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FORTCOMING IN THE BRITISH JOURNAL OF MANAGEMENT

The Impact of Investment Networks on Venture Capital Firm Performance: A Contingency Framework[1]

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The Impact of Investment Networks on Venture Capital Firm Performance: A Contingency Framework

Abstract

Venture capital (VC) syndicates involve repeated transactions among partners and therefore possess network-like characteristics. Although networks provide access to important externalities, extant literature has not studied the effects of the focal firm's resource needs on performance benefits arising from different network structures. We investigate the impact of two proxies for firm-level resources, namely maturity and status, on the relationship between network cohesion and VC performance. We find that mature and high-status VCs benefit less from network cohesion. We also show that maturity and status simultaneously determine the performance effects of network cohesion.

Introduction

Syndicates are a common practice in various financial markets including VC investments and bank lending. Syndicates are formed when a group of financiers makes a joint decision to provide finance under conditions of uncertainty, and payoffs are subsequently shared among them (Lerner, 1994). In the entrepreneurial finance context, prior studies indicate that the majority of VC investments are syndicated and this practice "creates a network of relations within the VC community" (Sorenson and Stuart, 2001: 1559). VC syndicates often involve repeated transactions among partners that lead to the formation of network-based relationships (Hochberg, Ljungqvist, and Lu, 2007, 2010), and VCs "are bound by their current and past investments into webs of relationships with other VCs" (Hochberg et al., 2007: 251). However, there is very little research on the structural characteristics of VC syndication networks and how they affect the performance of individual syndicate members.

When selecting co-investment partners, a VC firm has to make a decision as to whether it wants to co-invest with partners already in its network, therefore increasing the cohesiveness of its network, or to establish new ties to form a network rich in structural holes (Echols and Tsai, 2005). The debate related to the cost-benefit trade-offs associated with membership of cohesive versus structural holes networks has become one of the most prominent conversations in the network literature, fuelled by a considerable ambiguity in empirical findings (Shipilov and Li, 2008). A cohesive network is beneficial to its members because it enhances an environment of trust and facilitates the flow of resources within the network (Coleman, 1988). However, Burt (1992) demonstrates that social constraints arising within a cohesive network limit the actor's flexibility and the scope of exchange in non-redundant resources. Burt (1992) emphasises the opportunities provided within a network rich in structural holes that supplies

non redundant resources and allows for brokerage opportunities that network members may exploit. Although network studies have emphasised the relevance of a network's structural characteristics (cohesion versus structural holes) for organisations, there is a dearth of research exploring the impact of syndication networks on performance of an individual syndicate member[2]. Our study aims to shed light on the effect of the structural characteristics of VC syndication networks on the performance of individual VCs and on the efficiency trade-offs associated with different network structures.

Previous research within the broader network literature has mainly focused on various externalities associated with cohesive or structural holes networks, such as formation of trust, information exchange and the flow of non-redundant resources among the network members. As indicated above, these studies are inconclusive in determining which type of network structure is more beneficial for a member firm (Kilduff and Brass, 2010). "One reason for a lack of consistent findings is that firms differ greatly [...], and such differences have not been considered yet" (Echols and Tsai, 2005: 233). In particular, previous network research has focused predominantly on the network's ability to supply relevant resources to the focal firm (e.g. Stuart, Hoang, and Hybels, 1999), and has overlooked differences between firms in terms of their idiosyncratic resource needs (Oh, Chung, and Labianca, 2004). In other words, extant research has extensively studied the supply side of network resources from the focal firm's perspective, and less attention has been paid to the demand side, which may depend on a number of firm-level resource contingencies. As Bae and Gargiulo (2004: 857) argue, "a joint consideration of actors' resources and of the social structure in which those resources are exchanged will lead to better understanding of the economic consequences of social relations",

[2] Notable exceptions are represented by Hochberg, et al. (2007, 2010), Echols and Tsai (2005).

and this is a focal theoretical lens we apply in our study of geographically bound VC co-investment networks.

We build on a contingency approach to explore the performance effects of network characteristics. Previous studies overlooked the moderation effect of the focal firm's resources on the relationship between network structure and firm performance. Researchers have tested moderators which fall under three broad categories, namely network context (e.g., Baum, McEvily, and Rowley, 2012), change in the environment (e.g., Gargiulo and Benassi, 2000) and business strategy (e.g., Shipilov, 2006). We argue that the benefits associated with a particular network structure are contingent upon complementarity and fit between resources accessible through the network and resources already controlled by the firm. More specifically, in the context of the VC industry, we focus on VC maturity and status as important firm-level factors that may help to unambiguously determine the balance between the costs and benefits of different network structural characteristics from the focal firm's perspective that, so far, has eluded network researchers. The maturity of a VC is an indication of its strong resource position vis-a-vis younger, recently formed funds (Gompers, 1996; Petty and Gruber, 2011). Mature VC firms have better access to financial resources provided by limited partners, more experience with selecting better investment targets in their environment, and a higher ability to develop and sell successful ventures compared to their newly established peers (Gompers, Kovner, Lerner, and Scharfstein, 2008). The VC firm's status is another important firm-level factor that underpins a favourable exchange position with regard to other firms (Podolny, 2001, 2005). High status VCs are more visible within the local VC community, and they are more likely to be invited to join syndicates organised by other VCs. By jointly considering these firm-level characteristics and network structure, we explore the following research question: *What are the effects of the focal VC firm's maturity and status on the relationship between network cohesion (versus structural holes) and the VC's performance?*

This research makes a number of contributions to both network and entrepreneurial finance literatures. First, we contribute to network literature by developing a contextualised framework within which we not only consider the network's supply of resources, but also the focal firm's demand for those resources within both cohesive networks and networks rich in structural holes. In doing so, we respond to recent calls for contextualised network research (Baum, et al., 2012; Tortoriello, Reagans and McEvily, 2012). We argue that the focal firm's resource endowment shapes the performance benefits arising from particular network structures. Considering both the firm's and the network's resources is an important contribution to network literature that currently lacks a resource-based view of social capital (Oh et al., 2004). More specifically, by introducing the firm's maturity and status as novel contingency factors, we shed additional light on the long standing debate between the benefits of cohesion (Coleman, 1988) and structural holes (Burt, 1992) which, despite its strategic relevance, still remains an unresolved issue in the network literature (Kilduff and Brass, 2010). Second, we advance entrepreneurial finance literature by developing a theoretical framework showing that VC syndicates can shape the network structure of the VC firms involved and that different structures offer different performance advantages depending on the VC firm's maturity and status.

We empirically test our hypotheses by collecting an extensive data set of VC investments in the United Kingdom (UK). For each VC in the sample, we construct its time-varying co-syndication network, and we calculate network cohesion and status. We focus on VC exits as a performance proxy since it represents a key strategic outcome of the investment syndication process. The number of portfolio company exits through an IPO or trade sale is an important measure of the performance of VC firms (Cumming, 2007). We find that younger and lower status VC firms have better performance when they join a cohesive network with other VC investors, while a network with structural holes is more beneficial for more mature

and higher status firms. Finally, using a three-way interaction model, we show that the effects of a firm's maturity and status strengthen each other. Therefore, maturity and status have joint effects in terms of shaping the cost-benefit trade-offs associated with cohesion and/or structural holes within syndication networks.

Theory and hypotheses

Financial syndicates received considerable attention in finance (e.g. Hochberg et al., 2007), strategy (e.g. Echols and Tsai, 2005), sociology (Ma, Rhee, and Yang, 2013) and entrepreneurship (e.g. Manigart et al., 2006) literatures. VC financing represents a "networked industry" (Echols and Tsai, 2005), and VC syndicates are an important mechanism to access network resources (Gargiulo and Benassi, 2000). The cost-benefit trade-off associated with network membership becomes particularly explicit in the analysis of one important characteristic of the VC syndication network structure, namely network cohesion as opposed to structural holes.

Network authors posited that both cohesion and structural holes can be advantageous under different contextual conditions (Kilduff and Brass, 2010). Researchers have empirically tested a number of contingencies that fall into three broad categories. First, scholars focused on the network context. For example, the performance benefits of structural holes decrease with ties' age (Baum et al., 2012) and increase with ties' strength (Tortoriello et al., 2012), diversity (Phelps 2010) and ties' 'imprinting effect' (McEvily, Jafee, and Tortoriello, 2012). Second, research considered changes in the firm's environment or the pace of the industry as important moderators of the network structure-performance relationship (Gargiulo and Benassi, 2000). Third, scholars focused on the moderating effects of business strategy. The firm's diversification as opposed to specialisation (Shipilov, 2006), capacity to absorb heterogeneous information, bargaining power and ability to protect against partner non-cooperation (Shipilov,

2009), all increase the benefits of a network with structural holes. We build on this literature by arguing that the focal firm's resources represent additional, and less explored, firm-level contingency factors that shape the relationship between network structure and performance.

Although it has been widely recognised that networks provide access to resources, extant network research has overlooked the demand side of network resources which depends on the existing resource endowment of an individual network member. Even within the same network, resource requirements vary between member organisations and for the same firm in different moments of its development. In particular, we propose two factors that account for resource differences across VC firms that, in turn, impact on the effect of network structure on firm performance: (a) the VC firm's maturity that reflects the evolution of internal resources such as investment experience, access to capital, market knowledge, and ultimately a capacity to develop portfolio companies, and (b) the VC firm's status that determines potential external resource advantages associated with the perception that other firms have of the focal VC, which translates into access to investment deals. Maturity and status capture a variation of resource needs not only across firms, but also with regard to the same firm in different periods of its life.

Network cohesion and the VC firm's maturity

We define firm's maturity as the extent to which the organisation has developed, over time, the resources necessary to compete in its environment. Young VC firms differ considerably from mature firms in their resource challenges and endowments and, everything else being equal, they have fewer resources than mature firms (Knockaert and Ucbasaran, 2013). In the VC context, this resource difference is evident when comparing first and follow-on funds. First-time funds have, as a rule, lower financial resources than follow-on funds (Petty and Gruber, 2011). Mature firms, however, due to their market and investment experience, are

in a better position to evaluate proposed deals and subsequently to add value to their portfolio companies leading them to a successful exit.

Young firms can alleviate their internal resource constraints by being embedded in a cohesive network. A cohesive network is based on a relational exchange, rather than market dynamics (Zaheer and Venkataraman, 1995) and, therefore, it is more likely to provide resources needed by a young firm at a relatively low cost and without the need for a short-run reciprocation (Hite and Hesterly, 2001). Although a newly established VC has fewer opportunities to add value to a start-up due to its limited market and investment knowledge (Schefczyk and Gerpott, 2001), by co-investing with a close circle of partners it will be able to rely on its co-investors' expertise to add value to the investee company, and learn from its peers (Al-Laham, Amburgey, and Bates, 2008). One may argue that young firms would be better off in a structural holes network to acquire different resources and grow. Yet, it is difficult for young firms to access these resources from experienced VCs outside of their immediate circle. Further, during the investment process, a young VC is at a higher risk of self-serving behaviour by other syndicate members, which Filatotchev et al. (2006) describe as "principal-principal" agency risk. These potential conflicts of interests may expose a young VC firm to exploitation by more established peers. Therefore, young firms will be better off in a cohesive network where social norms mitigate the dangers of self-serving partner behaviour (Coleman 1988; Reagans and McEvily, 2003).

Although the socially embedded mechanism of mutual support typical of a cohesive network is important during the early phase of the VC firm's development, it may limit firm flexibility and opportunities during the maturity stage. A mature firm requires less protection from the network. Rather, it needs opportunities to grow further and sustain its performance, and structural holes provide better access to new business opportunities (Shipilov and Li, 2008). In addition, although social constraints derived from a cohesive network offer protection, they

may limit flexibility and partner diversity necessary to thrive in the long term. As Kogut, Urso and Walker (2007) show, although co-investing with the same partners over time provides advantages, this may compromise the firm's ability to enter into new, more lucrative markets. Considering that the VC industry is a dynamic and cyclical environment that changes fast and recurrently (Gompers et al. 2008), flexibility is a key strategic component.

Therefore, for a mature VC firm with built up internal resources, a structural-holes position will help it to access non-redundant resources and information, to be aware of market shifts and consequently, to achieve better performance. On the other hand, younger VC firms that lack internal resources will benefit from a cohesive network that provides social protection and resource support. Hence, we suggest the following hypothesis:

H1: The relationship between VC network cohesion and individual VC firm performance is contingent on the firm's maturity. Specifically, for younger (more mature) VC firms, membership in a cohesive (structural holes) network improves performance.

Network cohesion and the VC firm's status

Our arguments above suggest that the VC firm's maturity, as a proxy of its internal resources (namely the ability to grow successful ventures), may determine the relationship between network structure and performance. In this section, we focus on how the firm can take advantage of its ability to marshal external resources associated with its status (Podolny, 2001, 2005). We define status as "a socially constructed, intersubjectively agreed upon and accepted ordering or ranking […] in a social system" (Washington and Zajac, 2005: 284). In particular, "network status refers to a firm's positional ranking in its interfirm networks" (Lin, Yang, and Arya, 2009: 924). Within the VC industry, "centrally positioned actors enjoy high status because they occupy prominent structural positions in the community's syndication network" (Sorenson and Stuart, 2001: 1560).

High-status VC firms are desirable partners (Podolny, 1994) and are therefore more likely to receive more invitations to co-invest in ventures with better prospects (e.g. Ozmel, Reuer, and Gulati 2013). As a result, high status VCs have higher chances to achieve a successful exit from their portfolio companies (Hochberg et al., 2007). On the other hand, low status firms are unattractive syndication partners and therefore they will be in a disadvantageous position in terms of both the number of invitations to co-invest and in terms of joining the most promising deals.[3]

However, low status firms can mitigate these disadvantages and enhance their access to the required external resources if they are embedded within a cohesive co-investment network. Social capital can act as a substitute for the lack of status and even low status VCs may be invited to high quality deals by their close allies with whom they have established relationships. Network cohesion offers a social mechanism that creates resource spill-overs, visibility benefits and higher legitimacy among market audiences (Suchman, 1995). In sum, we argue that low status VCs are able to overcome the limitations of their status if they are embedded within a cohesive network.

On the other hand, high-status VCs have the 'pulling power' to receive multiple co-investment invitations, usually many more than they can deal with. Key resources that high status firms need are non-redundant information and a flexibility to tap into the best new investment opportunities that come about. For them, a cohesive network is a constraint; it makes them search more locally and puts them under pressure to partner with (and often end up helping) their close allies because of the existing relationship. Instead, a network with structural

[3] We have to note here that network structure remains a choice factor and it is not directly related to a firm's status. Invitations to co-invest (independently from how many each firm receives) can come from both existing and new partners. Both low and high status firms can decide whether they want to stick to their usual partners inviting them to yet another deal, or to reach out to new partners that invite them to co-invest.

holes offers the resources they need; by reaching out further than their immediate contacts, they can access non-redundant information, improve their selection of investments and benefit from brokerage opportunities. Consequently, high status VCs embedded in investment networks rich in structural holes would have an increased probability of creating successful exits.

In sum, VC firms benefit most from networks that offer a fit between resource demand and supply. Low status investors need a higher number of invitations and for better deals, a cohesive network helps them to overcome their unattractiveness arising from their lack of status. On the other hand, high status firms need non-redundant information, flexibility and brokerage opportunities, and a network rich in structural holes is the ideal setting to provide these resources (Podolny, 2001). These arguments lead us to our second hypothesis:

H2: The relationship between VC network cohesion and individual VC firm performance is contingent on the firm's status. Specifically, for lower (higher) status VC firms, membership in a cohesive (structural holes) network improves performance.

Maturity, status and network structure: a three-way interaction

Our previous arguments suggest that the VC firm's status and maturity are important contingency factors that affect the impact of a network's structural characteristics on the focal firm's performance. We extend these arguments further and suggest that the effects of a firm's maturity and status are not orthogonal but mutually reinforcing. We note that a young firm may have either high or low status. For example, VC firm Andreessen Horowitz, established in 2009, quickly gained status in the U.S. VC industry. By 2012 the firm was named among the top early stage investors by various business sources such as *BusinessInsider, Entrepreneur.com* and *Forbes*. Similarly, although a firm may gain status as it matures, this is not always the case and

sometimes status can be lost. A well know example is Terra Firma, which went through scandals and underperforming investments (The Economist, 2014).[4]

In previous sections we argued that maturity and status independently moderate the relationship between network cohesion and performance. In this section we argue that, to fully exploit the opportunities arising in a structural holes network, a VC firm needs to be both mature and enjoy a high status. Hence, we suggest a three-way interaction effect on the VC firm's performance, comprising of maturity, status and network structure.

Mature VCs are better at supporting their ventures towards a successful exit, but these (internal) resources are most useful when firms receive invitations to join promising deals due to their high status. In this ideal situation of maturity combined with high status, networks rich in structural holes will maximise the VC firms' performance, as they provide maximum flexibility and brokerage opportunities for these 'strong' firms. In contrast, young VC firms with low levels of status will maximise their performance in a cohesive network. In this type of network, the mechanisms of social cohesion may offer the focal VC the resources to grow a venture towards a successful exit, and also provide an improved deal flow. As we mentioned above, a cohesive network is based on a relational exchange, rather than pure market transactions (Zaheer and Venkataraman, 1995). Therefore, it is likely that in a cohesive network, some 'stronger' VCs (i.e. mature and with high status) would 'share' the resources needed by the focal 'weaker' players (i.e. young and with low status). Such a transfer of resources is less likely in a non-cohesive network because the actors are more loosely connected and the partnerships are more transactional rather than relational (Hite and Hesterly, 2001).

[4] The online sources have been accessed on the 25th of August 2015.

VCs operating in intermediate conditions (e.g. high maturity - low status) will also face difficulties outside of a cohesive network. A VC firm with significant internal resources may have the ability to develop and grow a portfolio company, but if the start-up has been selected from a low quality pool due to the lack of investment opportunities available to a low status firm, it may still be very difficult to transform it into a "unicorn".[5] Similarly, a high-status VC firm that is still young and inexperienced in growing portfolio companies will also face performance issues despite being invited to co-invest in good deals. This reasoning leads us to the following hypothesis, suggesting a three-way interaction between maturity, status and network structure:

H3: The relationship between VC network cohesion and individual VC firm performance is contingent on the interaction of the firm's maturity and status. Specifically, a structural holes network improves performance for more mature VC firms with higher levels of status.

Methods

The UK venture capital industry

The empirical context of this study is the UK VC industry. Several factors make this industry a useful research setting. In the VC industry, networks are crucial and a fruitful research setting for network studies (e.g. Hochberg et al., 2007). We choose to focus on the UK VC market because, although being the most important VC market in Europe (EVCA, report on European VC activity 2012) and the third most attractive worldwide (IESE, *2013*), it has received considerably less attention than the US VC market (Bellavitis, Filatotchev, and Kamuriwo, 2014).

[5] "Unicorns" are ventures valued at over $1 billion before an IPO.

As of 2015, UK VC firms invested in 17 tech unicorns, compared to 22 in the U.S.. Comparing the investment patterns in 2013 between UK and U.S. investors, we find both similarities and differences. According to data from the BVCA, at $7b the UK VC market is considerably smaller than the U.S. market ($30b; NVCA statistics)[6]. In both countries, internet and software ventures received most VC investments. A major difference between the U.S. and the UK concerns the stage of investment. The U.S. VC investments are more evenly distributed between seed/early stage (34%), expansion (42%) and late stage (25%). In contrast, in the UK only a small portion of capital is invested in seed/early stage (10%) and expansion deals (16%), while the majority is invested in late stage deals. Both in the UK and U.S. markets VCs predominantly exit through IPOs or trade sales. However, in the U.S., a larger portion of exits was through IPO (81 IPOs, 385 M&A deals) than in the UK (17 IPOs, 171 M&A deals).

Data

The primary source for investment data was the Thomson One Banker (previously Venture Expert). We used Zephyr and MergerMarket to collect data on exits (i.e. IPO and M&A) and venture advisors. We identified the advisors that worked alongside VCs for the UK investments. In total we identified 427 advisors including accounting firms, brokers, debt providers, financial PR firms, law firms, insurers, lead managers, and underwriters.[7]

[6] BVCA is the British Venture Capital Association, while the National Venture Capital Association (NVCA) is the American equivalent.

[7] We were able to identify at least one advisor in only 21% of the UK investments made by our VCs and in 4.5% of the exits.

Our sample includes all VC firms, mostly but not exclusively based in the UK, investing in UK start-ups from 1998 to 2008[8]. We decided to sample on the basis of the location of the investee ventures for theoretical reasons. First, VC investing is a particularly geographically bound activity. Cumming and Dai (2010) indicate that: "Some VCs even make their investment decisions based on the 20-minute rule, which is that if a start-up company seeking venture capital is not within a 20-minute drive of the VCs' offices, it will not be funded." Both theoretical and empirical work is consistent with this observation (e.g., Sapienza, 1992; Sapienza et al., 1996; Lerner, 1995). Although we identified VCs investing across countries, based on this evidence we argue that the resource benefits arising from a VC network are geographically constrained. Second, limiting the network to UK-based investments avoids sample variations with regards to macro-institutional factors (e.g. regulation, cultural dimensions) that can bias the findings.

Based on the above, we constructed a geographically constrained VC network using data on co-investments in the UK. We acknowledge that some of the VC firms in our sample have cross-border investments and we control for this (see below). We focused on VC investments from seed to later stages, excluding buy-outs. The final dataset contains 1235 VC-backed companies, including 1954 deals made by 503 VC firms. In total we have 351 VC exits through IPOs and trade sales, approximately 29% of the total number of portfolio companies. These figures are in line with those reported by the BVCA for the available years (i.e. 2007-2012) within our sample period.

In line with previous research we created a longitudinal dataset of co-investment networks among VC firms. We coded two VCs co-investing in the same portfolio company as

[8] Our records track the investment outcomes until September 2012 because VC portfolio companies require a few years to develop a venture and exit (Hochberg et al., 2007).

having a tie. Relationships may change, and entry and exit from a network influence each VC network (Hochberg et al., 2007). We constructed our adjacency matrices using a 5-year moving window from t-4 to t (Sorenson and Stuart, 2001; Ma et al., 2013). For example, if two VCs invest together in 2002, they will be connected until 2006 (inclusive). The final dataset has a total of 3285 VC-year observations.

Measures

Performance. Previous studies indicate that the ultimate goal of VC firms is to exit their portfolio companies either through a trade sale or an IPO. The number of exits is a clear and objective way to assess VC performance (Cumming, 2007), and IPOs and trade sales are widely regarded as the best exit outcomes for VCs (Gompers and Lerner, 1999). Alternative measures of success, such as accounting measures, may be misleading in this industry and are seldom available; both the portfolio companies and the VCs are private companies that rarely disclose their financial results (Bellavitis et al., 2014). Therefore, in order to test our hypotheses, we used the number of exits (trade sales and IPOs) in a given year as a proxy of VC performance[9].

Network cohesion. This variable estimates how cohesive a VC network is. We used the network constraint measure suggested by Burt (1992: 55) implemented in UciNet 6 (Borgatti, Everett, and Freeman, 2002):

$$c_{ij} = \left(p_{ij} + \sum_{q \neq i \neq j} p_{iq} p_{qj} \right)^2$$

[9] We did not find reliable data for return on VC investment (ROI) and successful versus unsuccessful sales (fire sales). To remove potential bias created by fire sales, we ran a robustness test with IPOs only as a dependent variable, as bringing a venture to IPO is the ultimate success for a VC. The results remained the same.

In the above formula, the focal actor *i* has two contacts *q* and *j*, and it estimates how redundant and cohesive is the relationship *i*-*j*. P_{ij} reflects the interaction between *i* and *j*, while P_{qj} defines whether q and j are related. Therefore, if the three VCs are all related, it is difficult to develop a structural hole and the network is cohesive. The sum of the cohesiveness of all VC relationships defines the overall cohesion. This is a continuous variable with higher values reflecting cohesive networks and lower values indicating that the network is disperse and rich in structural holes.

Maturity. In order to determine the VC firm's maturity, we used the number of funds under management at time t. The number of funds is a better proxy for maturity than, for example, age, because it captures the amount of internal resources available to the focal VC.

Status. "The dominant way of measuring status is to use Bonacich's centrality" (Piazza and Castellucci, 2013: 21). Bonacich centrality has been widely used to measure VC status (e.g. Hallen, 2008; Petkova et al., 2014). We adopted the procedures implemented by Ma et al. (2013), Hochberg et al. (2007) and Lee et al. (2011). Each firm's Bonacich (1987) centrality was computed as follows:

$$C_{it}(\alpha,\beta) = \sum A_{ij}(\alpha + \beta c_j)$$

where α is a scaling factor that normalises the measure in a given year and β is a weighting factor. Bonacich centrality appropriately measures status and access to external resources in our context as it associates higher values to central firms in the syndication network. As Sorenson and Stuart (2001: 1560) theorise: "Centrally positioned actors enjoy high status [… and] high-status venture capitalists likely receive many invitations to join investment syndicates."

Control variables. In order to rule out alternative explanations we included three types of controls related to the VC firm, the portfolio companies and environmental conditions. In relation to the focal VC firm, we controlled for the *average syndicate size* in which the focal VC participated in any given five year moving window. We controlled for *experience* by using the number of VC investments made by the focal VC up to the year of analysis. We controlled for potential resource differences due to non-co-investment links that are specific to certain types of VCs. For example, corporate VCs may learn from their parent companies. We therefore included *VC-type* fixed effects in the analyses.[10] We also controlled for resources acquired from connections with advisors. We collected additional data from Zephyr and MergerMarket about all types of advisors and financial institutions involved in each UK VC deal (investment and exit). We created two measures that compute the proportion of *top advisors* (top 10% in terms of advisory roles in VC deals within a five-year moving window) and *non-top advisors* that a VC has worked with in the last five years. We note that the two measures were not symmetrical as they could both have a value of zero if the focal VC did not employ any advisor in the last five years. To account for status derived from overseas investments of the VCs in our sample, we controlled for *global prominence.* This was measured as the number of VC investments made by the focal VC in the U.S., Germany, France and Canada in any given five year moving window. We controlled for *Firm location,* namely whether the VC headquarter was located in the UK, the U.S. or elsewhere. *Diversification* was computed with a five year moving window and is measured by a Herfindahl index based on the six industries reported by the Venture Expert.

[10] In our sample, apart from independent VCs, we have bank-affiliated VCs, corporate VCs, government-affiliated VCs, university-affiliated VCs, insurance-affiliated VCs, and VCs associated with endowment foundations and pension funds.

Controls related to portfolio companies included the *average venture age at financing.* This measure controls for how old (in years) the average venture in the portfolio of the focal VC firm was at the time of its first VC investment. We also controlled for the *average portfolio age* (i.e. for how many years the average venture has been in the focal VC portfolio).

Finally, we controlled for environmental conditions. We controlled for the "hotness" of public markets through the annual net new listings on the London Stock Exchange (*LSE*), market *competition* in terms of the yearly amount of VC invested in the UK and *lending interest rates* in the country where the VC headquarter is located.

Analytical approach

We recognised that endogeneity can be a problem with our data structure and we tried to take this into account in our analytical approach. To investigate whether endogeneity was present and to identify suitable instruments, we followed the procedures suggested by Shipilov and Li (2008), Zaheer and Soda (2009) and Abdallah, Goergen and O'Sullivan (2015). We started by testing whether maturity, status, cohesion and performance were endogenous. We ran an augmented regression Durbin-Wu-Hausman test for the existence of endogeneity in the models with a system of 2SLS with interchangeable dependent and independent variables. We did find that maturity was indeed codetermined with status ($F=4.24$; $p<.05$), cohesion ($F=5.61$; $p<.05$) and performance ($F=7.22$; $p<.01$). We also found that status was endogenous with regard to cohesion ($F=84.8$; $p<.001$) and performance ($F=7.23$; $p<.01$). Considering these results, two sets of estimators were deemed appropriate.

First, we ran a Hausman-Taylor (HT) regression treating maturity, status, cohesion and performance as endogenous variables (Table 2, models 1 through 4). This approach offers two important benefits. Similar to a fixed effects model, a HT regression accounts for unobserved heterogeneity by allowing for correlation between regressors and the effects of the individual

VC firm. Yet, contrary to the fixed effects model, it allows estimation of regressors that are invariant over time (Greene, 2003). This method also accounts for endogeneity by using both the between and the within variations of the exogenous variables as instruments for the specified endogenous variables (Baltagi, 2008). We performed a Hausman post-estimation test to ensure that this model is preferable over a panel regression with fixed or random effects. The test (Chi2=27.10, p<.10) suggested that the HT estimation was appropriate.

Second, we ran a longitudinal G2SLS random-effects instrumental variables (IV) regression (Table 2, models 5 through 7). We use *average syndicate size*, *pension funds assets* under managements as a percentage of GDP, and *CVC type* (corporate venture capital) as instrumental variables. The Appendix discusses the validity of these instruments in detail.

Prior to analysing our data, we standardised all our main variables (*cohesion*, *maturity* and *status*) around the Z-score to avoid high inter-item correlations among the interaction terms (Gao, Gopal, and Agarwal, 2010). After this standardisation, we created two- and three-way interaction terms to test our hypotheses following the guidelines of Friedrich (1982).

Results

Table 1 provides descriptive statistics and correlations. To ensure that multi-collinearity was not an issue we conduct a VIF test. All the variables except the interaction maturity*status (VIF = 13.94) were within the acceptable limit of 10 (Neter, Kutner Nachtsheim, and Wasserman, 1996), with the average VIF being 4.48. Removing *maturity*status* from our analyses did not change our results. Our network has similar levels of *cohesion* compared to Shipilov and Li (2008) for the investment banking sector and Echols and Tsai (2005) for the U.S. VC industry.[11] Our standardised measure of cohesion ranged from -.65 to 1.96. Our

[11] Echols and Tsai (2005) do not report the raw measure of cohesion. We reconstructed the mean of their measure.

standardised measure of status ranged from -.24 to 18.21. VC maturity, measured in terms of funds managed to date, ranged from 1 to 23. The most mature firm is 3i.

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Insert Table 1 about here
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Table 2 reports results of the Hausman-Taylor and G2SLS random-effects IV panel regressions. In model 1, we included only the control and main variables. Not surprisingly, VC firm's *maturity* ($p<.05$) and *status* ($p<.001$) are positively and significantly related to performance. This finding is in line with our theory. More mature and higher status VC firms possess and control resources that increase their ability to add and extract value from their portfolios. Most importantly, the network *cohesion* measure showed no significant direct relationship with performance. The lack of significance strengthens our main argument that the effects of the syndication network structure on performance should not be considered in isolation from the two contingency factors. In line with our expectations, *experience* and *global prominence* boosted performance. Interestingly, our variables for advisors are not significant. *Lending interest rates* positively and significantly impact performance. In contrast, both the listings on the *LSE* and the amount of *competition* do not significantly impact performance.

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Insert Table 2 about here
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In models 2 and 5, we included the interaction between network cohesion and firm maturity to test hypothesis 1. The interaction coefficient was negative and highly significant in both models ($p < 0.01$), in line with our first hypothesis. To further confirm the significance of this interaction, we run a Wald test to investigate whether the interaction significantly contributes to the model's explanatory power. The significance of the interactions' coefficients may not always accurately reflect the impact of the interaction (Weiers, 2010). The Wald test confirmed that the interaction significantly increased the explanatory power of our models

(Wald test chi2 = 13.32 and 15.18; $p < .01$). Young firms benefited from having a cohesive network, but once they matured, a structural holes network is associated with better performance.

In models 3 and 6, we added the interaction between cohesion and status. This addition significantly increased the explanatory power of our models (Wald test chi2 = 10.59 and 8.55; $p < .01$). Hypothesis 2 predicts a negative effect of the interaction between a cohesive network and status on performance. Supporting this hypothesis, the two-way interaction was negative and highly significant in both models ($p < 0.01$).

Finally, in models 4 and 7, we entered the three-way interaction term to test hypothesis 3. To test this interaction, we also needed to include the interaction between maturity and status. The addition of these variables significantly increased the power of our models (Wald test chi2 = 22.42 and 18.30; $p < .01$) and confirmed the significant effect of the three-way interaction, suggesting that there is a strong interplay between a syndication network structure and the firm's maturity and status in relation to performance. Supporting hypothesis 3, the three-way interaction term was negative and highly significant ($p < 0.01$). A negative sign indicates that status and maturity, taken together, reinforce the benefits of a structural holes position.

To help further interpretation of our results, we plotted the three interactions in Figures 1, 2 and 3. Figure 1 shows that a firm's maturity has a strong impact on the relationship between network structure and performance. A cohesive network exerts a positive influence on the performance of younger firms, whereas a network rich in structural holes is beneficial to more mature firms. Interestingly, a cohesive network evens out the advantages stemming from maturity.

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Insert Figure 1 about here

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Figure 2 illustrates the moderation effect of status. A cohesive network has a positive effect on the performance of lower status firms. On the other hand, a network with structural holes is beneficial to higher status firms. The interaction is disordinal. A cohesive network not only evens out the advantages stemming from status, but at high levels of cohesion, the performance of high and low status firms is inverted.

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Insert Figure 2 about here
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Finally, Figure 3 illustrates the joint moderation effect of maturity and status. A structural holes network is particularly supportive to performance of mature and high status firms. More mature firms have better performance in a structural holes network, but even more so when maturity is combined with high status. To fully benefit from a structural holes network, a VC firm needs both high levels of maturity and status. In intermediary situations, as well as when a firm has both low status and low maturity, a cohesive network is associated with stronger performance.

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Insert Figure 3 about here
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Robustness tests

In order to confirm the robustness of our findings, we performed several additional tests using different estimation methods and variable operationalisations. First, we used a panel regression with standard errors clustered around the focal VC firm with fixed and random effects as alternative regression tests to verify our results. A fixed effect model offers an alternative technique to deal with endogeneity issues. Further, in order to alleviate the reverse causality concerns and endogeneity, we re-ran the Hausman-Taylor regressions including our dependent and independent variables with a one year lag (Abdallah et al., 2015). In addition,

we attempted to remove the potential bias created by unsuccessful exits (e.g., fire sales) by using a more conservative test with IPOs only as the dependent variable. Finally, considering that the VC literature approximated status by alternative measures such as eigenvector centrality (e.g. Petkova, et al., 2014), we re-run our analyses using eigenvector centrality, as well as an index based on the type of VC as a proxy for status. In this index, independent VC firms hold the highest status (coded as 3), followed by CVCs (coded as 2), universities and endowments (coded as 1), and finally governments sponsored funds (coded as 0).[12] In all of these analyses the results were very similar to our main findings.

Discussion

In this study we link together network research with entrepreneurial finance by arguing that the structure of a VC syndication network is an important predictor of VC performance. Specifically, we show that the effects of the investment network structure are contingent upon the resource endowment of the focal VC firm. We build on previous research arguing that network cohesion has both advantages and disadvantages (Kilduff and Brass, 2010), and we propose two contingency factors, the VC firm's maturity (a proxy for its internal resource endowment) and status (a proxy for external resource endowment). We find that the resource endowments (both internal and external) reduce the performance benefits arising from a cohesive network. We also find that maturity and status reinforce each other in terms of their moderating effects on the relationship between network cohesion and VC performance. Although maturity helps to support the development of promising start-ups, high status is needed to be invited to participate in investment syndicates. These findings suggest that a VC firm needs both status and maturity to gain full advantage of a structural holes position.

[12] We would like to thank an anonymous reviewer for these helpful suggestions.

In general, our results show that firms with higher levels of resources will experience negative performance in a cohesive network. We explain this finding as follows: Cohesion of the social structure on the one hand triggers the creation of effective support for members with lower amounts of resources but, on the other hand, it causes the proliferation of mutual commitments, obligations and expectations (Coleman 1988). Portes and Sensenbrenner (1993) and Gargiulo and Benassi (2000) showed that the obligations that result from a cohesive network create attrition in the entrepreneurial process. In our context, VCs possessing high amount of resources may face similar pressures within a cohesive network, which could be detrimental for their performance.

Interestingly, Figure 3 shows that VCs with either intermediary configurations of resources (high-low) or with low resources (low-low) experience better performance within a cohesive network. Figure 3 also shows that, although a cohesive network exerts a positive impact on the performance of VC firms with neither maturity nor status, this impact is limited. In contrast, firms with intermediary configurations of resources have considerably stronger performance benefits in a cohesive network. Taken together, these findings may suggest that while a resource poor VC is likely to be supported in a cohesive network, this support will be stronger when the focal VC has some resources to offer in exchange.

Despite the finding that mature and high-status VCs would benefit from a structural holes position, surprisingly, we observed positive bivariate correlations between cohesion, status and maturity. That means that as VC firms grow older, their status increases and they seem to embed themselves in a more cohesive network. Our study suggests that this is a sub-optimal strategy. We believe that such a strategy may be the result of inertia and path dependency.

Some of our findings regarding the control variables are interesting and worth discussing. We found that having *top-advisors* increases the number of exits, while having *non-top advisors* reduces the number of exits. However, while these relationships are in the expected direction, they are not statistically significant. The lack of significance could indicate that the quality of the advisors has a stronger impact on the value raised from successful exits rather than on the actual number of exits. *Lending interest rates* positively and significantly impact performance. This may be explained by the fact that interest rates are higher in a period of economic growth. Economists argue that low interest rates incentivise investments. Our findings show that in times of high interest rates these investments actually pay off. We believe that these relationships offer interesting insights worth further investigation.

Our theory and evidence advance prior research in both network and entrepreneurial finance in several ways. First, we contribute to the broader network research, which mainly considered externality effects associated with resources available to the focal firm through the network. We complement previous work by accounting for the focal firm's resource needs which are contingent upon its characteristics. Taking into account both the supply and the demand for resources in a network is an important contribution to network theory which currently lacks a resource-based view of social capital (Lavie, 2006; Oh et al., 2004).

Second, we utilise our resource-based approach to network research to contribute to the intense and important debate about the effects of network cohesion on firm performance (Burt, 1992; Coleman, 1998). To explain inconsistent findings, the literature suggests that both cohesion and structural holes can be advantageous under different conditions (Burt, 2001; Kilduff and Brass, 2010). We extend this literature by suggesting and analysing two additional potential factors that may tip the cost-benefit trade-offs associated with network structural characteristics, namely firm maturity and status.

Third, we contribute to the entrepreneurial finance literature. Previous studies highlighted both the positive (Bygrave, 1988; Hochberg et al., 2007; Lerner, 1994) and negative (Filatotchev et al., 2006) effects of financial syndication. We demonstrate that the VC syndication network structure has a strong impact on exit outcomes.

Limitations and future research

This paper is not without limitations. First of all, as previously mentioned, endogeneity is a problem in our dataset. We took extreme care in dealing with this issue and our results are robust to an extensive number of statistical iterations. We mainly use two techniques that are deemed appropriate to treat endogeneity: A Hausman-Taylor regression and a G2SLS random-effects IV regression. To identify suitable instrumental variables required for the latter set of analyses, we implemented a strict theoretical and statistical procedure (see Appendix for details). Yet, it is already challenging to find a suitable instrument for one independent variable. To find instruments for a system with one predictor and two moderators was a daunting task. While we did our best with the available data, we cannot guarantee that our final set of instruments is the ultimate optimum. We believe though that the compromises we have made do not undermine our results that, in fact, remained robust to numerous alternative models.

Second, our focus is on formal investment ties. We only study co-investment ties among VCs, overlooking other types of ties such as informal (e.g. friendship) or formal personal networks of managers (e.g. directorships). Our approach is justified by data limitations, and it is in line with previous VC research (e.g. Hochberg et al., 2007). Yet, data availability aside, studies about the combined effects of different types of ties would be valuable.

Third, our dataset involves single country-industry investment networks. This approach has been widely used in previous research due to the geographical boundaries involved in VC decision making. Yet, this may not apply to other industries where resources and investment opportunities may be more mobile. Future studies could extend our findings to other settings.

Finally, in line with VC research, we focus on one measure of success, namely the amount of VC exits. Although this measure is generally regarded as appropriate in the VC context, it does not capture other types of performance such as portfolio survival rate, or VC fund raising. Future studies may offer interesting insights by investigating the effect of cohesion on alternative performance measures.

Appendix

Appropriateness of the instruments in the G2SLS random-effects IV regression

The G2SLS random-effects IV regression requires the identification of instruments. We instrumented cohesion by using the *average syndicate size:* A focal VC that participates in syndicates with many interconnected investors is likely to have a more cohesive network than when it participates in syndicates with fewer investors. Syndicate size is less likely to impact other variables in the dataset, especially maturity. We instrument *maturity* by using *pension funds assets* under managements as a percentage of GDP. This measure is collected in the country of origin of each focal VC fund. Pension funds are the main source of funds for VCs, therefore when pension funds have higher assets they are more likely to invest in VCs and, consequently, VCs are more likely to raise follow on funds, which is our measure of maturity. Considering that pension funds are not involved in the day to day management of the VC funds, there is no reason to believe that they impact performance and status of the focal VC firm, or cohesion of the VC industry. We instrumented status by using *CVC type* (corporate venture capital). As previously mentioned, CVCs are likely to carry a lower status than independent VC firms (Souitaris, Zerbinati, and Liu, 2012). At the same time, CVCs do not necessarily have stronger performance, maturity or cohesion.

Clearly, the identification of instruments for the four interrelated variables was theoretically and statistically challenging and the instruments have been chosen after numerous tests and iterations. We ran a Shea test to investigate the impact of instruments on the endogenous variables (Godfrey, 1999). To optimise our models, we ran a test for over-identifying restrictions (Baum, Schaffer, and Stillman, 2003) and, as suggested by Abdallah et al. (2015), we ran a Hansen J square test (1982). These tests showed that the instruments selected were statistically robust.

Assessment of face validity

We argue that a firm's maturity and status are appropriate proxies for internal and external resources respectively. In order to confirm the validity of our measures we conducted an assessment of face validity following Echols and Tsai (2005) that suggest a qualitative approach to prove the validity of their measures in the VC context. More specifically, we interviewed six VC experts: a partner of a consultancy firm specialised in VC fund-raising, a legal counsel of a VC firm, three VC managers, and two CEOs of VC-backed firms. The purpose of the interviews was to explore whether our measures (maturity and status) are associated with the concepts of interest (access to internal and external resources).

The interviewees linked VC maturity with internal resources. A VC-backed entrepreneur argued that: "with more [...] years of experience a VC has developed more knowledge about the market condition and probably has raised more money." Another interviewee explicitly underlined the association between follow-on funds and internal resources: "a VC firm with a follow-on fund will have more internal resources in the form of more experienced investment managers [and] more experience working as a team."

Further, status was associated with external resources. An entrepreneur mentioned that "top tier VCs have more deal-flow and get access to the best opportunities in the market […]. One expert suggested: "if a VC is highly regarded, that VC will receive a higher deal flow,

because they will be recommended". This qualitative information suggest that our operationalisations and constructs are appropriate and valid in the context of our study.

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Table 1. Descriptive Statistics and Pearson Correlations

	Variable	Mean (S.D.)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Performance	.11 (.45)																		
2	Lending interest rate	5.03 (2.50)	-.06*																	
3	LSE	50.36 (191.21)	-.01	.04*																
4	Competition	12257 (7400)	.08*	-.13*	-.12*															
5	Experience	2.96 (7.77)	.51*	-.18*	-.02*	.13*														
6	Global prominence	3.57 (13.38)	.11*	.07*	.02	-.07*	.13*													
7	Diversification	.57 (.17)	.00	.11*	-.00	-.03*	-.00	-.01												
8	Top advisors	.06 (.23)	.10*	.04*	.00	-.00	.19*	.07*	.10*											
9	Non-Top advisors	.04 (.18)	.05*	.06*	-.01	.06*	.11*	-.00	.09*	.07*										
10	Average portfolio age	1.32 (1.45)	.08*	.29*	.01	.11*	.20*	.03*	-.21*	.01	.01									
11	Average syndicate size	3.79 (2.94)	-.01	.10*	.03	-.14*	-.05*	.06*	.02	-.00	-.05*	-.02								
12	Average ventures age at financing	4.20 (2.07)	.01	.27*	-.05*	.21*	.08*	-.03*	-.39*	-.06*	-.04*	.66*	-.11*							
13	Maturity (Z)	0.00 (1.00)	.45*	-.19*	-.03*	.12*	.83*	.15*	.02	.21*	.15*	.20*	-.01	.05*						
14	Status (Z)	0.00 (1.00)	.16*	-.03*	.02	-.11*	.24*	.13*	.04*	.13*	.03*	.10*	.20*	.00	.32*					
15	Cohesion (Z)	0.00 (1.00)	.04*	-.06*	.03*	-.02*	.08*	.01	.14*	.08*	.06*	.30*	.26*	.03*	.14*	.17*				
16	Cohesion*maturity	.13 (.84)	-.02	-.01	-.00	.02	.06*	-.02	.00	.03*	.02	-.02*	-.06*	.00	.12*	-.07*	.00			
17	Cohesion*status	.17 (.70)	-.09*	-.00	-.00	.08*	-.13*	-.08*	.03*	-.03*	-.02*	-.00	.15*	.00	-.09*	.35*	-.00	.08*		
18	Maturity*status	.32 (5.42)	.23*	-.00	.00	-.03*	.34*	.22*	-.03	.11*	.01	.01	.00	-.00	.34*	.60*	-.01	-.16*	-.31*	
18	Network cohesion*maturity*status	-.06 (2.55)	-.23*	-.00	-.01	.02	-.30*	-.22*	.05*	-.09*	.00	-.00	-.00	.00	-.27*	-.44*	.02	.18*	.39*	-.92*

n= 5015.

Table 2. Main models

	Hausman-Taylor longitudinal estimation[a]				*IV estimation*[b]		
Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Lending interest rate	.011*** (.003)	.010*** (.003)	.011*** (.003)	.010*** (.003)	.016*** (.004)	.011*** (.003)	.016*** (.004)
LSE	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)
Competition	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	-.000 (.000)	.000 (.000)	-.000 (.000)
Experience	.025*** (.001)	.024*** (.001)	.025*** (.001)	.023*** (.001)	.023*** (.001)	.024*** (.001)	.022*** (.001)
Global prominence	.001*** (.000)	.001*** (.000)	.001*** (.000)	.001** (.000)	.001* (.000)	.001*** (.000)	.000 (.000)
Diversification	.028 (.046)	.032 (.046)	.030 (.046)	.040 (.045)	-.008 (.052)	.028 (.045)	-.000 (.052)
Top advisors	.007 (.030)	.008 (.030)	.004 (.030)	.005 (.030)	.020 (.033)	.006 (.030)	.020 (.033)
Non-Top advisors	-.026 (.039)	-.028 (.039)	-.029 (.039)	-.029 (.039)	-.021 (.043)	-.030 (.039)	-.021 (.042)
Average portfolio age	.011 (.009)	.012 (.009)	.010 (.009)	.012 (.009)	.006 (.010)	.010 (.009)	.007 (.010)
Average syndicate size	-.002 (.003)	-.004 (.003)	-.001 (.003)	-.004 (.003)	IV	IV	IV
Average ventures age at financing	-.006 (.005)	-.008 (.005)	-.006 (.005)	-.007 (.005)	-.005 (.005)	-.005 (.005)	-.005 (.005)
Maturity (Z)	.030** (.013)	.041*** (.014)	.031** (.013)	.050*** (.014)	.061*** (.015)	.035*** (.013)	.066*** (.015)
Status (Z)	.027*** (.009)	.023*** (.009)	.029*** (.009)	.039** (.018)	-.001 (.008)	.020*** (.007)	.008 (.016)
Cohesion (Z)	.001 (.013)	.017 (.012)	.000 (.013)	.014 (.011)	-.000 (.008)	-.000 (.007)	-.001 (.008)
Cohesion*maturity		-.029*** (.008)		-.024*** (.008)	-.031** (.008)		-.029*** (.008)
Cohesion*status			-.034*** (.010)	-.022 (.017)		-.030*** (.010)	-.005 (.017)
Maturity*status				-.017*** (.005)			-.012** (.005)
Cohesion*maturity* status				-.037*** (.007)			-.030*** (.008)
Location fixed effects	YES	YES	YES	YES	YES	YES	YES
Firm type fixed effects	YES	YES	YES	YES	YES - IV	YES - IV	YES - IV

Constant	-.103 (.074)	-.090 (.074)	-.095 (.074)	-.090 (.074)	-.053 (.062)	-.064 (.055)	-.051 (.062)
VC-year observations	3285	3285	3285	3285	2920	3285	2920
VC firm	503	503	503	503	487	503	487
Wald chi2	1284.4***	1308.1***	1294.4***	1339.8***	242.6***	1178.6***	259.5***
R-squared (overall)	-	-	-	-	.28	.28	.28
Wald test chi2	-	13.32***	10.59***	22.42***	13.44***	8.84***	12.49***

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

[a] Hausman-Taylor longitudinal estimation with random effects. Dependent variable: VC performance. VC performance, status and network cohesion are treated as endogenous.

[b] G2SLS random-effects IV regression. Instrumented variables: cohesion, maturity and status. Instruments: Average syndicate size, CVC type, Pension funds assets, Models 5 and 7 have fewer observations due to missing observations for the variable *Pension funds assets*.

Figure 1. Cohesion and maturity

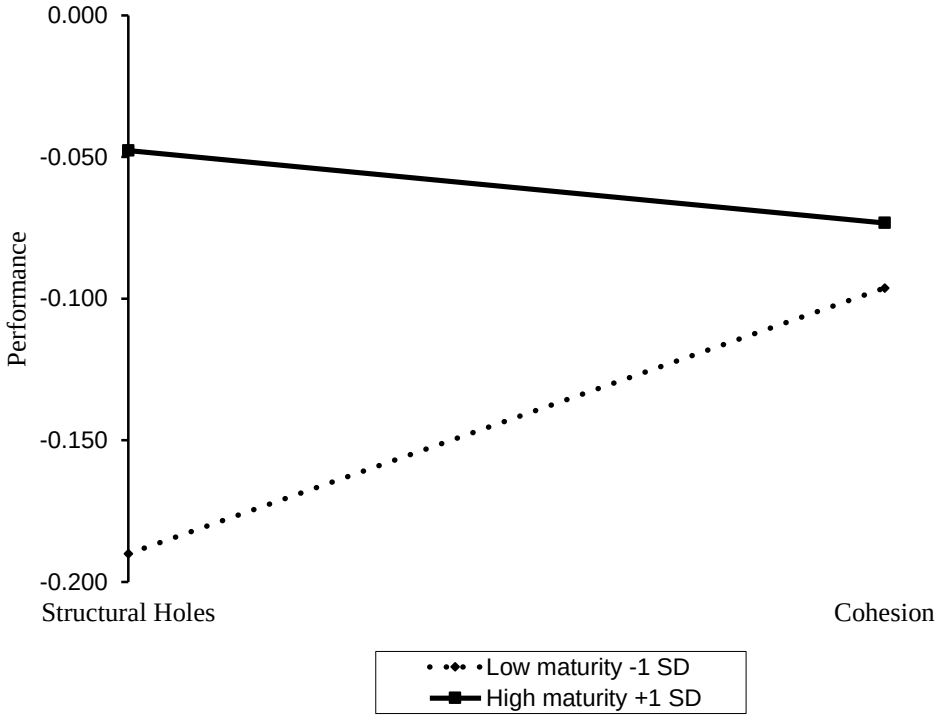

Figure 2. Cohesion and status

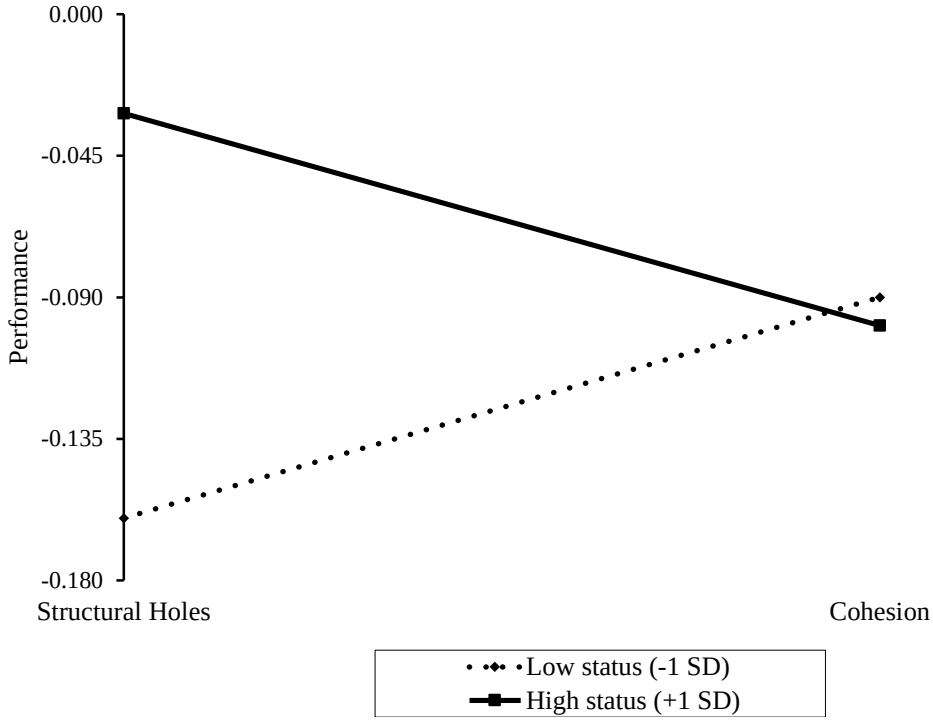
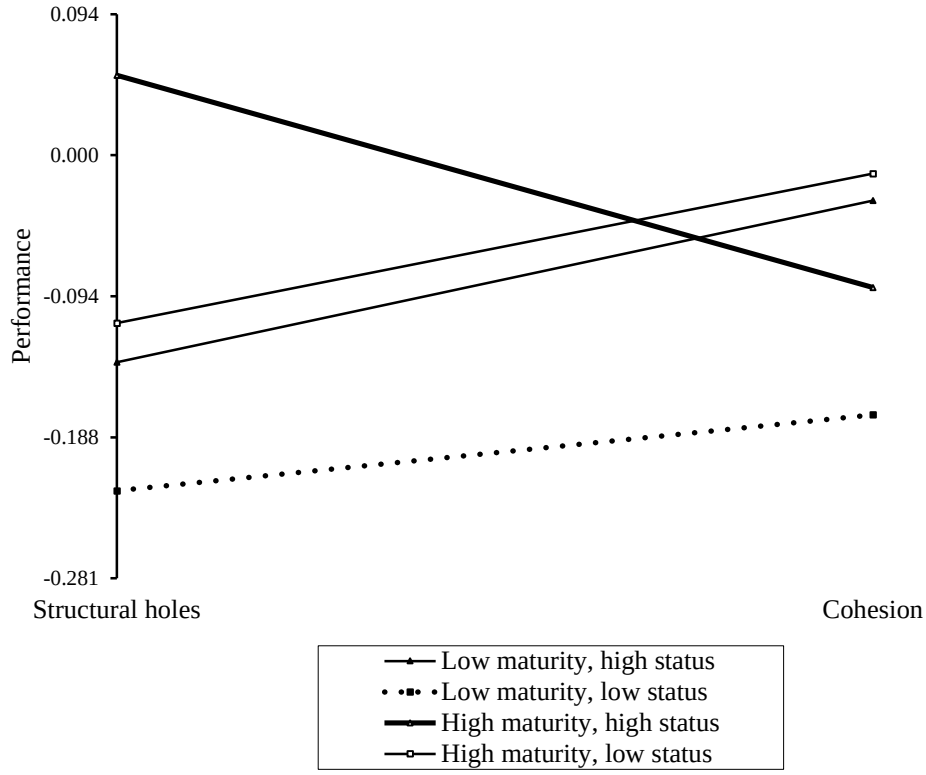
Figure 3. Cohesion, maturity and status