Paper to be presented at the

35th DRUID Celebration Conference 2013, Barcelona, Spain, June 17-19

The best of both worlds: The benefits of specialized-brokered and diverse-closed syndication networks for new venture success

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Abstract

The social capital literature has featured a long-lasting debate on whether brokerage or closure represent higher-value information advantages. We maintain that this tension cannot be fully resolved without recurring to explanations of actor diversity, arguing that brokerage is of most value in networks with high actor similarity, whilst closure is most beneficial in networks with high diversity. In the context of newly funded ventures attempting to attract additional funding, we argue that they are most likely to succeed if their first-round investors have either specialized-brokered or diverse-closed networks. These balanced representations of social capital allow the venture to simultaneously reap in-depth and broad information from their investors? syndication networks. By contrast, advice emerging from diverse-brokered or specialized-closed syndication networks is of limited value to the venture, representing situations of under- and

overembeddedness respectively. Our empirical setting is based on CrunchBase data that covers all venture capital investments in the US Information Technology Industry between 2005 and 2010. Controlling for the quality of the venture, we find strong support for our predictions.

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Keywords: venture capital; social capital; start-ups; brokerage; closure; network diversity

JEL codes: G24, L26, M13

INTRODUCTION

Social capital and network theorizing have established a strong foothold in our current thinking of how entrepreneurial opportunities arise and come to fruition (Greve & Salaff, 2003). Social networks of family and friendship ties often form the breeding ground through which entrepreneurial ideas take shape, and broader professional networks play a key a role in securing financial and other types of resources (Baum, Calabrese, & Silverman, 2000; Shane & Cable, 2002). For example, ventures that receive funding from venture capitalists (VCs) do not only gain access to financial capital and human capital, VCs also act as important channels of information that may give new ventures a competitive edge over others (Hallen, 2008; Hochberg, Ljungqvist, & Lu, 2007). As such, VCs and the networks they maintain constitute an important form of social capital that new ventures can leverage to sustain profitability and long-term survival. This study addresses the question of what determines the value of VC social capital for the ventures in which they have invested. More specifically, we examine how information advantages that newly funded ventures can retrieve from their first-round investors' syndication networks positively contribute to the venture receiving a second funding round.

In arguing how new ventures benefit from social capital, the vast majority of studies have relied on arguments of network structure, and in particular on the information advantages of brokerage versus closure. In essence, it is argued that brokering a relation between two actors that would otherwise be unconnected – in other words, spanning a structural hole in a network – yields information advantages in terms of access to unique, novel information (Burt, 2004). At the same time, however, being embedded in closed rather than brokered network structures facilitates the exchange of in-depth information through frequent, trust-based interactions among interconnected actors (Reagans & McEvily, 2003; Uzzi, 1996). In recent decades, there has been a long-lasting debate in the broader network

literature whether brokerage or closure yields greater information advantages (e.g. Ahuja, 2000; Burt, 2005; Gargiulo & Benassi, 2000).

Despite increasing insights into the conditions under which brokered or closed network structures may be more beneficial (Baum, McEvily, & Rowley, 2012; Zaheer & Bell, 2005), we maintain that the tension between these largely contrasting views of network advantage cannot be fully resolved without recurring to explanations of actor diversity. Put differently, we propose that invoking whether closed or brokered connections exist among specialist or diverse actors may help us understand when brokerage or closure are more advantageous. To do so, we rely on a second stream of network research that adopts a different logic in defining informational network advantages. This stream of research has looked at characteristics of the actors in the network rather than at pure structural measures to define informational benefits (Fleming, Mingo, & Chen, 2007; Reagans & McEvily, 2003; Tortoriello, Reagans, & McEvily, 2012). Here it is argued that belonging to a network where actors are similar to each other provides access to in-depth, specialist information, whereas being embedded in networks of dissimilar actors yields access to diverse information. Thus, without referring to any structural network properties the central argumentation of network diversity – i.e. specialist versus diverse networks – bears strong resemblance to the brokerage-closure debate.

Our core argument rests on merging these two streams of literature, and postulating substitutive relationships between the informational advantages attainable from simultaneously aiming for diversity and brokerage, or for specialization and closure. More specifically, extant literature (e.g., Burt, 2004) implicitly assumes that brokered relations are more likely to exist amongst actors who hold a diverse range of information. However, we argue that it may be questionable that relatively weakly linked actors may effectively exchange, recombine, and exploit largely unrelated information. Rather, effective brokers

may span structural holes to collect and combine information from actors that in fact hold strongly similar information. Likewise, it is assumed that closed network relations exist predominantly amongst actors holding a limited range of information. In contrast, we argue that closed network relationships may equally exist amongst actors that have diverse information, and that these types of connections provide higher information advantages in closed networks. That is, the lack of inflow of novel and diverse information that characterizes closed networks can be compensated for by a high level of actor diversity. Likewise, a lack of inflow of novel and diverse information that characterizes specialized networks can be compensated for by the sparseness of brokered network structures. By contrast, we maintain that having a specialized-closed network corresponds to a situation of overembeddedness, where dense interaction among likeminded network members limits the inflow of new and different perspectives. Similarly, we argue that diverse-brokered networks represent a situation of underembeddedness, where an excessive range of diverse information is of little value as it lacks a core of specialist information to which it can be associated.

Accordingly, for entrepreneurial ventures, we expect that those start-ups will benefit most from the syndication networks of their VCs, when the latter display closed structures and focus on a diverse set of technologies (diverse-closed) or if they can draw broad information from networks rich in structural holes yet a focused on a narrow set of technologies (specialized-brokered). These balanced representations of VC social capital allow the venture to simultaneously reap in-depth and broad information from their VCs' syndication networks.

While we expect these network configurations to offer a whole variety of opportunities to the new venture, in this paper we focus on a specific yet vital potential outcome to their striving for growth. Specifically, we study the combined effect of network structure and diversity on the likelihood and speed of a venture receiving a second round of

funding. Notably, receiving a continuous supply of venture capital to fund the initial growth of the venture is crucial for entrepreneurial success (e.g., De Clercq, Fried, Lehtonen, & Sapienza, 2006), and several recent contributions have made clear that network-based explanations should be taken into account as even stronger predictors of VC investment (e.g., Alexy, Block, Sandner, & Ter Wal, 2010; Hallen, 2008; Hochberg et al., 2007). Our expectation is thus that ventures are most likely to (quickly) receive a second round of funding when their first-round VC investors are embedded in specialized-brokered or diverse-closed syndication networks.

Our empirical setting is based on CrunchBase data that covers all venture capital investments in the US Information Technology Industry between 2005 and 2010 (Block & Sandner, 2009). Controlling for the quality of the venture, we find strong support for our predictions. Although, when considered separately, both balanced network structures (neither extreme brokerage nor closure) and levels of diversity (neither extreme specialization nor diversity) favorably affect second-round funding, when looked at jointly, we find that specialized-brokered and diverse-closed network outperform other possible configurations, including a balanced-balanced one. As such, we establish that syndicate networks indeed constitute an important form of social capital for new ventures, which need access to broad, yet also specialized information, which they can draw in two different ways from the syndication network.

In doing so, our study makes several contributions to the literature on social capital, networks, and entrepreneurship. In particular, we employ this setting to highlight the interplay between elements of network structure and the diversity of its actors. We bring together the largely contradictory and often disconnected arguments on the benefits of brokerage-closure (Burt, 1992; Coleman, 1990) and specialization-diversity (Reagans & McEvily, 2003) by showing how advantages related to network structure are contingent on

the diversity of actors in the network. It matters whether opportunities arising from brokerage or closure are among specialized or diverse actors. Brokerage produces most value in networks of high actor similarity, whilst closure is most beneficial in networks with high diversity. Specialized-brokered networks allow for access of widely-spread information, while keeping integration costs at bay by ensuring familiarity with the actual subject of information transfer. Similarly, the integration of diverse information can more easily be facilitated in established channels of trust representative of closed networks. These insights further allow us to elaborate on Uzzi's (1996, 1997) work on overembeddedness. We show how overembeddedness is a two-dimensional construct that is generated by actors relying on closed networks of low diversity. In addition, we propose the notion of underembeddedness to describe the problems of knowledge integration that lead brokerage networks of high diversity to exhibit lower levels of performance than other configurations. Finally, for the entrepreneurship literature, our findings extend current understanding on the configuration of VC syndication networks and its relationship to new venture performance.

THEORY AND HYPOTHESES

The VC syndication network as a form of second-order social capital

Venture capitalist investment decisions are inherently complex and uncertain and VCs have to overcome information asymmetries to obtain good judgment of the potential of a target venture (Gompers, 1995). Therefore, VCs typically co-invest in a venture with other investors, forming a syndicate that monitors the new venture and often assumes an advisory role for day-to-day management whilst sharing the pay-off of the investment (Lerner, 1994; Wright & Lockett, 2003). Not only does syndication of investment directly mitigate the financial risk of failed investment decisions, through prior syndication relationships VCs also build a network from which they can derive informational advantages that inform their investment decisions (Bygrave, 1987). Embeddedness in a syndication network provides VCs

with strategic information about potential new investment opportunities and the performance history of investment targets that is shared in a high-trust environment, unavailable to those who are unconnected to the network (Sorenson & Stuart, 2001). As such, embeddedness in past syndication networks is considered an important form of social capital that VCs use to make better investment decisions (Hsu, 2006; Pratch, 2005). In fact, VCs with strong social capital have been shown to have a higher willingness to invest in start-ups, because privileged access to information on venture quality may lower the perceived risk of the investment and increase evaluated future cash flows (Alexy et al., 2010).

However, the advantage of the social capital that VCs obtain through their network of past syndication is not limited to VCs, but transcends also to the venture in which they invest (Hallen, 2008; Hochberg et al., 2007). It has been established that new ventures are likely to gain performance benefits and achieve successful outcomes such as IPOs when backed by VC investment (Fitza, Matusik, & Mosakowski, 2009; Hsu, 2006; Shane & Stuart, 2002). In addition to direct performance effects of the financial capital that VCs provide, it has also been shown that there are strong human capital effects that can partially explain this performance premium (Dimov & Shepherd, 2005).

Increasingly, however, researchers have turned their attention to the social capital effects of VCs investment (e.g. Hallen, 2008; Hochberg et al., 2007). After the first round of investment, VCs typically assume an advisory and monitoring role towards the venture, making the expertise and social capital they have gathered through their past investment activities available to the benefit of the venture, and ultimately the return of their investment (Sorenson & Stuart, 2001; Stuart, Hoang, & Hybels, 1999). In essence, VCs network resources function as a form of second-order social capital, a nascent concept that has recently been used to describe the advantage of being connected to high social-capital alters (Galunic, Ertug, & Gargiulo, 2012). In this line of work, studies have shown that the number

of network connections held by a VC positively affects the performance of the ventures they have invested in (e.g., Hochberg et al., 2007). These effects should be a result of the information and expertise that reside in VCs syndication network which spills over to the venture when VCs bring business and strategic advice to it (Sapienza, Manigart, & Vermeir, 1996). The larger the set of relations the syndicate has built with other VCs through prior syndication – in other words, the larger the syndicate's aggregate social capital – the stronger the expertise base the venture gains from its investors.

Network brokerage versus closure and venture success

However, it is of course not merely the total amount of network resources that determine the quality of social capital available, it is also the structure of this network that shapes the informational advantages actors can derive from their social capital (Zukin & DiMaggio, 1990). The concept of structural embeddedness describes how social action and outcomes are shaped by the structure of the overall network of which actors are part, rather than exclusively by the relations they hold themselves (Granovetter, 1992: 33).

This insight has spurred a long-lasting debate in the social capital literature about which network structures exhibit the greatest informational advantages. Hence, over the past years several studies demonstrated how structural aspects of networks are reflected in performance differences in areas including innovation, collaboration and knowledge transfer (e.g. Ahuja, 2000; Gargiulo & Benassi, 2000; Rowley, Behrens, & Krackhardt, 2000). One stream of thought argues in favor of dense networks with overlapping ties among cliques of network actors, i.e. the closure of networks, where certain ties are 'redundant' in the sense that they may provide the same information to network members (Coleman, 1990; Uzzi, 1996). Closed network structures are thought to promote the development of trust (Powell, Koput, & Smith-Doerr, 1996; Shipilov & Li, 2008; Uzzi, 1997), which in turn facilitates the exchange of sensitive and complex knowledge (Reagans & McEvily, 2003). As a result,

relative to more open, low embeddedness network environments, closed networks are argued to provide its members with access to higher-quality information (Fleming et al., 2007).

A contrasting line of reasoning focuses on the advantages of being embedded in sparse network structures full of opportunities for the brokerage of information (Burt, 1992; Burt, 2004). Brokerage occurs by being the sole actor forming a network path – i.e. spanning a structural hole – between actors who otherwise would be disconnected. This grants brokers privileged access to information that is diverse by virtue of the missing connection between its alters. Thus, brokers occupy strategic positions "at the nexus of diverse information" (Fleming et al., 2007: 445), which they can exploit to their own advantage (Burt, 1992) or instrumentally use for establishing connections for collaboration among those who were disconnected (Lingo & O'Mahony, 2010; Obstfeld, 2005). By contrast, closed networks may lack the flexibility to allow the inflow of fresh, diverse perspectives and ideas, as a result of which actors in closed networks may get 'trapped in their own nets' (Gargiulo & Benassi, 2000; Uzzi, 1997).

More recently, researchers have advocated the view that the benefits of closure and brokerage may not be as incompatible as they appear (Reagans & McEvily, 2008). Various studies have shown that advantages of brokerage and closure may differ in timing, where brokerage advantages manifest themselves more immediately and are more short-lived relative to closure advantages (Baum et al., 2012; Soda, Usai, & Zaheer, 2004; Zaheer & Soda, 2009). Other studies have demonstrated that brokerage and closure effects may operate at different levels in the network, for example within and beyond teams (Zaheer & Bell, 2005). Interestingly, however, some studies argue that the possibility should be left open that closed and brokered structures co-exist concurrently and at the same level in someone's individual network (Reagans & McEvily, 2008). Individuals who combine dense structures in one part of their network, and brokered relations in others part of their network may be able

to simultaneously access high-quality, trust-based information through closure and diverse information through brokerage. Such hybrid network positions – with intermediate values on the brokerage-closure continuum – may give rise to a curvilinear effect of closure (or its opposite, brokerage) on performance outcomes (Oh, Chung, & Labianca, 2004; Schilling & Phelps, 2007).

Against this background, we argue that the social capital of venture capitalists has greatest value for the ventures in which they invest if it embodies a combination of closed and brokered structures in the network of prior syndication relations. Brokerage structures in the syndicate's network allow for the inflow of diverse information that provides the perspective at which the knowledge held in denser parts of the network can be interpreted. That is, it allows the syndicate to combine elements of information shared in the dense core of their network with information that some of their syndicate partners can bring from their unique prior syndication relations when giving strategic advice to the venture in which they invested. Neither extreme brokerage – where the syndicate members each bring unique and mutually unconnected partners to the network – nor extreme closure of the syndication network – where the partners of the syndicate's members all have syndicated an investment before – produce the same level of informational benefits for the venture. It is rather the balance between the two that helps the syndicate to provide the venture with the highest quality of advice, which will be reflected in the venture's success in obtaining new VC funding. Therefore, we hypothesize that the level of closure of the syndicate's network is taking an inverted U-shape relation to the probability that the venture receives a second funding round.

> Hypothesis 1: The degree of closure of *the syndication network of a venture's first*-round investors is curvilinearly related (taking an inverted U-shape) with the probability that the venture receives a second round of funding.

Network diversity versus specialization and venture success

We have argued that new ventures thrive when receiving balanced advice from the syndication of VCs that invested in them, particularly if that advice combines elements of high-quality in-depth information with elements of broader and more diverse information. We relied on arguments of network structure to explain how a VC may achieve such balance. Here we put forward an alternative logic of how new ventures may extract similar informational advantages from their VCs' syndication network, ignoring its structural properties and instead focusing on diversity that characterizes the syndicate's network resources.

In building the structural embeddedness argument above, we followed the implicit assumption made in the respective literature that the absence or presence of structural holes reflect content diversity (Zaheer & Soda, 2009: 2): network contacts with high levels of closure tend to hold similar information and hence bring redundant information to the syndicate, whereas brokered connections tend to exist among contacts with diverse information and hence these supply unique information to the syndicate. This assumption is increasingly called into question in recent networks research (Kilduff & Brass, 2010; Zaheer & Soda, 2009). A purely structural explanation of brokerage (or closure) oversees the role of node-level characteristics as important contextual factors which may influence the extent to which brokered or cohesive relations hold in-depth or diverse information.

An alternative logic for how actors can derive informational benefits from the network has to date received much less prominence in the networks literature: actor diversity, also called network range. A selective number of studies have indicated that it is the diversity of actors present in one's network that drives access to in-depth or diverse information, rather than assuming that this emanates from the structure of the network (Fleming et al., 2007; Reagans & McEvily, 2003). It may be true that cohesive networks are more likely to exist

among similar actors and brokered connections among diverse actors, yet closed network structures may equally exist among heterogeneous actors and brokered structures among homogeneous actors (Fleming & Waguespack, 2007). In fact, VC syndication networks typically contain a mix of homogeneous and heterogeneous ties among investors (Baum, Rowley, Shipilov, & Chuang, 2005). VCs have a tendency to syndicate investments with other VCs that have similar investment portfolios in terms of the industry of the companies in which they formerly invested (Sorenson & Stuart, 2001). Yet, heterogeneous syndication ties are formed every time that VCs with different backgrounds and portfolios are attracted to the same target companies (Sorenson & Stuart, 2008) or when VCs decide to alter their investment policies on the basis of inconsistent performance feedback from prior investments (Baum et al., 2005).

We argue that the extent to which a syndicate's network contains ties to homogeneous and heterogeneous actors – in terms of the industry profile of alters' past investments – provides an alternative mechanism through which a balance between in-depth and diverse information can be obtained. On the one hand, a syndication network that contains ties among VCs with very similar industry profiles encompasses information of a specialized nature. The quality of information in a specialized syndication network is likely to be high by virtue of the ease with which information is transferred and interpreted among investors who share common ground (Cramton, 2001; Reagans & McEvily, 2003). Having investment from VCs with a specialized network, therefore, brings advantages for the venture similar to those associated to receiving investment from VCs with a closed network. On the other hand, a syndication network that taps into a range of investors with diverse industry portfolios provides access to non-redundant, diverse information (Reagans & McEvily, 2003), and hence functions as an alternative to having a network with high levels of brokerage.

Mirroring the argument of hypothesis 1, we therefore propose that new ventures take most advantage from the network resources of their VCs, if these have prior syndication networks that balance specialization and diversity in terms of the industry focus of the past investments of the contacts in their network. That is, VCs that have networks that are too strongly specialized in certain industries preclude the flow of diverse information to the venture, whereas networks that are too diverse lack the coherence from which valuable advice to the venture can be formulated. Therefore, we argue that ventures who received a first-round investment from VCs with intermediate levels of network specialization (or diversity) are most likely to receive a second round of funding (quickly).

> Hypothesis 2: The level of specialization of the syndication network of a *venture's* first-round investors is curvilinearly related (taking an inverted U-shape) with the probability that the venture receives a second round of funding.

The trade-off between brokerage-closure and specialization-diversity

So far, we have advanced two alternative logics of how ventures may extract information from their VCs' syndication network that balances specialized, in-depth and diverse, broad information. This raises the question how these network properties interplay. Specialized and closed networks function as a repository of high-quality, specialized information, whereas diverse and brokered networks channel broad and diverse information. Do the structural properties of syndication networks reinforce the corresponding information advantages obtained through network diversity effects? Or conversely, can a lack of diverse (specialized) information on the structural dimension be compensated for by access to specialized (diverse) information on the network diversity dimension?

Extending our earlier argument that ventures need a balance between specialized, in-depth information and broad, diverse information, we propose that the network brokerage (closure) and network diversity (specialization) properties of syndication networks are

substitutes. That is, our expectation is that ventures are most likely to receive a second round of funding, if the VC syndicate obtains specialized information on one dimension, and diverse information through the other. Table 1 portrays the possible network configurations when combining the network brokerage-closure and network specialization-diversity properties of syndication networks and the value these configurations of VC social capital embody for the ventures in which they invest.

Advice that incorporates both elements of diversity and specialization is of highest value to the venture, as diverse information provides the enriching perspective at which specialized knowledge can be interpreted. This implies that there are two ways for the venture to obtain "the best of both worlds": through VCs with specialized-brokered networks or VCs with diverse-closed networks. First, balance of the VCs' social capital is maintained at high levels of network closure if the network is diverse. The closed structure of the network facilitates the exchange of complex and sensitive information in a high-trust environment whilst the diversity of its members in terms of their investment history ensures that the breadth of information inflow is maintained. Second, ventures can take advantage of balanced VC social capital if their prior syndication networks have high levels of brokerage among specialized VCs, i.e. with strong similarity in their past investment focus. In this case, the specialized nature of the VCs in the syndicate's network ensures that complex and sector-specific information can be easily exchanged and understood, whilst the brokerage structure of the network safeguards syndicate's access to diverse, non-redundant information.

By contrast, if VCs have networks where the structure and actor diversity provide similar information advantages, the value of the VC social capital for the venture is limited. We argue that a syndication network in which advantages of information depth are obtained through both network closure and network specialization corresponds to a situation of overembeddedness. The term of overembeddedness was first coined by Uzzi (1997) to

describe a situation where "all firms in a network are connected through embedded ties, [which] can reduce the flow of new and novel information into the network because […] there are few or no links to outside members who can potentially contribute innovative ideas" (Uzzi, 1997: 58). We extend this conceptualization of (over)embeddedness to include a lack of inflow of novel ideas through excessive levels of specialization in a network. That is, we believe that the problems associated with a lack of connections to outside members of a network are exacerbated if members of the network are strongly similar. In the context of our study, VCs that have a closed network where members have strongly similar investment profiles are likely to give biased and incomplete advice to the ventures in which they invest, which we argue will ultimately be reflected in their inferior ability to attract a new round of capital.

Likewise, we conceptualize a situation of underembeddedness – not described in Uzzi's (1997) work – as a syndication network in which advantages of information diversity are obtained through both network brokerage and network diversity. VCs who broker connections between investors with strongly dissimilar investment profiles are unlikely to be able to formulate coherent advice that will be of value to their ventures. Both the VCs and the ventures may be overwhelmed with a too diverse array of information through the lack of industry-overlap of the brokered connections. A lack of network closure (or network specialization) makes it unlikely they can meaningfully interpret the sheer diversity of information in the form of advice towards new ventures.

Taken together, the value that VCs' social capital with a brokered versus closed structure has for the venture is contingent on the level of specialization of the network resources. Closed syndication networks gives rise to higher value advice for the venture if the network members are diverse. Brokered syndication networks, by contrast, engender higher value advice if the network members are specialized.

Hypothesis 3: The level of specialization *of the syndication network of a venture's* first-round investors moderates the relation between the network*'s level of* closure and the probability that the venture receives a second round of funding, such that:

(a) the level of network closure is negatively related to receiving funding for ventures whose investors have specialized networks;

(b) the level of network closure is positively related to receiving funding for ventures whose investors have diverse networks.

METHOD

Data

Our dataset is constructed from the database CrunchBase (www.CrunchBase.com), a public domain database that can be edited by anyone and gives a virtually complete overview of VC funding in the US IT and Internet industry in recent years. CrunchBase acts as a data provider for TechCrunch, a popular Internet blog now owned by AOL, delivering structured and unified information on startup firms, entrepreneurs, and investors. Although TechCrunch is only a "blog" it is one of the major information sources on startups in the IT and Internet business which has readers all over the world. The website contains longitudinal data about start-up firms, entrepreneurs, and investors in US high-tech industries, in particular the IT and Internet industry. For these industries, CrunchBase contains information, including funding histories, board compositions for a wide spectrum of companies from privately held small ones with few employees to large publicly listed corporations that have international operations, such as Microsoft, Google, or Facebook. Regarding investors, the data includes well-known funds like Sequoia Capital as well as CVC funds such as Siemens Venture Capital. Unlike VentureXPert, CrunchBase also includes those ventures that have recently been founded and have not yet received funding.

Notably, following prior research on VC (e.g., Alexy et al., 2010; Block & Sandner, 2009), we make use of the fact that CrunchBase provides reliable and detailed information to construct longitudinal syndication networks. We collected the data from CrunchBase on February 15, 2011. At that time, the database contained 56,658 firms, 6,073 financial organizations (primarily VC funds), and 19,812 funding rounds over the lifetime of these ventures. To play to the strengths of the CrunchBase data, we focus on companies residing in the US and operating in the IT and Internet area for our analysis. As we investigate the impact of syndication networks on additional funding, we only consider those firms that received a first round of funding, and further removed all firms with only one investor (i.e. non-syndicated investments). Our final dataset comprises 1,879 syndicated first-round investments into IT and Internet startups.

For the start-up ventures in our sample, we compiled their IP portfolios by identifying the trademark and patent filings these firms have undertaken. We obtained the official register of all available US trademarks from the US Patent and Trademark Office (USPTO) and identified those legal applicants that are clearly associated with the companies in our sample. Note that due to complex organizational structures (subsidiaries with different names, etc.) and misspellings a company in our sample is usually reflected by an array of legal entities each holding trademarks. Complete corporate portfolios can thus only be compiled if all trademarks of these legal entities filed are pooled. We aggregated all trademarks for various legal entities on the company level, compiled corporate trademark portfolios for all companies in our sample. We used the same approach for patents. Here, as data source, we relied on the PATSTAT database (version October 2011) provided by the OECD and the European Patent Office (EPO). This database contains all worldwide patent applications and patent publications. The EPO Worldwide Patent Statistical Database (PATSTAT) is available under license from the OECD-EPO Task Force on Patent Statistics.

Dependent variable

In our study of the effect of the structure and diversity of VCs' syndication networks on venture success, we estimate the effect of the VC syndicate network at the time of the first investment round on the probability that the venture receives a second round of funding. More precisely, for a sample of ventures who received a first round of VC investment, we estimate the incidence of and duration until receiving a second.

The probability and speed of receiving a second round of founding are essential to the survival and eventual success of any new venture (De Clercq et al., 2006). Especially firms active in high-tech sectors like IT and the Internet require several rounds of funding at comparatively short intervals to fund the investments they need to make for the development of their products and services (Gompers, 1995). Here, the achievement of a second round of funding is a clear quality signal that investors are happy with the progress that a venture has made in the first round and the information gathered about the venture since, and are thus willing to contribute additional resources (e.g., De Clercq et al., 2006; Lerner, 1994).

Independent variables

The independent variables of this study relate to the network resources of the syndicate that make the first-round investment in the focal venture. Network variables are defined at two different levels in order to disentangle the network relationships between the VCs that syndicate the investment in the focal venture (i.e. the within-syndicate network) and the broader network of prior syndication relations that exist beyond the syndicate. In the graphical example in Figure 1, VCs A, B and C syndicate a first-round investment in venture X (not shown) at time t.

Prior syndication relations include all pairs of VCs who have co-invested in a venture, in a time window of five years up to and including the month prior to the focal investment. The within-syndicate network contains the prior syndication relations between A, B and C

only. In the example of Figure 1, only A and B have previously syndicated an investment in the five years preceding the focal investment in X. The beyond-syndicate network contains all prior syndication relationships – again in the five-year window up until the month before the focal investment – of any of the syndicate members. In the Figure 1 example, A has formerly syndicated with D and E, B has prior syndication with E and F, and C with G. The within-syndicate network variables can be regarded as control variables, as the main interest of the paper – reflected in the hypotheses – centers on the beyond-syndicate network variables. Whereas the within-syndicate variables capture qualities of the syndicate itself, the beyond-syndicate measures capture the broader social capital that the syndicate members can bring to the table in their relation with the venture in which they invest.

First, we include beyond-syndicate network closure to test Hypothesis 1. This variable is computed as the number of existing ties among partners of the syndicate over the maximum number of possible ties, ($\frac{N*(N-1)}{2}$ where N is the beyond-syndicate network size). The measure ranges from 0 (full brokerage) to 1 (full closure). In the example of Figure 1, there is only a tie from D to E among 6 possible ties, yielding a closure value of 1/6. We include the squared term to account for non-linear effects.

Second, to test Hypothesis 2 we include beyond-syndicate network specialization. The variable relies on the past investment portfolio of each of the syndicate's prior partners, describing the relative specialization of a VC's investments over the five years preceding the focal investment. The technological specialization of each VC in the beyond-syndicate network is described by a vector of length 11, where a cell describes which fraction of investments were made in start-ups from each of the 11 sub-sectors of the IT industry. Beyond-syndicate network specialization is then calculated as the average cross-product of the vectors for each pair of beyond-syndicate network partners. In the hypothetical example of Figure 1, D invested 100% in RED, E 50% in RED and 50% in GRAY, F and G both

100% in BLUE. As a result, the vector cross-products for DE, DF, DG, EF, EG and FG are 0.5, 0, 0, 0.5, 0.5 and 1 respectively, yielding an average beyond-syndicate network specialization score of 0.42. The measure ranges from 0 (complete diversity) to 1 (complete specialization). We include a squared term to account for non-linear effects.

Control variables

A first set of control variables relate to the within-syndicate network, in order to show the effect of social capital above and beyond the network resources that the syndicate itself embodies. First, we include the syndicate size, as larger syndicates may have larger resources pools, and therefore may positively affect the chances of attracting a second round of funding (Lerner, 1994). Second, to control for the structural properties of the relations among the syndication members themselves, we include a measure of within-syndicate closure. Akin to the beyond-syndicate closure measure described above, it is essentially a local density measure that is calculated by the number of ties present among the syndicate partners over the maximum number of ties possible ($\frac{S*(S-1)}{2}$ where S is the syndicate size). The measure ranges from 0 (no prior ties) to 1 (full closure). We also include the squared term to account for non-linear effects. Third, we include within-syndicate specialization to control for the level of specialization-diversity within the syndicate. To compute this variable, we calculated the average cross-product for all pairwise combinations of syndicate members, in a similar fashion as for the beyond-syndicate network specialization measure. Finally, our theoretical argument has also made clear that we have to control for the sheer amount of networking partners that the members of the syndicate have. Therefore we include a measure of beyond-syndicate network size, without double-counting contacts that multiple syndicate members have (i.e. both A and B are connected to E). In the Figure 1 example this variable takes value 4, for the syndicate's relations to D, E, F and G.

A second set of control variables relate to the quality of the venture. We include the log of the raised amount from the first funding round. Importantly, this allows us to control for the initial conditions of the start-up, such as the social capital of the founders or the perceived quality of the idea; as Shane and Stuart (2002: 160) argue these initial conditions should be of little importance in subsequent funding rounds if their effect on the first round of funding is properly accounted for. We also include cumulative counts of patents and trademarks, including dummy variables where no trademarks or patents were found as these 0-values could either result from having no patents/trademarks or lack of data. Patents and trademarks are further important quality signals that may help to attract (a second round of) VC funding, but may also hold a certain liquidation value in case the startup fails, both of which may raise VCs' propensity to invest (De Clercq et al., 2006; Shane & Stuart, 2002; Tyebjee & Bruno, 1984).[1] Further, we also include firm age, because a higher firm age presents informational advantages to VCs (Gompers, 1995); we use a dummy when firm age information was unavailable. The final set of controls are contextual variables, including the year of first funding round to account for cyclical effects (5 dummies), the sub-sector of IT in which the venture is specialized to account for sectoral investment preferences (11 dummies), and three dummies for US states with high concentrations of IT firms to account for the geographical clustering of investments (3 dummies).

[1] With both trademarks and patents, we rely on applications of intellectual property rights instead of considering granted rights. That is a reasonable approach for two reasons: first, the process until an IP right is granted can take, especially with patents, up to five years. If we rely on granted rights, our data would be subject to office actions that cannot be influenced by the start-up. Further, investors obviously do not wait until issuance of an IP right. Rather, they appraise the IP filings and value the start-up based on this information. Second, filings of IP rights are closest to the point in time where a business decision has been made. We acknowledge that when a patent or a trademark is filed the business decision is usually some weeks or months previously. Yet, the date of filing is the closest we get to the time of decision-making and we therefore argue that patent and trademark applications inform us reasonably about the IP assets the firm holds – or seeks to hold – on which an investor is basing his valuation. Thus, for the remainder of this work we for simplicity use patents and patent applications interchangeably. The same applies to trademarks.

Estimation

To estimate the effect of the properties of VC syndication networks on the likelihood that a venture receives fundig, we employed standard Cox regression techniques. That is, we used hazard models to estimate the incidence and duration of receiving a second funding round.

We clustered the standard errors by syndicate size. The size of the syndicate may influence the values that the beyond-syndicate network variables can take. Most notably, small syndicates are more likely to have either high or low values of brokerage/closure or specialization/diversity rather than intermediate values. Their networks may be too small to incorporate variance on those dimensions due to their limited size. As a consequence, the standard errors of beyond-syndicate network effects may be non-independent of syndicate size.

RESULTS

Table 2 provides the summary statistics and correlations for all variables included in the regression. Half of all ventures in the dataset that received a first round of VC funding attracted a second round of funding, with 613 days on average between both funding rounds. The first-round syndicates have an average size of 3.2 members, which all together have an average beyond-syndicate network size of 56 other investors.

Table 3 shows the Cox regression analysis. Model 1 includes the control variables only. Models 2 and 3 separately introduce the effects of network closure and network specialization, respectively. All interpretations are based on the full model (Model 4). In order to interpret the curvilinear and interaction effects, we plot the probability that a venture receives a second round of funding two years after the first funding round (Figure 4). After two years, approximately half of all ventures were successful at attracting additional funding. This probability was calculated using the estimated survival function through the stcurve command in STATA, comparing the probability at time t=730 (i.e. two years after first

funding round) at varying levels of the independent variables whilst setting all remaining variables at their means.

Regarding our control variables, we find that the larger the amount raised in the first round, the longer it takes before a second funding round will take place. Surprisingly, we also find that the higher the number of patents and trademarks the venture has, the lower the probability it will attract a second funding round (quickly). A potential explanation is that these factors may have driven the first funding round decisions, where higher amounts raised may delay the incidence of a second funding round. The size, structure and specialization of the syndicate itself – i.e. rather than the network resources beyond the syndicate members – do not significantly affect second-round funding outcomes.

We find strong evidence for the network closure and network diversity effects of VCs' social capital on venture funding. Network closure in the VCs syndication network is positively associated with the probability that the venture attracts a second round of funding up to a threshold value where the relationship turns negative. Figure 2 plots the probability that funding was successfully obtained after two years. The optimal level of VC network closure is approximately 1 standard deviation above average, suggesting that – in general – closure is more beneficial than brokerage but that excessive closure dampens the probability of receiving a second funding round. Despite the fact that the dampening effect is relatively modest, these results support our predictions in Hypothesis 1.

Very similar results were obtained regarding Hypothesis 2. VC network specialization is positively associated with the venture's success in obtaining new funding up to a threshold, after which the relation turns negative. Figure 3 shows that the optimal level of VC network specialization, at which ventures are most likely to obtain second-round funding, exist between 1.5 and 2 standard deviations above the mean. This implies that – overall – VC network specialization is more advantageous for ventures than network diversity, but that

excessive levels of network specialization dampen the probability of getting a second round of funding.

The above results regarding network closure and network diversity have disregarded how these two factors may interact. Table 4 includes interaction effects between network closure and network specialization. Model 5 assumes that the relationship between network specialization and venture funding is linear and does not therefore include a squared term for network specialization. Model 6 does include this squared term, but shows coefficient estimations highly consistent to those in Model 5.

The estimation suggests that the advantages of brokerage versus closure are contingent on the level of network specialization. Figure 4 plots the interaction effects based on Model 5, showing the probability that a venture receives a second round of funding within two years after the first round for varying levels of network closure and network diversity. For VC networks with high levels of specialization we find that VC networks with low levels of closure – i.e. with high levels of brokerage – are positively associated with the chance that a venture is successful at attracting new funding. In line with Hypothesis 3a, at high levels of network specialization, the relation between network closure and venture funding is negative. This implies that the odds that a venture receives a second round of funding are higher if the VCs that invested in them have a specialized-brokered rather than a specialized-closed network. For VC networks with low or average levels of specialization (i.e. network diversity), however, we observe that – in line with Hypothesis 3b – network closure is positively associated with the probability that the venture receives additional funding. Only after a high threshold value of closure, the effect dampens. As a result, we find that the chance a venture receives new funding is higher if their VCs have a diverse-closed network than if they have a diverse-brokered network.

Taken together, we find that ventures with VCs that have specialized-brokered or diverse-closed networks have the highest probabilities of receiving funding (p=0.50 and 0.54, respectively), lending support to the notion that these represent balanced forms of VC social capital. By contrast, ventures whose VCs have underembedded networks – i.e. diverse-brokered networks – have a much lower probability (p=0.36) of attracting new funding within two years. Similarly, ventures that received funding from overembedded VCs have a relatively low chance of success in obtaining new funding (p=0.42). Interestingly, even a network with balanced levels of both network closure and network specialization (i.e. a moderately closed network with moderate specialization) grants the venture a lower chance of receiving funding (p=0.47) relative to the specialized-brokered or diverse-closed networks.

DISCUSSION AND CONCLUSION

Syndicating venture capitalists typically take on an advisory role towards the start-ups in which they invest (Stuart et al., 1999). In this study, we advanced the argument that the network the syndicate built with other investors through prior syndication – is an important form of second-order social capital. The information encapsulated in the syndicate's network may shape the quality and value of the advice they can give to the ventures in which they invested.

We demonstrated how the structure and diversity of VC social capital at the time of a first investment round impacts on the probability that a venture receives a second round of funding. The odds of that happening are greatest when VCs' syndication networks exhibit either relative open structures full of opportunities for brokerage among investors highly specialized in the same industries, or when their networks are relatively closed and cohesive structures among investors with diverse investment portfolio histories. That is, when the factors of network closure and network diversity were studied in isolation, closed VC networks (but not excessively so) and specialized VC networks (but not excessively so) were

shown to be more conducive to the venture's success in attracting additional funding. Both network closure with limited opportunities for brokerage and network specialization with limited space for diverse network members allow VCs to formulate advice that incorporates elements of high-quality, in-depth knowledge from their closed or specialized connections whilst allowing for the inflow of diverse, broader knowledge from the brokered or diverse connections.

When studying the interplay between network closure and network specialization, however, we revealed that the advantages of closure and similarity in terms of access to in-depth knowledge do not add up, and that advantages of brokerage and diversity in terms of access to broad knowledge do not mutually reinforce each other either. Instead, ventures whose VCs have networks that combine advantages of information depth from one dimension and information breadth from the other appeared most successful in attracting new funding. This implies that there are two configurations of VC social capital that combine the best of both worlds: specialized-brokered networks and diverse-closed networks. Advice emerging from VC networks that combine advantages of information depth through both network closure and network specialization, however, suffer from problems of overembeddedness, as both the structure and diversity of the network do not allow for the inflow of diverse information that can put the specialized information from the network into perspective. Similarly, advice emerging from diverse-brokered networks represents a situation of underembeddedness. VC syndicates with such networks will have difficulty formulating a coherent advice, as the sheer diversity of information they obtain through brokered connections to diverse actors cannot be associated to a basic core of information that is shared among a group of investors with redundant ties, or similar investment histories.

Implications for theory

This paper is positioned at the interface of the social capital, networks, and entrepreneurship literatures and makes contributions to each of these three streams of theory.

First, our study supports recent theorizing in the social capital literature that social capital may not only be beneficial to those holding the network resources, but may actually provide positive externalities to those to whom high social-capital actors are connected. In a recent study, Galunic, Ertug and Gargiulo (2012) demonstrated that investment bankers connected to senior brokers – and not necessarily brokering themselves – gain a performance premium. In a similar vein, this study has demonstrated that networks of prior syndication relations are not only valuable for VCs themselves, but are also an important form of second-order social capital through the advice that VCs draw from their social capital.

Second, we added new insights to the ongoing debate in the social capital literature on whether closure or brokerage structures represent higher-value social capital. Adding to recent nuances regarding the timing and the level in the network at which brokerage and closure advantages manifest themselves (e.g. Baum et al., 2012; Zaheer & Soda, 2009) and building on prior work on network diversity (Fleming et al., 2007; Reagans & McEvily, 2003), we have demonstrated how advantages related to network structure are contingent on the diversity of actors in the network. It matters whether opportunities arising from brokerage or closure are among specialized or diverse actors. In our context of the value of VC social capital for new ventures, closed structures exhibit the greatest information benefits if they exist among dissimilar actors, whereas networks with opportunities for brokerage are of highest value when they occur among actors with similar profiles. Naturally, the question arises to what extent such findings can be generalized to different contexts such as creativity and innovation. Yet, this study has unequivocally shown that incorporating the dimension of actor diversity into the existing framework of social capital may lead to novel insights. Future

research may look into the benefits and costs of specialized-brokered and diverse-closed networks in other settings.

Third, we advanced a two-dimensional definition of over- and underembeddedness. To date, the social capital literature has portrayed overembeddedness as a situation where a lack of inflowing novel perspective is limited merely by an emphasis on strong, embedded ties in dense network structures and the absence of connections beyond that strongly interconnected group (Uzzi, 1997). We added that such lack of inflow of novel and diverse information may equally arise from having networks whose members are too similar – i.e. regardless of their interconnectivity – but may be particularly salient when high levels of similarity and high levels of network closure are combined. Similarly, we coined the term underembeddedness to describe a situation where the opposite holds true. When networks are open structures among diverse actors, members of that network may be too loosely embedded in a network to extract any benefit from them.

Fourth, we made a contribution to the wider networks literature by showing how structural attributes of networks interplay with actor characteristics. All too often studies suffer from a strong "structuralist" view (Kilduff & Brass, 2010), attributing large proportions of the observed variance to differences in network position without controlling for actor heterogeneity (Reagans & McEvily, 2003) or network content (Chua, Ingram, & Morris, 2008). Our study has emphasized that the value members of a network obtain from it is a function of their structural position in the network, the diversity of actors in the network, and the interplay between those factors, lending support to the idea that effects of network structure cannot be studied in isolation.

Finally, we added new insights to the entrepreneurship literature. The value of the social capital that ventures obtain from VCs emanates from the structure and composition of syndication networks. New ventures need access to broad, yet specialized forms of

information, which they can obtain in two different ways from the syndication network. The investment history of the VCs forming a syndicate matters for the value ventures can extract from their social capital. VCs who "dance with strangers" (Baum et al., 2005) and allow investors with whom few other members of the syndicate have prior syndicated and who have a diverse industry portfolio may not only enrich their social capital to their own direct benefit, they may also facilitate the success of the ventures in which invested, ultimately boosting their return on investment.

Implications for practice

Our findings have implications for new ventures seeking to optimize their chances of success in securing continued access to venture capital as well as for investors seeking to get the highest possible return on their investment.

Young ventures are in a continuous struggle for new funding for their long-term growth and survival. Also after achieving initial VC investment, additional funds are typically necessary to realize the entrepreneurs' ambitions in terms of revenue and growth (Gompers, 1995). This study has highlighted that the configuration of the syndicate – and the network resources – they bring with them actually has a substantial impact on whether and how the venture can attract additional funding and may further develop. It may be logical for ventures to exhibit a preference for syndicates that are strongly specialized in investments in their subsector or syndicates who have extensively syndicated investments in the past. Yet, it may be worth considering for the venture that the advice they can obtain from the syndicate may be richer if the syndicate either consists of a group of investors with diverse specializations who syndicated in the past to a great extent, or accept funding from more specialized investors who have lower levels of past shared investment.

Similarly, VCs may need to refrain from overembedding in networks of investors with whom they frequently syndicated in the past and who have strongly similar industry

specializations. The involvement of "non-local" investors in their syndicates – with whom they have not syndicated before and who have different past portfolios of investments – may be considered risky (Baum et al., 2005), yet our study has demonstrated that such syndication relations are valuable. The addition of dissimilar investors enriches their networks, providing a broader perspective to the knowledge held in the core of their networks. This may have a direct effect on the investment decisions they make in the future, but – as this study has shown – it may also positively affect the fortunes of the ventures in which they invest, helping them to obtain larger returns on them.

Limitations, suggestions for future research, and conclusion

Our study suffers from several shortcomings, which in turn also open avenues for future research. First, our findings relate to the indirect effect of the structure and diversity of social capital on desirable performance outcomes. Our conclusions are based on models of statistical inference. Despite the fact that the mechanisms we laid out have strong validity through reference to prior work that has established VC social capital effects on venture performance (Hallen, 2008; Hochberg et al., 2007), future research is required to get a more fine-grained understanding of the elements of advice VC syndicates bring to their ventures, and how these may help ventures on their road to success.

Second, this study has suggested that advantages of access to in-depth knowledge (broad knowledge) obtained through actor similarity (diversity) or network closure (brokerage) are not mutually reinforcing in the context of VC social capital. It remains an open question whether the brokerage-closure and specialization-diversity dimensions of networks interplay in similar ways in different research contexts. In particular, the literature on brokerage versus closure appears to be reaching consensus that brokerage may be particularly conducive to processes of idea generation and knowledge creation, whereas closure may be more helpful for the implementation of ideas and innovations (Kilduff &

Brass, 2010). Also, it has been suggested that closure and brokerage effects differ in the timing at which they manifest themselves (Baum et al., 2012; Soda et al., 2004). This study has disregarded those contextual factors, and is therefore unable to establish to what extent these explanations are compatible with our approach using actor diversity. Future research in other settings could explore the interplay between network structural factors and actor diversity to test whether similar substitution effects can be observed, or whether these factors rather reinforce each other in other contexts. This study has shown that taking actor diversity into account can put the information advantages associated with closure and brokerage into a new perspective, representing a meaningful angle on which to enrich the ongoing debate – and our future research – on the structure and composition of high-value social capital.

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TABLES AND FIGURES

Table 1: Over- and underembeddedness in a framework of network closure and network diversity

		NETWORK DIVERSITY	
		Specialized network	**Diverse network**
NETWORK CLOSURE	**Closed network**	Specialized + closed **Overembeddedness**	Diverse + closed **Balanced social capital**
	Brokered network	Specialized + brokered **Balanced social capital**	Diverse + brokered **Underembeddedness**

Figure 1: Hypothetical example of a VC syndication network

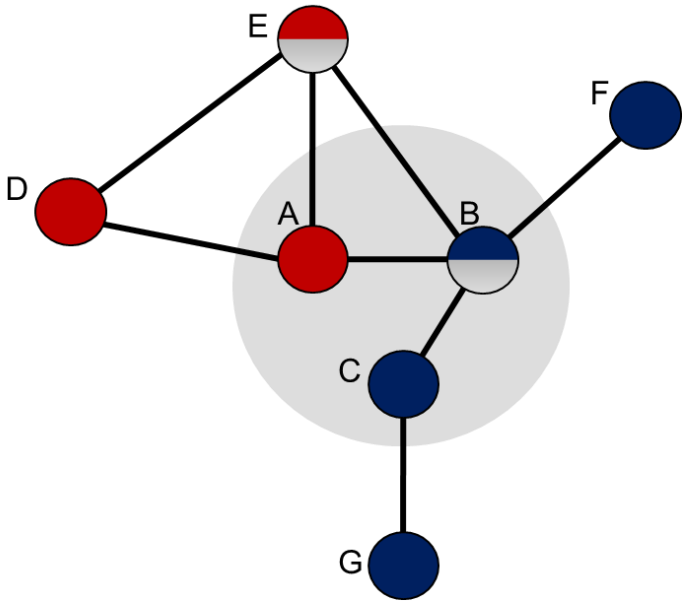


Table 2: Descriptive statistics and correlation

		Mean	S.D.	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Second funding round received	0.50	0.50	0	1														
2	Time until second funding round (days)	856.59	613.07	28	2281														
3	Log of raised amount (first round, log million USD)	1.61	1.19	-4.96	8.07	0.00	0.24												
4	Cumulative number of patents (venture)	3.83	13.15	0	229	-0.04	0.12	0.23											
5	Cumulative number of trademarks (venture)	3.41	9.99	0	263	-0.07	0.13	0.21	0.29										
6	Dummy: no patent information found (venture)	0.24	0.43	0	1	-0.13	-0.01	-0.21	-0.14	-0.19									
7	Dummy: no trademark information found (venture)	0.21	0.41	0	1	-0.13	-0.04	-0.23	-0.15	-0.17	0.91								
8	Syndicate size (first funding round)	3.29	2.06	2	28	-0.01	-0.08	-0.06	0.05	0.03	0.00	0.02							
9	Within-syndicate closure (synd. network)	0.14	0.30	0.00	1.00	-0.01	-0.10	0.04	-0.05	-0.02	-0.01	0.00	-0.09						
10	Within-syndicate network specialization (synd. network)	0.11	0.13	0.00	1.00	0.02	-0.03	0.11	-0.04	0.00	-0.03	-0.03	-0.06	0.32					
11	Beyond-syndicate network size (synd. network)	56.43	62.93	0.00	418.00	-0.08	-0.24	0.09	-0.01	0.00	-0.02	-0.01	0.35	0.31	0.21				
12	Beyond-syndicate network closure (synd. network)	0.18	0.20	0.00	1.00	0.03	0.04	-0.05	-0.02	-0.02	0.05	0.04	-0.09	-0.13	-0.16	-0.28			
13	Beyond-syndicate network specialization (synd. network)	0.24	0.16	0.00	1.00	0.09	0.09	0.07	-0.04	-0.01	-0.02	-0.03	0.06	-0.08	0.15	-0.13	0.52		
14	Firm age (venture)	1.55	1.33	-4.17	33.44	-0.05	0.06	0.21	0.04	0.05	-0.01	-0.01	-0.02	0.01	0.00	0.02	0.01	-0.03	
15	Dummy: firm age is missing (venture)	0.72	0.45	0	1	-0.09	0.25	0.31	0.13	0.10	-0.11	-0.14	-0.10	-0.01	0.05	-0.11	0.04	0.12	-0.06

Correlations greater than |0.046| are significant at 5%

Sector, year and region dummies not shown.

Table 3: Cox regression explaining INCIDENCE of and DURATION until second funding round after first funding round

	Model 1	Model 2	Model 3	Model 4
Log of raised amount (first round)	0.923 [0.024]***	0.914 [0.026]***	0.912 [0.028]***	0.911 [0.028]***
Cumulative number of patents (venture)	0.993 [0.003]**	0.993 [0.003]**	0.993 [0.003]**	0.993 [0.003]**
Cumulative number of trademarks (venture)	0.976 [0.006]***	0.976 [0.006]***	0.976 [0.006]***	0.976 [0.006]***
Dummy: no patent information found (venture)	0.753 [0.200]	0.735 [0.201]	0.751 [0.204]	0.740 [0.204]
Dummy: no trademark information found (venture)	0.721 [0.279]	0.734 [0.285]	0.718 [0.280]	0.729 [0.284]
Syndicate size (first funding round)	1.043 [0.025]*	1.039 [0.025]	1.033 [0.026]	1.034 [0.025]
Within-syndicate closure (synd. network)	0.898 [0.074]	0.909 [0.072]	0.908 [0.074]	0.912 [0.072]
Within-syndicate closure – squared (synd. network)	1.067 [0.038]*	1.061 [0.036]*	1.064 [0.038]*	1.062 [0.037]*
Within-syndicate network specialization (synd. network)	1.048 [0.055]	1.027 [0.046]	1.000 [0.042]	1.002 [0.037]
Within-syndicate network specialization (synd. network)	0.996 [0.011]	0.999 [0.010]	1.003 [0.010]	1.002 [0.010]
Beyond-syndicate network size (synd. network)	1.001 [0.001]**	1.002 [0.001]***	1.001 [0.001]**	1.001 [0.001]***
Beyond-syndicate network closure (synd. network)		1.222 [0.060]***		1.127 [0.048]***
Beyond-syndicate network closure – squared (synd. network)		0.942 [0.018]***		0.959 [0.014]***
Beyond-syndicate network specialization (synd. network)			1.134 [0.039]***	1.082 [0.045]*
Beyond-syndicate network specialization – squared (synd. network)			0.964 [0.014]**	0.980 [0.012]*
Firm age (venture)	0.916 [0.024]***	0.915 [0.025]***	0.916 [0.026]***	0.916 [0.026]***
Dummy: firm age is missing (venture)	0.636 [0.033]***	0.630 [0.032]***	0.629 [0.032]***	0.627 [0.032]***
Sector dummies (venture)	Jointly significant			
Year dummies (venture)	Jointly significant			
Region dummies (venture)	Jointly significant			
Observations	1879	1879	1879	1879

Robust standard error in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Figure 2: Non-linear effect of syndicate network closure on the probability of receiving a 2nd funding round (H2)

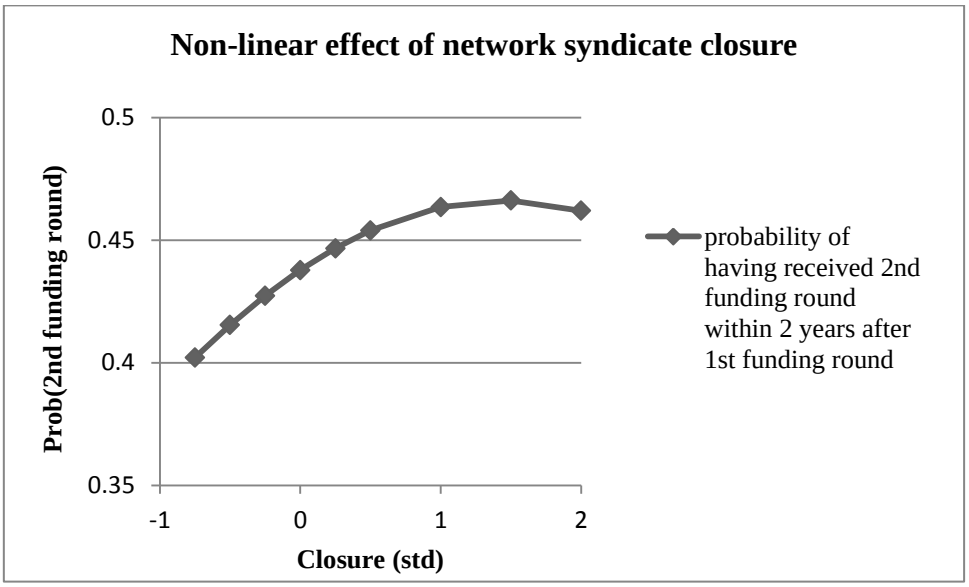
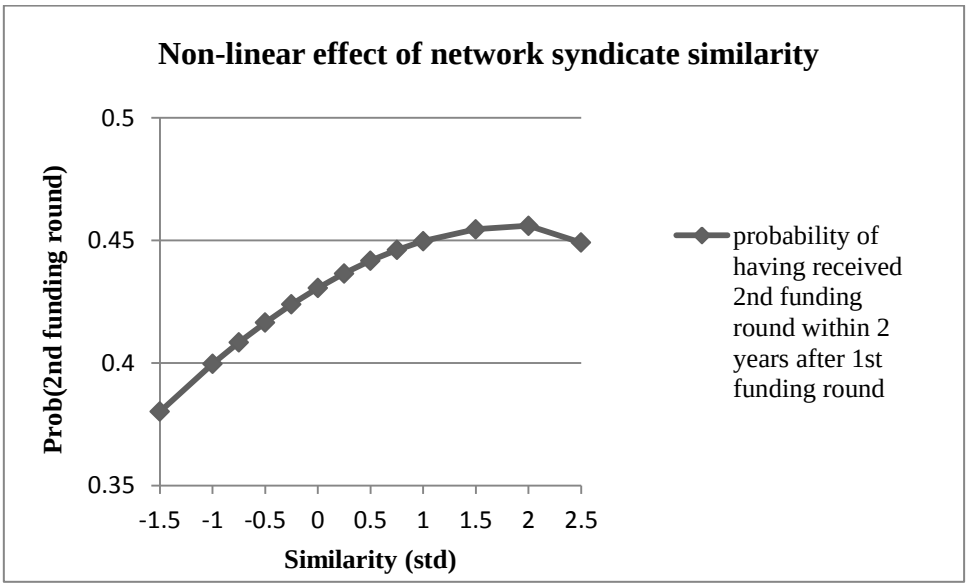


Figure 3: Non-linear effect of syndicate network specialization on the probability of receiving a 2nd funding round (H3)



Figures 2 and 3 were obtained with STATA's stcurve command, calculating the estimated survival function and cumulative hazard:

- Based on Model 4 in Table 1
- at varying levels of beyond-syndicate network closure and beyond-syndicate network specialization;
- at time t=730 (=2 years after funding round);
- setting all other variables at their means.

Table 4: Cox regression explaining

INCIDENCE of and DURATION until 2nd funding round after 1st funding round

including interactions between structural and relational network variables

	Model 5	Model 6
Log of raised amount (first round)	0.904	0.904
	[0.028]***	[0.029]***
Cumulative number of patents (venture)	0.993	0.993
	[0.003]**	[0.003]**
Cumulative number of trademarks (venture)	0.976	0.976
	[0.006]***	[0.006]***
Dummy: no patent information found (venture)	0.744	0.746
	[0.199]	[0.200]
Dummy: no trademark information found (venture)	0.725	0.723
	[0.278]	[0.278]
Syndicate size (first funding round)	1.037	1.036
	[0.025]	[0.025]
Within-syndicate closure (synd. network)	0.906	0.906
	[0.069]	[0.069]
Within-syndicate closure – squared (synd. network)	1.063	1.063
	[0.035]*	[0.035]*
Within-syndicate network specialization (synd. network)	0.997	0.992
	[0.034]	[0.033]
Within-syndicate network specialization (synd. network)	1.007	1.008
	[0.010]	[0.010]
Beyond-syndicate network size (synd. network)	1.001	1.001
	[0.001]***	[0.001]**
Beyond-syndicate network closure (synd. network)	1.199	1.180
	[0.034]***	[0.046]***
Beyond-syndicate network closure – squared (synd. network)	0.939	0.943
	[0.015]***	[0.015]***
Beyond-syndicate network specialization (synd. network)	1.000	1.015
	[0.026]	[0.029]
Beyond-syndicate network specialization – squared (synd. network)		0.993
		[0.008]
B-s closure * b-s specialization	0.881	0.883
	[0.046]**	[0.045]**
B-s closure-sq * b-s specialization	1.036	1.035
	[0.016]**	[0.016]**
Firm age (venture)	0.916	0.916
	[0.026]***	[0.026]***
Dummy: firm age is missing (venture)	0.626	0.626
	[0.033]***	[0.033]***
Sector dummies (venture)	Jointly significant	
Year dummies (venture)	Jointly significant	
Region dummies (venture)	Jointly significant	
Observations	1879	1879

Robust standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

Interacted variables were standardized before computing interactions.

Figure 4: Interaction between syndicate network closure and syndicate network specialization on the probability of receiving a 2nd funding round

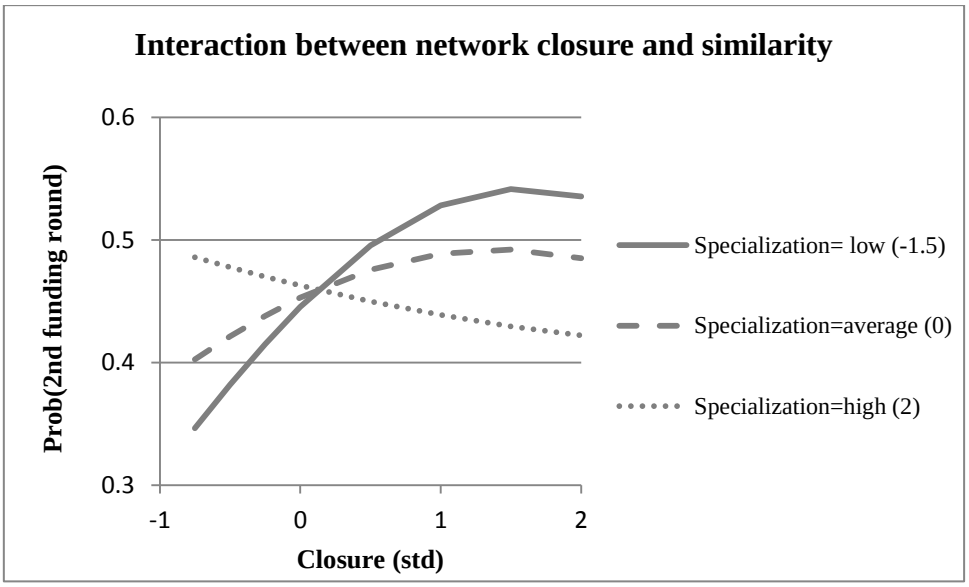


Figure 4 is obtained with STATA's stcurve command, calculating the estimated survival function and cumulative hazard:

- Based on Model 5 in Table 2
- at varying levels of beyond-syndicate network closure and beyond-syndicate network specialization;
- at time t=730 (=2 years after funding round);
- setting all other variables at their means.