012). The value of networks to a spin-off depends upon the collective activities of the founding team and university support mechanisms to identify, acquire and exploit appropriate relationships (Chandler and Lyon, 2009; Wiklund and Shepherd, 2009). For the reasons identified, this paper proposes that the social networks of founding teams, developed in

conjunction with university support, can provide an important contribution to the resource and knowledge acquisitions of founding teams.

*H1: A founding team of a university spin-off can improve its capabilities by exploiting social networks*

Nofsinger and Wang (2011) argued that founding 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 founding teams (Uzzi, 1996; Freiburg and Grichnik, 2012). 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 (Kreps, 1997; 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 (Lee and Venkataraman, 2006; Carpentier et al., 2010). Social relationships allow potential investors to obtain private information about the talents and tendencies of members of founding teams (Nofsinger and Wang, 2011), and resolve some moral hazard issues (Shane and Cable, 2002). By associating with well-regarded individuals and organizations, founding teams are able to increase their reputation determined by the information about past performance of the members of founding teams to attract and convince more investors of their business projects (Podolny, 1994). Social networks also leverage the trust between founding teams and financial providers (Kautonen et al., 2010) eventually positively influence the investment decision.

*H2: The social networks of founding teams leverage the early-stage fundraising of university spin-offs*

### **Capabilities of founding teams**

Vohora et al. (2004a) have 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, for the purpose of this paper, 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 (Tushman and Anderson, 1986; 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 are 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 (Hornsby et al., 1993; Zahra, 1993). The human capital construct is measured through the levels of education and experience available within the management team (Alvarez and Busenitz, 2001; McKelvie and Davidsson, 2009). Measures of proactiveness, innovativeness, risk-taking and competitive aggressiveness (Lumpkin and Dess, 1996; Dess et al., 1997) are employed to measure entrepreneurial strategy-making. A firm's commercial resources are represented by the quality of bespoke relationships with customers (Powell and DentMicallef, 1997; Nadherny, 1998), these trusting and value enhancing relationships require complex coordination and communication skills to create and maintain (Hall, 1993).

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 founding 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 founding 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 founding 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 early-stage fundraising ability of university spin-offs.

*H3: The capabilities of founding teams influence the early-stage fundraising of university spin-offs.*

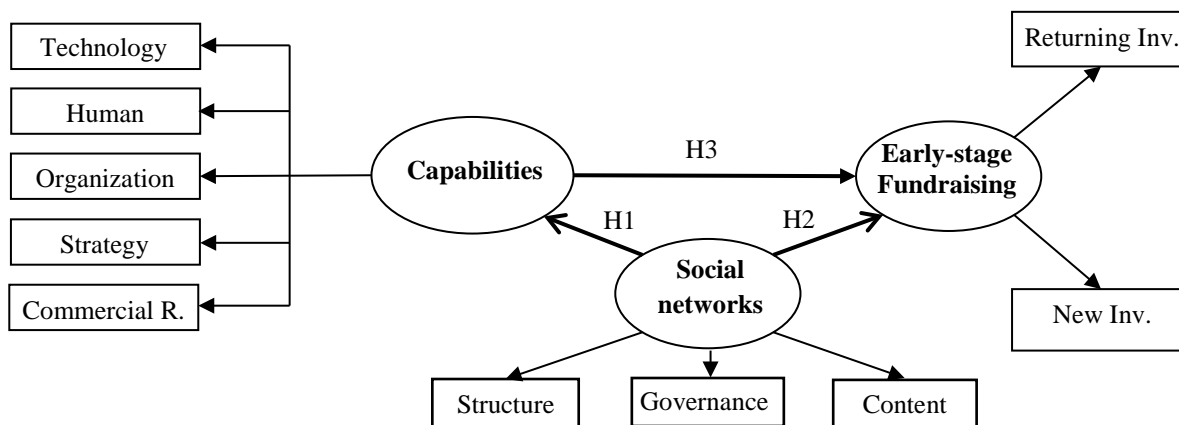


Figure 1. Conceptual model

## METHODS

### Sample and data collection

We draw 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 the public or private universities within the first Spanish National Plan of R&D 1988-1999 to enhance the relationships between the scientific world and productive sectors. OTRI's engage in a wide range of R&D activities but only 35 are involved in the creation and development of spin-offs. While university spin-offs can be created by individuals or teams those spin-offs participating in this research were created by teams that included at least one academic member from a university.

With the help of the OTRIs, a database of 862 spin-offs was conducted from which 181 responses were received (21 per cent of research population) from a web-based survey. All respondents were members of the founding teams 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 inside university

incubators, and after 2003; 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.

## **Measurements**

To ensure the content validity of measurements, this study uses questions that employ seven-point Likert scales from existing entrepreneurship and management studies (Tsai and Ghoshal, 1998; Antoncic and Hisrich, 2001), and requires respondents to self-report on a variety of issues that relate to a founding team's capabilities and social networks during the creation phase against the early-stage fundraising ability of its university spin-off.

### *Early-stage financial sources*

The study employs the suggestions of Shane (2004), Harrison and Mason (2000) and Greene and Brown (1997) to construct the early-stage fundraising measurements including returning investors (private investors or angels, venture capitalists, government grants, and strategic partners), and new investors (initial public offering, employees, and customers).

### *Capabilities*

The capability construct is derived from previous research (McGrath, 1997; Antoncic and Hisrich, 2001; Lumpkin and Dess, 2001) and employs measures for entrepreneurial technology, organizational viability, human capital, strategy, and the commercial resource of founding teams. More specifically, in terms of technology, respondents must answer six questions about the ease of imitation, scope, continuity, and the market signals of their entrepreneurial technology (McGrath, 1997). To measure the organizational viability, we adapt the measurements from studies of Leonard-Barton (1992), Zahra (1993) and Antoncic and Hisrich (2001) to construct five questions that relate to the internal communication mechanisms, formal control mechanisms and organizational support within founding teams during the creation period. To measure human capital, four-item measurement evaluating the industrial, managerial and entrepreneurial experience adapted from the studies of Alvarez and Busenitz (2001) and McKelvie and Davidsson (2009) is used. Questions investigating the notions of innovation, proactiveness, risk-taking, and competitive aggressiveness (Covin and Slevin, 1989; Lumpkin and Dess, 2001) were employed to constitute the entrepreneurial strategy-making measurement. Finally, four questions based on the customer relationship, staff's technology training, and process design were used to measure the commercial resource founding teams (Powell and DentMicallef, 1997; Nadherny, 1998).

### *Social networks*

By adapting prior management research, eight social network measurements are constructed in the areas of: ties, density, centrality, reputation, reciprocity, trust, information quality and diversity. The strength of founding-team's ties is measured by constructs that look at the willingness to engage in discussions that relate to social, political, and family matters (Marsden and Campbell, 1984; Parks and Floyd, 1996). The density of a network is measured by three-item scales evaluating interactions within networks (Marsden, 1993). Centrality is based on the measurements of Rowley (1997) that evaluate the location of actors within information flows using four questions about how directly respondents communicate with others within networks. To measure the quality of information within social networks, five questions developed by O'Reilly III (1982) are employed which evaluate the accuracy, relevance, reliability, specificity, and timeliness of information. The degree of availability of business relevant information will be used to measure the diversity of information within networks: market data, product designs, process designs, marketing know-how, and packaging design or technology (Gupta and Govindarajan,

2000). Furthermore, we measure trust by four questions, which require respondents to self-report on how trustworthy they are perceived in 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 is constructed to obtain the views of other participants within networks. Reciprocity is measured by four questions regarding to the level of support, 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 founding 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 early-stage fundraising ability of a spin-off created outside the university's 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 which resulted in the survey being to avoid potential question confusion by respondents. 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 social network, capability, and early-stage fundraising factors are unlikely to be caused by this 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. The results prove that research's measurements are both valid and reliable (see Appendix 2).

## RESULTS

### Model estimation and fit

First, exploratory factor analysis (EFA) is used to construct the research indicators. The results from the EFA of network structure model revealed that item loadings were mostly significant (over 0.5) and the four items that had loadings under 0.5, trust, information quality and diversity, and strategy factors that loadings were removed. The EFA is not considered as a sufficient method to evaluate the dimensions because it cannot test the models with higher-order factors (Rubio et al., 2001). Therefore, in this study, we will utilize first-order confirmatory factor analysis (CFA) to construct the lower-order factors, and the second-order CFA to construct the higher-order factors by applying the AMOS program. The research employs CFA based on the maximum likelihood method to test the hypotheses as the normality test revealed that all of the observed variables have significant kurtosis and skewness p-values, and the relative multivariate kurtosis is within an acceptable range (1.036). Moreover, the sample size, 181, is more than the minimum requirement for the CFA (The models with latent variables require at least 150 observations for normal distribution with no missing data) (Muthen and Muthen, 2002).

However, in a CFA model with fewer than 200 observations, a goodness-of-fit (GFI) test must be used (Barrett, 2007), for this purpose a combination of the ratio chi-square/degrees of freedom (CMIN/DF<3), RMSEA (<0.08), GFI (>0.9), NFI (0.9), and CFI (0.9) is employed to test the model (Ping Jr, 2004).



Before constructing our structural model, the average scores of eight first-order factors of social networks are estimated by using all items identified from the first-order CFA of structure, governance, and content models. The first-order CFA results from the social network model revealed an acceptable fit and all factor loadings (Density, centrality, tie, reputation, reciprocity, trust, and quality and diversity of information) are significant at 0.01 levels (Table 1). The results also demonstrate that these structure, governance, and content factors are valid and reliable ( $CR > 0.7$  and  $AVE > 0.5 > SIC$ ) to indicate the social network variable. Thus, these factors can be used as observed variables that construct the social network endogenous latent variable.

Table 1: First-order CFA of Social Network Model

Paths	Loadings	CR	AVE
Network Structure →		0.7678	0.5249
Density	0.756**		
Centrality	0.739**		
Ties	0.676**		
Network Governance →		0.7776	0.5416
Reputation	0.621**		
Reciprocity	0.829**		
Trust	0.743**		
Network Content →		0.7219	0.5650
Information quality	0.736**		
Information diversity	0.767**		
Model fit (CMIN/DF=1.416, RMSEA=0.048, NFI=0.946, CFI=0.980, GFI=0.961)			
** Loading significant at the 0.01 level			

Second, we compute the average scores of the other seven first-order factors: Technology, organizational viability, human capital, strategy, commercial resource, and returning and new investors from first-order CFA of capability and early-stage fundraising factors. In combining these factors with three social network variables, it is possible to construct a measurement model. The first-order CFA of the measurement model revealed an excellent fit (the ratio chi-square/degrees of freedom is smaller than two; RMSEA is smaller than 0.8; and all fit indexes are greater than 0.9) (Table 2). Moreover, the factor loadings are greater than 0.5 and significant at 0.01 levels, and  $CR > 0.7$  and  $AVE > 0.5 > SIC$  leading to a conclusion that the construct passes the validity and reliability tests. Thus, all constructs are adequate for use to test the research hypotheses.

Table 2: First-order CFA of Measurement Model

Paths	Loadings	CR	AVE
Social Network →		0.9196	0.7930
Structure	0.904**		
Governance	0.799**		
Content	0.961**		
Capability →		0.8436	0.5292
Technology	0.682**		
Organizational Viability	0.821**		
Human Capital	0.520**		
Strategy	0.915**		
Commercial Resource	0.725**		

Early-stage financing →		0.8894	0.8027
Returning investors	0.989**		
Potential investors	0.792**		
Model fit (CMIN/DF=1.186, RMSEA=0.032, NFI=0.940, CFI=0.990, GFI=0.945)			
** Loading significant at the 0.01 level			

The result from null model test reveal that the goodness-of-fit is not acceptable (CMIN/DF=13.402) leading to a rejection of null model in which no relationships are posited. The analysis results of hypothesized model (figure 2) also reveal an acceptable goodness-of-fit (CMIN/DF=1.324, RMSEA=0.042, NFI=0.931, CFI=0.982, and GFI=0.938), thus it is appropriate to test hypotheses 1, 2, and 3 with research data.

### Hypothesis tests

Hypothesis 1 states that social networks of founding teams positively affect their capabilities. The results indicate that the path between social networks and capabilities is positive and significant (0.291,  $p < 0.01$ ) leading to a conclusion that hypothesis 1 is supported. The results reveal that the relationship between the social networks of a founding team and its early-stage fundraising ability is not significant (0.133,  $p > 0.05$ ) leading to a rejection of hypothesis 2. Hypothesis 3, that the capabilities of a founding team positively influence its early-stage fundraising ability (0.142,  $p < 0.05$ ), is also supported (Figure 2). To understand how a founding team can exploit its social networks to improve its capabilities and enhance its early-stage fundraising ability, the indirect paths of this model then will be analysed.

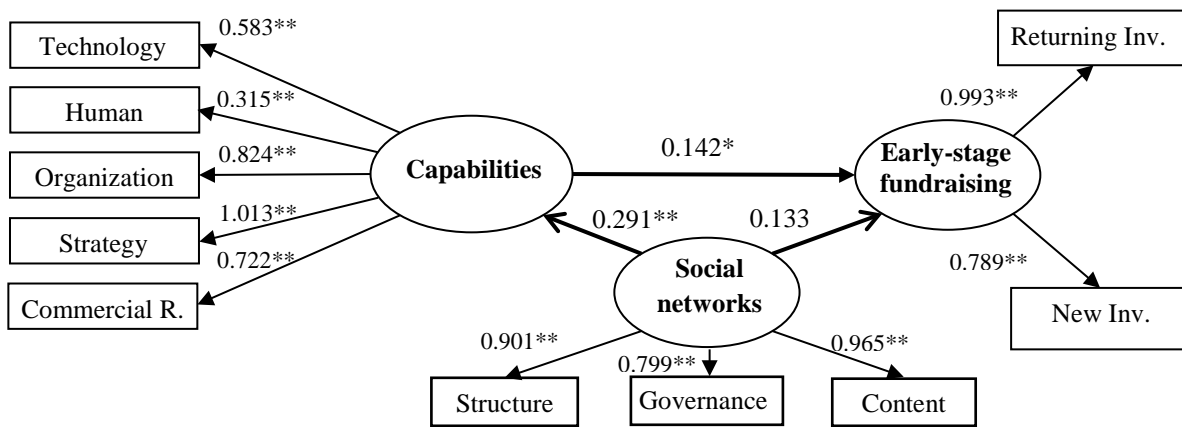


Figure 2. Result model (\*\* denotes  $p < 0.01$ , \* denotes  $p < 0.05$ , all error terms omitted for

The results (Table 3) suggest that social networks are likely to exert indirect influences on all aspects of capabilities, but fail to prove the indirect effects of social networks have on returning investor and new investor factors. Social networks, consistent with hypothesis 1 appear to influence positively and significantly capabilities with respect to technology (0.265,  $p < 0.01$ ), organizational viability (0.320,  $p < 0.01$ ), human capital (0.185,  $p < 0.01$ ), strategy (0.362,  $p < 0.01$ ), and commercial resource (0.362,  $p < 0.01$ ). Capability appears to have significant positive indirect effects on the returning investor and new investor factors of early-stage fundraising ability (0.184, 0.196,  $p < 0.01$ ) (see table 3).

Table 3: Path analysis results: Direct and indirect effects

Paths	Standardised Direct Effects	Standardised Indirect Effects
Social Network ↔ Capability	0.198**	
Social Network → Early-stage Fundraising	0.166	
Capability → Early-stage Fundraising	0.184*	
Social Network → Early-stage Fundraising		0.067
Social Network → Existing Investors		0.067
Social Network → Potential Investors		0.071
Capability → Returning Investors		0.184**
Capability → New Investors		0.196**
Social Network → Entrepreneurial Technology		0.265**
Social Network → Organizational Viability		0.320**
Social Network → Human Capital		0.185**
Social Network → Strategy		0.362**
Social Network → Commercial Resource		0.362**
<i>Control</i>		
Within incubator → Early-stage Financing	0.191	

\*\* denotes  $p < 0.01$ ; \* denotes  $p < 0.05$ ; Two Tailed significance 0.

From the above results, we construct a mediation model that considers the mediate role of a team's capabilities between its social networks and early-stage fundraising. In other words, founding teams exploit their social networks to improve their capabilities during start-up and subsequently enhance their early-stage financing activities (Figure 3).

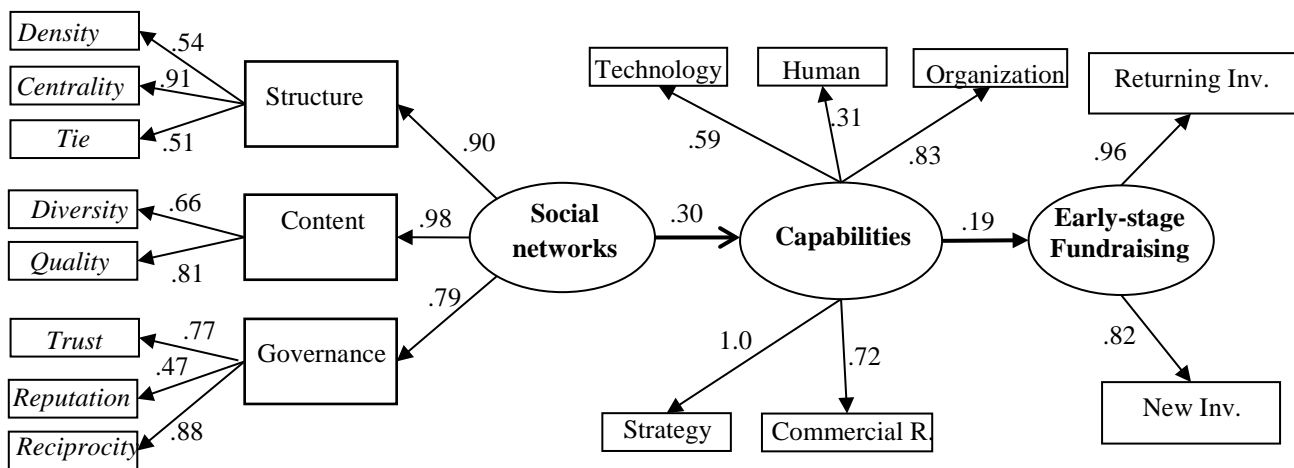


Figure 3. Optimal model (All estimates are significant at the 0.01 level, all error terms omitted for clarity)  
(Model Fit: CMIN/DF=1.337, RMSEA=0.043, NFI=0.930, CFI=0.981, and GFI=0.936)

#### Control Variables

All spin-offs in this study were created by academic teams and received support from their universities. Moreover, a spin-off's created location (within universities' incubators) does not significantly influence its early-stage fundraising (Table 3). Thus, these control variables do not affect the analysis of relationships among founding team's social network and capability, and early-stage fundraising factors.

## DISCUSSIONS

This paper investigates the impact on early-stage fundraising spin-offs as a consequence of the capabilities and social networks exhibited by founding teams associated with their creation and development. Previous literatures have focused upon new ventures in general (Zahra et al., 2006) and on the impact of the capabilities and social network associated with the new venture not the founding teams (Walter et al., 2006). The research is distinctive in its focus upon university spin-offs, the use of teams as the unit of analysis, and scrutinising the early-stage fundraising of university spin-offs through their founding team's perspectives. This research posited that the capabilities and social networks of a founding team would be positively related to improvements of early-stage fundraising ability of a university spin-off, this hypothesis was tested on survey data from 181 spin-offs of 35 universities in Spain. 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 to access early-stage financial resources. However, we could not find a significant direct relationship between the social networks of a founding team and its early-stage fundraising. Further, we found support for a mediating role of capabilities between social networks and spin-off's early-stage fundraising.

The ability to improve a founding team's capabilities through the deployment of their own social networks to support the development of university spin-offs is supported by research undertaken on new ventures per se (Chen, 2003; Tsai-Lung, 2005). Both authors suggest that a new venture's relationship with various actors (i.e. consultants, universities, and other companies) support the acquisition of technological knowledge. Deakins (1996) identified that information and knowledge, received and learned from social networks, also improve capability which, in turn, helps to enhance organisational viability. In addition, Yli-Renko et al. (2001) indicated that, by exploiting business experience and market knowledge achieved from social networks, founders can build their commercial resources to allow them to commercialise their products or services. Therefore, this paper indicates that, like other new ventures, founding teams involved in university spin-offs can exploit social networks to improve their capabilities. Acknowledging this evidence, universities should support networking activities with industries through events, practical courses, and research projects involving both academia and businessmen. These activities will stimulate the exchange of information and create relationships that benefit the spin-off activities of universities in the future.

This study therefore agrees with previous literature (Shane, 2004; Vohora et al., 2004a; Mustar et al., 2006), in recommending that university spin-offs, like generic new ventures, create founding teams that are in receipt of the necessary capabilities or are able to call upon their wider social networks to enhance existing capabilities. To support these requirements, it is recommended that universities and policymakers develop and facilitate entrepreneurial communities that integrate academia, entrepreneurs, experts from industries, the public sector, and investors. It is suggested that these communities are established to share knowledge and experience, and discuss, identify and exploit solutions for potential challenges in entrepreneurship.

The empirical tests reveal that the early-stage fundraising ability of university spin-offs can be improved by showing the capabilities of founding teams considered as signals of value to investors. This result supports the findings of Chen et al. (2009), Rasmussen and Sørheim (2012), and Miloud et al. (2012) toward the role of signals

in the investment decision of venture capitalists. These signals are utilised to convince the investors that their investments is profitable with acceptable risks. These results support the findings of many scholars who concluded: the resources of entrepreneurs improve the financing ability of new ventures (Deeds et al., 1997; Chandler and Hanks, 1998), and the importance of human capital in early-stage financing of new ventures (Osnabrugge, 2000; Paul et al., 2007; Brush et al., 2012). However, the results contradict the findings of Lindstrom and Olofsson (2001) which shows that lower-technological firms experience less problems in early-stage financing than technology-forefront ventures, and Cassar (2004) who indicates that investors do not account the education and experience of entrepreneurs as financing preferences.

This study found that the social networks of founding teams during creation phase, generically, do not directly relate to the early-stage fundraising ability of university spin-offs. It partially contradicts the results of prior scholars (Batjargal, 2007; Heuven and Groen, 2012; Rasmussen and Sørheim, 2012; Mahto and Khanin, 2013) who emphasised the important role of social networks of founders in the early-stage financing processes of new ventures. For instances, they indicated that the founders of new ventures can quickly access to public or private financial resources by utilising their reputation (Mahto and Khanin, 2013), and strength of their network ties (Jenssen and Koenig, 2002; Shane and Cable, 2002; Shane and Stuart, 2002; Batjargal, 2007; Heuven and Groen, 2012).

## CONCLUTIONS

In general, this research strengthens the roles of capabilities of founding teams in early-stage fundraising, and recognises the indirect influences of the teams' social networks in decreasing the problems of uncertainty and asymmetric information in the fundraising processes of university spin-offs. Therefore, academic entrepreneurs are recommended to identify their existing abilities, and determine which capabilities they need to improve to form capable teams, which possess technology, management, and industry knowledge by learning from or employing external resources. Moreover, universities and authorities are suggested to be involved in activities which support the founding teams of university spin-offs to enhance their capabilities. Universities can encourage staff and students to improve entrepreneurial and managerial skills through relevant seminars, conferences, and additional courses. Universities and authorities should also support spin-off activities by establishing 'incubators', institutions, and mentoring boards to provide low cost facilities, services (i.e. R&D, products' development, marketing, recruitment, accounting, and legality), and executive advice.

The existing network-based entrepreneurship literature have mostly employed ego network analysis which takes as its focus network structure; this study takes a more holistic view and analyses three dimensions of social networks: structure, governance, and content. The results of the quantitative analysis demonstrated that measurements are valid and reliable to determine the roles of social networks in an entrepreneurship process. Thus, this paper consolidates the validity of the network approach method not only in entrepreneurship studies but also in networks-based management research. By embedding capability 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 spin-offs, but this paper has delighted the important role of a founding team's capabilities. The capabilities of a founding team comprising technology, human capital, organizational viability, strategy, and commercial resource make an important contribution to the early-stage investment decisions of external investors. In part, this is achieved by exploiting the benefits of social networks which, over time, make a significant contribution to the capabilities of the founding team. It is this enhancement of existing capabilities through the exploitation of social networks which

supports signalling the value of university spin-offs. Thus, this paper enriches university entrepreneurship theory by identifying factors and processes that underpin the successful creation and development of university spin-offs.

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. In comparing to the requirement of SEM, 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. 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 certain cognitive bias based on post-hoc rationalisation; they were asked to comment on the constructs of capabilities and social networks of founding teams at start-up, but were making these evaluations some time later in the spin-off's development. To address this, the research tested Harman's one-factor on all variables and the result showed that this issue does not affect the overall finding of the study.

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APPENDIX 1: Means, standard deviation, ranges, and correlations for variables in the measurement model

Variables															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
(1) Density															
(2) Centrality	.503**														
(3) Ties	.294**	.445**													
(4) Reputation	.087	.344**	.110												
(5) Reciprocity	.297**	.643**	.351**	.400**											
(6) Trust	.279**	.612**	.254**	.410**	.677**										
(7) Info Quality	.353**	.652**	.417**	.279**	.692**	.395**									
(8) Info Diversity	.371**	.496**	.517**	.036	.449**	.318**	.564**								
(9) Entrepreneur Technology	.042	.161*	.109	.082	.182*	.171*	.149*	.215**							
(10) Organizational Viability	.070	.289**	.189*	.254**	.268**	.270**	.314**	.272**	.388**						
(11) Human Capital	.028	.156*	.150*	.136	.162*	.162*	.070	.201**	.190*	.393**					
(12) Strategy	.050	.225**	.155*	.217**	.193**	.241**	.211**	.256**	.589**	.835**	.289**				
(13) Commercial Resource	.123	.160*	.035	.215**	.120	.134	.158*	.197**	.553**	.558**	.333**	.729**			
(14) Returning Investors	.011	.167*	.012	-.024	.198**	.170*	.119	.119	.154*	.160*	.027	.186*	.154*		
(15) New Investors	.023	.108	-.006	.003	.119	.145	.095	.055	.178*	.106	-.061	.159*	.095	.784**	
Mean	4.03	4.83	3.51	3.53	5.82	5.68	4.03	3.45	5.58	5.76	5.10	5.14	5.63	2.01	2.39
S.D.	1.77	.89	1.63	.36	.89	.69	1.01	1.27	1.13	.97	1.50	.90	1.25	.93	1.15
Min.	.30	1.95	1.08	2.25	2.82	2.74	.83	.82	1.77	2.43	1.66	1.67	1.63	.89	1.00
Max.	6.78	6.13	6.14	4.08	7.05	6.39	5.74	6.69	7.32	7.53	8.25	6.81	8.06	4.41	5.44

\*. Correlation is significant at the 0.05 level (2-tailed).

\*\* . Correlation is significant at the 0.01 level (2-tailed).

## APPENDIX 2: Validity and Reliability

### *Convergent validity*

We construct the CFA of sixteen first-order factors: density, centrality, tie, reputation, reciprocity, trust, information quality, information diversity, technology, organizational viability, human capital, strategy, commercial resource, and returning and new investors. These factors indicate five second-order variables: structure, governance and content of networks, capability, and early-stage financing. The results revealed that both first- and second-order CFA of measurement models are acceptable fit, and each item loads on a single factor and is significant at 0.01 levels (Table 1).

To assess convergent validity, the extent to which the indicators of measurement converge to a high proportion of variances in common, we examine construct loadings and average variance extracted. The results from the first-order CFA of social network, capability, and spin-off's fundraising models reveal that all standardized loadings estimates are higher than 0.5 (Table 1). Moreover, all indexes of average variance extracted (AVE), the amount of construct variance relative to measurement error, are greater than 0.5 (Table 2) suggesting adequate convergent validity.

### *Discriminant 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) (Table 2) inferring discriminant validity of the hypothesized structure are supported by our data.

### *Reliability*

We compute the composite reliability, analogous to Cronbach's alpha, of all first-order factors by the formula of Fornell and Larcker (1981). Most factors revealed sufficient composite reliabilities (above 0.70) except the reputation (0.632) and new investor factors (0.668) (Table 2). However, according to Hatcher (1994), the cut-off level of 0.6 is acceptable for a new conceptual variable. Thus, the measurements of this research are reliable.

Table 1: Factor Loading of CFA

### SOCIAL NETWORK

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

Measures		First order loadings	Second order loadings
Structure			
Density			0.769**
	Knowing each other by name	0.688**	
	Talking to each other about business	0.941**	
	Seeing each other regularly in business situations	0.933**	
Centrality			0.797**
	We talked directly about business issues	0.67**	
	We received directly helpful business information	0.712**	
	We could call for advice about running our business	0.697**	
	We were the first to receive new things in the group	0.781**	
Ties			0.681*

	We would share personal matters with them	0.663**	
	We might discuss family matters with them	0.917**	
	We might ask them for advice about private matter	0.832**	
Governance Reputation			0.627**
	We generated a lot of enthusiasm	0.711**	
	We had a forgiving nature	0.604**	
	We persevered until the task is finished	0.742**	
	We liked to play with ideas	0.775**	
Reciprocity			0.755**
	People were generally fair in dealings with us	0.759**	
	People were willing to do us a favour if asked	0.598**	
	We did favours for each other from time to time	0.762**	
	People patronized my business	0.87**	
Trust			0.826**
	We were dependable by these people	0.888**	
	People would say that we are sincere	0.917**	
	They would say that we are trustworthy	0.604**	
Content Infor. Quality			
	Their information was usually accurate	0.878**	
	Their information was relevant	0.916**	
	Their information was specific	0.859**	
	I quickly received their information	0.777**	
Diversity Infor. (information used to be exchanged)	Market data	0.782**	
	Product design	0.913**	
	Process design	0.854**	
	Marketing know-how	0.75**	
	Packaging design/technology	0.744**	

- Structure model (CMIN/DF=1.269, RMSEA=0.039, NFI=0.961, CFI=0.991, GFI=0.964);  
- Governance model (CMIN/DF=1.149, RMSEA=0.029, NFI=0.950, CFI=0.993, GFI=0.963);  
- Content model (CMIN/DF=1.288, RMSEA=0.040, NFI=0.973, CFI=0.994, GFI=0.965);  
\* Loading significant at the 0.05 level; \*\* Loading significant at the 0.01 level

## CAPABILITIES

Reliving spin-off's creation period, evaluating these statements about what the founding team possessed (1: Not true...7: Very true).

	Measures	First order loadings	Second order loadings
Technology			0.685**
	Hard to make a substitute for the technology	0.686**	
	Our products might replace numerous existing one	0.78**	
	Might replace other technologies in the industry	0.729**	
	Potential to generate large economic returns	0.778**	
	A platform for variety of commercial applications	0.598**	
	Developed products with considerable demand in market	0.752**	
Organizational viability			0.743**
	Team's members were encouraged to improve working method	0.772**	
	Team's members had power to make decisions	0.770**	
	Rewards and reinforcement were used	0.690**	
	Individuals had time to incubate innovative ideas	0.600**	
		0.729**	

Human Capital	Training in working techniques and attitudes was major emphasis	0.605**	0.531**
		0.767**	
Strategy-making	Good working experience	0.712**	
	Good business management knowledge	0.856**	
	Good industrial experience		
	Good entrepreneurial experience	0.711**	0.923**
		0.793**	
Commercial resource	Strong emphasis on R&D, technological leadership, and innovation	0.751**	
	The first to introduce new products and services, administrative technologies, etc...	0.616**	
	Strong tendency to be ahead of other competitors in introducing novel ideals and products		
	Strong tendency for high-risk projects with chances of very high returns	0.605**	0.685**
	Building long-term customer relationships	0.767**	
	Good plan to redesign management process	0.712**	
	Good plan to redesign marketing and sales process	0.895**	
	Focusing on customer satisfaction		

Model fit (CMIN/DF=1.078, RMSEA=0.021, NFI=0.945, CFI=0.990, GFI=0.915)

\* Loading significant at the 0.05 level; \*\* Loading significant at the 0.01 level

#### EARLY-STAGE FINANCING

Describing how easy your new firm could access to these financial sources right after it was established (1: Much more difficult...7: Much easier).

Measures		First order loadings	Second order loadings
Returning investors			
	Private investors/ angels	0.767**	
	Venture capital	0.784**	
	Government grants	0.693**	
	Strategic partners	0.627**	
New investors			
	Initial public offering	0.741**	
	Employees	0.685**	
	Customers	0.711**	

Model fit (CMIN/DF=1.415, RMSEA=0.048, NFI=0.953, CFI=0.985, GFI=0.978)

\* Loading significant at the 0.05 level; \*\* Loading significant at the 0.01 level

Table 2: Reliability and validity tests

	Construct Reliability (CR)	Composite Reliability <sup>a</sup>	Average Variance Extracted (AVE)	Squared Interconstruct Correlation (SIC)
<b>Social Network</b>				
Structure	0.7940		0.5634	
Density	0.8949	0.888	0.7431	0.0751; 0.2025
Centrality	0.8076	0.736	0.5129	0.1475; 0.2052
Ties	0.8499	0.840	0.6576	0.0751; 0.1475
<b>Governance</b>				
Reputation	0.7825		0.5485	
Reputation	0.8020	0.632	0.5054	0.1043; 0.1246
Reciprocity	0.8379	0.850	0.5678	0.1043; 0.3894
Trust	0.8523	0.879	0.6647	0.1246; 0.3894
<b>Content</b>				
Infor. Quality	0.7220		0.5650	
Diversity Infor.	0.9182	0.926	0.7379	0.2767
Diversity Infor.	0.9053	0.922	0.6580	0.2767
<b>Capability</b>				
Technology	0.8427		0.5249	
Technology	0.8668	0.839	0.5221	0.3204; 0.2927
Organizational Viability	0.8384	0.794	0.5113	0.1069; 0.5083
Human Capital	0.8279	0.808	0.5498	0.0320; 0.1069
Strategy	0.8109	0.702	0.5195	0.0600; 0.5083
Commercial Resource	0.8135	0.708	0.5226	0.0841; 0.3881
<b>Early-stage Fundraising</b>				
Returning Investors				
Returning Investors	0.8108	0.724	0.5191	0.4045
New Investors	0.7557	0.668	0.5079	0.4045

<sup>a</sup> analogous to Cronbach's Alpha