The Social Capital of Venture Capitalists and Its Impact on the Funding of Start-Up Firms

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ERIM REPORT SERIES *RESEARCH IN MANAGEMENT*	
ERIM Report Series reference number	ERS-2010-028-ORG
Publication	June 2010
Number of pages	36
Persistent paper URL	http://hdl.handle.net/1765/20274
Email address corresponding author	block@ese.eur.nl
Address	Erasmus Research Institute of Management (ERIM) RSM Erasmus University / Erasmus School of Economics Erasmus Universiteit Rotterdam P.O.Box 1738 3000 DR Rotterdam, The Netherlands Phone: + 31 10 408 1182 Fax: + 31 10 408 9640 Email: info@erim.eur.nl Internet: www.erim.eur.nl

Bibliographic data and classifications of all the ERIM reports are also available on the ERIM website: www.erim.eur.nl

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RESEARCH IN MANAGEMENT

ABSTRACT AND KEYWORDS	
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Free Keywords	venture capital, social capital, start-ups, social networks, structural holes
Availability	
Classifications	

THE SOCIAL CAPITAL OF VENTURE CAPITALISTS AND ITS IMPACT ON THE FUNDING OF START-UP FIRMS

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This version: June 25, 2010

ACKNOWLEDGEMENTS

Alexy and ter Wal gratefully acknowledge financial support from the Engineering and Physical Sciences Research Council's IMRC at Imperial College London. All authors thank participants at the Babson Conference 2010 for helpful comments. Of course, all remaining errors are solely our own.

THE SOCIAL CAPITAL OF VENTURE CAPITALISTS AND ITS IMPACT ON THE FUNDING OF START-UP FIRMS

ABSTRACT

How does the social capital of venture capitalists (VCs) affect the funding of start-ups? Extant entrepreneurship literature conceptualizes a substitute effect between the social and financial capital that new firms attain from their investors. On the contrary, by building on the rich social capital literature, we hypothesize a positive effect of VCs' social capital, derived from past syndication, on the amount of money that start-ups receive. Specifically, we argue that both structural aspects of VCs' social network, such as the number of connections and the spanning of structural holes, and relational aspects, such as the diversity of network partners' attributes, provide VCs with superior access to information about current investment objects and opportunities to leverage them in the future, increasing their willingness to invest in these firms. Our empirical results, derived from a novel dataset containing more than 5,000 funding rounds in the Internet and IT sector, strongly confirm our hypotheses. Both structural and relational attributes of VCs' syndication networks have a significant influence on the funds received by start-up firms, highlighting the importance of a social capital perspective on new venture funding. We discuss the implications of our findings for theories of venture capital and entrepreneurship, showing that the role and effect of VCs' social capital on start-up firms is much more complex than previously argued in the literature.

Keywords: venture capital; social capital; start-ups; social networks; structural holes

INTRODUCTION

Venture capital investment plays a pivotal role in entrepreneurial processes. Aside from the capabilities and resources of the start-up and its founders (e.g., Burton et al., 2002; De Clercq et al., 2006), venture capital firms (VCs)[1] arguably have the highest level of influence in shaping and developing start-up firms (Hsu, 2006). Simply put, VCs, often as a syndicate of several VCs rather than alone and with the goal of their own financial profit in mind (Lerner, 1994; Wright & Lockett, 2003), equip growth-oriented start-ups with essential resources to support them in their evolution and eventual success. In doing so, VCs impact on new ventures in two distinct ways: directly, by lending money (financial capital) and providing management skills (human capital) to the start-ups they fund, and indirectly, by giving them access to their network, thus taking on the role of information and resource brokers (social capital) (De Clercq et al., 2006; Dimov & Shepherd, 2005; Pratch, 2005; Sapienza et al., 1996).

Generally, social capital is receiving ever more attention in entrepreneurship research (e.g., Aldrich & Zimmer, 1986; Dimov et al., 2007; Hoang & Antoncic, 2003). For example, the social capital of starting entrepreneurs has widely been acknowledged to play an important role in the evolution of firms and their eventual success (e.g., Brüderl & Preisendörfer, 1998; Hallen, 2008). Indeed, past studies have shown the positive effect of entrepreneurs' social networks on access to information, reputation-building, and recognition of opportunities (e.g., Burton et al., 2002; Hsu, 2004). Also, the variety in types of partners in a new venture's alliance network has been shown to positively impact on its success (Baum et al., 2000). As these examples illustrate, studies on the role of social capital in entrepreneurship often focus on the social capital of the entrepreneurs

[1] We understand that VCs are not the only source of funding for innovative start-ups. However, since they are the largest category of investors in our dataset, and, more generally, likely to be the most important and impactful source of funding for new ventures (De Clercq et al., 2006), we will use this term to also include corporate venture capitalists and business angels, and thus use it interchangeably with the more general term "investor."

themselves, and how this may help them to become successful.

On the contrary, the role of the social capital and social networks of the investing VCs takes a much less prominent position. Thus, the question of how exactly VCs' social capital affects the funding of new ventures still lacks systematic research (Fitza et al., 2009). Specifically, the actual (monetary) effect of VCs' social capital on the amount of funds raised by a start-up has so far not been the subject of study. Therefore, the research question we pose in this study is: *how does an investor's social capital influence the amount of money a start-up can raise in a funding round*? Existing research suggests that VCs' social capital might actually need to be "bought" or "paid for" by the new venture, reflected in entrepreneurs' willingness to accept lower offers from well-networked VCs (Hsu, 2004). From the perspective of the start-up, this suggests the existence of a trade-off between the financial capital and social capital they can receive from their VCs.

Building on the literature on social capital (Burt, 2005; Coleman, 1988), we expand this view. Through the application of social network analysis on VCs' syndication networks, we examine how VCs' social capital affects their willingness to invest more or less in an entrepreneurial venture. In doing so, we follow Granovetter (1992) in distinguishing structural and relational aspects of social capital, i.e. paying attention to both the configuration of a VC's syndication network and the diversity of its partners. Both aspects should, through distinct mechanisms, give a VC access to information that is helpful to them both in the pre- and post-investment phase (Bygrave, 1987; Tyebjee & Bruno, 1984). For the pre-investment phase, VCs with higher social capital may have better knowledge of the most promising firms currently looking for funding (see, e.g., Burt, 2005). Regarding the post-investment phase, Pratch (2005) and Hsu (2006) both show that VCs actively try to improve the odds of success of their investment using their social

capital, which they derive from the social networks in which they are embedded through syndication. Privileged access to information highlighting such opportunities should consequently lead to the VC either evaluating future cash flows of the venture more positively, or attributing them with lower risk (see Tyebjee & Bruno, 1984 for how VCs valuate firms). Overall, compared to VCs that do not have access to these types of information, a high-social-capital VC should have a higher willingness to invest into a specific venture in the present (than a low-social-capital VC) for the same share of ownership in the new venture. Ceteris paribus, we thus maintain that start-ups that are being invested in by VCs with high social capital should be able to raise significantly larger amounts of financial capital than ventures that are being invested in by VCs with lower levels of social capital.

To understand the effect that VCs' social capital has on the investments they make in start-ups, we follow Sorensen and Stuart's (2001) approach in constructing the social network through VC syndication: a tie between a new venture and a VC exists when the VC invests in it. Thus, when multiple VCs syndicate their investment, they are also connected to each other through the shared investment object. Our social capital indicators focus on a VC's structural and relational position in this network of prior syndication ties among venture capitalists. We then regress the lagged structural and relational attributes of investors on the amount of funds that they invest into a certain start-up. As a data source, we employ a novel dataset obtained from the information provider CrunchBase. Within this dataset of over 34,300 firms, 3,800 financial organizations, and 11,300 funding rounds, we focus on VC activity in the Internet sector, for which (almost) complete network data covering the last years are available. This allows us to derive longitudinal, valued, network-based structural and relational measures, while other work in this area often relies on cross-sectional, survey-based, positional measures (Hoang &

Antoncic, 2003).

In doing so, we make three contributions to the literature on entrepreneurship and venture capital. First, we show that VCs' structural position in syndication networks positively influences the amount of money they invest in start-ups. Specifically, structural embeddedness measured by the number of connections gives VCs access to more information, and the spanning of structural holes increases the likelihood of incoming information to be of unique value. Both effects positively impact VCs' willingness to invest in new firms. Second, we also find clear indications for the importance of relational attributes of VCs' syndication networks. In particular, contrary to the extant literature on venture capital that argues mainly in favor of network specialization, we show that arguments from the social capital literature promoting the positive effects of diversity amongst network partners also hold for the setting of VC syndication and their investment in start-ups. In addition, we highlight that network strategies emphasizing *either* diversity *or* similarity are preferential in their effect compared to hybrid approaches. Taken together, our results reemphasize the importance of social networks and social capital for entrepreneurship research and entrepreneurs alike. In particular, we show that the role of social capital in the VC-venture relationship may be more complex than previously hypothesized.

THEORY AND HYPOTHESES

Venture capital investment plays an essential role in the evolution and eventual success of new ventures. Besides the capabilities and resources of the start-up and the characteristics of its founders (e.g., Burton et al., 2002; Franke et al., 2006) venture capital firms (VCs) arguably have the highest level of influence in shaping and developing start-up firms (Hsu, 2006). By investing in new ventures, often as a syndicate of several VCs rather than alone (Lerner, 1994; Wright &

Lockett, 2003), VCs impact new ventures in several ways. Primarily and most obviously, VCs, expecting a high rate of return at high risk, lend financial capital to new firms so that these can compensate their often negative cash flows and fund their growth ambitions (De Clercq et al., 2006). Moreover, VCs can assist start-ups by providing human capital in the form of management skills, experience, and expertise (Dimov & Shepherd, 2005). VCs can do so in several ways, for example by providing strategic advice and planning support, by taking a governance role on a board of directors, or – though somewhat less likely – by actively engaging in day-to-day operations (Lerner, 1995; Sapienza et al., 1996).

In addition, VCs have social capital that the start-ups will seek to access. This social capital is derived from the (social) network of professionals, experts (e.g. for industry, market, technology, and law issues), and other VCs in which the VCs are embedded. In particular, VCs are strongly linked with each other, through the joint investments they have made in the past (Bygrave, 1987; Sorenson & Stuart, 2001, 2008). Through the social networks arising from such past syndication, VCs receive from and pass on to each other strategic information about current investment opportunities as well as future innovation and technological trends, which helps them to reduce the uncertainty they face (Bygrave, 1987, 1988). Specifically, depending on the amount of social capital they have, VCs will have access to more or less of such information, which they will then exploit to the advantage of the firms in their portfolio (Hsu, 2006; Pratch, 2005). Thus, any effect of social capital that VCs receive from their embeddedness in social networks should result from their superior access to high-quality information (about any type of resource), and their ability to use it to the benefit of the firms they (intend to) invest in.

A strong social network of its VCs thus offers the start-up with access to unique and valuable resources and future opportunities. Consequently, choosing the right VC matters. When

evaluating an investment offer, start-ups should thus consider VCs' social capital as an essential part of the added value they may bring to the table, in addition to the financial and human capital they can offer (Sapienza, 1992). Past research even suggests that entrepreneurs may be willing to pay a price for access to VCs with high social capital. For example, Hsu (2004) shows a clear tendency of entrepreneurs to accept bids from high-social capital VCs, even if the respective investment offers are much lower than those made by low-social capital VCs. In this sense, it seems as if entrepreneurs are facing a trade-off: they can expect to receive *either* financial capital *or* social capital from their VCs, but probably not both simultaneously.

In this paper, we strive to expand this view. Fundamentally, a strong social network does not only hold opportunities for the start-up. VCs themselves may as well directly benefit from the prospects of their own network when investing in a start-up. In a nutshell, their social capital may allow VCs to benefit from having superior access to high-quality information and thus increase their chances of identifying the most promising investment opportunities in the pre-investment phase, as well as foreseeing opportunities to add value to the venture after the investment has been made (see Tyebjee & Bruno, 1984 for how VCs valuate firms). Looking at the potential for pre-investment information arbitrage, VCs are competing against each other to identify and invest in the most promising new ventures (Bygrave, 1987). High social capital should give a VC an advantage in spotting suitable candidates for investment (see Burt, 2005; Granovetter, 1985; Uzzi, 1997) and also increase the likelihood that their bid is accepted (Hsu, 2004). Subsequently, during the post-investment phase, VCs can leverage their investment through value-adding involvement in their ventures "as related to perceiving and responding to opportunities and threats to increase the chances of success of the portfolio companies." (Dimov & Shepherd, 2005, p. 5) High social capital should again increase the likelihood that a VC will

become aware of such opportunities and threats (see Burt, 2005; Coleman, 1988). For example, a VC with high social capital may be aware of specific customer groups or complementary ideas in development stage that may useful to the start-up it is considering investing in (Bygrave, 1988). For such a VC, consequently, the value of future cash flows it may receive from the start-up should increase, and the associated risk decrease, which should lead to a higher willingness to invest into the start-up at present (Tyebjee & Bruno, 1984). From the perspective of the start-up, this means that the total funds it can raise in one funding round should *increase* with the social capital of the investors that participate in it.

There are two sources of social capital that VCs can derive from their network, which, in distinct ways, will provide them with access to valuable information from their environment as we have described above. These are the structural as well as relational aspects of the network in which a VC is embedded. Structural aspects describe the configuration of the network, such as the number and intensity of connections it has with others (Uzzi, 1997), and the position of a firm in a network (Burt, 2005). Relational aspects on the other hand focus on who you are connected with (Granovetter, 1992). For example, whether I am central or not within a network is a structural characteristic, whether I am connected to people that are similar or dissimilar to me is a relational characteristic. In the following, we will derive hypotheses for why and how structural and relational aspects of a VC's social network should have an effect on the investment sum a start-up receives. In doing so, we build on Fleming et al. (2007, 444-445) who note that "[m]ost research on the influence of brokerage has focused on purely structural explanations. (...) Little research in the controversy has started from the premise that individuals have biographies and experiences and attributes that they bring to their brokered or cohesive collaborations." We thus follow more recent studies that pay increasing attention also to the

relational characteristics of networks (e.g., Moran, 2005; Reagans & McEvily, 2003).

Structural aspects and investment sum

Due to the syndicative nature of the VC industry, most VCs make their investments in new start-ups jointly with other VCs (Lerner, 1994; Wright & Lockett, 2003). On the one hand, this may bring at least "another pair of eyes" to a deal, thus decreasing the likelihood of failed investments. At the same time, other VCs may contribute to the partnership distinct competencies that will increase the likelihood of venture success (for a discussion of these partly competing explanations, see, e.g., Brander et al., 2002). On top of this, joint investments create ties between organizations through which information can be exchanged in the future, which may well be independent of the investment that created the tie (Bygrave, 1987, 1988). Finally, multiple ties between two organizations may result from multiple joint investments in different start-ups, which will allow for an increased amount and quality of information flowing between them (Bygrave, 1988).

The number and strength of ties that a VC has with its peers is thus an essential source of information it may use to leverage its portfolio investments. The structural network attribute that captures this, is the number of connections the VC has (also accounting for the fact that a connection with the same partner may occur repeatedly). Ceteris paribus, the more information the VC has available to use, filter, or recombine, the higher the likelihood that it can extract value from this information (Uzzi, 1997).

In our setting, the more connections an investor holds, the higher the likelihood that they become aware of new high-quality investment prospects, as well as opportunities that it can use to leverage (also more widely-known) investment prospects if they were to become part of its

portfolio. As argued previously, both factors should positively impact a VC's anticipated returns from the investment object they are considering, relative to investors with fewer network connections. This will increase the focal VC's willingness-to-invest—that is, both the likelihood of investment as well as the amount of funds invested—into this start-up, which will result in the start-up ultimately receiving higher investment funds. However, it might be naïve to assume that anyone could establish and maintain an unlimited number of connections to other parties. On the contrary, keeping alive and healthy a network tie to another party requires actors to bear significant cost and effort, while the additional information a new connection can add will decrease (Uzzi, 1997). Considering that management attention and information processing capability is limited (Ocasio, 1997) we expect that, after a certain threshold, the marginal value that an additional network connection can add for the firm will begin to decrease, and might even turn negative (Uzzi, 1997). Consequently, we can formulate two hypotheses that:

> *H1a [valued degree - linear]: The number of connections investors have in the syndication network prior to their investment in the start-up will have a positive effect on the funds raised by the start-up in an investment round.*

> *H1b [valued degree - curvilinear]: With an increasing number of connections investors have in the syndication network prior to their investment in the start-up, the positive effect of an additional connection on the funds raised by the start-up in an investment round will decrease.*

In addition to the sheer volume of incoming information, the quality and uniqueness of incoming information should fundamentally impact a VC's ability to engage in information arbitrage. Burt's work (1982, 1992, 2005) shows how a structurally advantageous network position may give actors in a network privileged access to such information. Specifically, Burt argues that firms or individuals that span structural holes in networks can acquire unique rents through information arbitrage. The spanning of structural holes happens when an individual or firm is the

sole link between two otherwise disconnected individuals or groups. The argument is that, in such a case, all information that has to travel from one group to the other must travel through the person or firm in the middle, the so-called broker (Burt, 2005). Since the broker is the only person who has access to both the disconnected knowledge (or: resource) pools, he or she is in a position to act strategically to derive personal benefits through information arbitrage. For example, the broker may selectively pass on or hold back information from one group according to the broker's best interest, or charge a fee for doing so. Alternatively, the broker may bring together information from the disconnected groups and combine them into a superior, more valuable configuration. The latter is for example crucial in innovation problems, which are often successfully solved by individuals at the interface between different fields (Jeppesen & Lakhani, 2010).

The benefits brokers can achieve from information arbitrage have been confirmed in a wide variety of settings. For example, Rodan and Galunic (2004) have shown that managers that span structural holes in organizational networks outperform others in terms of overall managerial performance. Fleming, Chen and Mingo (2007) find that brokerage is positively associated with creativity, particularly when the brokering individual bridges people with diverse backgrounds. Likewise, at the organizational level, Hargadon and Sutton (1997) empirically substantiate that a design firm's ability to develop innovative products strongly depends on its brokerage position across their partner firms from different industries.

In the case of investors, a VC that is able to span structural holes should have access to unique and valuable information related to both the pre- and post-investment phase. Furthermore, the more structural holes a VC spans (i.e., the fewer connections exist between the members of a VC's network), the higher the likelihood that the focal VC is the only one to know about

prospective investments and/or future opportunities to leverage. As a consequence, this VC should, following our earlier argumentation, arrive at a higher willingness to invest into the focal venture, which will ultimately increase the amount of funds this venture will receive in a funding round. Thus, we specify as our second hypotheses:

> *H2 [structural holes]: The more an investor is spanning structural holes in the syndication network prior to their investment in the start-up, the higher the funds raised by the start-up in an investment round.*

Relational aspects and investment sum

In addition to the structural aspects of VCs' syndication networks, their relational attributes should matter. Relational attributes refer to the characteristics that network partners have, and how these compare with each other, as well as to the focal organization. Relational attributes thus capture the fact that it is important and relevant to the organization with whom it is connected, implying that diversity or similarity of connections will affect social capital (Granovetter, 1985; Reagans & McEvily, 2003). In this study, we focus on our analysis of the relational attributes of the VCs' past syndication partners on two particular elements, namely the type of investor a VC syndicates with (other VC, CVC, or business angel) and the structure of the investment portfolio of the syndication partners.

Interestingly, past literature is split on whether it is similarity or diversity of partners in the social network that might be a more potent source of information arbitrage. Diversity will give a VC access to more exclusive and varied information (Granovetter, 1985), going beyond the advantages associated with the mere spanning of structural holes (Fleming & Waguespack, 2007). Generally, the social networks and social capital literature would argue that, with increasing diversity in the relational attributes of an actor's network, the higher the likelihood that this actor has access to rich, unique, and varying information (Reagans & McEvily, 2003).

Furthermore, information from outside the domain of the focal actor, provided that it fits the actor's needs, is likely to have a higher impact on performance-related outcomes. For example, as Poetz and Schreier (2009) show, problem solutions that are based on analogies from more cognitively distant fields are likely to be more innovative than those based on local knowledge. In our case, access to more diverse information should thus provide VCs with access to more unique opportunities, in particular regarding their identification in the post-investment phase. For example, being linked to different types of investors such as CVCs or business angels through past deals will give a VC a higher chance of receiving a certain unique piece of information, for example about an upcoming technology, than VCs without this type of relation. Similarly, being linked to investors that have diverse investment portfolio structures might give the focal VC unique information in the form of new markets for start-ups it has invested in. To ensure that they have a continuous inflow of non-redundant information, Bygrave (1988) (referring to both the issue of similar investor types and portfolio specialization) thus recommends that VCs "should have as many links as possible to other organizations and individuals *besides* venture capitalists" (p. 138, formatting added).

On the other hand, much of the existing venture capital literature and its wider theoretical foundations strongly argue in favor of specialization. At the core of the argument is the idea that being embedded in a network of similarly specialized VCs will increase the focal VC's ability to extract valuable information from the network and efficiently and effectively process it (Bygrave, 1987). In particular, in fast moving areas, specialization will be the only way to keep up with technological progress and guarantee the ability to process newly incoming information relating both to the pre- and post-investment phase (Bygrave, 1987; De Clercq & Dimov, 2004). Repeated engagement with the same type of partner and in similar industries or sectors should

lead to VCs being able to build specific routines and capabilities for doing so. Similarly, a smaller cognitive distance between the VC and its network partners will increase the VC's effectiveness in processing information sent out by the partners (Gulati, 1995; Nooteboom, 2000; Uzzi, 1997). This will make it easier for the focal VC to use this information to learn about new investment prospects and opportunities to leverage them, which could for example reside in collaborating with a similar firm in the portfolio of one of the partners. Thus, specialization, both regarding the type of partner a VC chooses as well as the structure of their investment portfolios as compared to each other and the VC firm, might enable the VC to extract more reliable and higher quality information from its social network. The effects of this are shown by Dimov & De Clercq (2006), who find that VCs following a specialization strategy actually see a lower default rate in their portfolio.

Summarizing, extant theory on social networks and venture capital makes competing claims concerning the effects of similarity/diversity on VCs' ability to benefit from information that is flowing through their social network. Thus, we can derive competing hypotheses for the effect of similarity/diversity of the type of past investment partner and the structure of their portfolios on the ability to draw valuable information from the network. That is, we arrive at two competing logics for how these two relational attributes of the network may improve the firms' ability to profit from information in its social network. Identical to the arguments we presented for the effect of network structure on investment sum, we can say that, whichever explanation holds true, VCs having superior information due to the relational aspects of their social network will again be in a preferential position when making an investment decision. They will have better knowledge about both upcoming investment prospects and how to potentially leverage them, using suitable information extracted from the social network. Similar to H1 and H2, and taking

into account that two competing logics for the effects of relational network attributes exist, we thus state:

H3a [type of investor: diversity]: The more diverse investors' networks in terms of the type of syndication partners prior to the investment in the start-up, the higher the funds raised by the start-up in an investment round.

H3b [type of investor: similarity]: The more similar investors' networks in terms of the type of syndication partners prior to the investment in the start-up, the higher the funds raised by the start-up in an investment round.

H4a [past investments: diversity]: The more diverse investors' networks in terms of the fields of investment of its past syndication partners prior to the investment in the start-up, the higher the funds raised by the start-up in an investment round.

H4b [past investments: diversity]: The more similar investors' networks in terms of the fields of investment of its past syndication partners prior to the investment in the start-up, the higher the funds raised by the start-up in an investment round.

Finally, we also note that our hypotheses, in fact, might not be competing, but indicative of a non-linear effect. For example, one might imagine that both very similar and very diverse syndication networks might help VCs in generating social capital. Yet again, we are not aware of corresponding theory that would allow us to make a clear prediction. Rather, we will control for potential non-linear effects in exploratory fashion when analyzing our data.

DATA AND METHOD

The CrunchBase data set

As data source, we make use of a novel dataset obtained from the web site CrunchBase (see also Block and Sandner, 2009). CrunchBase can be best viewed as a "repository" of start-up companies, individuals, and investors having a focus on US high-tech sectors (in particular IT and Internet). CrunchBase describes itself as a "free database of technology companies, people,

and investors that anyone can edit." Also complying with the characteristics of a repository, CrunchBase offers – for the last years – almost complete coverage of start-ups and investors in the Internet sector, including the relationships between them. Therefore, we can derive longitudinal, valued, network-based structural and relational measures, while other work in this area often rests on cross-sectional, survey-based, positional measures (Hoang & Antoncic, 2003). CrunchBase is operated by TechCrunch located in the Silicon Valley, one of the most popular Internet blogs and information sources concerning technological innovations and market developments related to high-tech, in particular the Internet. CrunchBase itself serves as a data provider for TechCrunch, as the latter frequently embodies standardized start-up or investor profiles from CrunchBase in the published articles.

Our analysis is based on data obtained from CrunchBase in early 2010. As of February 15, 2010, CrunchBase included information on 34,302 firms, 3,843 financial organizations, and 11,375 funding rounds. The companies covered by CrunchBase span a wide spectrum. On the one hand, large companies like Google or eBay are included in the dataset. On the other hand, small start-up companies that might have been founded recently or do not rely on third-party investments are included as well. Thus, as the database covers privately held companies with very few employees as well as multi-billion dollar businesses, the spectrum of companies included is wider compared to other company databases. As we seek to analyze the social capital of VCs, we first remove those 7,926 companies that did not receive any funding. Because of our focus on US high-tech sectors (in particular, IT and Internet sector – a focus that also holds true for both CrunchBase and TechCrunch), we then exclude those companies not related to the IT and Internet sector. This resulted in a sample of 5,649 start-up companies in the areas of advertising, e-commerce, enterprise software and services, games and video, hardware, mobile,

network hosting, search, security, software, and web. Second, we dropped those start-up companies that were not based in the US (1,381 observations) or whose domicile was unknown (600 start-ups), arriving at a reduced sample of 3,668 start-up companies. Finally, we only consider those financial organizations, that have invested in the start-ups above and which have significant activities in the US. This implies that we only consider 1,688 out of the total 3,843 financial organizations. We compute our network metrics and conduct our regression analysis on these reduced samples. This implies that both our analysis and the conclusion will also reflect the structure of our sample, and might thus potentially be limited to a North American, Internet & IT setting. Consequently, as a robustness check, we also conducted an analysis identical to the one above, but where we did not drop the observations originating from other industries, affecting both the social network of VCs resulting from the syndication data as well as the other variables entering the regression. Results remain largely identical, with all variables of interest keeping their sign and only minor changes in coefficient sizes and levels of significance.

Social network analysis – the network

The CrunchBase dataset is a formidable dataset to employ social network analysis as it covers almost complete relationships between start-ups and VCs. This is contrasted by other research relying on survey data which leads to methodological difficulties as networks can only partly be observed. The relationships between start-ups and VCs – materializing through investments (i.e., funding rounds) is thus the point of departure for calculating the network metrics on the VC syndication network. This syndication network is a one-mode representation of a two-mode network; a network of investors (one-mode) is created on the basis of investments by investors in startups (two-mode). The value of links in the one-mode network among investors – i.e. the

syndication network – is given by the number of times they have jointly invested in the same startup firm. Using a five-year moving window procedure, the investment volume of a funding round in which a VC participates in year *t* is regressed on metrics of the VC's position in the syndication network covering the five years preceding that investment. The syndication network that was generated in this way is shown in Figure 1 at three different points in time. The network grows substantially over the complete observation period, from 110 unique investors in 1998-2002 up to 1,050 unique investors in 2005-2009.

Dependent variable

Our dependent variable is the amount of funds raised by the focal start-up in a particular funding round (variable *funds raised*). The measure reflects realized, rather than intended investments (see also Dimov & De Clercq, 2006). In addition, this variable may also be regarded as a proxy for the value of the firm at the time when the investors jointly conducting a funding round equip the start-up with VC money. Since the variable is highly skewed in nature, we apply the logarithm of this variable in our regression model (see also Dimov & De Clercq, 2006).

Independent variables – social network measures

Valued degree. To test the first hypothesis, we measure the number of connections VCs have in the syndication network. In network terminology, we measure the valued degree (Wasserman & Faust, 1994). This is a centrality measure that indicates the number of direct co-investment relationships, where (vs. the unvalued degree) multiple co-investment relations with the same partner are also counted as such. To cater to potential multicollinearity issues, we divide this number by the number of investments a VC has made in the same 5-year moving window.

Network constraint. In order to measure the effect of structural holes on investment sum, we use Burt's constraint measure (1992, p. 55). Network constraint is an index that measures the extent to which a person's contacts are redundant. More precisely, the lack of structural holes in a VC's network of direct relations – also referred to as network redundancy – is measured by the extent to which relations are directly or indirectly concentrated in a single contact. For each node in a focal VC's network, we calculate which proportion of the focal VC's direct connections directly or indirectly have a network path through that node. The constraint measure is the sum of squared proportions for all nodes in the VC's network of direct syndication links. The richer a network of a VC's network of direct syndication partners is in structural holes, the lower constraint, and the more opportunities for information arbitrage should exist.

E-I index. To measure similarity in past investment partners, we used the E-I index (Krackhardt & Stern, 1988). The E-I (or external-internal) index measures the extent to which an investors direct connections are within or outside the group to which the investor itself belongs. Investors in the syndication network can be categorized as business angels, corporate venture capitalists (CVCs) or other venture capitalists (VCs). For each investor, the E-I index is calculated as the number of ties external to its group minus the number of ties that are internal to its group divided by the total number of ties. The E-I index is bound between -1 and 1, where +1 indicates a full external orientation of an investor towards syndication partners of a different type than itself, and -1 a full internal orientation of an investor towards syndication partners of the same type as itself.

Network specialization index. Diversity in a VC's network can also result from the sub-sectors within the IT sector in which its syndication partners have invested. On the basis of their investment history over the five years preceding the focal investment, we calculated the extent to which a VC's syndication partners have invested in similar versus diverse range of subsectors.

That is, for each investor we defined a vector specifying the shares of its investments over 11 subfields. Taking the cross-product of vectors for each pair of investors (Bonacich, 1972), results in a measure of specialization in terms of their investment focus. To relate this measure only to those investors to which the focal investor is connected, we calculated the weighted sum of this specialization index, where the weight is the value of the connection (the number of times two investors co-invested in a firm in a moving 5-year period). A value of 1 represents the situation where a VC's syndication partners exclusively invested in the same subfields as the focal VC (a specialized network) and 0 a situation in which a VC's syndication partners entirely invested in different subfields as the focal VC (a diverse network).

Control variables

To not confound the effects of the VC's social network with other effects, we include a number of control variables. Based on a careful review of extant literature (e.g., De Clercq & Dimov, 2004; Dimov & Shepherd, 2005; Dimov et al., 2007), we include variables related to the characteristics of the start-ups, the investors and the respective funding rounds.

Start-up characteristics. To distinguish between early stage and later-stage start-ups, we include the age of the start-up (in days). Since this variable is highly skewed, we take its natural logarithm. To distinguish between start-ups belonging to different subsectors *within* the Internet and IT industry, we included the more fine-grained indicator variables: *consumer web*, *electronic commerce*, *enterprise, advertising*, *games/video/ entertainment*, *hardware*, *mobile/wireless*, *software*, *network hosting*, *search*, and *security*. The categorization is based on the categories provided by CrunchBase.

Investor characteristics. As a proxy for the experience of the VC investor, we include the

number of prior investments (to control for general experience) as well as the percentage of prior investments in the same sector as the focal start-up (specific sector experience). In addition, we inserted dummy variables indicating whether the investor is a business angel, a (financially-oriented) VC or a strategic investor (industrial firm or corporate VC).

Funding round characteristics. To control for funding round characteristics, we calculate the number of participants in the funding round and insert this variable in linear and squared terms. Also, we include several dummy variables indicating whether the respective funding round is a seed round, angel round, series A round, debt round, etc. Finally, to account for business cycle effects in the provision of VC (e.g., Block & Sandner, 2009), we include several year dummies.

RESULTS

Descriptive statistics

Insert Tables 1 and 2 about here

Table 1 shows descriptive statistics and correlations of the variables in our regression models. Not surprisingly, the social network measures are correlated with each other. For example, the higher the investor's degree, the more likely this financial organization is able to span structural holes. Yet, given the large number of observations in our data set (N=5,120), we regard the potential issue of multicollinearity to be only of minor concern. Some descriptive statistics are noteworthy: about 98% of investors are VCs; only a small portion of investors are strategic investor such as industrial firms (2%) or business angels (0.3%). The mean syndicate size is 3.2 and the mean number of total investments of each investor is 22. About 25% of all prior investments of any investor were in the same sector. This may seem low but can be explained by the fine-grained categories which we use. The mean investment sum per funding round is 15 million US dollars. However, this number is highly skewed. The median investment sum is

'only' 7.75 million. To account for this high degree of skewness in the regressions, we use the natural logarithm of the raised amount.

Regression analysis

As explained above, our unit of analysis is the individual VC participating in a funding round. We argue that the amount raised in a funding round depends on VCs' social capital as derived from the social network created through past syndication. Table 2 shows different regression specifications with the amount of funds raised in the focal funding round as the dependent variable. Model I contains the control variables and all but one of our variables of interest. Namely, in Model II, we add the squared term of valued degree, and we can interpret both the change in model fit as well as the significance level of this coefficient to understand the effect of this variable. Model II is thus our preferred specification. Finally, in Model III, we explore potential non-linear effects of the relational network attributes. To do so, we replace the E-I Index and network specialization index (originally ranging from -1 to 1) with their absolute values, so that higher values of both may represent both higher similarity or diversity, and lower values are indicative of the use of hybrid forms in between.

Looking at Model II, most of our hypotheses relating to the VCs social capital are supported. We first look at our hypotheses on the effect of the structural attributes of VCs' syndication networks on funds raised in an investment round. In support of H1a, we find that the higher the investor's degree of connection to other investors, the higher is the start-up's amount of funds raised in the respective funding round ($ß=0.13$, $p<0.01$). In contrast, H1b is not supported: the squared term of the investor's degree of connection to other investors is insignificant ($ß=-0.03$, $p>0.1$). Finally, Burt's constraint measure (H2) shows a negative effect on the amount of funds

raised (ß=-0.17, p<0.01). That is, the more the VC investors are spanning structural holes in the syndication network prior, the larger is the amount of funds raised in the particular funding round.

Our results further support our arguments on the role of relational aspects of VCs' syndication networks. Whereas we do not find any effect with regard to the diversity of syndication networks in terms of the type of investors a VC is linked to (H3), our results strongly support the role of network diversity regarding the relative composition of network partners' investment portfolios (H4). The more diverse the syndication network of the VC in terms of the sectors in which the investor's prior syndication partners invested (relative to the VC), the higher is the amount of funds raised by the start-up in the current round (H4a, ß=-0.48, p<0.05). However, when we control for the possibility of a non-linear effect, we find indication that both specialization and diversity may in fact matter Specifically, when we transform the network specialization index to a format were 0 indicates a perfectly hybrid strategy between similarity and diversity, and 1 may stand both for a perfectly similar and a perfectly diverse network (see Model III), we see that the coefficient for network diversity/specialization in terms of IT sectors carries a positive sign and remains significant. This indeed indicates that *both* similar and diverse networks may have positive effects on the investment made by the VC when compared to hybrid approaches.

DISCUSSION AND IMPLICATIONS

Discussion of results

In this paper, we looked at the effects of VCs' social capital, coming from the relational and structural attributes of VC syndication networks, on investments made into start-up firms. Regarding the structural dimension of social capital, we find that brokerage has a significant

effect which is significant in all specifications. Also, the variable capturing the number of connections has a linear positive effect on investments made. The fact that it is not curvilinear might be due to censoring issues in our data (i.e., we do not observe any VC that has done too much syndication, which could for example be caused by VCs dropping existing ties that they do not consider valuable), rather than eradicating the possibility of decreasing returns of additional connections.

The relational elements of social capital, too, showed an effect. While diversity in terms of type of partner did not matter, we found that portfolio specialization indeed mattered. In fact, exploratory analysis showed that both specialization and diversity of a VC's syndication network had positive effects on investment sum. Both effects, however, disappear when controlling for past investments made into the same venture. In the following, we analyze the implications of these findings for theory and practice.

Implications for theory

With this study, we make three contributions to the literature on entrepreneurship and venture capital. First, we look at how the structure of syndication networks affects investment into start-ups. Extant theory on the effects of syndication emphasizes the importance of knowledge flows between the involved investors, and how this may benefit their future investment decisions (Bygrave, 1987, 1988). Extending this stream of research using arguments from the social networks and social capital literature, we maintain that the structure of investor networks will be crucial to flows of information about potential investment objects as well as how these may be leveraged in the future. Specifically, we highlight the effects of degree and brokerage, representing, respectively the sheer volume of incoming information available to an investor and

the uniqueness of this information resulting in opportunities for information arbitrage. First, we show that the sheer amount of information that VCs have at their disposal thanks to the structural attributes of their network will increase the amount of money they put into start-ups. In doing so, we show that structural embeddedness (see Uzzi, 1997) in the social network of investors has a clear effect on the investment decisions that VCs make. Structurally embedded investors will have access to more information, and be able to leverage that to their own benefit as well as to the benefit of the ventures they invest in. In addition, we find clear effects for the importance of brokerage (see, e.g., Burt, 2005). The spanning of structural holes gives VCs access to unique information flowing through the network and allows them to engage in information arbitrage. They can use this unique information, in turn, to their own advantage by selecting better investment targets, as well as to the advantage of the firms they invest in, by linking them to opportunities arising in the network. We thus show that brokerage, as for many other fields, matters for venture capital. Here, too, it will allow VCs to achieve abnormal returns and lower risk through information arbitrage (Burt, 2005), thus positively affecting their willingness to spend money on a startup.

Second, we add to the literature by shedding light on the role and importance of relational network attributes. In particular, we offer a new perspective on the debate about the relative advantageousness of investors having either similar or diverse syndication networks. We do so by extending existing literature on venture capital arguing in favor of specialization and focus (e.g., Bygrave, 1987; De Clercq & Dimov, 2004; Dimov & De Clercq, 2006) with arguments from the social capital literature emphasizing the advantages of diversity (e.g., Fleming & Waguespack, 2007; Granovetter, 1985; Reagans & McEvily, 2003). Importantly, we show that, regarding the relative composition of network partners' investment portfolios, we find that

diverse networks affect investment sum more strongly than similar ones. This would be in accordance with the literature on social capital arguing that diverse networks facilitate access to richer information than similar networks. However, on closer inspection, we see that *both* similarity *and* diversity have positive effects on the information available to a VC and thus the investments they are willing to make. Thus, our findings suggest that VCs may be successful by strategically building networks alike to both focused boutiques as well as broad generalists. Both archetypes of networking strategy and design seem to facilitate improved access to information as compared to hybrids. Boutiques should have higher chances at processing valuable information flowing through their network, whereas generalist may have a chance of receiving, on average, higher-value information. In turn, following our theoretical argumentation, both boutiques and generalists may show higher willingness to invest in a focal start-up. These start-ups, as a consequence, need not have a preference for any of the two archetypes, as long as the VC *either* has a clear specialization *or* diversity strategy with regards to their approach to the selection of syndication partners.

Taken together, our main contribution lies in extending the present perspective on venture capital and its role for entrepreneurship by applying a comprehensive social capital perspective. Overall, we clearly show that the social capital of venture capitalists, derived from the structural and relational attributes of the syndication networks they are embedded in, matters for the investment decisions they take, and thus the amount of funding that start-ups may receive. In doing so, we challenge extant theory, which has conceptualized a substitutive, rather than a complementary relationship between the two (cf. Hsu, 2004). Indeed, we find that start-ups that are invested in by high social-capital VCs receive higher levels of funding that those new ventures supported by low social-capital VCs, and we identify the elements of social capital that

drive these investments. In so doing, we show that the role and nature of VCs' social capital might be much more complex than previously stated in the respective literatures. This claim is further supported by some of our more specific results, which for example illustrate that both similarity and diversity in the social network may lead to higher investments, whereas hybrid strategies do not (cf. Uzzi, 1997). However, we need to emphasize that further research into all elements of social capital brought forward in this paper is needed to truly understand the effect of VCs' social capital on the investment decisions they make in practice. In particular, we think that our work raises a call for more qualitative work to investigate and scrutinize this issue, as our understanding of the processes inside venture capital organizations, including their management and use of social capital as well as its effect on the ventures in their investment portfolio, is currently limited at best.

Implications for practice

Our results have practical relevance both for VCs and entrepreneurs. For VCs, they further indicate the importance of social capital, which they will need to build and maintain through suitable strategies. Specifically, we point out that both a strong diversification as well strong specialization strategies seem to have merits, whereas hybrid forms could be of lower value. Regarding the start-up, we find that they do not have to be shy about approaching high-social capital VCs. Indeed, if there is a chance their social capital is beneficial to a specific deal, there is no reason why this should result in the start-up receiving a discount on their inherent valuation. In fact, the opposite may hold.

Suggestions for future research

In addition to those already stated earlier, this study opens up several avenues for future research on the role of social capital for investors in general, and in particular for their funding of new ventures and their eventual success. First, regarding investor strategies aimed at building social capital, we did not find the expected curvilinear effect on investment sum that we had expected, and we encourage future research to investigate why. Similarly, while our results allow us to point out that both similarity and diversity in the social networks of VCs should have positive effects on them extracting valuable information from the network, we cannot draw any conclusions on the circumstances under which one of the two strategies would be preferable, and thus leave this question open for future research. Finally, our paper raises the question of how social capital in general, and specific attributes of it, may affect new ventures beyond the funding decision. In particular, we encourage future research to take a closer look at the impact of VCs' social capital on new venture survival, growth, and, ultimately, success.

Limitations and conclusion

Some limitations of our study need to be mentioned. First, we do not observe exact ownership percentages by VC in a funding round. However, since we control both for the size of the syndicate as well as many other characteristics, we do not expect this effect to have a large impact on our results. Similarly, our data is biased towards North American IT and Internet firms. Yet, as said earlier, a robustness check including all reliable investment information we had (worldwide and across many different industries) gave us almost identical results, with all results reported qualitatively unchanged. Nevertheless, future research that can link the CrunchBase dataset to other sources that may cater to its disadvantages (e.g., *VentureExpert*) will help to ensure the validity of our findings.

Limitations aside, our study has shed new light on the role of VCs' social capital for the entrepreneurship and venture capital literatures, showing that its effects are likely to be more complex than previously hypothesized. While answering some questions on this issue, we have simultaneously created many new ones, which we hope will encourage further research on this topic. Before this background, we think that our study can provide a valuable building block to help improve our still limited understanding of the role of VCs' social capital and its effects on the start-up firms they invest in.

FIGURES AND TABLES

Figure 1: VC syndication networks over time

Nodes represent venture capitalists; lines represent joint investments in a start-up firm through syndication. The size of the nodes indicates their degree centrality in the network.

Figure 1a: 1998-2002

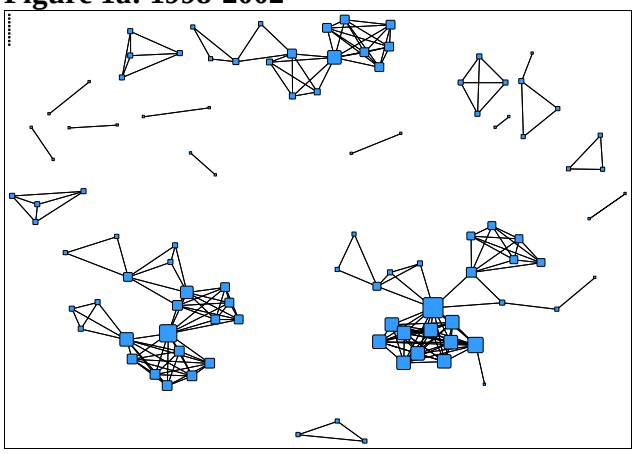

Figure 1b: 2001-2005

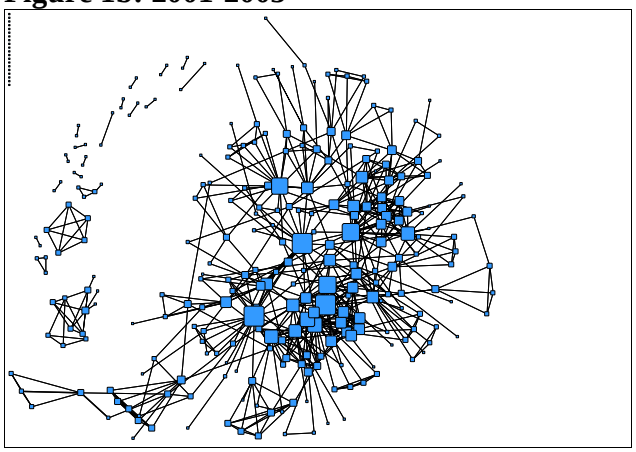

Figure 1c: 2005-2009

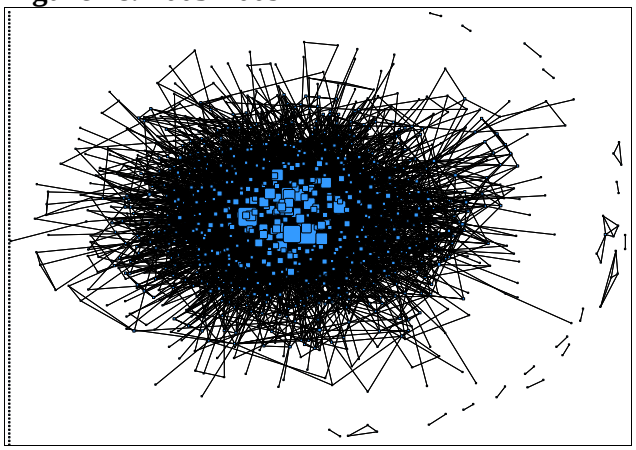

Table 1: Descriptive statistics

	Variable	Mean	S.D.	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Raised amount	14.69	80.78	0.01	3200												
(1)	Log (raised amount)	2.13	1.05	-4.42	8.07												
(2)	Burt's constraint measure	0.36	0.31	0.04	1.68	-0.09											
(3)	(Degree / N total investments)	1.07	0.55	0.07	5	0.17	-0.25										
(4)	Network specialization index	0.19	0.09	0	1	-0.02	0.34	0.03									
(5)	E-I index	-0.89	0.28	-1	1	-0.06	0.00	-0.13	0.04								
(6)	N total investments	20.15	22.11	2	138	0.13	-0.57	-0.07	-0.25	-0.06							
(7)	% of prior investments in start-up's sector	0.21	0.25	0	1	-0.04	0.26	0.00	0.32	0.02	-0.18						
(8)	Investor is VC	0.98		0	1	0.38	-0.08	-0.02	-0.07	-0.72	0.24	-0.12					
(9)	Investor is business angel	0.003		0	1	-0.41	0.02	0.01	0.05	0.01	-0.22	0.11	-0.90				
(10)	Investor is strategic investor	0.02		0	1	0.01	0.08	0.02	0.07	0.72	-0.08	0.04	-0.33	-0.08			
(11)	N participants in funding syndicate	3.22	1.74	1	18	0.03	-0.01	0.14	0.07	-0.03	-0.07	0.09	-0.30	0.33	-0.04		
(12)	Seed round	0.08		0	1	-0.44	0.01	-0.10	-0.02	0.09	-0.05	0.02	-0.27	0.28	0.03	0.05	
(13)	Log (age of start-up)	1.29	0.40	-1.82	5.35	0.34	-0.05	0.09	0.03	-0.02	0.12	0.02	0.26	-0.27	0.01	-0.04	-0.27

Notes: S.D.=standard deviation
N = 5,120 obs.; correlations with an absolute value larger than 0.03 are significant at $p \leq 0.05$.

Table 2: Linear regression on log (*raised amount*)

Independent variables	Model I Coeff (SE)	Model II Coeff (SE)	Model III Coeff (SE)
Investor's social network position			
Burt's constraint measure	-0.17 (0.07) **	-0.15 (0.07) **	-0.15 (0.07) **
Degree/ N total investments	0.13 (0.03) ***	0.21 (0.08) ***	0.21 (0.08) **
(Degree / N total investments) ²		-0.03 (0.02)	-0.03 (0.02)
Network specialization index	-0.48 (0.20) **	-0.50 (0.20) **	
E-I index	-0.14 (0.09)	-0.13 (0.09)	
Absolute value of network specialization index			0.24 (0.11) **
Absolute value of E-I index			-0.06 (0.12)
Other investor characteristics			
N total investments	0.003 (0.001) ***	0.003 (0.001) ***	0.003 (0.001) ***
% of prior investments in start-up's sector	-0.04 (0.06)	-0.04 (0.06)	-0.05 (0.06)
Investor is VC	-0.51 (0.26) *	-0.50 (0.26) *	-0.28 (0.24)
Investor is business angel	0.07 (0.09)	0.06 (0.09)	0.07 (0.09)
Investor is strategic investor (reference cat.)			
Funding round characteristics			
N participants in funding syndicate	0.26 (0.03) ***	0.26 (0.03) ***	0.25 (0.03) ***
(N participants in funding syndicate) ²	-0.017 (0.004) ***	-0.017 (0.003) ***	-0.017 (0.004) ***
Seed round	-0.74 (0.09) ***	-0.74 (0.09) ***	-0.74 (0.09) ***
Angel round	-0.38 (0.09) ***	-0.38 (0.09) ***	-0.38 (0.09)
Series A round (reference cat.)			
Series B round	0.22 (0.04) ***	0.21 (0.04) ***	0.21 (0.04) ***
Series C round	0.23 (0.04) ***	0.23 (0.04) ***	0.23 (0.04) ***
Series D round	0.15 (0.06) ***	0.15 (0.06) ***	0.15 (0.06) ***
Series E round	0.39 (0.09) ***	0.39 (0.09) ***	0.39 (0.09) ***
Series F round	0.01 (0.14)	0.02 (0.12)	0.03 (0.11)
Debt round	0.10 (0.11)	0.11 (0.11)	0.11 (0.11)
Grant round	-2.00 (0.65) ***	-1.99 (0.64) ***	-2.00 (0.65) ***
Unattributed round	0.22 (0.05) ***	0.22 (0.05) ***	0.22 (0.05) ***
Start-up characteristics			
Log (age of start-up) [1]	0.36 (0.07) ***	0.36 (0.07) ***	0.36 (0.07) ***
Sector dummies (reference cat.: security)	10 cat. (p<0.01)	10 cat. (p<0.01)	10 cat. (p<0.01)
Year dummies (reference cat.: year 2003)	9 cat. (p<0.01)	9 cat. (p<0.01)	9 cat (p<0.01)
Constant	1.19 (0.25) ***	1.15 (0.34) ***	
N investment observations (funding rounds)	5,120 (2,529)	5,120 (2,529)	5,120 (2,529)
F-test	p<0.01	p<0.01	p<0.01
R^2	0.32	0.32	0.32

Notes
two sided tests: * p≤0.10 ** p≤0.05 ***p≤0.01
Coeff=coefficients; SE=robust and clustered standard errors; cat.=category
[1] Observations with missing values are proxied by the sample mean. To control for this, we included also a dummy variable which indicates whether the firm age was missing or not. The variable shows an insignificant effect (e.g., ß=0.07, p>0.1 in Model I)

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