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# THE INFLUENCE OF VC SYNDICATE DENSITY AND STRUCTURE HOLE ON STARTUP COMPANY PERFORMANCE



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## ABSTRACT

Venture capital (VC) firms often form syndicates to back up startup companies. However, despite the importance of syndication, what kinds of VC syndicates are more likely to be helpful are still underexplored. In this paper, we examine whether, and when, internal and external syndicate structures may facilitate the success of startup companies. Using archival data of VC investments from the period 1985–2000, we found that both internal syndicate density and external structural holes positively influenced the performance of startup companies. The positive impact of syndicate density is greater in syndicates with larger size and/or more experience heterogeneity.

## INTRODUCTION

Venture capital (VC) firms often syndicate to back up start-up companies. VC syndication can help to select startup companies with better quality; add value to startup companies through monitoring and nurturing; help share risks in VC investment; and also boost VC reputation by investing in successful startup companies (Brander, Amit, & Antweiler, 2002; Bygrave, 1987; Joshua Lerner, 1994). Although empirical studies have already confirmed the positive impact of using VC syndication, how attributes of VC syndicates may influence startup company performance is still underexplored. On the one hand, some studies have shown that syndicate size (Brander, et al., 2002; De Clercq & Dimov, 2008; Tian, 2011) and syndicate homogeneity in performance (Du, 2009) are positively related to a startup company's performance, and VC syndicate diversity has both a direct and indirect negative impact on company IPO performance (Chahine, Arthurs, Filatotchev, & Hoskisson, 2012). On the other hand, many other contextual variables of VC syndicates are left unexamined. One of these important attributes is syndicates' network structure. When VC firms form a syndicate, their prior relationships among each other constitute an internal local network structure at the syndicate level, and the syndicate itself locates in an overall VC network based on its members' connections with other VC firms outside of the focal syndicate. Since prior research has demonstrated that network structure is critical to firm performance, it is important to understand how the network structures of VC syndicates may influence the performance of startup companies.

For example, De Clercq and Dimov (2008) examined how a focal VC's total number of prior interactions with other VC syndicate members influenced startup company performance. While this line of research improved our understanding regarding network dynamics within syndicates, it raises questions about the relationships among other VC syndicate members, as well as the external network structure of the syndicate, because research found that non-lead VC firms in a syndicate also play an important role in affecting the startup company's performance (e.g. Brander, et al., 2002; Tian, 2011).

In an attempt to fill this gap, we have undertaken this study to investigate the impact of both internal network density within a syndicate and the external structural hole position of the syndicate in the overall VC network. Based on network closure theory (Coleman, 1988, 1990) and structural hole theory (Burt, 1992), we argue that both the internal syndicate density and external network structural hole will have a positive impact on a startup company's performance. Moreover, we propose that the effects of syndicate internal density may vary depending on the company's syndicate attributes, such as syndicate size and experience heterogeneity.

### HYPOTHESES DEVELOPMENT

#### Internal syndicate density

Internal syndicate density is the extent to which syndicate partners have prior partnerships before the focal syndicate formation. Greater internal syndicate density suggests more network closure among syndicate members. Traditional social network theory emphasizes the positive influence of network closure and argues that actors in a network benefit from network embeddedness. According to the social closure theory, the existence of common third parties and indirect ties not only makes it easier to access information, but also helps validate the accuracy of the information (Gargiulo & Benassi, 2000; Walker, Kogut, & Shan, 1997). The rapid information flow in a dense network will help establish norms of behaviors that enforce cooperation among actors (Gargiulo & Benassi, 2000; Walker, et al., 1997). Reputation arising from network embeddedness prevent actors from engaging in malfeasance (Granovetter, 1985; Raub & Weesie, 1990). All these aspects of network closure promote cooperation and coordination among partners. Since group performance depends on successful involvement of collaboration (Kanter, 1994), network closure has been expected to influence group performance positively. Empirical studies have shown proof of the positive impact of network closure at the team level (Lazega, 2001; Reagans, Zuckerman, & Mcevely, 2004; Reagans & Zuckerman, 2001).

In the case of VC investments, internal network density of VC syndicates influences syndicate performance at the startup company level in more than one way. On the one hand, the internal network density of a group of potential syndicate partners enables them to make quicker and better decisions in deal selection. In doing due diligence and deal evaluation, VC firms often count on other firms to have second opinions. In this process, second opinions from previous partners are especially trustworthy. Repeated ties, established trust, and shared norms not only enhance information exchange among VC firms and thus improve decision making, but also promote economies of time (Uzzi, 1996, 1997) and help VC firms make quicker decisions. On the other hand, syndicates with higher tie density may add more value to invested ventures. Besides reputational capital (Black & Gilson, 1998)1998, it has been shown that VC firms add value to ventures through many post-investment activities, including monitoring the progress of ventures; shaping the strategies of ventures; improving the professionalism of ventures through management recruiting and soliciting customers, suppliers, and strategic partners for ventures; and locating additional financial resources (Gorman & Sahlman, 1989; Hellmann & Puri, 2002; Josh Lerner, 1995; Megginson & Weiss, 1990; Sapienza, 1992). The prior ties among syndicate members minimize chances of unexpected behaviors, prevent freeriding from occurring, and reduce the likelihood of conflict. In addition, trust among syndicate members and the reputation effect may also improve the chances of securing follow-on investments from the existing syndicate partners. Thus, we expect,

*H1: Syndicate internal density will positively influence the performance of the startup company.*

By minimizing the chances of unexpected behaviors, preventing freeriding from occurring, and reducing the likelihood of conflicts, internal syndicate density will facilitate coordination among syndicate partners. However, coordination may also vary with other syndicate attributes. Prior research (Litwak & Hylton, 1962; Litwak & Rothman, 1970) suggests that coordination difficulties increase with the number of partners involved. While there is only one two-way interaction in a syndicate of two VCs, VC partners in a multi-firm syndicate face dyadic interactions of  $n(n-1)/2$ , where  $n$  is the syndicate size. Hence, the need to facilitate coordination will be greater in larger syndicates. Since trust can be a means of addressing coordination difficulties (Gulati & Singh, 1998), and since trust develops through prior ties among VC firms, syndicate density may ease the coordination issues incurred by the larger size of VC syndicates. Thus,

*H2: The positive impact of syndicate density on startup company performance will be greater in larger syndicates.*

Besides syndicate size, experience heterogeneity of VC syndicate partners is another important factor in coordination difficulties (Litwak & Hylton, 1962). Because different experiences of firms often accumulate different knowledge and skills (Haleblian & Finkelstein, 1999), VC firms with different experiences may make different judgments and have different preferences. Heterogeneity in experience not only requires more coordination (Litwak & Hylton, 1962), it may also increase cooperation difficulties due to conflicts of interest (Ancona & Caldwell, 1992; Chahine, et al., 2012; Reagans & Zuckerman, 2001). Since the collaboration difficulties arising from experience heterogeneity may be alleviated by higher network density, we expect,

*H3: The positive impact of syndicate density on startup company performance will be greater in more heterogeneous syndicates.*

### **External structural hole**

Besides the local internal network constructed by the ties among syndicate members, the syndicate itself is also located in the VC syndication network that resulted from the prior ties of its syndicate members with other VCs who are not participating in the focal syndicate. According to structural hole theory (Burt, 1992, 1997), the number of structural holes spanned by a syndicate in an overall VC syndicate network may also be influential on startup company performance. Actors in a network rich with structural holes will get information from disconnected clusters. The adding of new information from disconnected partners increases both the efficiency and effectiveness of information flow. Meanwhile, actors with more structural holes enjoy the control benefits by playing other partners against each other. Thus, the structural hole theory suggests that to maximize the benefits from the network, an actor should increase size and nonredundancy as much as possible (Podolny & Baron, 1997).

Since structural hole theory seems to be contradictory with network closure theory, researchers have reconciled these two perspectives by distinguishing between local and global structural holes (Burt, 2000; Reagans, et al., 2004). These studies have concluded that while network closure within a group fosters team performance through facilitating coordination and cooperation, external structural holes beyond the team will help improve the team's performance by providing nonredundant information and brokerage opportunities.

A VC syndication network is an environment through which VC firms share information and resources (Bygrave, 1988). The tacit knowledge and resources that VC firms have are critical to the performance of startup companies. VC firms that syndicate with each other often learn

about each other's unique resources and networks. By partnering with different firms that share less redundant ties, a syndicate ego network may span more structural holes. This means that VC firms in the syndicate can get access to diverse information and resource endowment (Gnyawali & Madhavan, 2001). Pooling diverse resources, rather than redundant information, will add value to the development of startup companies. For example, VC firms connected by syndication networks may jointly help their portfolio companies form alliances or expand customer pools (Hochberg, Ljungqvist, & Lu, 2007)\*. A syndicate with more structural holes, and thus more diverse information and resources, may offer more options in helping to solicit customers, suppliers, and partners, recruit professionals, and access additional financing. Such a syndicate may be able to provide different perspectives in helping to shape startups' strategies. Thus,

*H4: A syndicate's external structural holes will positively influence the performance of the startup company.*

### METHODS

In this paper, we examine how network structures of VC syndicates may influence the performance of startup companies. Using VC investment data from the VentureXpert database, we selected our sample using following procedures. First, we limited our sample to only U.S.-based companies. Second, we focused on first-round syndicates. A first-round syndicate is the first syndicate formed by a group of VCs for a start-up company. Third, since the dynamics of cooperation may be different depending on whether companies were young or mature when they received the funding, we limited our analysis to companies less than ten years old. Fourth, since first-round syndicates that were at the "Startup/Seed" stage, the "Early Stage", or the "Expansion" stage accounted for 90 percent of the syndicates in the sample, and since collaboration within VC syndicates at these stages is more important than at later stages, we concentrated on the first-round syndicates at these stages and excluded those first-round syndicates at all other stages. Fifth, because foreign VC firms, compared to U.S. VCs, may behave differently in cross-border investments, we excluded first-round syndicates involving any foreign VCs. Those cases accounted for less than 10 percent of all ventures. Sixth, due to the difference between angel investors and VC firms, angels were excluded from the analysis. The exclusion of angels did not change the number of startup companies included in the sample. Seven, in order to have a whole picture of who are the syndicate members, we also excluded those first-round syndicates where any undisclosed VC firm was involved.

To ensure that startup companies have enough time to exit, we focused on startup companies that received their first syndicate investments between 1985 and 2000 and tracked them down till 2010. That is to say, companies in our sample had at least 10 years to achieve IPO or acquisition. Our sample contains 1978 startup companies with first-round syndicates formed by U.S. VC firms during 1985–2000. As a robustness check, we also tested our hypotheses using investment data from 1985 to 2003; we report the results in the robustness analysis section of this paper.

The dependent variable in this paper is a dummy variable that indicates whether a startup company went public or was acquired by the end of 2010. Startup company performance was coded as 1 if the company had an exit and coded as 0 otherwise.

Syndicate internal density was calculated as the proportion of prior ties to the possible ties in a syndicate based on tie history in the prior five years. A prior tie exists between two VC firms if they co-invested in the same round for the same company in the prior 5 years. To measure the external

network position of a focal VC syndicate, we calculated the number of ties between its members and other VC firms outside of the focal syndicate in the prior 5 years. Thus, a focal syndicate is treated as the ego in the VC syndication network when its network structure is measured. A VC partner who did not invest in the focal syndicate but had ties with *any* members in the focal syndicate becomes an alter in the ego network of the focal syndicate. The tie strength between a focal syndicate and its alter VC will be calculated by the total tie strength that its syndicate members have with this particular alter. Based on the ego network of a focal syndicate, we measured its external structural hole using Burt's (1992) effective size of the network. The effective size of an ego network of syndicate  $i$  was calculated as  $\sum_j [1 - \sum_q p_{iq} m_{jq}]$  where  $p_{iq}$  is the proportion of the ego  $i$ 's ties with alter  $j$ ;  $m_{jq}$  is the tie strength between alter  $j$  and  $q$  divided by the maximum tie strength that alter  $j$  has with anyone in the network.

Syndicate size was measured using both continuous and categorical variables. First, we measured syndicate size by counting the number of VC firms involved in a syndicate. Since the continuous measure is highly skewed, we took a log transformation. Second, we coded syndicate size into 3 categories: two, three, and four or more. Then we generated two dummy variables for syndicate size three and syndicate size four or more. We calculated syndicate experience heterogeneity using the variance of VC experiences. VC experience used in this measure was calculated as the total number of years of investments that a VC firm has until the prior year of the syndicate was formed. To test the interaction effect, we also split experience heterogeneity into two categories using its sample mean. A dummy variable was generated to indicate the category of higher experience heterogeneity (greater than the sample mean of experience heterogeneity).

We included three categories of control variables, including characteristics of the startup company, attributes of the first-round syndicates, environmental variables. 1) For the characteristics of startup companies, we controlled for company age, company stage, as well as number of rounds a company has received. 2) About the attributes of the first-round syndicates, we controlled for disclosed round amount, average geographic distance and average industry distance among syndicate partners. We also included various measures of syndicate heterogeneity, including VC type heterogeneity and centrality heterogeneity (centrality measured using Bonacich's power). 3) To take environmental influence into consideration, we controlled for the total number of VC-backed companies in the "Startup/Seed" stage, the "Early Stage", or the "Expansion" stage in the focal startup's industry segment in the same year of focal investment. We also included industry dummies, year dummies, and location dummies indicating whether the company is in Massachusetts or in California. In accordance with the choice of a dummy variable as the dependent variable, we used a probit model to test the hypotheses.

## RESULTS

The results show that both syndicate density and structural holes have significant and positive relationships with companies' chances of going public or getting acquired (H1 and H4). The Smith-Blundell test as well as probit model with endogenous regressors show no proof of endogeneity, providing further support of value addition argument of syndicate density. Using categorical measure of syndicate size and syndicate experience heterogeneity, we find that syndicate density will have a greater impact on the companies' chances of exit when the syndicate size is larger (H2) or syndicate partners are more heterogeneous in experience (H3).

## DISCUSSION AND IMPLICATIONS

In this study, we examine how a VC syndicate's internal syndicate density and external structural holes influence a startup company's chance of going public and being acquired. Specifically, we argue that syndicate density may be positively associated with the startup company performance, because higher tie density among a group of VC firms may not only help them select better deals more quickly, but may also enable the formed syndicate to add more value to the development of the startup company. An important reason that a dense syndicate may offer greater value addition is that higher syndicate density may facilitate the cooperation and coordination of VC syndicate partners. Because the collaboration challenges are greater in VC syndicates that are larger in size and/or have greater heterogeneity in experience, we expect that the positive impact of syndicate density will be greater in those syndicates. In addition to the network structure within a syndicate, we also study the impact of a syndicate's external network structure. Based on structural hole theory, we propose that the structural holes of a syndicate may also enhance startup company performance. The empirical analyses of VC investments during 1985–2000 provide support for our arguments.

### Implications for research

This paper makes important contributions to the entrepreneurship literature. Research has established that VC syndicates are a means of resource pooling (Ferrary, 2010) and can add more value to startup companies than single VC investment (Brander, et al., 2002; Tian, 2008). However, when VC syndication gets more popular, it is necessary to find out what kinds of syndicates are more helpful. Taking a structural perspective, this paper links network theory with the entrepreneurship literature and identifies the type of network structures of VC syndicates that are more beneficial for startup companies.

Previous research has found that structural holes in entrepreneurs' personal networks will positively influence startup company performance (Stam, Arzlanian, & Elfring, 2014; Vissa & Chacar, 2009) 2009. This paper further shows that structural holes in the networks of companies' institutional investors will also boost startup company performance. Since the number of structural holes or the degree of brokerage tends to persist at both team level (Zaheer & Soda, 2009) and firm level (Yin, Wu, & Tsai, 2012), it is not surprising that the structural holes of first-round syndicates tend to be associated with successful company exits in the end.

This research also casts light on how network formation behaviors may influence collaboration performance. Although it has been found that firms tend to form ties with familiar partners, it is not clear whether such network formation behavior may actually have a positive influence on task performance. Due to the important influence of prior ties on network tie formation, the study of syndicate network structure based on prior ties has important meaning for the network formation literature. The performance consequences of such formation behaviors may be used to guide future network tie formation.

By distinguishing internal and external syndicate network structures, this paper provides empirical evidence in reconciling the argument of social network closure and network structural holes. Consistent with the argument of Burt (2000), it shows that while social network closure theory better fits for internal network structure, structural hole theory is more desirable for external network structure. The distinction of internal and external syndicate networks helps to bridge the network closure and structural hole theories. Previous research suggests that the network closure

and structural hole theories differ in how amplifiers of reciprocity make influence (Burt, 1999), although they both view “cohesive relationships as amplifiers of reciprocity” (Gargiulo & Benassi, 2000, p. 185). Interestingly, the positive correlation we found between internal syndicate density and external structural holes suggests that the “amplifiers of reciprocity” in local/internal networks may actually help to create structural holes in global/external networks.

### **Implications for practice**

This paper also offers important implications for VC firms in practice. It shows that there is merit in the VC firms’ preference for prior partners. Prior ties among syndicate partners are especially important in larger syndicates or in syndicates with greater experience heterogeneity. Syndicating with prior VC partners may actually help form syndicates that span more structural holes, which will also help to improve startup company performance. In addition, forming syndicates with greater heterogeneity in centrality may also help form syndicates that span more structural holes. Because of the persistence of structural holes and bridging, forming first-round syndicates with more structural holes may actually help a startup company exit in the end.

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