Technische Universität München
TUM School of Management

# Venture Capital Networks in Europe

## Fragmentation, Performance Implications, and Strategies behind VC Networks

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*To my parents and Flo.*
*Your love and support - through every high and low - mean the world to me.*

# Summary

This thesis builds on the idea that whom you know matters in Venture Capital (VC). It explores VC networks with a focus on Europe's multi-national setting from three angles: Employing methods from Social Network Analysis, it explores the European co-investment network of VC firms from the perspective of the network itself and the VC firms embedded within it. Then, it shifts the perspective to the personal networks of venture capitalists in an in-depth, multi-case qualitative study.

First, I provide the first empirical view on the connectedness of Europe's VC market and compares it to that of the United States and China. This is the first systematic analysis of these three regional networks over time, introducing a structured, graph-theory-based framework to analyze network fragmentation. Drawing on a dataset of 238,317 PitchBook deals from 2000 to 2022, the findings confirm the widely held belief that Europe's VC network is more fragmented than its US or Asia counterparts. While Europe still splits into regional startup ecosystems, it has become increasingly interconnected in the time considered. These insights help policymakers and investors gauge Europe's (dis)connectedness more accurately and identify suitable investor communities to engage with.

Then, I shift to the perspective of individual VC firms and examines whether bonding (being part of a tight-knit group of co-investors) or bridging (brokerage between investor communities) yields higher performance and how the presence of an alternative broker affects performance benefits. Analyzing 2,710 funds from 1,418 VC firms that invested in European startups between 2000 and 2019, the analysis shows that both bonding relationships with co-investors and unique brokerage opportunities in the overall network lead to better outcomes in Europe's multi-national setting. In practice, VC firms should cultivate trust and collaboration among their co-investors while also striving for a unique brokerage role that grants privileged access to information and investment opportunities.

Lastly, I move beyond firm-level networks and explore the personal relationships among venture capitalists. Drawing on in-depth, semi-structured interviews with 50 venture capitalists, the study reveals a "give-and-take" dynamic driven by industry norms, VC firm characteristics, and human motivations. Introducing four collaboration archetypes (Feeder, Frenemy Peer, Friendly Peer, Follow-on), it reveals how venture capitalists' personal networks shape each step of the VC decision-making process and highlights the role of trust and reciprocity. For practitioners, it offers guidance on how venture capitalists can strategically use their venture capitalist connections to identify investment opportunities and trends, evaluate deals, and secure follow-on funding for their portfolio companies.

# Zusammenfassung

Grundlage dieser Dissertation ist die Idee, dass Beziehungen in der Venture-Capital-Industrie (VC-Industrie) eine entscheidende Rolle spielen. Im europäischen, multi-nationalen Kontext werden VC-Netzwerke aus drei Perspektiven untersucht: Mittels sozialer Netzwerkanalysen (SNA) beleuchte ich das europäische Co-Investment-Netzwerk aus der Perspektive des gesamten Netzwerks sowie der darin eingebetteten VC-Firmen. Eine qualitative Studie ergänzt abschließend die Rolle von persönlichen Beziehungen unter Wagniskapitalgebern.

Zunächst präsentiere ich die erste SNA-Analyse der Netzwerkstruktur europäischer VC-Märkte im Vergleich zu den USA und China. Auf Basis einer graphentheoriebasierten Analyse von 238.317 PitchBook-Deals aus den Jahren 2000 bis 2022 bestätigt die Studie die weit verbreitete Annahme, dass das europäische VC-Netzwerk stärker fragmentiert ist. Gegenwärtig zerfällt Europa in regionale Startup-Ökosysteme, vernetzt sich jedoch im untersuchten Zeithorizont zunehmend. Die Studie unterstützt politische Entscheidungsträger, Investoren, und Gründer dabei, die europäische VC-Landschaft besser zu verstehen und (sich) gezielt zu vernetzen, indem sie geeignete Investoren-Communities identifizieren.

In einer zweiten Analyse untersuche ich, ob VC-Firmen erfolgreicher sind, wenn sie Mitglied einer eng verbundenen („bonding“) Investorengemeinschaft sind oder die Rolle eines ("bridging") Vermittlers zu anderen Investorengruppen einnehmen, und inwiefern dies beeinflusst wird, wenn ein alternativer Vermittler existiert. Die graphentheoriebasierte Analyse von 2.710 Fonds aus 1.418 VC-Firmen, die zwischen 2000 und 2019 in europäische Startups investierten, zeigt, dass sowohl enge Beziehungen zu Co-Investoren als auch Positionen als - idealerweise einziger - Vermittler im multinationalen europäischen Kontext zu besseren Ergebnissen führen. VC-Firmen sollten daher aktiv ihre Beziehungen zu Co-Investoren pflegen und diese untereinander vernetzen, sowie gezielt eine Vermittlerposition im Austausch mit anderen Investorengemeinschaften aufbauen.

Abschließend betrachte ich VC-Netzwerke aus einem neuen Blickwinkel und stelle die persönlichen Beziehungen zwischen Wagniskapitalgebern in den Vordergrund. Basierend auf 50 semi-strukturierten Interviews deckt die Studie eine "Give-and-take"-Dynamik in der VC-Industrie auf und beschreibt, wie Vertrauen und Reziprozität den Austausch fördern. Zudem werden anhand von vier Archetypen der Zusammenarbeit (Feeder, Frenemy Peer, Friendly Peer, Follow-on) Wege aufgezeigt, wie persönliche Netzwerke den gesamten Investitionsentscheidungsprozess prägen. Für Wagniskapitalgeber bietet die Studie konkrete Handlungsempfehlungen, um mithilfe ihres Investorennetzwerkes beispielsweise neue Investitionsmöglichkeiten zu identifizieren und zu bewerten, bestehende Portfoliofirmen operativ zu unterstützen und Folgefinanzierungen zu ermöglichen.

# Overview

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# Acronyms

**AIC** Akaike Information Criterion.

**B2B** Business Products and Services.

**B2C** Consumer Products and Services.

**BPNT** Basic Psychological Needs Theory.

**CVC** Corporate Venture Capital.

**DV** Dependent Variable.

**EFTA** European Free Trade Association.

**EU** European Union.

**GCC** Giant Connected Component.

**IPO** Initial Public Offering.

**IV** Independent Variable.

**LR** Likelihood Ratio.

**M&A** Merger and Acquisition.

**MNL** Multinomial Logistic Regression, Multinomial Logit Regression.

**msp** Mean Shortest Path Length.

**RQ** Research Question.

**SDT** Self-Determination Theory.

**SNA** Social Network Analysis.

**UK** United Kingdom.

**US** United States of America.

**VC** Venture Capital.

**vc** venture capitalists.

**VIF** Variance Inflation Factor.

# Acknowledgements

I am deeply grateful to my supervisor, Prof. Dr. Reiner Braun, for sparking my interest in venture capital networks, for trusting me and giving me the chance to work on this topic, and for his continuous, insightful, and enjoyable guidance throughout this dissertation.

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*"Your network is your net worth"*

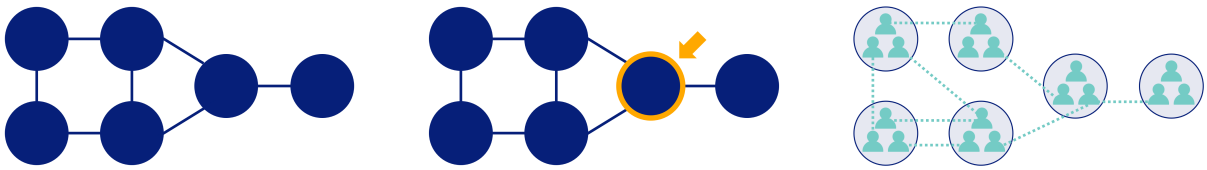
Saying

# 1 Introduction

## 1.1 Motivation

Networks are at the core of the Venture Capital (VC) industry. They shape the flow of information, access to resources, decision-making, and ultimately the success of ventures (Brander, Amit, & Antweiler, 2002; Y. Hochberg, Ljungqvist, & Lu, 2007; Lerner, 1994; Lockett & Wright, 2001). One prominent feature of venture capital is syndication, where two or more VC firms jointly invest in a venture (Lerner, 1994; Lockett & Wright, 2001). When syndicating, VC firms become connected in a broader co-investment network, which is commonly used as a proxy for VC networks (e.g., Y. Hochberg et al. (2007)). In general, networks in VC are typically approached from one of three perspectives[1]: (a) the co-investment network as a whole, (b) the viewpoint of individual VC firms embedded within this network, and - shifting the focus from firms to individuals - the (c) personal relationships and collaboration among venture capitalists (vc). While research has concentrated mainly on VC firm-to-VC firm networks (a, b), individual venture capitalists naturally tend to focus their attention on their own personal networks and relationships with other venture capitalists (c). Figure 1.1 illustrates the three perspectives and Table 1.1 provides an overview of the current state of research.

[1] Notably, the connections between venture capitalists and entrepreneurs represent an additional network perspective that has received attention in entrepreneurship literature. However, this thesis primarily focuses on the relationships among VC firms and venture capitalists. A brief overview is provided in Chapter 2.



**(a)** VC network **(b)** VC firm within VC network **(c)** Venture capitalists' relationships

**Figure 1.1** VC networks can be analyzed from different perspectives: (a) the structure of the VC network itself, (b) from the perspective of a VC firm embedded in this network, and (c) the underlying relationships among venture capitalist. The figure depicts VC firms and joint co-investments as blue nodes and ties, while venture capitalists and their personal connections with each other are represented as people and dotted ties in turquoise.

Although the structure of networks is known to affect the flow of information, knowledge, and resources (Granovetter, 1973; Newman, 2003), little is known about the overall structure of VC networks (Provan, Fish, & Sydow, 2007), especially across multiple regions or in multi-national contexts. The few existing studies usually focus on a single region at a specific point in time — such as Kogut, Urso, and Walker (2007) on the United States of America (US), Siddiqui, Marinova, and Hossain (2016) on Australia, or Jin, Zhang, Shan, and Li (2015) and Jin, Zhang, and Li (2016) on China — leaving substantial gaps in understanding more diverse or international VC markets. In particular, insights on the European VC market are scarce (D. Yang, Hu, Wu, & Xie, 2019), even though the European VC network differs substantially from the US or China in its polycentric infrastructure, diverse languages and cultures, varying degrees of government support, and distinct institutional landscapes (BCG, 2015; European Investment Fund, 2019; SpeedInvest, 2023). This research gap is increasingly salient in light of Europe's rapid growth in funding volumes[2] and unicorn creation[3], spurred partly by initiatives like the European Union's "VentureEU" fund-of-funds (DealRoom, 2024; Forbes, 2023; Goldman Sachs, 21.03.2022; i5invest, 2022; PitchBook, 2024a, 2024b). Still, Europe lags behind the US and China and has yet to close the funding gap. Recent discourse (e.g., Arnold, Claveres, and Frie (2024); Forbes (19.07.2024); IE.F, BVK, Lakestar, and Schalast Tax (2023)) has emphasized the need to strengthen the region's underdeveloped VC ecosystem. This further underscores the importance of understanding its underlying structure.

While the literature on venture capital networks frequently centers on individual VC firms, most attention has been directed toward (b1) VC firms' roles in the overall network and (b2) their relationships with other VC firms, with less emphasis on (b3) the structure of their immediate co-investor network. Extant studies primarily highlight how well-connected VC firms attract larger funding rounds, expand their investment scope,

[2]Europe's VC investment growth rate now surpasses that of the United States (Forbes, 2023; Goldman Sachs, 21.03.2022). Funding in European ventures currently accounts for one-fifth of global VC investments, a substantial rise from just 5% two decades ago (DealRoom, 2024).

[3]Unicorns - startups valued at more than USD 1 billion - emerge at more than double the rate observed in the United States (i5invest, 2022). The number of European unicorns has increased over fourfold in the past five years (PitchBook, 2024a). As of 2024, Europe counts 141 active unicorns with a combined valuation of EUR 447 billion (PitchBook, 2024b).

and improve performance (e.g., Cumming and Dai (2010); Y. Hochberg et al. (2007); Jääskeläinen and Maula (2014); Sorenson and Stuart (2001)) or focus on the formation and strength of relationships (e.g., Bellavitis, Rietveld, and Filatotchev (2020); Hallen (2008); Sorenson and Stuart (2008)). For example, Y. Hochberg et al. (2007) demonstrate that better-networked VC firms in the US achieve superior performance. Similar positive network effects appear in the European (Abell & Nisar, 2007; Christopoulos, Koeppl, & Köppl-Turyna, 2022) and Chinese VC network (Liu & Chen, 2014; X. Wang & Tan, 2024; D. Yang et al., 2019). By contrast, researchers have devoted relatively little attention to (b3) the immediate co-investor network of a VC firm (Kwon, Rondi, Levin, de Massis, & Brass, 2020; R. Zhang, McCarthy, Wang, & Tian, 2021). This gap is notable given the long-standing debate between Coleman (1988)'s emphasis on cohesion and Burt (1992)'s structural holes theory from the social science field — both of which find empirical support in venture capital settings (Alexy, Block, Sandner, & ter Wal, 2012; Bellavitis, Filatotchev, & Souitaris, 2017; S. Yang, Li, & Wang, 2018). While cohesive, tightly knit networks foster trust, flow of resources, and enforcement of norms (Dyer & Nobeoka, 2000; Rowley, Behrens, & Krackhardt, 2000; Uzzi, 1997; Walker, Kogut, & Shan, 1997), more dispersed connections grant access to diverse, non-redundant resources and brokerage opportunities (Ahuja, 2000; Balkundi, Wang, & Harrison, 2009). Recent studies argue that cohesion and structural holes can both be advantageous under different network contexts and may complement each other (Rauch, Rosenbusch, Unger, & Frese, 2016; Stam, Arzlanian, & Elfring, 2014). Yet, in the context of VC, most findings stem from single-country contexts outside Europe.

Lastly, when moving from VC firm networks to venture capitalist networks, far less is known about connections among individual venture capitalists, possibly because data on personal relationships is not readily available. This gap is especially striking given that venture capitalists devote a substantial amount of time — on average, at least seven hours per week — to building personal networks, making it their fourth most important activity (Gompers, Gornall, Kaplan, & Strebulaev, 2020). Such personal relationships are considered critical for obtaining private information about potential investment opportunities (Wuebker, Hampl, & Wüstenhagen, 2015), as evidenced by the practice of warm intros and referrals[4]. Nevertheless, empirical work rarely examines the venture capitalist-to-venture capitalist network, instead focusing on formal ties among VC firms (Gompers, Mukharlyamov, & Xuan, 2016). Even studies that consider personal connections typically rely on broad indicators, such as shared educational, professional, or ethnic backgrounds (Gompers et al., 2016; Sunesson, 2009), without confirming whether venture capitalists have interacted directly. Consequently, the observed syndication patterns may reflect homophily - peoples' tendency to associate with others who share similar attributes, such as alma mater ("birds of a feather flock together") - rather than the presence of genuine

[4]For example, Marc Andreessen, co-founder of Andreessen Horowitz, underscores the importance of warm intros: "If somebody shows up without a referral, [...] it's really hard" (Business Insider, 2023).

interpersonal relationships (Bhagwat, 2011). Finally, while VC network literature acknowledges the importance of VC networks, the VC decision-making literature (e.g., Gompers et al. (2020)) rarely explores the role of venture capitalists' personal connections.

**Table 1.1** Overview of VC networks, focusing on the (1) VC network itself, the (2) VC firm, or the (3) venture capitalists.

| | **(a) VC network** | **(b) VC firm** | | | **(c) Venture capitalist** |
|---|---|---|---|---|---|
| | | **(b1) Role** | **(b2) Relationship** | **(b3) Network** | |
| |  |  |  |  |  |
| *Description* | Overall VC network, encompassing all VC firms and their relationships amongst each other (structural attribute) | Role of a VC firm within the overall VC network (relational attribute) | Relationship between two VC firms (relational attribute) | Immediate network of a VC firm, encompassing its co-investors and the relationships among those co-investors themselves (structural attribute) | Focus on personal relationships between venture capitalists, i.e., venture capitalist-to-venture capitalist network |
| *Concept from graph theory* | Macro-level analysis, focusing on the entire network, and meso-level analysis, examining substructures within this network | Micro-level analysis, focusing on the characteristics of individual nodes within the network | Micro-level analysis, focusing on the characteristics of individual ties within the network | Ego network analysis, focusing on a subset of the larger network centered around a specific node | Similar to VC firm-to-VC firm networks, analysis is possible at multiple levels but currently underexplored |
| *Selected research findings* | • Network structure affects information and knowledge flow (Granovetter, 1973; Newman, 2003)<br>• In the US, local financial markets have been integrated into a cohesive national VC network (Kogut et al., 2007), whereas the VC network in China remains loosely connected (Luo et al., 2023) | • Better-networked VC firms expand their geographic and industrial reach (Cumming & Dai, 2010; Jääskeläinen & Maula, 2014; Sorenson & Stuart, 2001), limit their competitors' entry (Y. Hochberg et al., 2010), and, ultimately, perform better (Christopoulos et al., 2022; Y. Hochberg et al., 2007; D. Yang et al., 2019)<br>Focus of extant VC network research | • Geographically and industry-distant syndicates are more likely to form in low-risk or trendy settings, such as investing in popular industries or mature ventures (Sorenson & Stuart, 2008)<br>• Repeated co-investments have a U-shaped effect on venture performance (Bellavitis et al., 2020) | • Long-standing debate on the optimal network structure for firms (Coleman (1988)'s cohesion vs. Burt (1992)'s structural hole theory); For VC firms, mixed empirical evidence on the optimal network structure (e.g., Alexy et al. (2012); Bellavitis et al. (2017); S. Yang et al. (2018)) | • Shared characteristics of venture capitalists, particularly ethnic and academic background, increase the likelihood of co-investments between VCs (Gompers et al., 2016; Sunesson, 2009) |
| *Research Gap* | Few studies empirically characterize VC markets - limited comparability due to focus on specific time, geography, and diversity of measures used; Call for analysis of the European VC market (D. Yang et al., 2019) | Isolated analysis of brokerage, with brokerage either limited to network brokerage roles or to the immediate network (Kwon et al., 2020). | | No insights on the optimal network structure for multi-national markets such as the European VC market | No studies on actual relationships among venture capitalists, as the few existing studies rather focus on a shared academic or ethnic background instead of actual connection |
| *Chapter* | Chapter 4 | Chapter 5 | | Chapter 5 | Chapter 6 |

## 1.2 Structure of the thesis

The current state of research calls for a more comprehensive exploration of venture capital networks, particularly within the European context. The present thesis aims to contribute to filling the identified gaps. It is organized around three research questions that focus on different aspects of VC networks in Europe (see Figure 1.2): The first set of research questions seek to confirm the myth of Europe's fragmentation by comparing the overall structure of the co-investment networks in Europe, the US, and China (RQ 1a) and characterizing Europe's communities (RQ 1b). The second set of research questions is related to the performance implications of brokerage for VC firms, analyzing their immediate co-investor network (RQ 2a) and role in the overall VC network (RQ 2b, RQ 2c). The third set of research questions examines the motives (RQ 3a) and strategies (RQ 3b) behind the personal connections between venture capitalists. Table 1.2 provides an overview of the findings and the data and methods used. Together, the studies advance our understanding of Venture Capital Networks in Europe and provide insights for practitioners and policymakers in the European startup ecosystem.

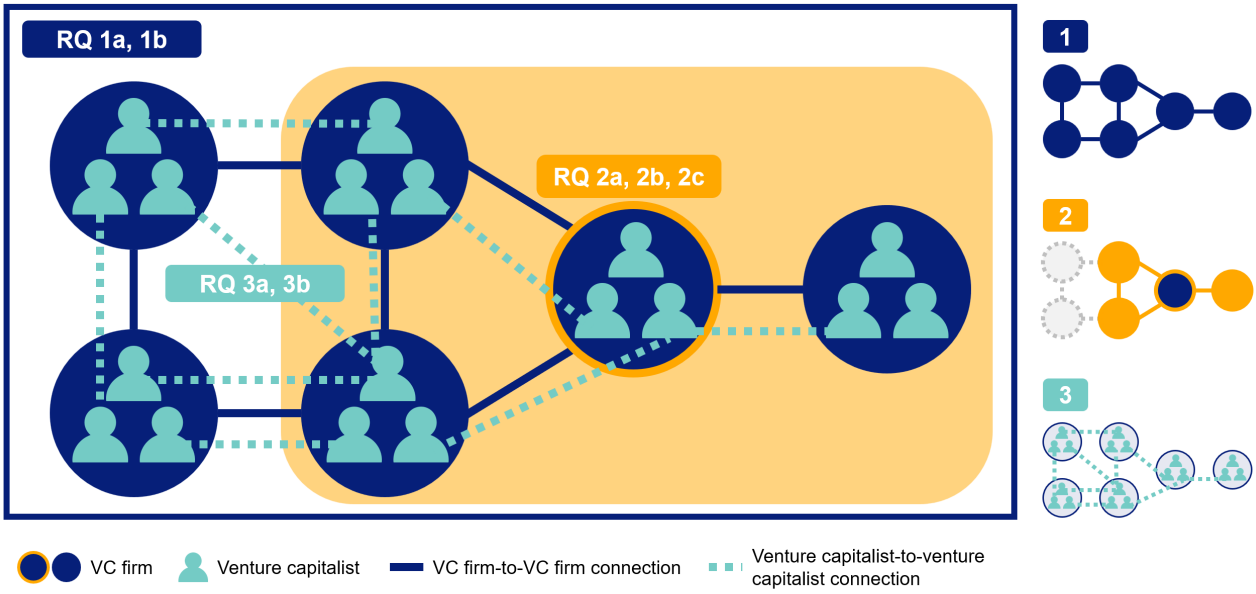



**Figure 1.2** The present thesis covers VC networks from three perspectives: (1) Research questions 1a and 1b focus on the overall structure of the VC network (Chapter 4); (2) Research questions 2a, 2b, and 2c consider the perspective of individual VC firms, analyzing their immediate co-investor networks and roles in the overall network (Chapter 5); and (3) Research questions 3a and 3b focus on relationships between venture capitalist (Chapter 6). The figure depicts VC firms and joint co-investments as blue nodes and ties, while venture capitalists and their personal connections with each other are represented as people and dotted ties in turquoise.

**Table 1.2** Overview of research questions, analyses, and findings

| | **VC network-level analysis** | **VC firm-level analysis** | **Venture capitalist-level analysis** |
|---|---|---|---|
| *Chapter* | **Chapter 4:** Europe's fragmentation - myth or reality? A social networks-based characterization of the VC network in Europe and its communities | **Chapter 5:** The best of both worlds – VC firm's optimal network structure: combining co-investor closeness and network brokerage | **Chapter 6:** A venture capitalist's rolodex - strategies behind vc networks: why and how venture capitalists use their personal connections to other venture capitalists |
| *Layer of analysis* | VC network "as a whole" and VC communities | VC firm's role and co-investor network within the overall VC network | Venture capitalists' personal connections |
| *Research question (RQ)* | RQ1a) Is the VC network in Europe less connected compared to that in the US and China?<br>RQ1b) Which investor communities emerge within the VC-network in Europe? | RQ2a) How do VCs perform when they broker between co-investors (vs. when they are part of a tight-knit group of co-investors)?<br>RQ2b) How do VCs perform when they have connections to many different investor communities (vs. few communities)?<br>RQ2c) How do VCs perform when they are the sole broker (vs. when they share the brokerage role)? | RQ3a) Why do venture capitalists collaborate with each other?<br>RQ3b) How do venture capitalists use their connections to other venture capitalists along the VC decision making process? |
| *Data* | PitchBook sample of 238,317 deals involving VC firms investing in European, Chinese, and US-based companies in the period 2000 - 2022 | PitchBook sample of 47,101 deals involving VC firms investing in European-based companies in the period 2000 - 2019 | Case-based evidence from 50 semi-structured interviews with European-focused venture capitalists |
| *Methodology* | Construction of regional co-investment networks, graph-theory based measures for overall network connectivity, MNL models with community number as DV | Construction of co-investment network and VC firms' investor networks, graph-theory based measures for brokerage, Logit regression with success as DV | Open coding approach and inductive analysis of multiple cases following Eisenhardt (1989); D. A. Gioia et al. (2013); Strauss and Corbin (1998) |
| *Main results* | 1) European VC network is less connected than the one in the US and China, confirming the myth of Europe's fragmentation<br>2) European VC network has become more connected over time<br>3) Communities in the European VC network mirror regional startup ecosystems, i.e., VC firms with the same geographic focus (rather than the same headquarter location) | 1) VC firms that are bonding with a tight-knit group of co-investors perform better<br>2) VC firms with connections to all communities in the network perform better<br>3) VC firms that are the sole broker perform better | 1) Collaboration is shaped by (i) an industry-wide "give-and-take" mechanism, (ii) the type of shareable resources of the VC firm, and (iii) the basic psychological needs of the venture capitalist<br>2) Venture capitalists use their connections throughout the entire VC decision making process, with level of intensity and types of resources shared varying across four collaboration archetypes: Feeder VCs, Frenemy peers, Friendly peers, and Follow-on VCs |
| *Summary of contributions* | The first study advances the empirical understanding of the European VC market by confirming the myth of its fragmentation. The study pioneers temporal and regional comparisons of the structure of VC networks. Additionally, it introduces a novel approach for assessing the connectedness of networks. | The second study expands the discourse on optimal VC network structures to multinational markets. It delivers a systematic investigation of brokerage for both the immediate co-investor network and the broader network structure. Further, it introduces the p-Z-classification - a SNA method - to the VC context. | The qualitative study adds a novel lens on VC networks: the role of personal connections among venture capitalists. It introduces a nuanced definition of VC networks that differentiates between four collaboration archetypes. Further, it adds to the VC decision making literature by incorporating the social tie perspective. |

First, we[5] examine the overall structure of the European VC network itself and compares it with the US and China. For the past decades, Europe has tried to replicate the tightly integrated VC industry exemplified by Silicon Valley in the US; however, venture capitalists and policymakers remain skeptical about Europe's ability to overcome its fragmentation into distinct national markets. To date, no empirical evidence supports these concerns. Chapter 4 seeks to provide a detailed descriptive analysis of (a) the overall structure of Europe's VC network, particularly exploring the myth of Europe's fragmentation. We employ an extensive dataset comprising 238,317 deals recorded by PitchBook to construct separate co-investment networks for each region and year from 2000 to 2020. Borrowing tools from Social Network Analysis, we introduce a structured approach to analyze the co-investment patterns in those 57 networks. We focus on five complementary aspects of network connectivity: First, we assess the size of the largest connected group of VC firms that can reach each other directly or indirectly through their connections. Second, we examine the size of the most tightly knit group of VCs, characterized by frequent co-investments with each other. Third, we explore the average number of intermediaries (i.e., "co-investor of a co-investor") that exist between any two VC firms. Fourth, we evaluate the proportion of VCs that act as unique intermediaries, thereby being able to serve as gatekeepers between two otherwise isolated investor groups. Fifth, we investigate the number of cohesive investor communities that emerge within the network. Across all five metrics, the European VC network exhibits lower connectivity than its counterparts in the US and, often, China. These findings empirically confirm the notion of Europe's fragmentation. Still, our analysis also uncovers a trend of increasing inter-connectedness within the European ecosystem, reducing the fragmentation over time. In doing so, this study is the first to characterize the European VC market from a connectedness perspective and compare it to those in the US and China. Digging deeper into the composition of the communities that emerge in the European VC market, we find that the investment style of the investors largely influences their community membership, specifically their geographic focus. That is, Europe's communities mirror regional startup ecosystems. Notable examples include the community investing in Italy-based ventures, the DACH community (investing in ventures based in Germany, Austria, and Switzerland), or the Ibero community (investing in ventures based in Portugal and Spain).

Then, we explore VC firm-to-VC firm networks in the multi-national European context from (b) the perspective of an individual VC firm. In Chapter 5, we extend the long-standing debate on the optimal network structure to multi-country VC settings. The bonding-versus-bridging debate contrasts Coleman (1988) view that inter-connected, closed networks ("bonding" social capital) generate trust and facilitate collective action, with Burt (1992)'s argument that networks rich in structural holes ("bridging" social capital) provide access to diverse information and brokerage opportunities. Drawing on a comprehensive PitchBook dataset of 2,710 funds from

[5] In this dissertation, I use the terms "I" / "my" and "we" / "our" since this dissertation is partially based on joint work with my supervisor Prof. Dr. Reiner Braun.

1,418 VC firms that invested in European-based companies between 2000 and 2019, we use Social Network Analysis (SNA) to capture the benefits of bonding-versus-bridging along three levels: the immediate co-investor network, the investor communities in the VC network, and the entire VC network. We argue that while a bridging position in the overall network grants VC firms access to non-redundant resources (Burt, 1992), such as deal opportunities and follow-on investors, trust and collaboration (Coleman, 1988) within a cohesive, tight-knit group of co-investors play a critical role in actually sharing that information. We further argue that the presence of alternative brokers diminishes the VC firm's ability to control or mediate information flows and, therefore, VC firms that uniquely occupy a bridging position should achieve higher performance. Controlling for both VC firm- and fund-specific factors, our MNL models indicate that the "best of both worlds" — cohesive ties combined with exclusive brokerage between investor communities — yields better performance for VC firms in Europe's multi-national VC landscape.

Lastly, Chapter 6 shifts the focus to (c) venture capitalist-to-venture capitalist relationships. How can venture capitalists use their connections with other venture capitalists? And: Why do they collaborate with each other, in the first place? Through in-depth, semi-structured interviews with 50 venture capitalists, our research aims to provide a more granular understanding of the motivations and strategies behind venture capitalist-to-venture capitalist networks. Following the Gioia methodology (D. Gioia, 2021; D. Gioia & Chittipeddi, 1991; D. A. Gioia et al., 2013), this thesis provides new evidence on the interplay of industry-level mechanisms that motivate "giving-and-taking", firm-level characteristics that shape the scope and nature of collaboration, and human factors on venture-capitalist level. Our interviews reveal that venture capitalists collaborate primarily to mitigate the information asymmetries inherent in financing new ventures, leading to a strong "give-and-take" dynamic across the industry. This dynamic is reinforced by three factors: (1) the specialization of VC firms, which makes much of the shared information worthless to the giver and highly valuable to the receiver; (2) the high-uncertainty nature of early-stage deals, pushing VCs to expand their funnel through reciprocal exchange; and (3) an industry norm of information sharing, where withholding opportunities risks to damage relationships because "people talk anyways." The strategic focus of VC firms determines which resources a venture capitalist can "give-and-take". Specifically, we find that VCs identify "relevant" partners based on their VC firms' reputation and investment overlap (e.g., industry and geography), proposing an inverted U-shaped relationship where some overlap fosters valuable exchanges but excessive similarity reduces the incentive to share. We then identify four collaboration archetypes, that differ in terms of competitive overlap and stage focus of the VC firm: Feeder VCs (earlier-stage investors providing a pipeline of opportunities), Friendly Peers (same-stage but low-competition partners), Frenemy Peers (same-stage but high-competition partners), and Follow-on VCs (later-stage investors helpful for subsequent rounds). We use the Basic Psychological Needs Theory (BPNT)

to explain that venture capitalists value personal rapport when choosing with whom to share opportunities and insights. Without relatedness, collaboration is often ineffective and stalls. Moreover, VCs seek peer recognition and engage in adaptive career behaviors (e.g., reputation-building, seeking coaching), which prompts them to "give" information more freely. Furthermore, we build on the VC decision-making literature (e.g., Gompers et al. (2020); Tyebjee and Bruno (1984)) by detailing how venture capitalists use their connections to other venture capitalists. Specifically, we propose four distinct strategies for each firm collaboration archetype and highlight the role of a strong, trust-based relationship in driving effective collaboration along the VC decision-making process.

The remainder of this thesis proceeds as follows: Chapter 2 provides theoretical background for the subsequent analyses. It summarizes how research has approached networks in the context of venture capital (2.1): the VC firm-to-VC firm network, the venture capitalist-to-entrepreneur network, and the venture capitalist-to-venture capitalist network. Moreover, it also briefly introduces the VC decision-making process (2.3) and Self-Determination Theory (2.4). Chapters 4, 5, and 6 each motivate the research questions, introduce the data and methods employed, present the respective analyses, discuss contributions to the field and acknowledge limitations. Chapter 4 begins by summarizing the basic structure of the PitchBook data used and constructing co-investment networks for Europe, the US, and China (4.1). It proceeds with a social network analysis using graph theory-based connectivity measures (4.2) and concludes with a detailed exploration of community structures within the European network (4.3). Chapter 5 opens with a theoretical framing of the bonding-versus-bridging debate in the context of VC, providing illustrative examples and developing hypothesis how brokerage affects the performance of VC firms (5.1). Next, it describes the sample for the European co-investment networks (5.2.1). Compared to Chapter 4, the networks in this Chapter are constructed over an adjusted time horizon to more appropriately assess the networks' performance implications. Chapter 5.2 provides details on the brokerage measures (5.2.2), performance metric (5.2.3) and controls (5.2.4) used. Chapter 5.3 presents the results of the MNL regression models employed. Chapter 6.1 outlines the qualitative research methodology employed in our third study and describes the interview sample. Chapter 6.2.1 presents the key motives why venture capitalists collaborate with each other; Chapter 6.2.2 outlines how venture capitalists collaborate with each other. Lastly, Chapter 7 delivers concluding remarks on Venture Capital Networks in Europe.

# 2 Theoretical background

## 2.1 Networks in VC

This chapter presents a brief overview of how existing literature has approached networks in VC. VC network literature often emphasizes formal links between firms, namely, co-investment networks. When considering the personal relationships of venture capitalists, entrepreneurship literature primarily focuses on their relationships with entrepreneurs, while the relationships with other venture capitalists are often overlooked in both entrepreneurship and VC network literature.

### 2.1.1 VC firm-to-VC firm network

It is well-known that networks matter in VC, tracing back to seminal studies by Bygrave (1988) and Lerner (1994): co-investment networks facilitate the sharing of information and resources among VCs and, therefore, syndicating - a form of firm-level collaboration, where VC firms jointly invest in a portfolio company - has become a common practice in the VC industry. The reasons behind why VC firms syndicate are well-documented (see e.g., Manigart et al. (2006) for an overview). Syndicates offer several distinct advantages over solo investments, including enhanced deal flow generation, more informed decision-making in the selection of investment opportunities, superior value-adding capabilities, and effective risk reduction (Brander et al., 2002; Cumming, 2006; Hopp & Rieder, 2011; Lerner, 1994; Lockett & Wright, 2001; Sorenson & Stuart, 2001).

Over the past decades, there has been a great deal of research on the resulting inter-organizational VC firm-to-VC firm networks, where VC firms are "bound by their current and past investments into webs of relationships with other VCs" (Y. Hochberg et al., 2007). Entrepreneurial finance scholars typically focus on the perspective of individual VC firms, analyzing their direct connections or positions within the overall network (e.g., Christopoulos et al. (2022); Jääskeläinen (2012); Liu and Chen (2014)). The primary objective has been to understand the performance implications, consistently finding that better-networked VC firms perform substantially better (e.g., Abell and Nisar (2007); Y. Hochberg et al. (2007)). Other facets of VC firm-centered analyses include identifying the optimal network structure for these firms (e.g., Alexy et al. (2012); Bellavitis et al. (2017); S. Yang et al. (2018)). In contrast, relatively few studies investigate the emerging network itself. Notable

exceptions focus on characterizing the structure of VC networks include Aleenajitpong and Leemakdej (2021); Bygrave (1988); Kogut et al. (2007) and Jin et al. (2016). Furthermore, some research integrates these two perspectives by examining the influence of VC behavior on network structure (Polizzi, 2020).

### 2.1.2 Venture capitalist-to-entrepreneur network

It is also well-known that venture capitalist-to-entrepreneur networks matter for venture finance decisions (Stuart & Sorenson, 2005). Social ties with entrepreneurs foster the transfer of private information and, thus, provide an important mechanism through which venture capitalists can overcome the information asymmetry related agency problems inherent in venture finance decisions (Shane & Cable, 2002; Venkataraman, 2019). Recommendations and introductions from trusted contacts can significantly reduce uncertainty and due diligence costs (Gompers et al., 2020). As a result, personal connections, such as through former employment or education, help founders to secure funding and venture capitalists to source investments (Batjargal & Liu, 2004; Bengtsson & Hsu, 2010; Hsu, 2007; Shane & Cable, 2002). It is, therefore, not surprising that venture capitalists dedicate a substantial portion of their time to building their personal networks[1].

### 2.1.3 Venture capitalist-to-venture capitalist network

Another component of a venture capitalist's network comprises social ties with other venture capitalists. Much like their connections with entrepreneurs, venture capitalists leverage their relationships with fellow investors to gain access to private information (Wuebker et al., 2015). Yet, focusing on these personal connections of venture capitalists – beyond their relationship with entrepreneurs – remains relatively under-explored in entrepreneurial finance research (Gompers et al., 2016). To our knowledge, very little network research has been applied to the connections among venture capitalists themselves (the venture capitalist-to-venture capitalist network). Extant VC research predominantly considers social ties between venture capitalists to explain VC firm-to-VC firm networks. For example, shared ethnic, academic or employment backgrounds between venture capitalists increase the likelihood of co-investment between two VC firms (Gompers et al., 2016; Rider, 2012; Sunesson, 2009). Still, there is no clear evidence for the role of personal connections, since most research designs do not require venture capitalists to have actually interacted with each other (Cohen, Frazzini, & Malloy, 2010; Fuchs, Füss, Jenkinson, & Morkoetter, 2021). Instead, these studies only explore the implications of being part of the same social network. The fact that investors attended the same university, irrespective of time overlap, does not necessarily indicate that they have established personal relationships; rather they belong to the same university

[1] According to Gompers et al. (2020), venture capitalists, on average, allocate more than 7 hours per week on networking, approximately 14% of a total reported work week of 55 hours.

alumni network. When venture capitalists are more likely to have directly interacted with each other, such as when they attend the same university and are of similar age, the likelihood and performance of syndication are higher compared to when venture capitalists merely share an academic background (Bhagwat, 2011). However, due to their study design and focus, Bhagwat (2011) do not provide detailed evidence on the underlying mechanisms. Understanding whether and how the venture capitalist-to-venture capitalist connections affect the VC decision-making process is, therefore, of particular importance. Chapter 6 investigates these questions empirically.

## 2.2 Bonding versus bridging debate

The long-standing debate about the benefits of bonding versus bridging positions goes back to foundational contributions in network theory, most notably Coleman (1988)'s concept of network closure versus Granovetter (1973)'s strength of weak ties and Burt (1992)'s structural hole theory.

According to Coleman (1988), bonding within these cohesive networks is advantageous, as dense, cohesive ties cultivate a high level of support, trust, and norm enforcement among all network members (Adler & Kwon, 2002; Burt, 2005; Labun & Wittek, 2014; Obstfeld, 2005). While cohesive networks can strengthen common understandings and group identities (Adler & Kwon, 2002; Burt, 2005; Obstfeld, 2005), the information circulating within these networks also tends to be homogeneous. Social pressure can lead to conformity or "group think", such that firms are hesitant to share divergent perspectives or pursue non-conforming actions (Bloodgood, Hornsby, Rutherford, & McFarland, 2017; Dimaggio & Powell, 2004).

Therefore, Granovetter (1973) and Burt (1992) posit that bridging positions are superior. Bridging occurs when one firm is connected to two (or more) other firms that are not themselves connected, such that there is a "structural hole" - or gap - between two network parts. This position allows the firm to facilitate an exchange or interaction between the disconnected firms and comes with information advantages[2] (in terms of access, timing, innovation, and reputation) and control advantages[3] (Kwon et al., 2020; Labun & Wittek, 2014; Stovel

[2] Information advantages arise from the access to non-redundant information and diverse perspectives across groups. When a firm's partners are not connected to one another, they share information from different sources. Moreover, being directly tied to different groups increases the likelihood of obtaining information earlier, as the information does not have to first pass through intermediaries. Burt (2004) further argues that "opinion and behaviour are more homogeneous within than between groups, so people connected across groups are more familiar with alternative ways of thinking and behaving" (p. 349). Such interaction with diverse groups, combined with timely access to diverse information and knowledge, has been suggested to stimulate more creative and more innovative ideas (Burt, 2004; Rodan & Galunic, 2004). In doing so, brokerage can help in gaining a good reputation (Rodan, 2010) and in spreading that reputation among a broader group of firms (Podolny, 2001)

[3] Control advantages arise when other firms rely on the broker to mediate their interactions. The broker can use this position to benefit the groups involved - such as by connecting two previously disconnected firms or facilitating information flow between disconnected groups — thereby fostering goodwill among those they assist (Burt, 2005; Kilduff & Brass, 2010). Alternatively, brokers can exploit the dependency by limiting the flow of information (or other resources) between the two groups (Simmel, 1950).

& Shaw, 2012; Xiao & Tsui, 2007). The economic returns of such brokerage positions for the broker are well documented (see e.g., Kwon et al. (2020) for an overview).

Since the beginning of the debate in the 20th century, as Sorenson and Stuart (2008) note, "there are probably hundreds of studies that pit cohesion [(bonding)] against brokerage in a horse race for explanatory power". Yet, despite the extensive scholarly attention, empirical studies applying these opposing theories to *multi-national* VC markets remain scarce. In the realm of venture capital, studies are often limited to single-country settings (e.g., the United States in Alexy et al. (2012), China in S. Yang et al. (2018), and the United Kingdom in Bellavitis et al. (2017)) - each shaped by one legal, cultural, and economic environment - and have produced mixed findings. Chapter 5 addresses this gap by extending the debate to the multi-national European context.

This gap is particularly salient given that, more recently, scholars have emphasized that the relative benefits of bonding-versus-bridging simply depend on the type of network (Rauch et al., 2016; Stam et al., 2014) and unit of analysis (e.g., individuals, groups, or firms) (Moliterno & Mahony, 2011). Consequently, findings derived from one context should not be easily generalized to others, underscoring the necessity for empirical studies that consider these contextual nuances. Overall, empirical evidence suggests that bridging is better when access to information is relevant, whereas bonding proves more effective in fostering collaboration, facilitating innovation, and transferring knowledge (Kilduff & Brass, 2010). In some cases, bonding and bridging positions may even complement each other. For example, Capaldo (2007) show that firms benefit from bonding with a core network of close collaborators, while simultaneously having weak ties to the rest of the network.

## 2.3 VC decision-making process

The decision to invest in a venture is a difficult one. Hence, the way venture capitalists make these investment decisions continues to attract considerable scholarly attention (see e.g., Petty, Gruber, and Harhoff (2023) for an overview). Figure 2.1 illustrates the VC decision-making process based on which we elaborate in Chapter 6 how venture capitalists use their connections to other venture capitalists (RQ 3b). Using the frameworks of Tyebjee and Bruno (1984) and Gompers et al. (2020), we differentiate pre-investment activities (deal sourcing, screening, evaluating, deal structuring) and post-investment activities (monitoring and value adding, crafting and executing an exit strategy).

The first pre-investment activity is deal sourcing (1), also commonly referred to as deal origination. VCs aim to generate a wide funnel of potential investment opportunities to identify the most promising investments (Sahlman, 1990). The majority of successful proposals originate from within the venture capitalist's trusted network, encompassing their professional network and referrals by other investors or portfolio companies

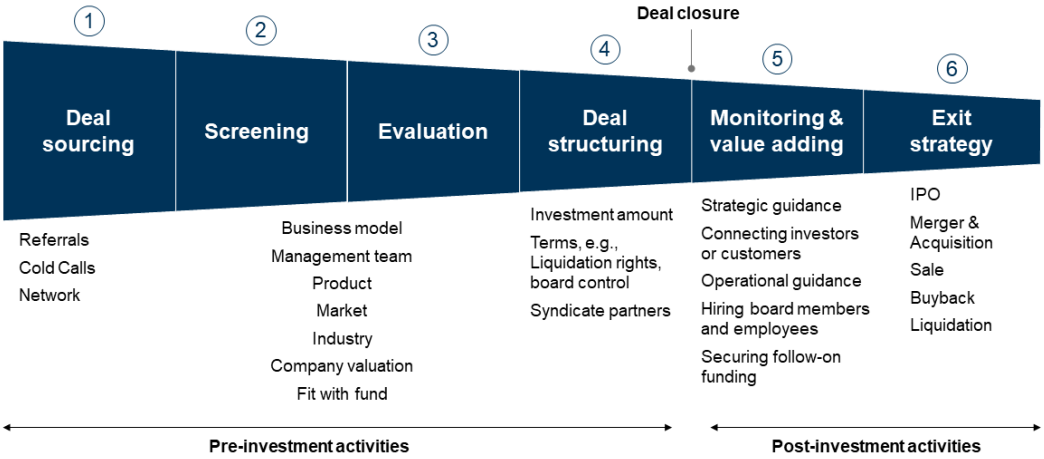



**Figure 2.1 VC decision-making process**. Own visualization based on Tyebjee and Bruno (1984) and Gompers et al. (2020).

(Gompers et al., 2020). Venture capitalists not only devote more time to evaluating referred proposals but are also more likely to provide financing for them (Petty et al., 2023). This is attributable to the venture capitalist's confidence in the referrer's judgment, on the one hand, and the referrer's understanding of the VC's investment preferences, on the other side (Fried & Hisrich, 1994). Other sources of investments encompass cold calls, which, despite their high volume, are typically of low quality and seldom result in successful outcomes. Additionally, investments may arise from proactively self-generated deals and quantitative sourcing methods (Fried & Hisrich, 1994; Gompers et al., 2020). Gompers et al. (2020) identify deal selection as the most important driver of value creation. Most researchers concur that the selection process consists of at least two phases: screening and evaluation (Hall & Hofer, 1993).

The screening (2) phase involves an initial assessment to filter out unsuitable opportunities based on both firm-specific (e.g., industry, investment stage, ticket size, and geography focus of the VC) and generic criteria (e.g., VC's judgement of business plan) (Fried & Hisrich, 1994). Most proposals are rejected during this phase without extensive review (Tyebjee & Bruno, 1984).

The evaluation (3) phase encompasses a thorough due diligence process, where VCs supplement the proposal with additional information from the company and external sources (Fried & Hisrich, 1994; Tyebjee & Bruno, 1984). Research indicates that the most commonly used investment criteria during this phase relate to the company's product/service, target market, financial potential, and management team (Petty & Gruber, 2011). However, perspectives on the importance of these criteria vary: S. N. Kaplan, Sensoy, and Strömberg (2007) suggest that investors should prioritize the business model and product ("the horse") over the management team ("the jockey"); Gompers et al. (2020) find that the management team is the most important investment criterion; Petty and Gruber (2011) observe that a set of fund-related criteria drives the decision to invest or reject.

The final pre-investment activity is structuring the deal (4), which involves formalizing the venture capitalist's conditions for financing. This phase may also include identifying syndicate partners for co-investments. Once the venture's management team and the venture capitalist agree on mutually acceptable terms, the investment is made.

Post-investment, VCs take an active role in monitoring and managing (5) their portfolio companies. They assist in strategic decision-making, provide operational guidance, help in hiring key personnel, and leverage their network to secure follow-on funding.

Finally, VCs plan and execute an exit strategy (6), which commonly involve IPOs, M&As, and, occasionally, liquidation.

## 2.4 Self-determination theory

Self-Determination Theory (SDT) by Ryan and Deci (2000) is a leading theory for understanding the motivations and needs explaining human behaviour (Deci & Ryan, 2008). Integrating SDT into the study of venture capitalist-to-venture capitalist relationships provides a valuable human-centric perspective, which we use to analyse the motivations for collaboration in RQ3a, specifically at the venture capitalist-level (see Chapter 6.2.1.3). The empirically grounded macro-theory encompasses six mini-theories: cognitive evaluation theory (CET), organismic integration theory (OIT), causality orientations theory (COT), basic psychological needs theory (BPNT), goal contents theory (GCT), and relationships motivation theory (RMT) (Ryan & Deci, 2020). SDT has demonstrated efficacy in identifying the contingencies that influence motivation and behaviour across diverse fields such as sports, education, politics, and business. In the realm of work motivation, SDT, particularly through BPNT, identifies three basic psychological needs as essential for optimal work motivation and outcomes: autonomy (i.e., the sense of volition, feeling in control over one's actions), competence (i.e., the sense of efficacy, feeling capable and effective in one's tasks), and relatedness (i.e., the sense of caring relationships, feeling connected with others) (Gagné & Deci, 2005; Martela & Riekki, 2018). By fulfilling these needs, organizations can enhance employee motivation, which leads to improved performance, persistence, and well-being (Ryan & Deci, 2000). Additionally, Martela and Riekki (2018) adds a fourth dimension of psychological satisfaction in the context of work meaningfulness: beneficence, which is the sense of making a positive contribution and having a positive impact on others.

# 3

# Methodology

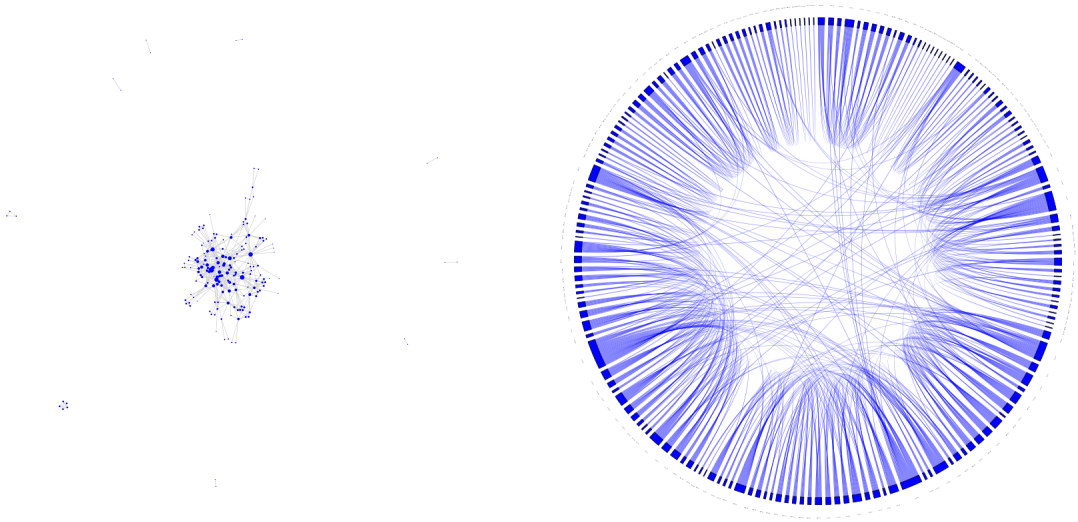
This chapter outlines the methodological approach used to investigate VC networks. I combine quantitative and qualitative research designs to capture both inter-organizational (VC firm-to-VC firm network) and inter-personal dimensions (venture capitalist-to-venture capitalist network). Specifically, I proxy the inter-organizational ties between VC firms through their past syndicate activity. The resulting co-investment networks (Chapters 4 and 5) are analyzed using graph-theoretic measures from Social Network Analysis (SNA). To explore inter-personal connections between individual venture capitalists - where extant research and systematic data is scarce - I adopt a qualitative approach grounded in in-depth semi-structured interviews.

## 3.1 Quantitative research design: SNA of co-investment networks

In entrepreneurial finance, analyzing co-investment networks is common for capturing and describing the relationship between VC firms (see e.g., Alexy et al. (2012); Y. Hochberg et al. (2007); Sorenson and Stuart (2001)). Co-investment networks are a good proxy for the relationships among VC firms because, once VC firms have invested in the same portfolio company, they frequently interact with their co-investors in board meetings and other activities.

Following established practices, I construct an inter-organizational network, where VC firms are connected if they have invested in the same portfolio company within the previous five years, irrespective of the financing round. Therefore, the network includes all ventures that have received investments from two or more VCs, either in the same or in different financing rounds. I construct yearly networks because the networks are dynamic. Specifically, they evolve in two ways: (1) VC firms enter or exit the VC market, and (2) firms begin or end collaborations with other VC firms in the VC market. I do not differentiate between earlier or later syndicates and move the rolling 5-year window forward one year at a time. For instance, the 2005 network is based on the investments made between 2000 and 2004, the 2006 network includes investments from 2001 to 2005, and so forth. Finally, I do not consider the role of lead investors, as Newman and Girvan (2004) show that it is often sufficient to consider undirected networks, ignoring the directed nature of a connection.

Graphs can effectively visualize the resulting co-investment networks, where individual VC firms (represented as nodes) are connected based on syndicate deals (represented as edges). In this sense, every VC firm is embedded in a web of connections with its co-investors, the co-investors of its co-investors, and so-forth. For example, Figure 3.1 represents the 2005 VC landscape for Germany. Each node corresponds to a VC firm that has invested in at least one Germany-based venture in the past five years, and the connections among those VC firms represent co-investments made between 2000 and 2004.

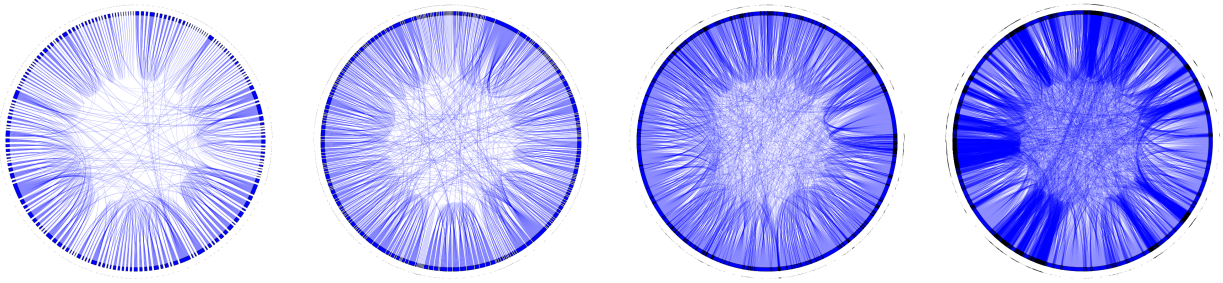


**(a)** Standard visualization **(b)** Circular visualization

**Figure 3.1 Visualization of network graphs:** The 2005 co-investment network for Germany is depicted as an undirected graph where each node represents a VC firm. An edge is drawn between two nodes if the corresponding VC firms have jointly invested in at least one venture within the past five years. Utilizing the Fruchterman-Reingold algorithm, the standard network visualization (a) positions nodes to minimize edge crossings and node overlap. Node sizes are proportional to each firm's number of syndicate partners (i.e., node degree), with larger nodes indicating a higher number of partners. In the circular layout (b), nodes are evenly arranged along the outer edge of a circle and grouped and positioned based on their community membership. Here, the angular span each node occupies on the circle corresponds to its number of syndicate partners (i.e., node degree), with firms with more syndicate partners occupying more space on the circle. Arcs within the circle represent co-investments ties.

The dynamic nature of the network is reflected by a change in the number of nodes and edges, respectively. The number of nodes changes as VC firms start or stop investing in the ecosystem. New connections (edges) emerge, as VC firms collaborate with new syndicate partners, and connections (edges) dissolve as VC firms stop collaborating with their past syndicate partners. Figure 3.2 illustrates the dynamic evolution of Germany's VC network between 2005 and 2020. For instance, the VC firm Index Ventures invested in Germany-based ventures in 2000, 2001, and 2003, and then annually from 2011 to 2020. As a result, the firm is represented as a node in the 2005, 2015 and 2020 networks but is absent from the 2010 network due to a lack of investments in the region in the previous five years (2005-2009). Similarly, the edge between the nodes representing the VC firms Earlybird Venture Capital and TVM Capital was present in the 2005 network but absent in 2010. Although both

firms continued their investment activity in Germany-based ventures — resulting in their inclusion as nodes in both the 2005 and 2010 networks — their co-investment activity was confined to a single venture with funding rounds in 2000 and 2005. As a result, the connection (edge) between the VC firms ceased to exist from 2010 onward.



**(a)** 2005 **(b)** 2010 **(c)** 2015 **(d)** 2020

**Figure 3.2 Temporal evolution of co-investment networks:** Between 2005 and 2020, Germany's VC ecosystem experienced significant growth in investment activity (295 syndicate deal in 2005 vs. 2930 in 2020). The corresponding network graphs (a) - (d) show an increase in the number of nodes (187 nodes in 2005 vs. 1128 in 2020) and number and density of connections (532 edges in 2005 vs. 6397 in 2020). However, some nodes and edges have also disappeared over time, as VC firms have stopped investing in the region (corresponding node disappeared) or ceased co-investing with other network members (corresponding edge disappeared).

Over the last decades, the use of SNA in the social sciences has grown exponentially (S. Borgatti, Everett, & Johnson, 2009; S. P. Borgatti & Foster, 2003). The method has also been frequently applied in the field of entrepreneurial finance (see, e.g., Y. Hochberg et al. (2007); Kogut et al. (2007); Sorenson and Stuart (2001); S. Yang et al. (2018)). SNA is a unique way to investigate the relations and interactions between economic actors, in our case, the co-investments of VC firms, because - unlike analyses based on attributes such as location or industry specialization of individual VC firms - it focuses on the connections themselves and, thus, yields more "relational, contextual and systemic understandings" (S. P. Borgatti & Foster, 2003). Social network analysis is typically conducted at three levels - the micro, meso, and macro level - each capturing different dimensions of a network (see e.g., Wasserman and Faust (1994), S. Borgatti et al. (2009), Scott (2000), Kilduff and Brass (2010)). At the macro-level, the network can be analyzed as a whole, capturing the overall structure of the investment ecosystem (e.g., analyzing the connectedness of the VC network in RQ1a). At the meso-level, the focus shifts to cohesive subgroups or clusters present within the network (e.g., analyzing the composition of investor communities in RQ1b). At the micro-level, the analysis centers on the immediate network of co-investors (e.g., analyzing the direct co-investment network in RQ2a) or on the structural position of individual VC firms within the broader network (e.g., analyzing the brokerage position of the VC firm in the overall network in RQ2c).

To conduct my analyses, I apply graph-theoretical measures such as modularity and centrality. The rationale for selecting these measures and their operationalization is driven by the specific research questions, which are discussed in detail in Chapters 4.2 and 5.2. These chapters address research questions RQ1a–RQ1c and RQ2a–RQ2b, respectively. Throughout this thesis, I rely on the Python packages NetworkX (Hagberg, Schult, & Swart, 2008) and pycirclize (Shimoyama, 2022) to construct, analyze and visualize the network graphs.

## 3.2 Qualitative research design: interview-based, multiple-case study

To investigate the connections among venture capitalists, I employ an inductive, qualitative research design based on multiple cases and in-depth interviews. This methodological approach is particularly suited for addressing research questions RQ3a and RQ3b for several reasons: First, the flexibility and exploratory nature of qualitative research designs is well-suited for investigating novel phenomena and poorly understood processes (Corbin & Strauss, 2008; D. A. Gioia et al., 2013), such as the relatively unexplored phenomenon of venture capitalist-to-venture capitalist networks. Second, in-depth interviews allow researchers to understand the subtleties and nuances of interactions ("why" and "how"), which are often lost in quantitative approaches (Stokes & Bergin, 2006). When complemented with a multiple-case design, this method enhances the accuracy, detail, and cross-contextual generalizability of findings, especially when answering "how"-oriented questions such as RQ3b (Eisenhardt, 1989; Morse, 2015; S. Yang et al., 2018). Finally, venture capitalist-level data is typically scarce, especially when exploring their personal network and collaboration with other venture capitalists beyond syndication. For example, these inter-personal connections may stem from shared educational backgrounds, prior professional affiliations, or more informal ties such as mutual acquaintances or common leisure activities. By engaging directly with the venture capitalists, qualitative methods provide access to such non-public information and, thus, offer valuable insights into otherwise hidden relationship dynamics.

Chapter 6.1 details the selection criteria for the interview sample, the systematic coding of interview transcripts, and the subsequent analysis conducted using the Gioia methodology (D. Gioia, 2021; D. Gioia & Chittipeddi, 1991; D. A. Gioia et al., 2013).

*"Our experience of the world depends on the actual structure of the networks in which we are residing and on all the kinds of things that ripple and flow through the network."*

Nicholas A. Christakis, Professor and Human Nature Lab Director at Yale University

# 4

# Europe's fragmentation - myth or reality?

## A social networks-based characterization of the venture capital network in Europe and its communities

Silicon Valley has played a pivotal role in nurturing and propelling today's tech giants to success, such as Intel, Apple, Cisco, Yahoo, Facebook, and Google. Consequently, it has become synonymous with innovation and entrepreneurship, often hailed as the "breeding ground for startups," the "cradle of innovation," and the "Mecca for entrepreneurs". It has also evolved into a symbol of a closely-knit community of entrepreneurs, venture capitalists, and other strategic partners in the US. Both practitioners and academics have emphasized the importance of these ecosystems and networks in achieving the region's success (e.g., Fox (2014); Saxenian (1996); Subrahmanya and Hillemane (2022)). Specifically, the collaboration among VC firms and the existence of a robust and dense VC network have contributed significantly to Silicon Valley's comparatively higher growth and development (Castilla, 2003; Ferrary & Granovetter, 2009).

Therefore, Silicon Valley serves as an inspiration for regions worldwide. It comes as no surprise that numerous regions have actively tried to establish and nurture similar ecosystems, aiming to replicate the success story of Silicon Valley and foster economic growth (Ferrary & Granovetter, 2009). In Europe, there are many claims of

success[1,2,3,4,5,6], but there also exists a less optimistic perspective[7,8]. For instance, concerns persist regarding the fragmentation within Europe's innovation ecosystem (Arnold et al., 2024; Forbes, 19.07.2024; Metzger et al., 2016). Investors characterize Europe's venture capital scene as multiple national ecosystems (BCG, 2015; SpeedInvest, 2023); the European Investment Fund states unifying the European VC market across (and within) national borders as a long-term policy objective (European Investment Fund, 2019); and five percent of VC fund managers investing in Europe even consider the cross-border market fragmentation as one of the biggest three challenges in the VC industry (European Investment Fund, 2023).

However, there is little research on the structure of VC networks on a macro-level, analyzing the network "as a whole" (Provan et al., 2007), and on a meso-level, analyzing the communities in the network. Among the few empirical studies, most analyze the US (e.g., Bygrave (1988); Kogut et al. (2007)) or Asia (e.g., Aleenajitpong and Leemakdej (2021); Jin et al. (2016)), often at a specific point in time (e.g., the network in 2022). This gap is notable given the established importance of networks and their position within the network for individual VC firms (micro-level, see e.g., Abell and Nisar (2007); Christopoulos et al. (2022); Y. Hochberg et al. (2007); Jääskeläinen (2012); Liu and Chen (2014)) and the broader implications of the overall network structure. For example, the structure affects how information and knowledge spreads within the network (Granovetter, 1973; Newman, 2003).

This is the first study to characterize the VC networks in Europe, the US and China separately, spanning a time period exceeding two decades. In doing so, we aim to answer two research questions: RQ 1a) *Is the venture capital network in Europe less connected compared to that in the US and China?* And: RQ 1b) *Which investor communities emerge within the venture capital network in Europe?*

The remainder of this chapter is structured as follows: In Chapter 4.1, we adopt established methods from entrepreneurial finance (e.g., Alexy et al. (2012); Y. Hochberg et al. (2007); Sorenson and Stuart (2001)) and model the VC networks as co-investment networks, where VC firms are connected if they have invested in the same portfolio company. We construct distinct networks for each region based on a comprehensive data

[1] "Saclay is a home to excellence unique in France and could become a French Silicon Valley.", Christian Blanc (Secretary of State, Région Capitale), 2009

[2] "[The artificial islands south of Copenhagen] could become a sort of European Silicon Valley.", Brian Mikkelsen (CEO of The Danish Chamber of Commerce), 2019

[3] "The United Kingdom is Europe's Silicon Valley – a tech and creative industries powerhouse.", Jeremy Hunt (chancellor of the exchequer, UK), 2023

[4] "In other words, instead of competing, we can build a new Silicon Valley — let's call it the New Nordic Tech Valley.", Kaja Kallas (Estonian Prime Minister), 2023

[5] "Let's break the [Silicon Valley] monopoly. We could build the same thing or even better in Europe", Niklas Zennström (tech entrepreneur and venture capitalist), 2023

[6] "[Bratislava] is part of a network of cities in this region that hope to become central Europe's answer to Silicon Valley", Financial Times, 2017

[7] "Europe in general is geographically fragmented - but the tech ecosystems in some countries, like in this case Poland, are VERY fragmented.", Pawel Chudzinski (venture capitalist), 2012

[8] "Europe does feel clubby. I don't think I'm in the club.", Hussein Kanji (venture capitalist), 2023

set sourced from PitchBook, encompassing 11,684 (17,371 / 5,705) VC firms that invested in European (US / Chinese) companies between 2000 and 2022. The basic structure of the data used and the resulting co-investment networks is summarized in Chapter 4.1.

In Chapter 4.2, we explore five complementary aspects of network connectivity by applying several well-established Social Network Analysis (SNA) measures. The measures will be introduced from a graph theoretical and venture capital perspective. The first main finding is that, today, the European VC network is still less connected than the US (and often China), thereby confirming the myth of Europe's fragmentation. Second, analyzing the evolution, we find that the European VC ecosystem has become more connected in the past decade.

In Chapter 4.3, we characterize European investor communities, whose member firms interact more frequently. Our findings reveal that the community structure within the European VC network is shaped by the investment style of the investors, particularly by the geographic focus of the VC.

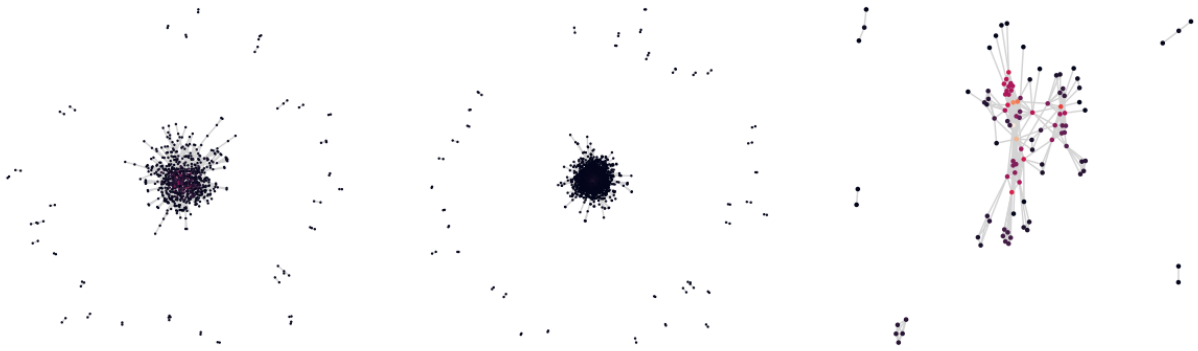
We make four key contributions to venture capital and applied network literature. Firstly, we enhance the currently limited understanding of the European VC market (Christopoulos et al., 2022; Cumming, Kumar, Lim, & Pandey, 2023), both in the venture capital and applied social network literature. Secondly, we compare the structure of the VC network over time (2000 - 2022) and geographies (Europe, US, China). Thirdly, we analyze the network at the macro- and meso-level. Finally, we offer a structured approach for characterizing social networks from a connectivity perspective.

These insights are also relevant for practitioners: For VC firms, understanding the characteristics and differences of US, Chinese, and European VC networks informs strategic decisions. Entrepreneurs can tailor their approach to access access the collective capital, knowledge and connections of a VC community by partnering with well-connected VC firms across or within one community. Policymakers can use these insights to cultivate a more cohesive European entrepreneurship system.

## 4.1 Construction of co-investment networks and summary statistics

We want to explore how well-connected VC firms are in the European, American, and Chinese ecosystem.

We define the regional networks based on the location of the portfolio companies' headquarters and, thus, concentrate solely on investments in target companies headquartered in Europe, China, and the United States. Specifically, the European VC network comprises both global and local VC firms that invest in European-based companies. This is the VC landscape entrepreneurs in Europe are looking at to secure capital and cultivate support for their venture. In the context of this thesis, the term 'Europe' refers to the member states of the



**(a)** European co-investment network **(b)** US co-investment network **(c)** Chinese co-investment network

**Figure 4.1** The network graphs for the European, US and Chinese co-investment network in the year 2005, with the node colors proportional to the number of syndication partners. Node positions were determined using the Fruchterman-Reingold algorithm, where interconnected nodes are drawn closer together.

European Union (EU)[9] and the European Free Trade Association (EFTA)[10]. We include the United Kingdom (UK), as it was a part of the EU for the majority of our sample period, with Brexit occurring only in 2020. Moreover, the UK is deemed the most attractive VC market in Europe (Groh, Liechtenstein, Lieser, & Biesinger, 2023). In total, our definition of Europe comprises 32 countries.

As described in Chapter 3, our definition of the European VC network centers on the relationships forged through syndicated investments in European-based portfolio companies. In the resulting co-investment network graphs, VC firms (represented as nodes) are connected based on syndicate deals (represented as edges). We build a unique network for every year and region to analyze how the relationships and, ultimately, the connectivity among the VCs in the network have evolved. Figure 4.1 illustrates the three co-investment networks at the beginning of our analysis.

We source data on VC investments, VC firms, and target companies from the global database PitchBook. Founded in 2007, PitchBook has since then back-filled the data until the 1960s. Its research team ensures data accuracy and mitigates positive survival and back-fill biases by directly communicating with limited partners, investors, and key contacts at target companies (Bowden, Harjoto, Paglia, & Tribbitt, 2016). Notably, Retterath and Braun (2020) identify PitchBook as one of the databases with superior coverage and accurate information on venture capital deals. Particularly post-2000, PitchBook demonstrates better coverage than other databases such as Prequin and VentureeXpert (Bowden et al., 2016; Sharma, 2017).

[9]The EU has the following 27 member states: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

[10]The EFTA has four member states, namely, Iceland, Liechenstein, Norway and Switzerland. While these countries are not members of the EU, they participate in the European Single Market through agreements such as the European Economic Area and bilateral agreements.

**Table 4.1** Sample description of Pitchbook dataset.

| | **Europe** | **US** | **China** |
|---|---|---|---|
| **VC firms** (#) | **11684** | **17371** | **5705** |
| Local VC firms (%) | 49.55 | 60.19 | 77.23 |
| Global VC firms (%) | 50.45 | 39.81 | 22.77 |
| VC firms per deal (#) | 4.31 | 6.21 | 3.07 |
| VC firms per company (#) | 7.01 | 13.06 | 7.27 |
| Mean VC founding year | 2011 | 2011 | 2010 |
| Median VC founding year | 2014 | 2014 | 2013 |
| Missing VC founding year (%) | 29.78 | 31.91 | 56.28 |
| Mean VC AUM ($ mn) | 2312.99 | 1968.51 | 6134.64 |
| Median VC AUM ($ mn) | 128.51 | 109.07 | 500.00 |
| Missing VC AUM (%) | 75.80 | 77.21 | 82.45 |
| Mean investments per VC (#) | 44.14 | 36.77 | 41.27 |
| Median investments per VC (#) | 13 | 11 | 5 |
| Missing investment number (%) | 0.00 | 0.00 | 0.00 |
| **Funds** (#) | **6040** | **11734** | **3251** |
| Missing fund information (%) | 59.53 | 45.55 | 61.23 |
| Mean fund number | 4.67 | 4.80 | 5.48 |
| Median fund number | 2.00 | 2.00 | 3.00 |
| Mean fund size ($ mn) | 178.10 | 154.09 | 155.77 |
| Median fund size ($ mn) | 65.72 | 56.33 | 49.07 |
| Missing fund size (%) | 18.28 | 15.83 | 5.51 |
| **Deals** (#) | **71166** | **124008** | **43143** |
| Deals syndicated (%) | 77.10 | 85.66 | 68.80 |
| Deals early stage (%) | 20.85 | 18.91 | 7.80 |
| Mean deal number | 3.75 | 4.21 | 3.45 |
| Mean deal size ($ mn) | 22.17 | 39.89 | 61.32 |
| Median deal size ($ mn) | 3.64 | 9.50 | 14.59 |
| Missing deal size (%) | 19.69 | 10.60 | 44.84 |
| **Companies** (#) | **45472** | **64826** | **21422** |

Therefore, we include all deals that were completed by VC firms between 2000 and 2022. In doing so, we drop deals that PitchBook classifies as cancelled, postponed, rumored, upcoming, or in progress. These deals collectively represent less than 0.3% of all VC investments in the PitchBook database. For completed deals, we drop investors with status pending, bidding or failed. We only consider completed deals because connections in the network should encapsulate a trusted relationship. This trust materializes during post-deal phases, for example, within the context of board meetings and collaborative endeavors. For deals with missing deal dates, we substitute the announced date and vintage year of the fund as a proxy and adjust them based on the average time lag in our sample. This information is available for approximately 1.5% of the missing dates; the remaining deals with missing information (8.3%) are dropped. Our analysis only considers deals made by venture capital or corporate venture capital firms, excluding other types of investors like business angels or private equity firms.

### 4.1.1 Sample description

Our final sample consists of 11,684 VC firms that invested in 71,166 deals in 45,472 portfolio companies headquartered in Europe, 17,371 VC firms that invested in 124,008 deals in 64,826 portfolio companies headquartered in the US, and 5,705 VC firms that invested in 43,143 deals in 21,422 portfolio companies headquartered in China. Around 50% of the VC firms investing in European-based companies also have their headquarter in Europe. The other half represents global VC investors that are active in Europe, with almost 29% headquartered in the US. A larger proportion of local VC firms invest in companies based in the US and China (around 60% and 77%, respectively). A possible explanation for this is linked to the well-established presence of VC in the United States and political considerations in China. Syndicated funding plays a substantial role, particularly in Europe (77.10% of investment rounds) and the US (85.66% of investment rounds). In China, 68.80% of investment rounds were syndicated. The average number of VCs per deal is 4.31 in Europe, 6.21 in the US, and 3.07 in China. Information on the fund involved is only available for approximately 46-61% of all deals. The average fund is a VC firm's 4.67th fund in Europe, 4.80th fund in the United States, and 5.48th fund in China, with corresponding sizes of 178 million USD in Europe, 154 million USD in the United States, and 155 million USD in China. A comprehensive sample description is available in Table 4.1.

On average, the resulting VC networks comprise 2,931 VC firms (nodes) interconnected by 20,330 edges in the European network, 5,241 VC firms (nodes) interconnected by 110,190 edges in the US network, 1,484 VC firms (nodes) interconnected by 14,000 edges in the Chinese network. Since 2005, the European network has witnessed an impressive tenfold growth of VC firms. Still, the latest US network remains almost 1.5 times larger. In contrast, the Chinese network, having surpassed the milestone of 1,000 VC firms in 2016, currently stands at about half the size of its European counterpart. As we use overlapping 5-year windows, the first network we analyse is the VC network in 2005. The data for this network encompasses VC investments from 2000 to 2004, the second network is based on syndicates established between 2001 and 2005, and so forth. In total, we analyze 57 co-investment networks (19 per region).

## 4.2 Europe's fragmentation - a comparative perspective on connectivity within VC networks

In our investigation into the myth of Europe's fragmentation, we use Social Network Analysis (SNA) to reveal the structural patterns in the VC networks from a connectivity perspective. While often used to analyze the embedding of individual actors within a network (e.g., the centrality of an individual VC firm in Y. Hochberg et al. (2007)), SNA also allows to explore the overall structure of VC networks at the macro-level.

**Table 4.2 Overview of measures used to characterize social networks from a connectivity perspective.** The underlying concept in the context of VC is described, each measure is defined and an example from the literature is given.

| Measure | Meaning in VC | Definition | Example literature |
|---|---|---|---|
| Giant Connected Component | Largest VC group | The largest connected sub-graph, i.e., the maximal set of nodes connected by a path of any length | Castilla (2003); Moody (2004) |
| k-Core | Core group of tightly-connected VC firms | The maximal sub-graph in which each node has a degree of at least k | Adiga and Vullikanti (2013) |
| (Mean) shortest path length | The number of intermediaries between any two VC firms ("co-investors of co-investors") | The shortest path length is the minimum number of ties linking any two nodes, either directly or indirectly. The mean shortest path refers to the arithmetic mean of all shortest paths | Cowan and Jonard (2004) |
| Articulation point | Gatekeeper VCs, that can mediate connections between two VC groups | A node whose removal, along with its incident edges, increases the number of connected components in the graph | Tian, Bashan, Shi, and Liu (2017) |
| Community | Groups of VCs, that invest more frequently with each other than with the rest of the network | A subset of nodes, that are densely connected internally and sparsely linked to the rest of the graph | Aleenajitpong and Leemakdej (2021); Bubna, Das, and Prabhala (2020) |

In this study, we focus on the overall connectivity of the macro-level network. We explore five complementary aspects of connectivity to determine whether the VC network in Europe is less connected compared to the one in the US and China. First, a VC firm can reach few or many other VC firms in the network, either directly or via other VC firms. We analyze the size of the largest group of connected VCs in the network (Chapter 4.2.1). Second, there can be a small or a large core group of VC firms that frequently co-invest with each other. We explore the size of the most closely interconnected group of VCs (Chapter 4.2.2). Third, two VC firms can be connected via many or few intermediaries ("co-investor of a co-investor"). We investigate the average number of intermediaries between any two VCs (Chapter 4.2.3). Fourth, VC firms may rely on a single VC firm to connect them with another group of VCs, or there can be many connections, and, therefore, brokers, between groups (Chapter 4.2.4). We examine the proportion of VCs that serve as gatekeepers, connecting two otherwise unconnected parts of the network (Chapter 4.2.4). Finally, there can be many or few separate investor communities of tightly interconnected VC firms. We compare the number of communities in the network (Chapter 4.2.5).

We borrow five concepts from graph theory to explore these different aspects of network connectivity (see Table 4.2 for an overview and Figure A.3 in the Appendix A.3 for an illustration). All metrics are widely used in Social Network Analysis. In the upcoming Chapters (4.2.1 - 4.2.5), we first motivate the practical relevance of the metrics within a business context. We then explain the graph theoretical foundations behind the metrics. Highlighting their limitations, we present a compelling rationale for the imperative use of multiple metrics. Lastly, we document our findings. Our focus is on comparing the European VC network with those in China and

the US. We acknowledge variations in size across time and regions by normalizing the metrics or considering shares rather than absolute numbers. All findings will be synthesized in discussion Chapter 4.4.

### 4.2.1 The largest VC group - Giant Connected Component

First, we analyze the largest group of VC firms that, either directly or through their co-investors, share investment opportunities and resources and are, therefore, connected via other VC firms. The size of this cluster serves as an indicator for the integration of the VC firms. Moreover, it reflects the network's information flow, highlighting the limitations for outsider VCs in accessing resources. Consider a scenario where a substantial cohort of VC firms is connected through their past co-investments. When another VC firm collaborates with a member of this group, it gains access to the group's resources, such as information about upcoming investments. This information enables the VC firm to potentially engage in one of the upcoming co-investments within the group. In contrast, a VC firm without connections to this group remains an outsider and is likely to miss out on opportunities for co-investment, even if it might be a more suitable syndicate partner - simply because it lacks access to critical information about potential investments.

The proportion of the VC network that belongs to this largest interconnected cluster of VC firms is quantified by the size of the *Giant Connected Component (GCC)*. A connected component refers to a subset of nodes within a graph where each node is reachable from every other node by at least one path, but there are no connections to nodes outside the subset (Scott, 2000). The largest connected component, the GCC, is the maximal set of VC firms connected by an existing path of any length. A larger GCC thus indicates that more firms are (indirectly) connected and that information can flow in a larger part of the network (Newman, 2003). In a well-connected ecosystem, the GCC will encompass all or a substantial proportion of VC firms. The presence of multiple components of significant size implies fragmentation. Figure 4.2 illustrates the structure of the European VC co-investment network in 2005, with the GCC at its core and peripheral clusters of less-connected VC firms.

**Europe:** Since then, the size of the largest connected investor group in the European network has increased, rising from approximately 90% in 2005 to over 95% of VC firms in 2022. Figure 4.3 further analyzes the GCC in terms of VCs and the countries and industries they invest in. The rising share of investors affiliated with the GCC serves as a clear indicator of the growing integration within the European VC ecosystem, also across target industries and countries. Since 2008, VC firms in the GCC are investing in all industries and, since 2014, VC firms within the GCC have extended their investments to encompass all European countries.

**Europe vs. US:** In comparison, the European network is less connected than the US . The largest VC group in the US network comprises a higher share of VC firms, with at least 96.30% of VC firms being members. However, the size of the US group remains relatively stable, while Europe is becoming more integrated. Consequently,

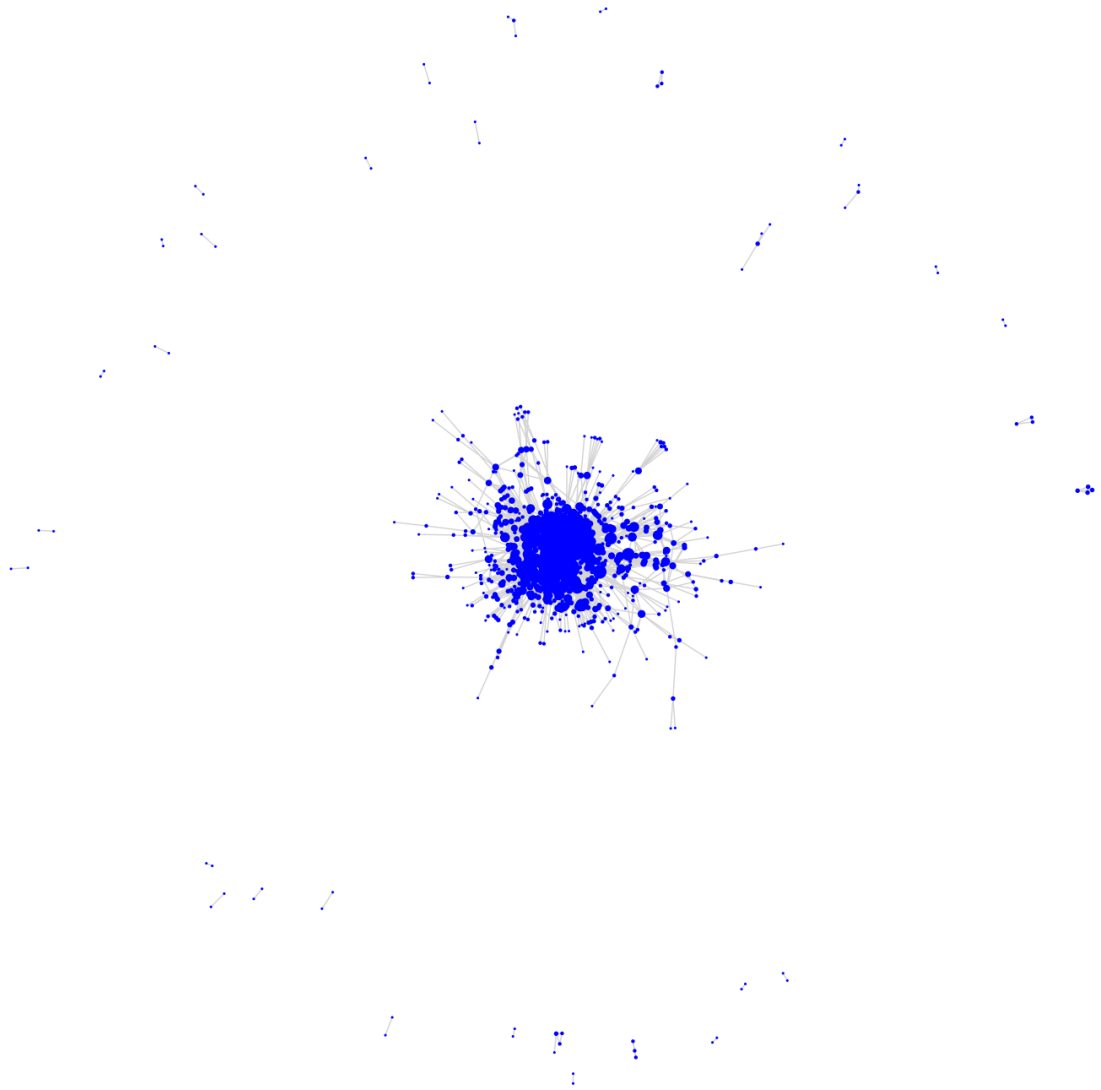


**Figure 4.2 Illustration of the European Giant Connected Component (GCC) in 2005.** The network graph visualizes co-investment ties among VC firms active in Europe, with nodes representing VC firms and edges representing co-investments. The dense cluster at the center illustrates the GCC - the largest group of interconnected VC firms that form the structural core of the European co-investment landscape. In contrast, the scattered nodes and smaller clusters around the periphery represent firms engaged in co-investments that are not linked to this core.

the disparity between the United States and Europe is diminishing (1.5 pp difference 2023). Table 4.3 offers a comprehensive comparison between Europe and the US (across all measures).

**Europe vs. China:** Recently, Europe appears comparatively less connected than China (since 2013) from the perspective of the largest VC group. At the beginning of our sample period, there was a larger group of VCs that was not yet fully integrated. For example, in 2005 the second largest VC group constituted 4.72% of VC firms in China vs. less than 0.50% in the US and Europe. This observation could reflect China's status and evolution as an emerging economy. Table 4.4 offers a comprehensive comparison between Europe and China (across all measures).

**Table 4.3** Comparison of metrics between Europe and the United States, presented as Europe/US ratios and differences between Europe and US.

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | Min | Max | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Europe/US ratio** | | | | | | | | | | | | | | | | | | | | | | |
| Size of GCC | 0.94 | 0.93 | 0.91 | 0.93 | 0.92 | 0.93 | 0.95 | 0.96 | 0.96 | 0.96 | 0.97 | 0.97 | 0.97 | 0.98 | 0.97 | 0.97 | 0.97 | 0.98 | 0.98 | 0.91 | 0.98 | 0.96 |
| Size of k-Core | 1.13 | 1.21 | 1.01 | 0.47 | 0.37 | 0.23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.13 | 0.17 | 0.15 | 0.13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.21 | 0.26 |
| Mean shortest path length | 1.25 | 1.21 | 1.20 | 1.28 | 1.29 | 1.28 | 1.25 | 1.28 | 1.28 | 1.29 | 1.29 | 1.27 | 1.27 | 1.25 | 1.25 | 1.24 | 1.25 | 1.23 | 1.21 | 1.20 | 1.29 | 1.26 |
| Articulation points | 1.89 | 1.67 | 1.56 | 1.75 | 1.69 | 1.76 | 1.65 | 1.63 | 1.66 | 1.69 | 1.61 | 1.72 | 1.75 | 1.89 | 1.79 | 1.89 | 1.99 | 1.76 | 1.82 | 1.56 | 1.99 | 1.75 |
| Main Louvain communities | 1.25 | 1.40 | 1.44 | 1.75 | 1.75 | 1.67 | 1.88 | 2.00 | 1.63 | 1.75 | 1.88 | 2.00 | 1.88 | 1.45 | 1.45 | 1.88 | 2.14 | 1.44 | 1.38 | 1.25 | 2.14 | 1.68 |
| **Difference Europe and US** | | | | | | | | | | | | | | | | | | | | | | |
| Size of GCC (pp) | -5.80 | -7.20 | -8.80 | -6.50 | -7.80 | -6.40 | -4.40 | -3.40 | -3.80 | -3.50 | -2.50 | -2.60 | -2.50 | -1.90 | -3.00 | -3.30 | -2.80 | -1.60 | -1.50 | -8.80 | -1.50 | -4.17 |
| Size of k-Core (pp) | 2.19 | 3.64 | 0.17 | -7.40 | -7.94 | -8.52 | -9.90 | -10.13 | -9.03 | -9.69 | -10.41 | -10.05 | -8.56 | -8.03 | -7.38 | -7.96 | -6.91 | -7.71 | -8.11 | -10.41 | 3.64 | -6.93 |
| Mean shortest path length | 0.77 | 0.65 | 0.63 | 0.86 | 0.90 | 0.89 | 0.80 | 0.88 | 0.88 | 0.89 | 0.86 | 0.81 | 0.80 | 0.74 | 0.74 | 0.71 | 0.73 | 0.65 | 0.60 | 0.60 | 0.90 | 0.78 |
| Articulation points (pp) | 7.19 | 5.32 | 5.19 | 7.10 | 6.93 | 7.43 | 6.26 | 5.79 | 6.05 | 6.00 | 5.08 | 5.39 | 5.55 | 6.00 | 5.16 | 5.16 | 5.00 | 3.70 | 3.54 | 3.54 | 7.43 | 5.68 |
| Main Louvain communities (#) | 3.00 | 4.00 | 4.00 | 6.00 | 6.00 | 6.00 | 7.00 | 7.00 | 5.00 | 6.00 | 7.00 | 8.00 | 7.00 | 5.00 | 5.00 | 7.00 | 8.00 | 4.00 | 3.00 | 3.00 | 8.00 | 5.68 |

**Table 4.4** Comparison of metrics between Europe and China, presented as Europe/China ratios and differences between Europe and China.

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | Min | Max | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Europe/China ratio** | | | | | | | | | | | | | | | | | | | | | | |
| Size of GCC | 1.06 | 1.09 | 0.94 | 0.95 | 0.95 | 1.00 | 1.02 | 1.01 | 0.97 | 1.00 | 0.98 | 0.97 | 0.98 | 0.98 | 0.97 | 0.97 | 0.98 | 0.99 | 0.99 | 0.94 | 1.09 | 0.99 |
| Size of k-Core | 0.22 | 0.24 | 0.19 | 0.09 | 0.07 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.17 | 0.26 | 0.23 | 0.17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.26 | 0.09 |
| Mean shortest path length | 1.28 | 1.33 | 1.25 | 1.34 | 1.35 | 1.32 | 1.31 | 1.26 | 1.24 | 1.22 | 1.22 | 1.17 | 1.19 | 1.20 | 1.22 | 1.20 | 1.22 | 1.20 | 1.18 | 1.17 | 1.35 | 1.25 |
| Articulation points | 0.99 | 0.86 | 1.19 | 1.21 | 1.24 | 1.33 | 1.23 | 1.11 | 1.16 | 0.99 | 0.99 | 1.05 | 1.09 | 1.24 | 1.28 | 1.29 | 1.26 | 1.09 | 1.10 | 0.86 | 1.33 | 1.14 |
| Main Louvain communities | 2.14 | 2.00 | 1.44 | 1.56 | 1.27 | 1.25 | 1.36 | 0.88 | 1.30 | 1.17 | 1.15 | 1.33 | 1.15 | 1.60 | 1.33 | 1.67 | 1.50 | 1.44 | 1.22 | 0.88 | 2.14 | 1.41 |
| **Difference Europe and China** | | | | | | | | | | | | | | | | | | | | | | |
| Size of GCC (pp) | 5.20 | 7.20 | -5.50 | -4.70 | -4.40 | 0.20 | 2.00 | 0.70 | -3.10 | -0.20 | -1.80 | -2.60 | -2.20 | -1.80 | -2.90 | -2.60 | -1.50 | -1.00 | -0.90 | -5.50 | 7.20 | -1.05 |
| Size of k-Core (pp) | -67.84 | -63.87 | -70.71 | -64.98 | -64.73 | -50.89 | -58.01 | -40.94 | -28.21 | -28.81 | -19.03 | -7.40 | -5.16 | -4.76 | -5.53 | -4.38 | -6.45 | -9.43 | -12.00 | -70.71 | -4.38 | -32.27 |
| Mean shortest path length | 0.83 | 0.92 | 0.75 | 1.00 | 1.04 | 0.97 | 0.93 | 0.82 | 0.77 | 0.71 | 0.70 | 0.56 | 0.59 | 0.61 | 0.66 | 0.62 | 0.67 | 0.58 | 0.53 | 0.53 | 1.04 | 0.75 |
| Articulation points (pp) | -0.10 | -2.20 | 2.28 | 2.92 | 3.22 | 4.28 | 2.98 | 1.50 | 2.12 | -0.09 | -0.07 | 0.57 | 1.08 | 2.45 | 2.57 | 2.43 | 2.10 | 0.70 | 0.74 | -2.20 | 4.28 | 1.55 |
| Main Louvain communities (#) | 8.00 | 7.00 | 4.00 | 5.00 | 3.00 | 3.00 | 4.00 | -2.00 | 3.00 | 2.00 | 2.00 | 4.00 | 2.00 | 6.00 | 4.00 | 6.00 | 5.00 | 4.00 | 2.00 | -2.00 | 8.00 | 3.79 |

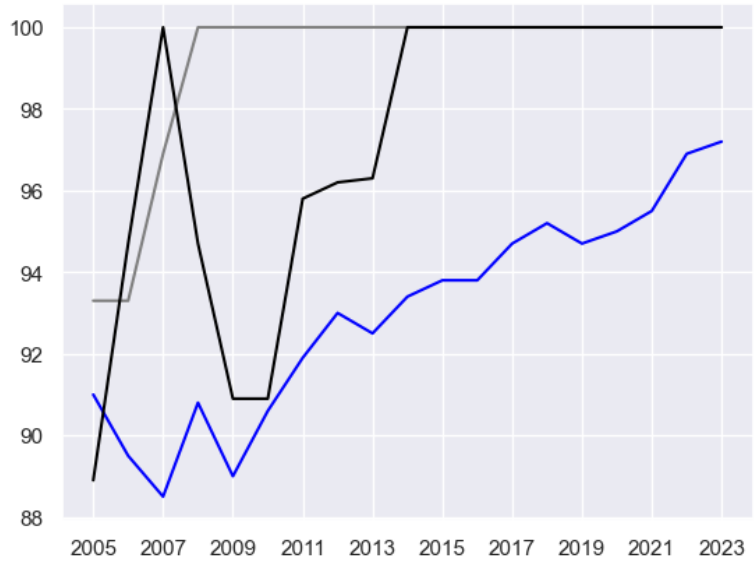



**Figure 4.3 Analysis of the European Giant Connected Component.** The share of investors in the GCC is depicted by the blue line. The black line denotes the share of countries, where the investors' portfolio companies are headquartered. The grey line denotes the industries, in which these portfolio companies are active. All values are in percent of the number of VC firms included in the European VC network.

### 4.2.2 The core VC group - k-Core

A large Giant Connected Component (GCC) can still be fragile, as the exit of a single VC firm can potentially disconnect the entire component (Moody, 2004). Therefore, we consider other measures to capture nuances of connectivity within this cluster (Chapters 4.2.2 - 4.2.5). These network metrics focus on the GCC, as some measures are defined solely for connected components (Hansen, Shneiderman, Smith, & Himelboim, 2020). For instance, the mean shortest path (Chapter 4.2.3) is not defined for a network with disconnected components. As the GCC encompasses nearly all VC firms, the findings are nonetheless meaningful when elucidating the overall connectivity of the network. Previous studies (e.g., Jin et al. (2016); Kogut et al. (2007)) have also disregarded isolated VC firms or components.

Simmel and Wolff (1964) argue that a group's essential characteristic is its ability to remain a group even if an individual member leaves. The GCC does not necessarily meet this criterion, since it requires only a single path between VC firms. Our second measure, the size of the *k-Core*, explores the size of the most tightly connected investor group (with at least k connections). The k-Core represents the subset of VC firms engaged in at least k investments with others within that subset (see Table 4.2). Hence, the k-Core meets Simmel's criterion, since they remain connected even if a single VC firm exits the network (Moody, 2004). The decomposition into k-Cores and their respective sizes describe the core-periphery structure of the network (Adiga & Vullikanti, 2013). The greater the size of a k-Core, the higher the number of well-connected VC firms within the network. Moreover, the core group is more interconnected, as k increases and VCs within the

core form at least k connections to other members. In contrast, in a more fragmented network, VC firms less frequently co-invest with VC firms from the same group, and both k and the k-Core will be smaller.

Given temporal and regional variations in network size, we dynamically define k as 1% of the respective network size. Additionally, we adhere to a criterion of considering at least the 2-Core to ensure that the k-Core comprises VC firms with more than one syndicate partner. Illustratively, k increases from 8 in 2005 to 70 in 2022 for the European network, reflecting the continuous growth of the network.

**Europe:** In nearly half of the years we analyze (specifically, 2011-2015 and 2020-2023), not a single VC firm co-invested with more than 1% of the European network. Over the past decade, the European core group comprised less than 2% of all VC firms.

**Europe vs. US:** In contrast, VC firms in the US network consistently managed to co-invest with 1% of all VC firms. Between 6.91 and 16.97% of the US network formed the 1%-k-Core. After 2007, Europe is again less connected than the US, with a proportionately smaller core group of VCs. This difference becomes even more noteworthy because, intuitively, one might assume that it would be easier for a VC firm to co-invest with 1% of the network in a smaller network. Kim and Park (2021) suggest an inverted U relationship between syndicate size and venture performance and highlight that coordination costs increase with the number of partners in a VC syndicate. Financial resource constraints also limit the total number of investments a VC firm can undertake. These constraints, in turn, restrict the extent to which VC firms can engage with k syndicate partners and, as k increases, it becomes increasingly challenging to co-invest in at least k syndicates[11]. In 2010, for example, a VC firm in the US network needs to co-invest with at least 27 syndicate partners, while having 12 syndicate partners suffices to be part of the European k-Core (k=12). Still, no VC firm in the European network managed to do so.

**Europe vs. China:** The European core group is also smaller than the Chinese one, with the Chinese 1%-k-Core comprising proportionately more VC firms. Until 2015, more than every fourth VC firm invested with 1% of the VC firms in the Chinese GCC. However, the 1%-k-Core is equivalent to the 2-Core or 3-Core in China between 2005 and 2010. After 2016, once the k-value has surpassed the threshold of 10, only 4.4% (in 2020) to 12.0% (in 2023) of VC firms belong to the Chinese 1%-k-Core. Overall, the Chinese VC network's smaller network size and correspondingly smaller values of k may partially drive the difference in 1%-k-Cores. For example, a VC firm in the 2023 k-Core in China needs to co-invest with at least 39 syndicate partners compared to 118 syndicate partners in the US and 79 syndicate partners in the European network. Another factor contributing to the proportionally larger 1%-k-Core in the Chinese VC network may be the ubiquitous influence of "Guanxi", a Chinese term that translates to "relationships" or "connections." Chinese culture

[11] Note that the growing network size may also contribute to the observed downward trend in the share of investors belonging to the k-Core across all networks.

and business practices emphasize cultivating and maintaining existing connections (Bruton, Ahlstrom, & Yeh, 2004; Xin & Pearce, 1996), also in China's VC industry (see e.g., Ahlstrom, Bruton, and Yeh (2007); Batjargal (2007)).Therefore, VC firms investing in Chinese-based companies may prioritize syndicate partnerships within the realms of their existing "Guanxi" networks, leading to larger k-Cores.

### 4.2.3 The number of intermediaries - path length

One shortcoming of the k-Core is that it neglects less densely connected network parts (Govindan, Wang, Xu, Duan, & Soundarajan, 2017). We address this limitation by considering additional measures, such as the mean shortest path length, that also reflect sparser network parts.

In alignment with the seminal experiment by Milgram (Travers & Milgram, 1969), we adopt the concept of "degrees of separation" as the minimum number of intermediaries between any two VC firms. Scholars have found that, for example, in 2011, any two Facebook users were separated by 3.74 "friends of friends" (Backstrom, Boldi, Rosa, Ugander, & Vigna, 2012). In the context of VC networks, one can conceptualize the degrees of separation by considering the number of co-investors required to contact their respective co-investors to get an introduction to a specific VC. A chain of "co-investor of a co-investor" statements can describe the degrees of separation of two VC firms. For example, if firm A has co-invested with firm B, and firm B has co-invested with firm C, but firm A and firm C have no portfolio companies in common, then firm C is the "co-investor of a co-investor" of firm A. There is at least one intermediary (firm B) involved and the degrees of separation, therefore, is 1. Y. V. Hochberg, Lindsey, and Westerfield (2015) found a chain of eight or fewer syndicate partners connected any two VC firms based in the US in 2003.

Related, the shortest path represents the most efficient way to traverse the network. The shortest path length between two nodes measures the minimum number of ties directly or indirectly linking one node to another and essentially equals their degrees of separation plus one. For instance, if two VC firms are directly connected, the absence of intermediaries results in zero degrees of separation, and the path length is consequently one. In the above example, the shortest path between firm A and firm C is the two-step path through firm B.

The *Mean Shortest Path Length (msp)* is the arithmetic mean of all such shortest paths and characterizes how closely the VC firms are embedded in the network. It reflects the ease by which VC firms can access resources in the network and collaborate with other VC firms. For instance, it is easier for a VC firm to retrieve information from their immediate co-investors compared to accessing information from its extended network, such as the co-investors of co-investors. In a well-connected network, all VC firms are connected by a few intermediaries and the mean shortest path is short. A well-connected network enables the efficient flow of information and facilitates knowledge transfer with minimal attenuation (Cowan & Jonard, 2004). For example, VC firms will

be able to identify suitable co-investors for upcoming deals or retrieve information on a target company through a few intermediaries in their network. Conversely, paths with greater lengths and more intermediaries imply the potential isolation of firms and, consequentially, a more fragmented network. To account for network size, we normalize the path lengths.

**Europe:** In the European network, the msp ranges between 3.51 and 4.03, reaching its minimum in 2022. From a shortest-path perspective, the European network has become more connected in our sample period.

**Europe vs. US:** In contrast, connecting two VCs in the US networks requires significantly fewer intermediaries. The msp in the US has been consistently around 3, ranging from 2.87 to 3.16. On average, contacting a VC firm in the European network would require contacting around 25% more co-investors, factoring in adjustments for size differentials (see Europe/US ratio in Table 4.3). However, the difference to Europe is decreasing.

**Europe vs. China:** The same holds true for the Chinese network: connecting two VCs in the Chinese networks requires significantly fewer intermediaries, and the disparity with Europe is diminishing. The Chinese network's msp is comparable to that in the US, ranging from 2.78 to 3.24.

In summary, the European network exhibits less connectivity than those in the US and China from an intermediary perspective. A mean comparison via an independent, two-sample t-test confirms that the mean shortest path in Europe is statistically significantly longer than in the US ($p < 0.01$) and China ($p < 0.01$).

### 4.2.4 Gatekeepers - articulation points

While widely employed, the mean shortest path exhibits a notable limitation in its ability to accurately gauge connectivity. Watts and Strogatz (1998) demonstrated that in sparsely connected and non-random graphs, incorporating a relatively small number of links between atypical partners (i.e., from distant parts of the network) can substantially reduce the average path length. For example, the path length decreases with the presence of central "hubs", to which many entities are connected to (Schilling, 2015), and increases with the presence of "gatekeepers", to which entities from otherwise unconnected parts of the network are connected to.

Therefore, fourthly, we investigate the prevalence of such gatekeeper VC firms, that are the sole connection between two groups of VC firms. In capital markets, gatekeepers can also provide stability and guidance to the market (Roychowdhury & Srinivasan, 2019). Gatekeeper VC firms influence both groups, mediate connections between VC firms from both groups, and control access to the information circulating within the groups. Therefore, other VCs may depend upon them to obtain relevant information or conclude deals (Burt, 2005). Consider the scenario where VC firm A stands as the sole investor engaging in co-investments with and, consequently, gaining valuable insights from VCs in Group 1 and Group 2. Then, VC A's co-investor from

Group 1 is limited in its access to information known within Group 2, for example about promising deals, solely through the conduit of VC A.

Graph theory captures the concept of gatekeepers as *articulation points*, sometimes called cut vertices or bridges (see Table 4.2). An articulation point refers to VC firms whose exit would fragment the network into multiple disconnected parts. Therefore, the abundance and properties of articulation points affects the network's resilience to external shocks. Moreover, gatekeeper VCs can also reinforce the overall connectivity within the network by acting as brokers, connecting co-investors from disparate groups. Therefore, the percentage of gatekeeper VCs reflects the network's current and potential future connectivity. In a well-connected network, there should be few gatekeepers.

**Europe:** In the European VC network, 8% to 17% of VC firms assume gatekeeping roles. On average, every 7th VC firm is a gatekeeper VC.

**Europe vs. US:** The European network is less connected than the US because it exhibits a greater prevalence of VC firms acting as gatekeepers. In the US, relatively fewer VC firms are gatekeepers throughout the entire sample period (>3.7 pp difference). To illustrate, in 2022, around every 10th VC firm mediates connections between otherwise disconnected VCs in the European network, compared to every 20th in the US network. Notably, the gap is narrowing (7.19 pp in 2005 vs. 3.54 pp in 2023) and the gatekeeper share is decreasing more prominently in Europe compared to the US, signaling improved connectivity within the European ecosystem. This transition could potentially be facilitated by gatekeeper VC firms leveraging their bridging capabilities to connect co-investors across unconnected parts of the network.

**Europe vs. China:** The disparity with the Chinese VC network is less pronounced, with an average difference of 1.55 pp and no clear time trend. In most years, the European network is more fragmented, with proportionally more VC firms acting as gatekeepers.

### 4.2.5 VC communities - Louvain communities

Finally, we investigate whether there are certain groups of VCs that co-invest more frequently with each other than with the rest of the network. The VCs more frequently participate in collaborative behaviours within their community and, thus, share more resources, such as knowledge and financial resources, and experience decreased transaction costs because of a heightened level of trust (Gu, Zhang, Xu, & Xue, 2023). We analyze how many of these investor communities exist. A higher number of communities signifies a more fragmented network structure, wherein isolated VC clusters frequently collaborate with just a few other firms. In contrast, a closely connected VC network will be characterized by just a few separate investor communities, because VC

firms frequently collaborate with a large number of VC firms. Figure 4.4 illustrates the community structure of the European VC network in 2005.

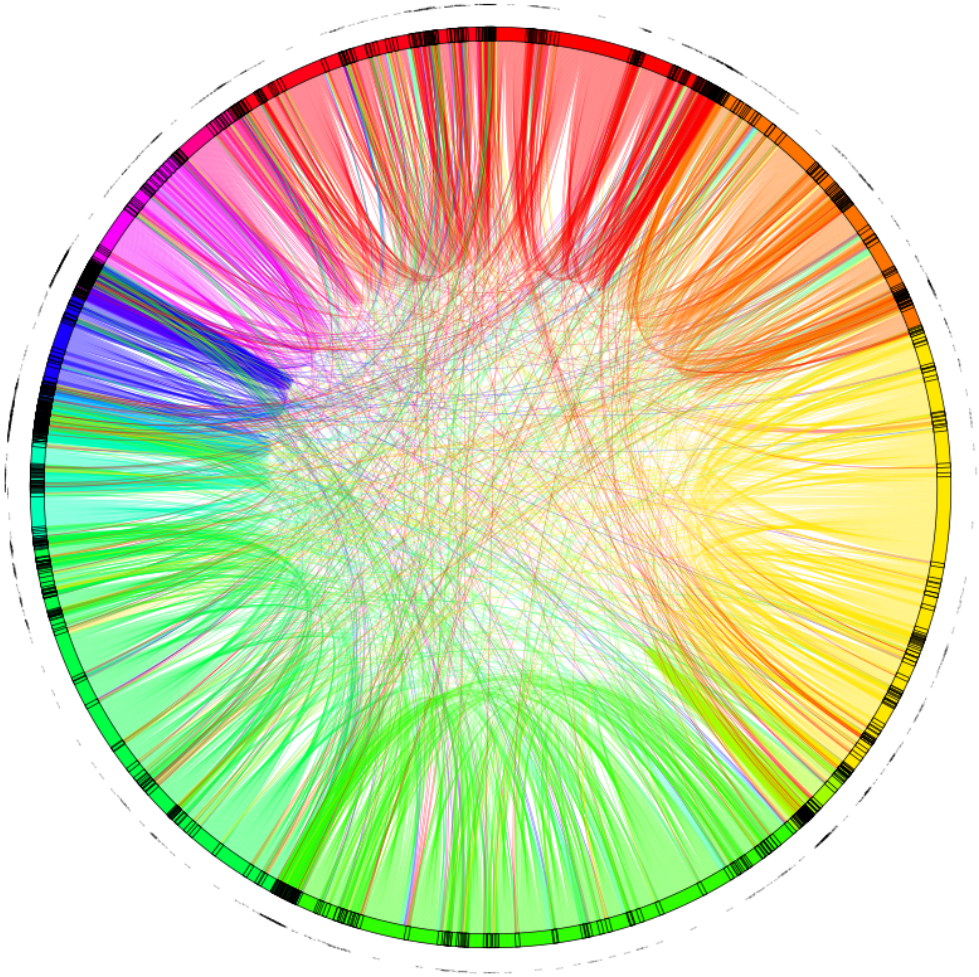


**Figure 4.4 Community structure of the 2005 European VC network.** The circular network visualization highlights groups of VC firms that frequently co-invest with each other than with the rest of the network. Each community is color-coded for clarity.

In graph theory, a *community* is a set of nodes tightly interconnected within the community while maintaining sparse connections with nodes outside the community. Therefore, the community structure of a network captures the distribution of ties rather than merely their existence (Tatarynowicz, Sytch, & Gulati, 2016).

Scholars have used numerous algorithms to detect communities (see, e.g., Lancichinetti and Fortunato (2009) or Danon, Díaz-Guilera, Duch, and Arenas (2005) for an overview). We use the Louvain algorithm by Blondel, Guillaume, Lambiotte, and Lefebvre (2008), because it outperforms other methods for community detection in terms of computational efficiency and reliable performance (Blondel et al., 2008; Lancichinetti & Fortunato, 2009; R. Zhang et al., 2021). Most importantly, the method is well-suited for real-world networks (Lancichinetti

& Fortunato, 2009). Therefore, the Louvain algorithm and improved algorithms based on it are among the most popular algorithms for uncovering global community structure (R. Zhang et al., 2021). For instance, D'Arcangelis, Levantesi, and Rotundo (2021) analyze the Louvain communities in a network of Italian pension funds. The Louvain method is a hierarchical clustering algorithm that detects communities based on modularity optimization (see Appendix A.3 for a detailed description and illustration). Modularity measures how well groups have been partitioned into clusters by comparing the relationships in a cluster to the expectations for a random network with the same number of nodes and edges. As a result, the Louvain method tends to identify communities encompassing only a few VC firms (Good, de Montjoye, & Clauset, 2010). Within these micro-communities, each VC firm has co-invested with every other VC, forming a sub-graph where every pair of nodes is connected. As an illustration, community 18 in Figure 4.5 depicts a complete graph, wherein all five VC firms are connected with each other. The segregation of these sub-graphs enhances modularity and, subsequently, the Louvain method detects them as a separate community. These micro-communities, though identified, do not provide substantial insights due to their limited scale. Therefore, we focus on the main communities, neglecting the micro-communities that comprise less than 1% of the VC network. This approach aligns with established practices in SNA (e.g., Carron-Arthur et al. (2016); Jin et al. (2016); Mirzaee and Wang (2020)). When we refer to communities in the subsequent analysis, we refer to the main communities.

**Europe:** Between 2005 and 2023, the European VC network breaks up into 11 to 16 communities. On average, 4.26 micro-communities were omitted. The 2023 network fragments into 11 communities, as shown in Figure 4.5. The largest among them contains 2,497 VC firms, while each of the remaining communities is less than half the size of the largest cluster. Chapter 4.3 further discusses the composition of the European communities.

**Europe vs. US:** Compared with the number of communities in the US, the European network exhibits a higher degree of fragmentation. The US network divides into 7 to 12 communities, while the European network, on average, splits into 5.68 (68.46%) more communities.

**Europe vs. China:** Europe also divides into more communities than the Chinese network, which splits into 7 to 16 communities. On average, there are 3.79 (40.94%) more communities in the European network.

## 4.3 Composition of the European VC communities

In this chapter, we analyze the latest European VC network (in the year 2023) at the meso-level, describing the composition of its communities.

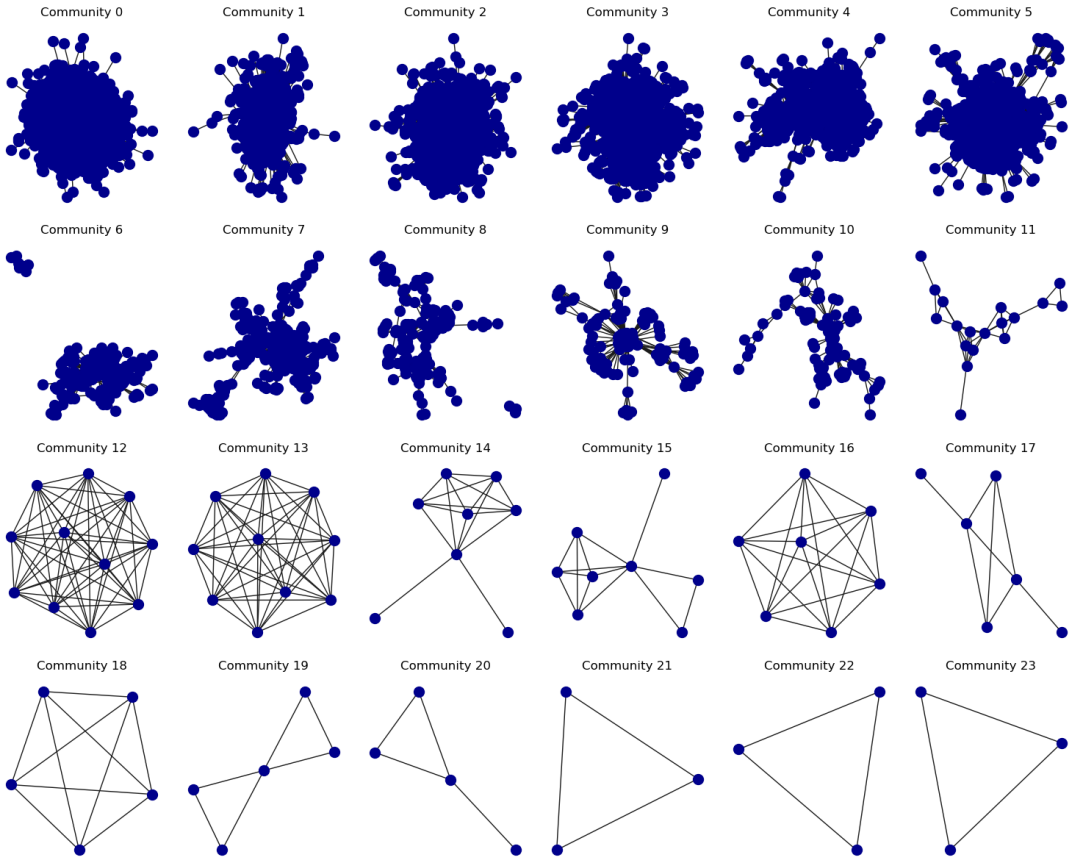



**Figure 4.5 Illustration of Louvain communities in the 2023 European VC network.** The communities are sorted by size. Our analysis focuses on the largest 11 communities (communities 0-10), that encompass between 97 and 2,497 VC firms. The 13 micro-communities (communities 11-23), each consisting of 3-18 venture capital firms, were disregarded.

One of the key differences between Europe and the United States is that Europe is more than one domestic market, with investors characterizing Europe's venture capital scene as multiple national ecosystems (BCG, 2015; SpeedInvest, 2023). The European Investment Fund states unifying the European VC market across (and within) national borders as a long-term policy objective (European Investment Fund, 2019). According to the latest EIF Survey, five percent of VC fund managers investing in Europe even consider the cross-border market fragmentation as one of the biggest three challenges in the VC industry (European Investment Fund, 2023).

It is often reasoned that the European aggregate disguises the diversity of its countries and national VC markets in terms of size of the economy, stage of development of the economy and innovation ecosystem, legal system, and local regulations (Metzger et al., 2016; SpeedInvest, 2023). Therefore, we are specifically interested in the relationship between geographic clusters and VC communities. Most economies feature geographic clusters of companies (Porter, 2000). Prior research has shown the existence of spatial patterns for the VC industry, as venture capitalists rely on local networks and knowledge for their investments and personal relationships. According to Sorenson and Stuart (2001), the circulation of information about investment opportunities is limited by geography. Moreover, geography impacts performance (Chen, Gompers, Kovner, & Lerner, 2010),

with syndicates of geographically concentrated VC firms tending to perform better (Kang, Li, & Oh, 2022). However, Bubna et al. (2020) find that, for US-based VC firms, spatial location is not a distinguishing factor in the formation of communities[12]. Rather, VC communities comprise VC firms that are similar in age (young vs. mature), industry focus (specialist vs. generalist) and connectedness.

### 4.3.1 Methods and data

We employ a MNL model to examine how the headquarter location of the VC (*HQ*) and its investment style impact community membership, with Community 0 (the predominant community) as reference category. Prior literature posits three dimensions characterizing the style of an individual VC firm: financing stage (*ST*), industry focus (*IND*), and geography focus (*GEO*) (Bubna et al., 2020). Operationally, we use four levels of financing stages (seed round, early stage, later stage, and other). According to PitchBook's classification, seed rounds encompass the initial funding reported for deals below 500,000 USD. Early-stage funding is denoted by Series A or B, while later-stage funding corresponds to Series C or D rounds. The financing stage is available for approximately 73% of deals made by the VC firms in the European 2023 network. Similarly, we create a vector per VC firm for the industry and geography focus based on past investments. We use seven industries according to the PitchBook classification of the target companies (Information Technology, Business Products and Services (B2B), Consumer Products and Services (B2C), Financial Services, Energy, Healthcare, and Materials and Resources). Given the local bias in VC investing (Chen et al., 2010; Cumming & Dai, 2010; Jääskeläinen & Maula, 2014; Mäkelä & Maula, 2008; Sorenson & Stuart, 2001) and resulting correlation between the geography focus and the headquarter location of a VC firm[13], the model includes either geography focus or headquarter location as an explanatory variable. Moreover, we estimate a model combining the geography focus within Europe and the headquarter location for non-European VC firms on a regional level (*HQReg*, e.g., Africa). Finally, we control for the type of VC firm by including a dummy (*CVC*) for Corporate Venture Capital (CVC) firms.

### 4.3.2 Empirical results

In contrast to the findings for the US (Bubna et al., 2020), we find that the European network still splits into regional ecosystems. Moreover, we find empirical evidence that geography matters in terms of the geographical focus of the VC (i.e., the portfolio companies' location) rather than the location of the VC's headquarter.

[12] Note that Bubna et al. (2020) employ a different definition of a community.

[13] The correlation between the geography focus and the dummy variable indicating whether a VC firm is headquartered in that country ranges between 0.29 (for Slovenia) and 0.90 (for Hungary), with the exception for Liechtenstein (0.0), Cyprus (0.07) and Malta (0.09).

The best performing model, Model 1, includes all variables related with the investment style of the VC firm (GEO, IND, ST) and the location of the VC's headquarter on a regional level (HQReg). The model achieves the best Akaike Information Criterion and an accuracy of 63.30% (see Table A.4 in the Appendix A.2 for a detailed comparison of goodness-of-fit)[14].

Specifically, the addition of one variable, the geographic focus of the VC firm, improves accuracy by 20.50 pp. For example, VC firms investing in the Nordics (Finland, Norway, Sweden, Denmark or Estonia) are more likely to belong to Community 3 (than to Community 0). Figure 4.6 illustrates the distribution of VC firms across communities based on their geographic focus[15]. Table A.5 and A.6 in the Appendix A.2 display more detailed results of Model 1.

In contrast, the model based on the headquarter location of the VC firm, Model 6, exhibits a lower AIC (21,729 compared to 17,859) and poorer accuracy (56.20% vs. 63.10%), indicating that the geographic focus matters more than the headquarter location (see Figure A.1).

## 4.4 Discussion and Conclusion

In this study, we have analyzed an ecosystem of 26,320 VC firms that invested in 131,720 portfolio companies in a total of 238,317 deals between 2000 and 2022. We have built 57 co-investment networks, in which two VC firms are linked if they have invested in the same portfolio company in the previous 5 years. We have then characterized and compared the structure of these networks at the macro-level across regions and time, borrowing five measures from graph theory. We also studied the community structure in Europe (meso-level). Through the comprehensive comparison and analysis, the following three conclusions are drawn:

First, our results confirm the myth of Europe's fragmentation. We provide empirical evidence that the VC ecosystem in Europe is less connected than the one in the US (and often than the one in China). We find that relatively fewer VC firms are connected to the largest group of VCs in the European network, indicating that there are more "outsider" VCs (Chapter 4.2.1). There are also fewer VC firms with a substantial number of syndicate partners (Chapter 4.2.2). In some years no VC firm managed to co-invest with 1% of the European network. On average, VC firms in the European network are connected via a higher number of intermediaries (Chapter 4.2.3). Additionally, a higher proportion of VC firms serves as the sole intermediary between otherwise

[14] When selecting the best model, we followed the guidelines of Wiersema and Bowen (2009). For limited dependent variable models, Wiersema and Bowen (2009) highlight that "the correct base model against which all other models should be compared is the full (unrestricted) model that includes all explanatory variables". A Likelihood Ratio (LR) test, using the LR Chi-square statistic, can be used to compare the partial, nested model (i.e., a model that includes a subset of the variables from the full model) against the full model. Information statistics such as the Akaike Information Criterion (AIC) by Akaike (1974) should be sued to compare two partial models (nested or non-nested).

[15] It is noteworthy that the multinomial logit model offers a more nuanced perspective by incorporating the geographical focus of VC firms as a vector, thus, considering all portfolio companies of the VC.

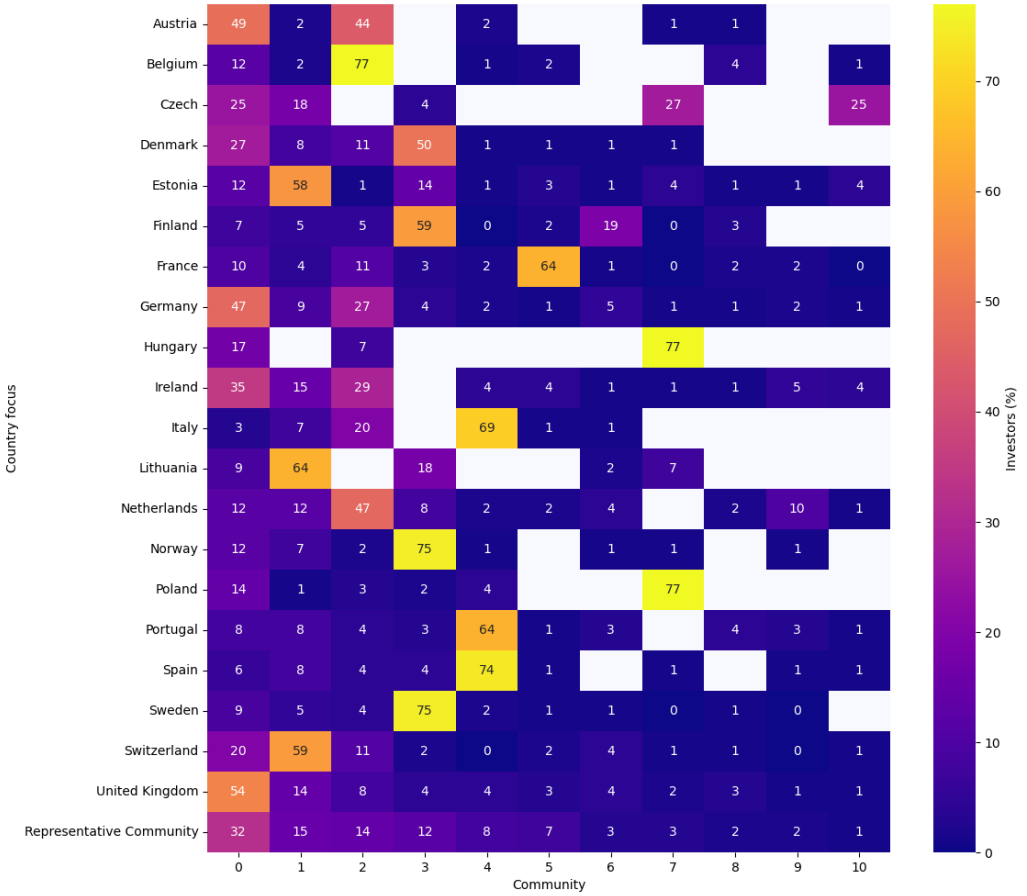



**Figure 4.6 Heat map of VC firm's country focus across main communities.** Each cell's color and value correspond to the proportion of VC firms associated with a specific community and focused on a particular portfolio company location, relative to all VC firms with the same geographic focus. Values are displayed as percentages. For example, 54% of VC firms that primarily invest in portfolio companies based in the United Kingdom are members of Community 0. Lastly, a hypothetical representative community is included, with VC firms distributed according to community size. Malta, Bulgaria, Greece, Luxembourg, Romania, Cyprus, Iceland, Latvia, Slovakia, Croatia, Liechtenstein and Slovenia were ommitted, because less than 30 VC firms primarily invest in portfolio companies located in these countries.

disconnected investor groups (Chapter 4.2.4). Finally, the European network splits into more main communities (Chapter 4.2.5).

While the VC networks are at different stages of development, we find that the European VC ecosystem has become more connected. The share of VC firms that are connected, either directly or through their co-investors, has increased from around 90% to more than 95% (Chapter 4.2.1). Moreover, the European VC landscape has narrowed the gap with the most mature VC ecosystem in the US. The disparity both in terms of number of intermediaries (Chapter 4.2.3) and share of gatekeeper VCs (Chapter 4.2.4) has decreased.

Lastly, we find that the European VC ecosystem is characterized by strong regional ecosystems. The distinguishing feature of the European VC communities is their investment style (see Chapter 4.3). Specifically, the geographic focus rather than the headquarter location of the VC matter more for community membership. Previous research and investor surveys (BCG, 2015; Kelly, 2011; SpeedInvest, 2023) hint that VC firms may

encounter increased complexity when transferring their knowledge from an investment in one European nation to another because of stronger differences in culture, language and legislation. This may drive both Europe's fragmentation and regional ecosystems.

### 4.4.1 Contribution and relevance

In doing so, we make four contributions to extant venture capital and network literature. First, this study brings novel insights on how the European VC network is structured. Therefore, it enhances the limited understanding of the European VC market. Extant research in the field of venture capital predominantly relies on empirical data and, thus, insights from the United States (Cumming et al., 2023). Especially network research is scarce for European data (Christopoulos et al., 2022).

Second, our research pioneers comparing VC networks both temporally (see e.g., X. Zhang, Feng, Zhu, and Stanley (2015)) and across geographies (see e.g., T. Wu, Hu, and Li (2021)). We analyse the evolution of the European VC network from 2000 until 2022 and highlight core differences to the US and Chinese VC networks. In doing so, our research adds to the existing body of literature on the structure of VC networks (see e.g., Kogut et al. (2007); Aleenajitpong and Leemakdej (2021); Jin et al. (2016)).

Third, we examine the European VC network "as a whole" (macro-level) and characterize the communities in the 2023 network (meso-level). While applied Social Network Analyses research often focuses on the position of one actor in the network (micro-level), the macro-level and meso-level have remained relatively unexplored, especially for business and VC networks (Gu et al., 2023; Pei & Dang, 2022; Provan et al., 2007; Xue, Dang, Shi, & Gu, 2019).

Finally, this study offers a structured approach for characterizing social networks from a connectivity perspective. We delineate five distinct facets of connectivity and the corresponding graph theoretical measures. Currently, there exists no structured approach for the characterization of networks in Venture Capital or beyond. Newman (2003) describe the techniques for analyzing networks as a "grab-bag of miscellaneous and largely unrelated tools". Similarly, scholars in Entrepreneurial Finance have employed a variety of measures, such as degree distribution, to characterize VC networks - often with no clearly defined objective other than the act of characterization itself.

Our insights also entail high practitioner relevance for venture capitalists, entrepreneurs and policymakers. The characterization and comparison of the US, Chinese and European VC networks empowers VC firms to make informed decisions when selecting networks and communities to engage with. There are different strategies for syndication, depending on the characteristics of the VC firm and network (e.g., Bellavitis et al. (2017); Sorenson and Stuart (2008)). For example, our findings suggest that a lower-status, younger VC firms may benefit most

from integrating into either the well-connected US network or the most interconnected European community, as these type of VC firms derive benefits from cohesive ego-networks (Bellavitis et al., 2017; Uzzi, 1997). Moreover, knowledge about key players within the network or community, such as gatekeeper VCs or members of the core group, allows the VC firm to identify potential syndication partners to strategically position itself within the network, access non-redundant resources, and, ultimately, improve their performance. For example, VC firms can optimize their network reach by co-investing with distant VC firms in their community, because a VC's network reach increases with the size of the group, the shortness of path lengths and the firm's centrality within the group (Schilling, 2015).

In a similar manner, our research enables (European) entrepreneurs seeking funding and strategic partnerships to tailor their approach. This is especially relevant for first-time founders, who do not yet have an investor network. By partnering with well-connected VC firms from different communities, or alternatively, collaborating with a well-connected VC and an influential VC within one community, entrepreneurs can access the collective expertise and knowledge of multiple communities, augment their network prominence and, thus, enhance the likelihood of attracting additional investment.

Finally, we facilitate policymakers in gaining a deeper comprehension of the European VC ecosystem's structure. Policymakers can use these macro- and meso-level insights to foster greater connectivity among VC firms investing in Europe. For example, they can identify key players to partner with, such as gatekeeper VCs, or connect VC firms from different communities.

### 4.4.2 Limitations and further research

Our study has several limitations that, hopefully, can be turned into future avenues of research.

We have considered the entrepreneurship ecosystem as an inter-organizational network of VC firms, with prior co-investments as a proxy. However, organizational ties and social ties are intertwined. Social ties, such as the ones based on the educational and professional backgrounds of venture capitalists, influence the likelihood of two VC firms forming a co-investment relationship (Rider, 2012). Within the United States, Ivy League universities serve as esteemed talent reservoirs for VC firms. Coupled with the geographical clustering of these VC firms in hubs such as Silicon Valley or the Bay Area, it may lead to heightened levels of personal relations and interaction among venture capitalists than in Europe. This may contribute to the cultivation of a more closely connected ecosystem than the one in Europe, which is not necessarily captured in the co-investment networks. As more than 60 % of the VC firms investing in US based startups are also based in the US, the US network may experience an even higher level of connectivity than presented in this study and the difference to the European network may be even stronger, when incorporating the social capital of employees. Additionally,

organizational ties could consider the repeated nature of syndicates. The connection between two VC firms, who share a history of multiple co-investments, is likely stronger compared to the connection between two VC firms, who have co-invested only once. Moreover, at least 11 additional actors, including universities, law firms, or investment banks, actively contribute to the creation, development and success of startups (Ferrary & Granovetter, 2009). Ferrary and Granovetter (2009) emphasize that the distinctive advantages intrinsic to the Silicon Valley ecosystem are challenging to replicate solely through the development of VC as a standalone enterprise, given that the value derived from VC firms is contingent upon their interactions with these actors. In order to foster a more comprehensive understanding, subsequent research is encouraged to contemplate the European VC network as a multiplex network, incorporating additional actors, personal ties, and organizational ties characterized by varying degrees of strength.

In this study, we addressed the fragmentation of Europe's network by characterizing it from an overall connectivity perspective, while there are numerous other approaches to characterize a network, that were beyond the scope of this study. Future research may further characterize the European network in terms of robustness to VC firms' exit (e.g., is it a scale-free network, in which a small number of high-degree actors are responsible for connecting the network?), behavioral properties (e.g., do VC firms tend to syndicate with high status VC firms (preferential attachment)?), network clustering and cohesion (e.g., to which extent do VC firms introduce their co-investors to each other?), or consider the role of individual VC firms (e.g., is the network centralized, dominated by a few central VC firms?).

Finally, we encourage further research on European venture capital. Studies have found varying results when examining data from markets beyond the United States, such as differing motives for syndication (Manigart et al., 2006)). It is questionable whether research findings can be generalized from the US market to other economic systems with different structures, such as the more fragmented European VC network.

*"Brokers are the bridges between islands."*

Marissa King, Organizational Behaviour
Professor at Yale University

# 5
# The best of both worlds

## VC firm's optimal network structure: combining co-investor closeness and network brokerage

While it is well-known that whom you know matters in venture capital, conclusions remain more mixed on the optimal network structure (whom you know and whom your connections know). Similarly, in social network research, a long-standing debate has centered on which type of network is advantageous for firms: A) Cohesive networks, where a firm is well-connected to other firms that are also inter-connected amongst themselves (i.e., firms are *bonding* with each other) (Coleman, 1988); or B) networks rich in "structural holes", where a firm is *bridging* the "holes" between otherwise disconnected groups of firms and, thus, gains greater access to diverse information (Burt, 1992; Granovetter, 1973). While bonding fosters a trusting and collaborative environment with shared norms (Burt, 2005; Obstfeld, 2005), brokerage offers advantages in information, vision, and control (Burt, 2004, 2005) (see Chapter 2.2). In the context of VC, some studies advocate for bonding (e.g., Alexy et al. (2012) for VC firms investing in the United States, others find bridging benefits (e.g., S. Yang et al. (2018) for VC firms investing in China), and yet others show that it depends on the characteristics of the VC firms (e.g., Bellavitis et al. (2017) for VC firms investing in the United Kingdom. Yet, all these studies have been confined to VC networks within single countries (e.g., US, China, UK), that are characterized by one culture, one legal system, and one economic environment. To date, no study has explored the benefits of bonding-versus-bridging in multi-national VC markets, despite the cross-border nature of venture capital activities. This issue is particularly relevant for the European VC market, where investors often define their geographic focus across multiple countries. For example, Earlybird is "a venture capital investor focused on European technology innovators", and SpeedInvest is "a venture capital fund with more than €1B to invest in pre-seed, seed, and early-stage tech startups across Europe" according to their value proposition published online (Earlybird, 2024; SpeedInvest, 2024).

We aim to address this gap by extending the bonding-versus-bridging debate to the multi-national European VC network. Specifically, we seek to answer the following three research questions: (RQ 2a) Do VC firms in a multi-national market better, when they are in a *brokering position between their co-investors*, compared to when they are part of a tigh-knit group of co-investors?, (RQ 2b) Does being connected to co-investors from different investor communities, that is *brokering positions between communities*, yield performance benefits?, and (RQ 2c) Does the *uniqueness of the brokerage position* yield performance benefits, compared to when the brokerage opportunity is shared? Throughout the study, we use the terms *bridging* (bridge), and *brokering* (broker) interchangeably.

The remainder of this chapter is divided as follows: Following previous research in entrepreneurial finance (e.g., Alexy et al. (2012); Y. Hochberg et al. (2007); Sorenson and Stuart (2001)), we model the European VC network based on the relationships forged through syndicated investments in European-based portfolio companies. To construct the associated co-investment network graphs, we use a comprehensive data set sourced from PitchBook, encompassing 2,710 funds of 1,418 VC firms that were founded between 2000 and 2019 and subsequently invested in European-based companies.

Our findings reveal that while there is a negative effect for brokering positions between co-investors, brokering positions between investor communities have a positive effect on VC performance. VC firms perform better when they are part of a tight-knit group of co-investors, and when those co-investors belong to different communities within the broader European VC network. This position enables firms to combine "the best of both worlds": leveraging the trust and cooperation benefits within their immediate co-investor network, while capitalizing on information arbitrage opportunities across the broader network. Moreover, performance improves as fewer VC firms share access to these brokerage opportunities. We find a positive effect of a more unique brokerage position on VC performance.

We make two contributions to the entrepreneurial finance and network literature. The key contribution of this study is to derive the optimal network structure for VC firms operating in multi-national markets, such as in the European context. Second, we enrich the prevalent understanding of brokerage: Unlike previous studies, we do not only consider the VC firms' immediate co-investors but also the structure of the whole European VC network. In doing so, we enable venture capitalists in defining their networking strategy and entrepreneurs in making informed decisions when selecting new investors.

## 5.1 Hypothesis development

### 5.1.1 Bridging between co-investors

First, we focus on the immediate investor network of a VC firm, which includes direct relationships with its co-investors as well as the connections among those co-investors. Do VC firms perform better when they are *bridging between their co-investors* versus when they are *bonding with a tight-knit group of co-investors*? (RQ 2a)

If the VC firm's co-investors are strongly inter-connected, the VC firm's investor network is characterized by bonding. This implies that any two VC firms share a significant number of the same co-investors. Consider the investor network of VC firm A depicted in Figure 5.1a. The co-investors of A form one group of tightly-grouped investors, where everybody knows everybody. Conversely, if the VC firm's co-investors are all disconnected from each other, the VC firm can bridge many structural holes in its investor network. The co-investors of VC firm B form three separate groups, and there is zero interaction among co-investors (see Figure 5.1b). Hence, VC firm B can bridge between every pair of co-investors: B can broker between 1 and 2, 1 and 3, and, 2 and 3.


**(a)** Bonding co-investors **(b)** Co-investor broker

**Figure 5.1 Co-investor brokerage.** Illustrative example of (a) bonding among co-investors versus (b) bridging between co-investors. Nodes represent VC firms. VC firms A and B are highlighted in orange. Co-investors of VC firms A and B are colored in blue. Ties represent co-investments in the same company.

We expect a negative relationship between brokerage and performance, because bonding with one's direct collaborators has been found to be superior in industries where collaboration matters (Kilduff & Brass, 2010). The VC industry is one of the, if not the, most collaborative industry. Its collaborative nature and the importance of having a network has been well-documented in academic and practitioner literature. Syndication among VCs is a common practice, as syndication leads to better decision-making, risk diversification, and greater access to resources, diverse expertise, and knowledge (Brander et al., 2002; Gargiulo & Benassi, 2000; Lerner, 1994; Lockett & Wright, 2001).

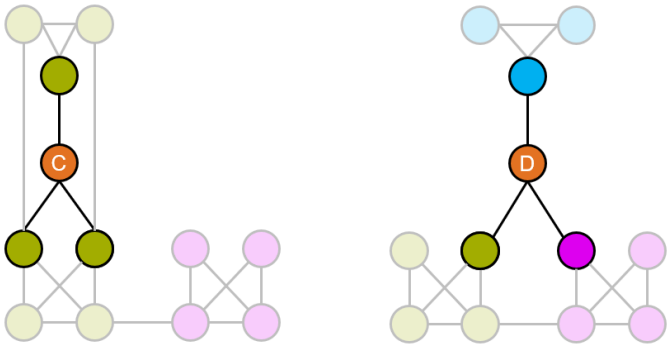
While broad access to information is essential for identifying promising investment opportunities (Sorenson & Stuart, 2008), the position of a VC firm and its co-investors within the broader network likely exerts a greater influence on the extent and quality of information access than the isolated structure of the co-investor network.

Cohesive networks can strengthen common understandings and group identities (Adler & Kwon, 2002; Burt, 2005; Obstfeld, 2005). In such networks, firms adhere to established norms, such as the reciprocity principle in VC syndication, because other firms easily observe when these norms are not followed (Obstfeld, 2005). Moreover, the greater the number of connections between two firms, the more robust their relationship is (Burt, 2005; Labun & Wittek, 2014). For example, even if direct interactions are currently limited between two VC firms, their shared connections in a cohesive network will likely keep them informed about each other's portfolio and investment activities anyways. Therefore, we hypothesize:

**Hypothesis 1.** *VC firms belonging to a group of tight-knit group of investors are associated with a better performance. VC firms that are in a brokerage position between their co-investors are associated with a worse performance.*

### 5.1.2 Bridging between communities

Second, we extend our focus from direct syndication partners to the rest of the network, in which the co-investor network is embedded (i.e., we also consider the co-investors of the co-investors, and so forth). This expansion acknowledges that brokerage benefits are influenced by the overall structure of the network. Consider Figure 5.2, which shows two VC firms with identical co-investor networks. But, the co-investors of VC firm C (Figure 5.2a) are part of one community due to their connections in the broader network, while those of VC firm D (Figure 5.2b) belong to separate communities. Do VC firms perform better when they are *brokering between communities*, meaning that their co-investors belong to many different communities (like VC firm D), or when they are *bonding within one community*, meaning that their co-investors mostly belong to the same community (like VC firm C) (RQ2b) ?




**(a)** Bonding in community **(b)** Community broker

**Figure 5.2 Community brokerage.** Illustrative example of (a) bonding within one community versus (b) bridging across three disparate communities. Nodes represent VC firms. Node colors represent the investor community (green, blue, and pink), with the focal VC firms C and D highlighted in orange. Ties represent co-investments in the same company.

We anticipate that community brokerage will positively correlate with performance because broker roles come with three information advantages: access to non-redundant information and diverse perspectives, early access to this information, and efficient dissemination of information.

Brokerage advantages are particularly important in non-transparent markets, where information is poorly distributed among network members (Shipilov, 2006; Stovel & Shaw, 2012). The VC market is characterized by information asymmetries, where few VCs have access to information about a specific investment opportunity and can judge its quality. Therefore, VC firms generally benefit from access to information (Sorenson & Stuart, 2008). These information advantages depend on the heterogeneity of information one's direct collaborators hold (Reagans & Zuckerman, 2008). Burt (2004) argues that "opinion and behaviour are more homogeneous within than between groups, so people connected across groups are more familiar with alternative ways of thinking and behaving" (p. 349). When a firm's co-investors belong to different communities, they share information from different sources, while co-investors belonging to the same community are likely to share similar perspectives and redundant information. Such interaction with diverse groups has also been suggested to stimulate more creative and more innovative ideas (Burt, 2004; Rodan & Galunic, 2004). For VC firm C in Figure 5.2, the co-investors are likely to provide access to the same information (because they get their information from the same sources) and share the same perspective (because they both interact with the same VC firms). In contrast, VC firm D's co-investors belong to three separate communities and, thus, are more likely to share non-redundant information and perspectives. For example, consider a scenario where the pink community views a venture as an attractive investment opportunity, but the green and blue community disagree. Then, VC C, whose co-investors are all within the green community, would primarily be exposed to reasons not to invest; while VC firm D, with co-investors from the pink, green, and blue community, would be exposed to a broader spectrum of opinions. In summary, brokerage between communities puts emphasis on the notion of how diverse the information the VC firm's co-investors hold is and how diverse the perspectives are that they share.

Moreover, being directly tied to different communities increases the likelihood of gaining early access to the knowledge circulating within these communities. Brokers are more likely to be connected to opinion leaders and the information does not have to first pass through other intermediaries (Labun & Wittek, 2014; Lin et al., 2022). Therefore, VC firms in bridging positions can more directly access and more quickly mobilize resources held by different communities, similar to the mechanism Stam et al. (2014) outline for entrepreneurs. Given that timing often plays a critical role in funding decisions, such timely access can provide a competitive advantage. Finally, brokerage between communities comes with the ability to spread information effectively across the entire network. Brokerage can help in gaining a good reputation (Rodan, 2010) and in spreading that reputation among a broader group of firms (Podolny, 2001). This is particularly valuable for VC firms when looking for

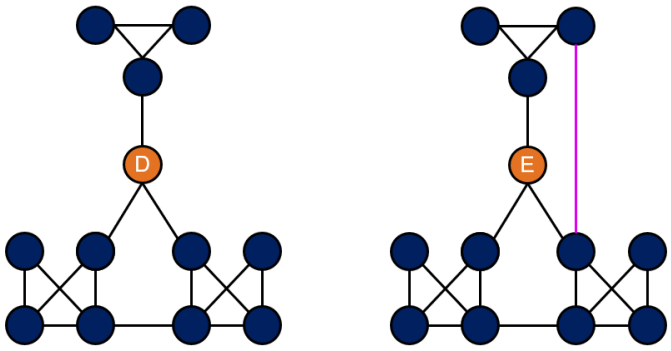
follow-on investors in an upcoming round of a portfolio company. Once again, consider VC firm C in Figure 5.2, that has no direct access to all communities, while VC firm D can directly reach all communities. Therefore, VC firm D is more likely to find a follow-on investor from the pink community.

We consider the diversity of a VC firm's network in terms of having connections to co-investors that belong to different investor communities and hypothesize:

**Hypothesis 2.** *VC firms with a diverse network, in terms of brokering between communities, are associated with better performance.*

### 5.1.3 Unique bridging position

Finally, we consider the position of the VC firm in the entire VC network, i.e., including the co-investors of co-investors (and beyond) and their relationships among each other. The networks illustrated in Figure 5.3 differ by a single connection, which determines whether the bridging opportunity is unique or shared. In the bridging network (Figure 5.3a), VC firm D serves as the sole connection between the lower and upper parts of the network. All communication paths between investors in these parts must pass through D. Its position is unique, as no alternative broker exists. In the bonding network (Figure 5.3b), an alternative bridge is present, reducing the reliance on VC firm E as the intermediary. E's bridging position is not unique, as VC firms bond across the network. Note that for the investors in the lower-right section, the alternative path is not only available but also uses fewer intermediaries.




**(a)** Unique brokerage **(b)** Shared brokerage

**Figure 5.3 Uniqueness of bridging position.** Illustrative example of (a) a unique bridging position, and (b) a shared bridging position within the entire network. Nodes represent VC firms. VC firms D and E are highlighted in orange. Ties represent co-investments in the same company. The networks differ by only one tie, which is highlighted in pink.

Does the VC firm benefit from a *unique bridging position* between different parts of the network or when *alternative brokers* are present (RQ 2c)? A VC firm that occupies a unique bridging position benefits from control benefits, because the other VC firms rely on the broker to mediate their interactions. The broker can

use this position to benefit the groups involved - such as by connecting two previously disconnected firms or facilitating information flow between disconnected investor groups — thereby fostering goodwill among those they assist (Burt, 2005; Kilduff & Brass, 2010). Alternatively, brokers can exploit the dependency by limiting the flow of information (or other resources) between the two groups (Simmel, 1950). The presence of an alternative broker makes it harder for both brokers to extract brokerage benefits (Kwon et al., 2020). Again, all connections within the entire VC network matter. For example, consider Firm D and E in Figure 5.3, that have the same investor network (depicted in Figure 5.1). If Firm D learns about an open ticket in an investment round among the three VC firms in the upper part of the network, it can transfer this information to investors in the lower section. These investors are entirely dependent on Firm D for access to such knowledge: if Firm D chooses to withhold the information circulating within one group, the disconnected groups will remain unaware. In contrast, while VC firm E can also provide access to information, its role is not exclusive. Firm E lacks the ability to restrict information flow between groups because alternative pathways exist. Even if Firm E chooses to withhold information, the alternative broker may still share it and, thus, diminish E's influence. The presence of an alternative broker may even impose a social obligation on VC firm E to share the information, because the other firms could otherwise notice and potentially retaliate. Therefore, we hypothesize:

**Hypothesis 3.** *VC firms that occupy a more unique brokerage position are associated with higher performance.*

## 5.2 Methods and data

### 5.2.1 The European co-investment network

We want to explore the optimal network structure and position for VC firms in the multinational European VC network. As outlined in Chapter 3, we follow prior research in entrepreneurial finance (e.g., Alexy et al. (2012); Y. Hochberg et al. (2007); Sorenson and Stuart (2001)) and model the European VC network based on relationships formed through syndicated investments. Co-investments serve as a good proxy for relationships between VC firms, as syndicate investments often lead to frequent interactions during board meetings and other collaborative activities. The co-investment network is represented via undirected, inter-organizational network graphs (see Figure 5.4), where VC firms are connected if they have co-invested in the same portfolio company, regardless of the financing round. Networks visualizations were created using the Python package pycirclize (Shimoyama, 2022).

The network dynamically evolves in two ways: (1) VC firms enter or exit the European VC market, and (2) VC firms begin or end collaborations with others VC firms in the European market. Therefore, we construct yearly

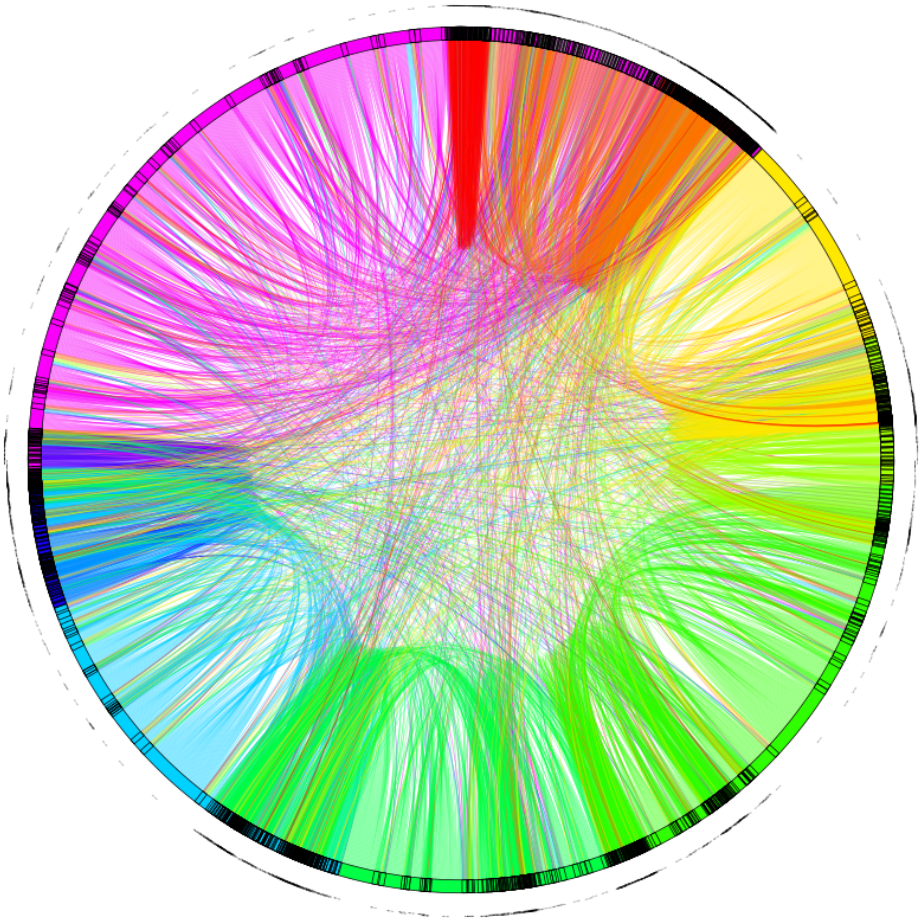


**Figure 5.4 European VC network in 2010.** Nodes along the outer edge of the circle represent VC firms, arcs within the circle represent joint investments in a company through syndication. In this sense, VCs are connected to their syndicate partners. Colors and node position correspond to the community of the VC firm. Node width (i.e., the space occupied on the outer edge of the circle) reflects the number of syndicate partners each firm has.

networks using rolling five-year time windows. For example, the connections in the 2010 network depicted in Figure 5.4 represent co-investments made between 2005 and 2009.

We construct networks, performance measures, and control variables using data from PitchBook and the Python package NetworkX (Hagberg et al., 2008). The European VC network includes both global and local VC firms investing in European-based companies. To focus on this network, we limit the dataset to deals involving investors classified as "Venture Capital" or "Corporate Venture Capital". The European scope is defined by the headquarters of target companies, covering the 27 member states of the EU, the four member states of the EFTA (Iceland, Liechtenstein, Norway, and Switzerland), and the UK, which was a member of the EU for the majority of the sample period and remains a dominant VC market in Europe (Groh et al., 2023). In total, our definition of Europe includes 32 countries. Only completed deals are considered, as meaningful relationships between VC firms typically develop throughout portfolio activities after the deal is finalized. The dataset is

further restricted to deals executed between 2000 and 2019, a period during which PitchBook's high level of coverage and accuracy are well-documented (Bowden et al., 2016; Retterath & Braun, 2020; Sharma, 2017). The cutoff date 2019 allows a sufficient observation period to evaluate investment success (see Chapter 5.2.3). For the subset of deals with a missing deal date, proxies such as the announced date or the vintage year of the associated fund were employed (1.4%). Deals for which no proxies were available were excluded (10.7%).

The European VC network from 2000 to 2019 consists of 7,702 VC firms that invested in 31,923 portfolio companies headquartered in Europe, totaling 47,101 deals. All investment activities involving European-based companies and both European and global VC firms are included. The geographic distribution of VC firms in the European VC network reflects a balanced composition, with approximately 57% headquartered in Europe and the remaining 43% distributed across other global regions. For example, 26% of investors are headquartered in the US. Approximately 8% of VC firms are corporate VC firms. Syndication plays a substantial role, as approximately 59% of deals involve multiple investors, averaging 2.58 VC firms per deal and 1.85 per company. Typically, investments occur during the second funding round, with an average deal size of USD 10.61 million. A comprehensive sample description is available in Table 5.1.

**Table 5.1** Sample description of the PitchBook dataset used for construction of the European VC network: The dataset includes 47,101 completed deals involving investments into 31,923 European-based companies by 7,702 VC or CVC firms during the period from 2000 to 2019.

| | No. | Mean | Min | Median | Max |
|---|---|---|---|---|---|
| **VC firms** (#) | **7,702** | | | | |
| Local VC firms (#) | 4,403 | | | | |
| Corporate VC firms (#) | 629 | | | | |
| VC firms per deal (#) | 47,101 | 2.58 | 1 | 2 | 56 |
| VC firms per company (#) | 31,923 | 1.85 | 1 | 1 | 64 |
| Founding year | 7,702 | 2009 | 1893 | 2012 | 2019 |
| AUM ($ mn) | 2,137 | 2903.17 | 0.02 | 152.29 | 3,688,587.31 |
| Investments per VC (#) | 7,702 | 56.31 | 1 | 17 | 3,768 |
| **Companies** (#) | **31,923** | | | | |
| **Deals** (#) | **47,101** | | | | |
| Syndicated deals (#) | 27,875 | | | | |
| Seed stage deals (#) | 8,241 | | | | |
| Early stage deals (#) | 20,026 | | | | |
| Later stage deals (#) | 9,549 | | | | |
| Deal number | 47,101 | 2.37 | 1 | 2 | 25 |
| Deal size ($ mn) | 31,704 | 10.61 | 0.00 | 1.47 | 14,500 |

### 5.2.2 Independent variables - brokerage

Throughout our analysis, we focus on two types of networks: the European VC network as a whole (see Figure 5.4) and the individual investor networks embedded within it. Investor networks, also known as ego networks in graph theory or personal networks in human social network analysis, consist of an individual VC firm and its direct connections, namely its syndicate partners, as well as the connections among them (see Figure 5.5). In the following, we briefly introduce the network measures used to capture brokerage: Burt's network constraint,

which measures brokerage opportunities between co-investors in the investor networks, Guimerà and Nunes Amaral (2005)'s hub classification, which captures brokerage between communities by integrating community information from the whole network with the composition of the individual investor network, and betweenness centrality, which reflects the uniqueness of a brokerage position by considering the investor's position in the whole network.

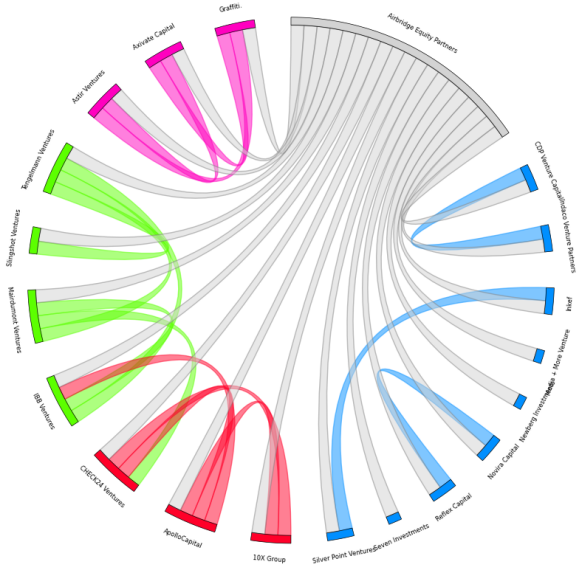



**Figure 5.5 Example investor network**. The investor network consists of the focal VC firm, its co-investors, and the connections between them. The focal VC firm and its connections to co-investors are depicted in grey. Co-investors and their connections to other co-investors are color-coded to indicate groups of inter-connected co-investors.

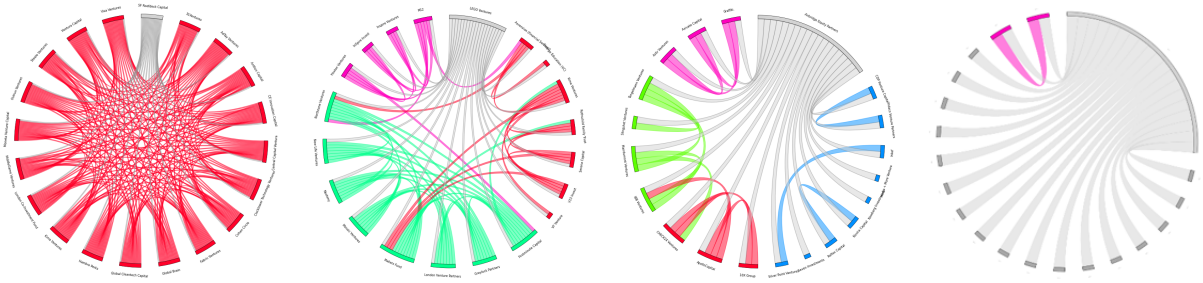
#### 5.2.2.1 Bridging between co-investors

In line with prior research (e.g., Alexy et al. (2012); Bellavitis et al. (2017)), we measure bridging opportunities among a VC firm and its co-investors using Burt (1992)'s network constraint. Network constraint quantifies the absence of structural holes within a network. In networks with high constraint (i.e., few structural holes), the VC firm has "invested the bulk of [its] network time and energy in relationships that lead back to a single contact" (Burt (1992), p. 55). As bridging requires the presence of structural holes that can be bridged, our first bridging measure $B(v)$ is defined as one minus the network constraint:

$$B(v) = 1 - C(v) = 1 - \sum_j \left( p_{vj} + \sum_q p_{vq} p_{qj} \right)^2$$

, where $C_v$ is the network constraint of node $v$, $p_{vj}$ is the proportion of $v$'s direct connections to $j$, and $p_{vq}p_{qj}$ represents the indirect connections between $v$ and $j$ through other nodes. For comparability across networks of

different sizes, we normalize the measure based on the network constraint of a fully-connected network of the same size.



**(a)** Bridging score: 0.00 **(b)** Bridging score: 0.11 **(c)** Bridging score: 0.37 **(d)** Bridging score: 0.85

**Figure 5.6 Illustration of bridging between co-investors.** Co-investor networks for (a) SF Roofdeck Capital in 2022, (b) LEGO Ventures in 2022, (c) Airbridge Equity Partners in 2022, and (d) a fictional VC firm. Each investor network consists of the focal VC firm (a-d), its 19 co-investors, and the connections between them. Both the focal VC firms (a-d) and their connections to co-investors are depicted in grey. Nodes and ties among the co-investors are color-coded to indicate groups of inter-connected co-investors.

To illustrate, Figure 5.6 depicts four co-investor networks with varying degrees of bridging opportunities between co-investors: SF Roofdeck Capital's co-investor network (5.6a) is highly interconnected and forms a single cohesive investor group. This network structure without any structural hole constrains SF Roofdeck Capital's ability to act as a broker ($B = 0.00$). In the co-investor network of LEGO Ventures (5.6b), three distinct groups of co-investors are present, with some connections between the groups. This network structure offers moderate bridging opportunities for LEGO Ventures ($B = 0.11$). The third co-investor network (5.6c) comprises four investor groups with little interaction among them. The structural holes between disconnected investor groups mean there are many bridging opportunities for Airbridge Equity Partners ($B = 0.37$). In the fictional fourth investor network (5.6d), only two co-investors are connected. Therefore, this VC firm can bridge between almost any pair of its co-investors ($B = 0.85$).

#### 5.2.2.2 Bridging between communities

The second bridging measure considers the diversity in the community membership of the co-investors. Guimerà and Nunes Amaral (2005) introduced a classification framework to categorize nodes in complex networks based on their roles within and between communities, reflecting Krackhardt (1999)'s notion that brokers may belong to multiple groups. Guimerà and Nunes Amaral (2005) identify roles based on two key metrics: within-

module degree ($z$-score) and participation coefficient ($P$). The within-module degree $z(v, C)$ measures how well-connected a node $v$ is within its own community $C$:

$$z(v, C) = \frac{d(v, C) - \bar{d}(C)}{\sigma_d(C)}$$

, where $d(v, C)$ is the number of connections (degree) of node $v$ within its community $C$, $\bar{d}(C)$ is the average degree of all nodes within community $C$, and $\sigma_d(C)$ is the standard deviation of the degree distribution within community $C$. The participation coefficient $P(v)$ measures how well-distributed the connections are across communities:

$$P(v) = 1 - \sum_{c=1}^{N_c} \left( \frac{d(v, c)}{d(v)} \right)^2$$

, where $N_c$ is the total number of communities in the network, $d(v, c)$ is the number of connections of node $v$ to community $c$, and $d(v)$ is the total number of connections (degree) of node $v$. Communities are detected using the Louvain method, an algorithm that optimizes modularity to identify densely connected clusters within a graph (see Appendix A.3). These communities represent groups of investors who co-invest more frequently within their community than with the rest of the network (see Figure 5.4 for an illustration). We focus on bridging opportunities between those communities that comprise at least 1% of the VC network. Neglecting smaller communities is an established practice in social network analysis (e.g., Carron-Arthur et al. (2016); Jin et al. (2016); Mirzaee and Wang (2020)).

The resulting classification (see Figure 5.7) differentiates hubs and non-hubs. Hubs are defined as nodes with edges that place them in central positions for facilitating interaction and traffic ("brokering") in a network. In the context of venture capital, this means that the VC firm is well-connected across multiple other investor communities, while also being highly connected within its own investor community. Therefore, hubs hold very powerful roles in networks. They can access diverse information from multiple communities and efficiently share it within their own community. At the same time, their within-community ties keep them well-informed about what is going on in their community, while their cross-community connections enable them to effectively distribute this information throughout the broader network. Examples of hubs can be found across various domains: Singapore, Frankfurt and Madrid serve as hub airports in the global aviation network; Google acts as a hub website within the World Wide Web; and capital cities function as hubs in road or transportation networks.

On a more granular level, Guimerà and Nunes Amaral (2005) differentiate three hub roles: (1) provincial hubs, that are well-connected within their community, but have few or no links to other communities, (2) connector hubs, that are well-connected within their community and have many links to other communities, and (3) kinless

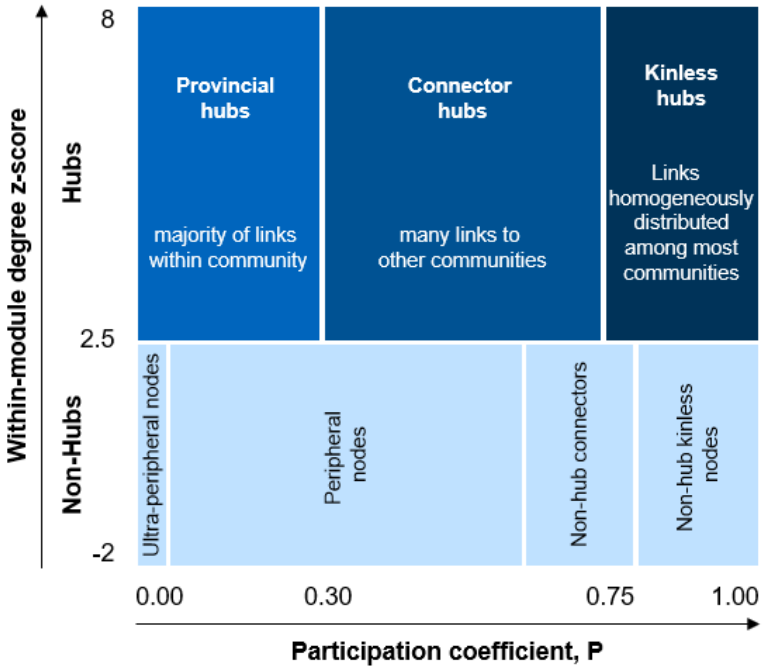


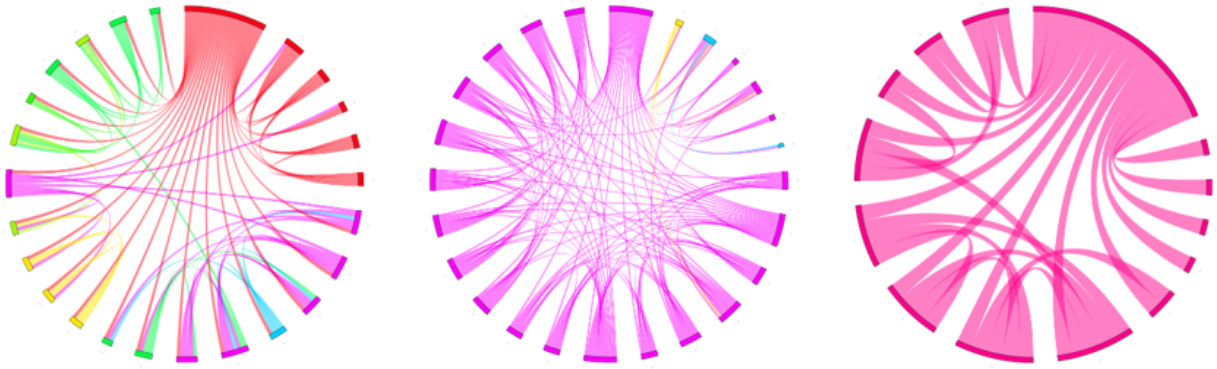

**Figure 5.7 z-P-classification matrix**. Guimerà and Nunes Amaral (2005) classify nodes into seven archetypes based on within-module degree (z-score) and participation coefficient (P-score), differentiating hub nodes (provincial hubs, connector hubs, and kinless hubs) and non-hub nodes. Own visualization adapted from Guimerà and Nunes Amaral (2005).

hubs, with connections to all communities. Therefore, connector hubs and kinless hubs serve as key measures for bridging between communities. We include corresponding dummy variables for each of the hub roles and use non-hubs as the reference category in our model. In our sample, the majority of funds' parent VC firms (92%) act as non-hubs within the European VC network.

To illustrate, Figure 5.8 presents the co-investor networks of three VC firms, all of which are well-connected within their respective communities (high z-score). BayTech Venture Capital (Figure 5.8a) acts as a kinless hub, bridging between many communities: it maintains numerous connections to VC firms from other communities. In contrast, Heartcore Capital (Figure 5.8b) and Clave Capital (Figure 5.8c) are classified as a non-hub, as their connections are predominantly - or entirely - restricted to a single community.

#### 5.2.2.3 Unique bridging position

To test whether the uniqueness of a VC firm's bridging position is positively associated with performance (H3), we calculate how often a VC firm acts as a broker along the shortest path connecting two other VC firms. In network terminology, we measure betweenness centrality, which was first proposed by L. Freeman (1977) and has been widely employed in applied network literature since (e.g., McEvily, Jaffee, and Tortoriello (2012)). Betweenness centrality is a "count of the structural holes to which a person has monopoly access" (Burt (2011), p. 297). It captures the control a focal node has over the flow of information: the higher the betweenness



**(a)** Role: hub (kinless hub) **(b)** Role: non-hub **(c)** Role: non-hub

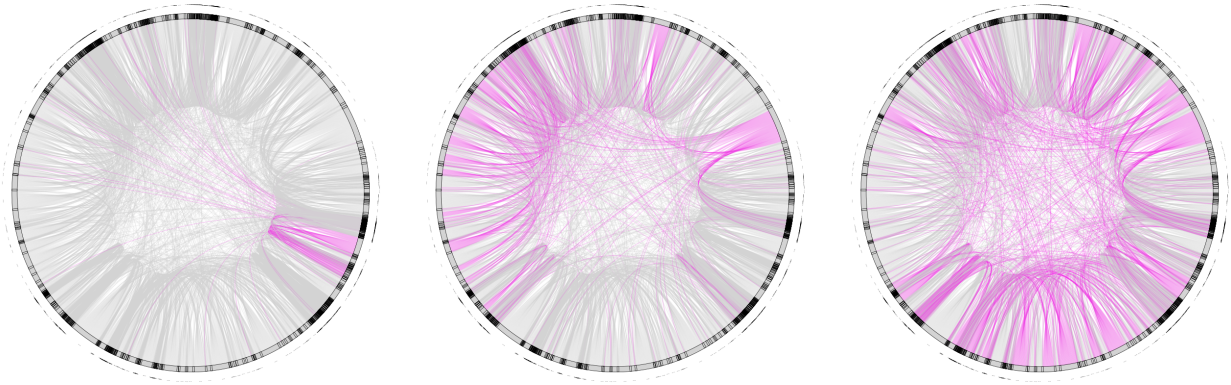
**Figure 5.8 Illustration of bridging between communities.** Co-investor networks for (a) BayTech Venture Capital, (b) Heartcore Capital, and (c) Clave Capital in 2010. VC firms and their ties are colored based on the community they belong to in the larger European network.

centrality, the more the other VCs depend on the focal VC to make connections with other VCs (X. Wu, Adbi, & Mahmood, 2024). Formally, betweenness centrality $C_B(v)$ is defined as the extent to which a node $v$ lies on the shortest paths between other pairs of nodes in a network:

$$C_B(v) = \sum_{s \neq v \neq t} \frac{\sigma_{st}(v)}{\sigma_{st}}$$

, where $\sigma_{st}$ is the total number of shortest paths between nodes $s$ and $t$ and $\sigma_{st}(v)$ is the number of those shortest paths that pass through node $v$ (L. Freeman, 1977; L. C. Freeman, 1978). We normalize the betweenness centrality based on the maximum value of betweenness centrality in the European VC network.

To illustrate, Figure 5.9 shows the European VC network in 2005 with the shortest paths passing through the respective VC firm highlighted in pink. Bessemer Venture Partners (Figure 5.9a) has no shortest paths passing through it, as it is not positioned between any other VC firms in the network ($C_B(v) = 0.00$). The highlighted paths represent direct connections between Bessemer Venture Partners and its syndicate partners. Deutsche Venture Capital (Figure 5.9b) serves as an intermediary for some VC firms within the network, with a moderate number of shortest paths passing through Deutsche Venture Capital ($C_B(v) = 0.16$). Intel Capital (Figure 5.9c) acts as a key bridge between multiple VC firms in the network, with many shortest paths passing through it, resulting in the highest betweenness centrality of 1.00. This makes Intel Capital the VC firm with the highest betweenness centrality in the European VC network.



**(a)** Betweenness centrality: 0.00 **(b)** Betweenness centrality: 0.16 **(c)** Betweenness centrality: 1.00

**Figure 5.9 Illustration of uniqueness of bridging position.** All three sub-figures depict the European VC network in 2005. Ties are colored in pink, if they directly connect a VC firm with its co-investors or if the shortest path between two VC firms goes through the VC firm: (a) Bessemer Venture Partners, (b) Deutsche Venture Capital, and (c) Intel Capital.

### 5.2.3 Dependent variable - fund performance

We measure the fund's performance via its *exit rate*, defined as the proportion of ventures in a fund's portfolio that successfully exited via an Initial Public Offering (IPO) or a Merger and Acquisition (M&A). In our sample, the average fund achieves an exit rate of 30.05 % (see Table 5.2), which is in line with prior literature. Ljungqvist, Richardson, and Wolfenzon (2017) report a success rate of 24.7% and Y. Hochberg et al. (2007) find a 34.2% success rate for the average fund. Our analysis is restricted to deals with known fund identifiers, which is available for 41% of the deals in the PitchBook database. Moreover, it focuses on funds with vintage years beginning in 2005, so that we can calculate the parent VC firm's network measures based on co-investment activity during the preceding five years. For example, we consider the co-investments of the fund's parent VC firm between 2000 and 2004 for a fund with a 2005 vintage year. Our resulting sample comprises 2,612 funds managed by 1,418 VC firms. We include all ventures financed by these funds until 2019, allowing for at least three years of operations (until the end of 2022). Prior research has employed varying temporal windows to assess fund performance, typically ranging from three to five years (e.g., Y. Wang (2016), Y. Hochberg et al. (2007), S. Yang et al. (2018)). To ensure the validity of our findings, we conduct robustness tests with observation periods of at least four and at least five years.

### 5.2.4 Control variables

To isolate the effects of the VC firm's network structure and position, we include a number of control variables. Following best practices in entrepreneurial finance literature, we include the following set of VC firm-specific and VC fund-specific control variables in our models. These controls are available for the majority of the

PitchBook dataset. We need to drop 1.43% of the funds due to missing controls. Table 5.2 presents descriptive statistics.

**Table 5.2 Descriptive statistics (fund performance model)**

The sample consists of 2,710 venture capital funds that were started between 2005 and 2019 (*vintage years*) by 1,710 VC firms. All funds made at least one investment in a European-based portfolio company between 2000 and 2019 and, thus, their parent VC firms are part of the corresponding European VC networks from 2005 until 2019. We measure the fund's performance via its *exit rate*, defined as the proportion of ventures in a fund's portfolio that successfully exited via an Initial Public Offering (IPO) or Merger and Acquisition (M&A). To allow for for at least three years of operation, fund's investments until 2019 are considered. Bridging measures are calculated for the parent VC firm of each fund (as of the fund's vintage year), as newly raised funds can still benefit from their parent VC firms' connections. The corresponding network graphs are constructed using all investments over the 5 years prior to the fund's vintage year. *Network constraint* focuses on the structure of the investor network and measures the bridging potential between an investor's direct syndicate partners. It is transformed into its complement ($B = 1 - C$) and normalized relative to a fully connected investor network with the same number of investors (network size). *Role* is a dummy variable, equal to 1 if the VC firm is classified as kinless hub, connector hub, provincial hub, or non-hub. It takes the position of the VC firm in its own community as well as the community membership of its syndicate partners into account. *Betweenness centrality* measures whether the brokerage opportunity is unique or shared with other investors. It is calculated based on betweenness centrality and normalized to the maximum value in the European VC network, such that a value of 1 indicates the VC firm with most unique brokerage opportunities. By definition, the network metrics are 0 for a VC firm that invests in a European-based company for the first time (within the last five years). We proxy the *status* of a VC firm via the network metric eigenvalue centrality. It is calculated as of the fund's vintage year. *CVC* is a dummy variable, denoting whether a VC firm is a corporate VC firm (=1). *VC age*, as proxy for the parent VC firm's experience, is calculated as of the fund's vintage year. *Foreign* is a dummy variable, indicating whether the VC fund is headquartered outside Europe (=1) or within Europe (=0). *First-time fund* is a dummy variable, indicating whether the fund is the VC firm's first fund (=1) or not (=0). The classification into *Early Stage VC funds* and *Later Stage VC funds* follows Pitchbook's fund type variable. *Industry focus* is a vector-based measure constructed from the VC firm's investments. Pitchbook classifies portfolio companies into the following seven industries: Business Products and Services (B2B), Consumer Products and Services (B2C), Energy, Finance, Healthcare, IT, and Materials Resources.

| | No. | Mean | Min | Median | Max |
|---|---|---|---|---|---|
| **VC fund** | | | | | |
| Exit rate | 2,710 | 0.30 | 0.00 | 0.20 | 1.00 |
| Foreign fund | 2,710 | 0.47 | 0.00 | 0.00 | 1.00 |
| First-time fund | 2,710 | 0.30 | 0.00 | 0.00 | 1.00 |
| Early Stage VC fund | 2,710 | 0.30 | 0.00 | 0.00 | 1.00 |
| Later Stage VC fund | 2,710 | 0.02 | 0.00 | 0.00 | 1.00 |
| Vintage Year | 2,710 | 2013 | 2005 | 2014 | 2019 |
| **Fund's parent VC firm** | | | | | |
| Network constraint ($B$) | 2,710 | 0.46 | 0.00 | 0.27 | 1.00 |
| Role: Kinless Hub | 2,710 | 0.02 | 0.00 | 0.00 | 1.00 |
| Role: Connector Hub | 2,710 | 0.08 | 0.00 | 0.00 | 1.00 |
| Role: Provincial Hub | 2,710 | 0.00 | 0.00 | 0.00 | 1.00 |
| Role: Non-Hub | 2,710 | 0.91 | 0.00 | 1.00 | 1.00 |
| Betweenness centrality ($C_B$) | 2,710 | 0.04 | 0.00 | 0.00 | 1.00 |
| Status | 2,710 | 0.07 | 0.00 | 0.01 | 1.00 |
| CVC | 1,418 | 0.06 | 0.00 | 0.00 | 1.00 |
| VC age | 2,710 | 9.16 | 0.00 | 6.00 | 117.00 |
| Industry focus B2B | 1,418 | 0.14 | 0.00 | 0.10 | 1.00 |
| Industry focus B2C | 1,418 | 0.17 | 0.00 | 0.10 | 1.00 |
| Industry focus Energy | 1,418 | 0.02 | 0.00 | 0.00 | 1.00 |
| Industry focus Finance | 1,418 | 0.03 | 0.00 | 0.00 | 1.00 |
| Industry focus Healthcare | 1,418 | 0.18 | 0.00 | 0.04 | 1.00 |
| Industry focus IT | 1,418 | 0.45 | 0.00 | 0.46 | 1.00 |
| Industry focus Materials Resources | 1,418 | 0.02 | 0.00 | 0.00 | 1.00 |

**VC firm-specific controls:** High-status VC firms have been shown to perform better (Y. Hochberg et al., 2007). We measure the *status* of the VC firm by its eigenvalue centrality, a network metric that captures the

influence of a firm based on its connections to other influential firms in the network. *CVC* indicates the ownership background of the VC firm. 7% of the VC firms are corporate VC firms. CVCs differ from traditional VCs in that they often prioritize strategic objectives over purely financial goals, such as gaining access to new technologies, entering new markets, attracting talent, or fostering a younger corporate culture (Anokhin, Wincent, & Oghazi, 2016; Dushnitsky & Lenox, 2006; Haslanger, Lehmann, & Seitz, 2023; Wadhwa & Kotha, 2006). *VC age* is a proxy for the experience of the VC firm, and measures the number of years since its founding or, where the founding year is not available in PitchBook, since its first investment activity. VC firms have an average age of 9.1 years at the time of fund establishment. We further control for the *industry focus* of the VC firm to account for sector-specific differences in exit potential and investment patterns. The industry focus is operationalized as a vector representing the share of a VC firm's investments across sub-industries and stages. We use the classification available in PitchBook and differentiate between seven industries (B2B, B2C, Energy, Financial Services, Healthcare, Information Technology, Materials and Resources) and three stages (Seed, Early Stage, Later Stage). Funds' parent VC firms exhibit a strong focus on IT investments, representing 45% of the average portfolio.

**VC fund-specific controls:** To account for fund-specific characteristics, we distinguish between *Early Stage VC funds* and *Later Stage VC funds* based on PitchBook's classification of Venture Capital funds. Most funds are generalist VC funds, with 30% specializing in Early Stage VC and only 2% in Later Stage VC. *Foreign fund* captures the potential influence of home affinity bias in venture capital, whereby investors may favor domestic over foreign ventures due to reduced information asymmetries and lower transaction costs associated with nearby investments (Cumming & Dai, 2010). Around half of the funds (47%) are headquartered outside of Europe. Moreover, we control for differences in experience and reputation of the VC firm by indicating whether a fund is the first fund raised (*first-time fund*). Every third fund is a first-time fund (30%), while the average fund represents the fourth fund of its parent VC firm. We also account for temporal and cyclical effects, such as macroeconomic conditions and industry trends. A set of *vintage year* dummies indicate the year the fund began its operations or, where the vintage year is not available in PitchBook, the year of its first investment activity.

## 5.3 Results

Our unit of analysis is the individual VC fund, with fund performance as the dependent variable and brokerage measures calculated for the fund's parent VC firm. Table 5.3 shows the results. All of our hypotheses relating to the VC's bridging position are (partially) supported.

Model 0 contains the control variables and represents our baseline model. We add our brokerage measures one at a time, resulting in three different regression specifications.

Model I adds our network constraint-based bridging measure $B$ as the Independent Variable (IV). The results support our arguments on the role of connectedness among co-investors. In support of H1, we find a negative effect of bridging between co-investors ($\beta = -0.0888$, $p = 0.000$). Funds achieve a higher performance, when the VC firm is part of a tight-knit group of investors.

In Model II, we explore the VC firm's role in the overall network and include dummy variables for kinless hubs, connector hubs, and provincial hubs. We find partial support for hypothesis H2. Kinless hubs, characterized by being well-connected within their own community and being connected to most investor communities, achieve a higher fund performance compared to non-hubs ($\beta = 0.0901$, $p = 0.062$). However, the effect for connector hubs is not statistically significant ($\beta = 0.0124$, $p = 0.601$). This indicates that the benefits of bridging between communities occur only once the VC firm is connected to most communities, while bridging between some communities does not yield significant performance benefits.

Finally, the betweenness centrality measure shows the hypothesized positive effect on fund performance (H3) in Model III ($\beta = 0.1189$, $p = 0.053$). That is, funds with a unique bridging position perform better than funds that share their bridging position with other funds, and H3 is confirmed.

### 5.3.1 Robustness checks

Multicollinearity is likely not a concern in our models. The correlation coefficients between predictors are below 0.35 and the Variance Inflation Factor (VIF) are well within established thresholds: the mean VIF is 1.55 and all values are below the conventional cut-off value of 5.00 (Gareth, Witten, Hastie, & Tibshirani, 2021; Vittinghoff, 2012). To mitigate potential multicollinearity among the bridging measures, we have added each measure individually. We add further robustness to our findings by conducting additional analyses. To conserve space, detailed results are omitted.

**Alternative time horizons**: While our models include funds with vintage years between 2005 and 2019, our findings are robust to excluding funds that have not yet completed their four-year (vintage years between 2005 and 2018) or five-year lives (vintage years between 2005 and 2017).

**Excluding small funds:** When excluding small funds — specifically, those that have made only one investment until 2019 — our findings are mostly consistent. Our robustness check demonstrates that VC funds perform better when embedded in a well-connected group of co-investors (H1), as holding a brokerage position negatively impacts VC performance ($\beta = -0.0877$, $p = 0.000$). However, the influence of community structure on performance shows no statistical significance, leading to the rejection of hypothesis H2: the roles of Kinless

**Table 5.3 The effect of bridging on fund performance.**

The sample consists of 2,710 venture capital funds that were started between 2005 and 2019 (*vintage years*) by 1,710 VC firms. All funds made at least one investment in a European-based portfolio company between 2000 and 2019 and, thus, their parent VC firms are part of the corresponding European VC networks from 2005 until 2019. We measure the fund's performance via its *exit rate*, defined as the proportion of ventures in a fund's portfolio that successfully exited via an Initial Public Offering (IPO) or Merger and Acquisition (M&A). To allow for for at least three years of operation, fund's investments until 2019 are considered. The bridging measures, our independent variables, are calculated for the parent VC firm of each fund, as a newly raised fund can still benefit from its parent VC firm's connections. The corresponding network graphs are constructed using all investments over the 5 years prior to the fund's vintage year. All bridging measures are mean-centered and scaled. *Network constraint* focuses on the structure of the investor network and measures the bridging potential between an investor's direct syndicate partners. It is transformed into its complement ($B = 1 - C$) and normalized relative to a fully connected investor network with the same number of investors (network size). *Role* refers to the role of the VC firm in the European VC network. It takes the position of the VC firm in its own community as well as the community membership of its syndicate partners into account. We take non-hub role as the reference category and include a set of three dummy variables, equal to 1 if the VC firm is classified as kinless hub, connector hub and provincial hub, respectively. *Betweenness centrality* measures whether the brokerage opportunity is unique or shared with other investors. It is calculated based on Freeman's betweenness centrality score and normalized to the maximum value in the European VC network, such that a value of 1 indicates the VC firm with most unique brokerage opportunities. By definition, the network metrics are 0 for a VC firm that invests in a European-based company for the first time (within the last five years). *Foreign fund* is a dummy variable, indicating whether the VC fund is headquartered outside Europe (=1) or within Europe (=0). *First-time fund* is a dummy variable, indicating whether the fund is the VC firm's first fund (=1) or not (=0). The classification into *Early Stage VC funds* and *Later Stage VC funds* follows Pitchbook's fund type variable. We also include a set of controls related to the fund's parent VC firm. We proxy the *status* of a VC firm via the network metric eigenvalue centrality. Due to multicollinearity concerns, we include status only in models 1 and 5, as it is highly correlated with betweenness centrality and hub roles. *CVC* is a dummy variable, denoting whether the VC firm is a corporate VC firm (=1) or a traditional VC firm (=0). *VC age*, as proxy for the VC firm's experience, is calculated as of the fund's vintage year. Because the distribution of VC age is highly skewed, we apply a logarithmic transformation. *Industry focus* is a vector-based measure constructed from the VC firm's investments. Pitchbook classifies portfolio companies into the following seven industries: B2B, B2C, Energy, Finance, Healthcare, IT, and Materials Resources. A set of year and industry dummies was included but omitted in reporting to preserve space. The mean mean variance inflation factor (VIF) of the variables included in the models is 1.55, indicating that multicollinerarity is likely not a concern. We report the estimated coefficients ($beta$) in the regression table and use ***, **, and * to denote their significance ($p$) at the 1%, 5% and 10% level, respectively.

| | **Model 0** | **Model I** | **Model II** | **Model III** |
|---|---|---|---|---|
| **Bridging measures (IV)** | | | | |
| Network constraint ($B$) | | -0.0888*** | | |
| Role: Kinless Hub | | | 0.0901* | |
| Role: Connector Hub | | | 0.0124 | |
| Role: Provincial Hub | | | -0.2333 | |
| Betwenness centrality ($C_B$) | | | | 0.1189* |
| **Controls** | | | | |
| Foreign fund | 0.0777*** | 0.0881*** | 0.0713*** | 0.0740*** |
| First-time fund | 0.0047 | 0.0145 | 0.0011 | 0.0026 |
| Stage focus: Early Stage | -0.0151 | -0.0119 | -0.0160 | -0.0152 |
| Stage focus: Later Stage | 0.0690 | 0.0624 | 0.0729* | 0.0729* |
| Status | 0.1623*** | 0.0508* | - | - |
| CVC | 0.0535** | 0.0508* | 0.0537** | 0.0536** |
| VC age (Log) | -0.0041 | -0.0060 | 0.0065 | 0.0058 |
| Vintage Year | x | x | x | x |
| Industry focus | x | x | x | x |
| Adjusted-$R^2$ | 17.2% | 17.8% | 16.9% | 16.9% |
| No. of observations | 2,710 | 2,710 | 2,710 | 2,710 |

($\beta = 0.0534$, $p = 0.179$), Connector ($\beta = 0.0173$, $p = 0.337$), and Provincial ($\beta = -0.1952$, $p = 0.136$) hubs do not significantly affect VC performance compared to non-hubs. Unique brokerage positions within the European VC network correlate with improved performance ($\beta = 0.1260, p = 0.008$), supporting hypothesis H3. The model accounts for approximately 25.7% of the variance in the data.

**Alternative measure for VC performance**: Our findings remain robust when using an alternative measure of VC performance. Follow-on funding is widely regarded as an interim indicator of success, as it serves as a proxy for the quality and growth potential of portfolio companies (Y. Hochberg et al., 2007; Ter Wal, Alexy, Block, & Sandner, 2016; Yimfor & Garfinkel, 2022). Accordingly, we expand the definition of success to include not only exits via IPOs or M&As but also the attainment of subsequent funding rounds, shifting the unit of analysis to the venture-investor pair. This robustness check focuses on ventures that received their initial financing between 2005 and 2019, with venture success as the dependent variable. In the context of first rounds, we define a venture as successful if it either exited or secured a second round of financing within three years or beyond. The PitchBook dataset includes 18,218 ventures that receive their initial financing from 4,362 VC firms. On average, 85.6% of ventures in our sample are successful. After the first round, 22.8% of ventures achieved an IPO or were acquired (M&A) and 62.8% of ventures obtained a second round of financing, while 14.4% failed to achieve either outcome within the defined time frame. We control for venture-specific and VC firm-specific effects. Table A.3 in the Appendix A.1 presents detailed characteristics of the VC firms and ventures. The most common sectors are IT (35%), B2B (23%) and B2C (22%). The average syndicate size is 1.3 VC firms. Among 4,362 VC firms, 30% are headquartered outside Europe, 8% are Corporate VC firms (CVC), 43% focus on Early Stage, and 41% invest pre-dominantly in IT industries.

We find the same bridging effects when considering venture success (see Table A.7 in the Appendix): Ventures are more likely to attract a second funding round or successful exit, when the VC firm's investor network is characterized by bonding (H1), the VC firm acts as connector or kinless hub in the European VC network (H2), and has a unique bridging position in the European VC network (H3). Our results are statistically significant. In support of H1, we find that bridging between co-investors has a negative effect on venture success ($\beta = -0.2896, p = 0.000$). In support of H2, we find that the likelihood of venture success is higher for both kinless hub and connector hub investors, with kinless hubs ($\beta = 1.568, p = 0.000$) outperforming connector hubs ($\beta = 0.6386, p = 0.000$). In support of H3, we find that the uniqueness of the bridging position, as measured by betweenness centrality, has a positive impact on venture success ($\beta = 2.7510, p = 0.000$).

We conduct additional robustness checks by analyzing ventures that secured a second round of financing, considering a third round of financing as interim success. Again, these analyses yield consistent results, but are omitted to save space.

## 5.4 Discussion and Conclusion

This study explores the effect of network structure on performance in the multinational European VC network. Specifically, we analyze whether VC firms benefit from either *bonding* or *bridging* on three levels: (5.1.1) the direct co-investors of the VC firm, (5.1.2) the investor communities in the VC network, and (5.1.3) all VC firms in the VC network. We argue that a brokerage position in the overall network is beneficial for VC firms, because it grants access to diverse perspectives and information, for example, about investment opportunities and potential follow-on investors. However, when considering the immediate network of co-investors, trust and collaboration matter more. Only then will VC firms actually share their diverse perspectives and information. Therefore, we hypothesize (and find) that the optimal network structure is one, where the co-investors of a VC firm are well-connected amongst each other (H1), while the VC firm has a brokerage position between different investor communities (H2) and does not share this brokerage opportunity with alternative brokers (H3). With such a network structure, we argue that these VC firms can combine "the best of both worlds", benefiting from trust advantages associated with bonding as well as information and control advantages associated with bridging.

### 5.4.1 Contribution and relevance

In doing so, we add to the entrepreneurial finance and network literature in at least two ways: This study is the first to examine the optimal network structure for VC firms within a multi-national market. While prior research has predominantly emphasized network position metrics, such as a firm's centrality, limited attention has been paid to the structural characteristics of a VC firm's co-investor network (R. Zhang et al., 2021). The few studies addressing network structure in the context of VC (e.g., Alexy et al. (2012); Bellavitis et al. (2017); S. Yang et al. (2018)) have largely focused on single-country markets and, predominantly, non-European markets. However, their (sometimes contradictory) findings are not directly transferable to the European context, as the optimal network structure typically depends on the network under consideration (Rauch et al., 2016; Stam et al., 2014). Therefore, the VC network in Europe, with its diverse cultures and institutions, requires a distinct analysis and allows to extend the debate to the multi-national context. Our results provide empirical evidence that VC firms in the European market perform better when they are part of a tight-knit group of co-investors (bonding), compared to when they obtain a brokerage position between co-investors (H1).

Second, this study takes a nuanced perspective on brokerage. Most of the previous studies on brokerage limit their analysis to the immediate network (i.e., the VC firm's co-investors), excluding connections and actors in the broader network (Kwon et al., 2020). However, as demonstrated in Chapter 5.1.2 and 5.1.3, the relationships in the broader network matter for the diversity of information firms can access within their network, as well as

the control they have over this information. Therefore, we not only consider the direct investor network, but also extend our analysis to the structure of the European VC network, including connections such as co-investors of co-investors and so forth. We are the first to apply Guimerà and Nunes Amaral (2005)'s classification in the context of VC and demonstrate that the roles VC firms play in the overall network matter for performance. So far, the framework has been applied mostly in the context of transportation, biological, and brain networks research (e.g., Cole, Ito, and Braver (2015); Farahani, Karwowski, and Lighthall (2019); Li et al. (2014); Power, Schlaggar, Lessov-Schlaggar, and Petersen (2013)). We find evidence for the advantages of brokering between many other communities (while also being well-connected within one's community). That is, VC firms operating as kinless hubs perform better. For VC firms acting as connector hubs, we find partial evidence on the performance benefits. While connector hubs help ventures to secure another funding round, there is no significant effect on the performance of VC funds. In Chapter 4, we found that the communities within the European VC network represent regional startup ecosystems. In the multi-national European context, brokering between communities thus allows VC firms to integrate the knowledge and insights of different regional ecosystems. Moreover, we find that VC firms perform better when their brokerage opportunities are shared with fewer alternative brokers, making their brokerage position more unique (H3). When considering the network position in the context of the network-performance relationship, scholars have previously found similar positive effects for betweenness centrality (see e.g., Y. Hochberg et al. (2007)). However, they have only interpreted their findings from a centrality perspective, while we incorporate them in an overall brokerage perspective.
Additionally, previous studies have lacked consistency in performance metrics, using measures such as second funding rounds, investment sums, or exit rates. To enable more meaningful comparisons, we assess both success at funding round and at exit.

Our findings also offer valuable insights for practitioners. First, venture capitalists should try to foster trust and collaboration amongst their co-investors. They can pass on investment opportunities from one group of investors to another, or make introductions in order to directly connect co-investors. For example, many VC firms host portfolio days, where they show-case their portfolio companies, but can also connect their co-investors.
Second, VC firms should try to obtain a (unique) brokerage position in the overall network. While little is known about the antecedents of brokerage positions in the context of VC, Stam (2010) has found that entrepreneurs are more likely to obtain a brokerage position when participating in heterogeneous industry events (e.g., conferences) or events with few overlapping participants. Moreover, VC firms could offer dedicated networking training programs for their venture capitalists, where they present an analysis of the VC firm's network, how the VC is positioned within its own community and to which communities the VC lacks connections to. While people seem to be poor at recognizing the structure of networks (L. C. Freeman, 1992), they can be trained

to do so (Burt & Ronchi, 2007; Janicik & Larrick, 2005). For example, venture capitalists are likely better at answering questions like "Who has co-invested with whom?" and "Who influences whom?" for their immediate connections (L. C. Freeman, 1992), and the VC firm can benefit as a whole by leveraging this information. Similarly, our findings underscore the role of investor networks for entrepreneurs, when looking for funding. The network structure of the VC firms significantly impacts venture success, including the likelihood of both exiting and receiving follow-on funding.

### 5.4.2 Limitations and further research

This study has a few limitations that, hopefully, can be turned into avenues of future research.

We examine brokerage from a structural perspective, defining a broker as an actor who occupies an intermediary position between two disconnected parties. Future research could detail the behavioral processes how VC firms capitalize on brokerage opportunities. Recent work (e.g., Grosser, Obstfeld, Labianca, and Borgatti (2019); Halevy, Halali, and Zlatev (2019); Kwon et al. (2020)) emphasizes the importance to also explicitly examine the behavior of firms, when occupying a brokerage position: Brokers can either create new ties between previously unconnected parties or deliberately maintain separation between them to preserve their strategic position as intermediaries (Grosser et al., 2019; Obstfeld, 2005; Soda, Tortoriello, & Iorio, 2018; Stovel, Golub, & Milgrom, 2011). The first behavior fosters an investor network characterized by bonding, which we have found to be associated with stronger performance (H1). Therefore, our findings suggest that brokers in the European VC landscape benefit from connecting their co-investors. Future research could investigate how the brokerage behaviors of VC firms affect their subsequent performance. Such a longitudinal analysis would not only validate our findings but also provide deeper insights into the performance implications of brokerage behaviors.

While this study demonstrates the impact of brokerage, an important avenue for future research lies in examining *how* VC firms become brokers. For example, investigating the evolution of a VC firm's network position could yield valuable insights. A qualitative case study design may be even better-suited, as quantitative data captures only the presence of new connections but not what led to them.

Our analysis centers on the perspective of a VC firm, emphasizing the performance implications of brokerage for the broker VC firm itself. However, while brokers often benefit, the outcomes for those they are connected to are more nuanced (see, e.g., Kwon et al. (2020) for an overview). Stovel and Shaw (2012) introduced the "dual aspect of brokerage", highlighting that brokerage can also "breed exploitation, the pursuit of personal profit, corruption, and the accumulation of power". For example, brokers extract economic rents from the parties they connect (Fernandez-Mateo, 2007) or prioritize individual gains at the expense of the broader network's welfare

(Bizzi, 2013). Future research could extend our work by examining the effects of being connected to brokers, shifting the lens from a single VC firm to the VC ecosystem as a whole.

Finally, we use co-investment networks as a proxy for relationships between VC firms. However, the resulting networks do not fully capture all aspects of connections among VC firms. For instance, VC firms are often embedded in a web of personal relationships among venture capitalists, forged through shared experiences at university, former workplaces, or industry events such as VC conferences. Depending on the type of network under consideration (e.g., co-investment versus alumni networks), VC firms may appear connected or disconnected. Consequently, the network of a given VC firm can be interpreted as either a bonding or brokering network based on the nature of the ties considered (Obstfeld, Borgatti, & Davis, 2014). Future research could broaden the scope beyond co-investment ties and explore multiplex brokerage ties.

*"Networking is the No.* 1 *unwritten rule of success in business. Who you know really impacts what you know."*

Sallie Krawcheck, former head of Investment Management at Bank of America

# 6

# A venture capitalist's rolodex

## Strategies behind venture capitalist networks: Why and how venture capitalists use their personal connections to other venture capitalists

The VC industry is widely recognized as relationship-driven, people-driven, and networking-heavy. However, network literature often emphasizes formal links between VC firms like co-investment networks (see chapter 2.1). While "there is a strong sense among researchers that informal relations undergird formal ties" (Powell & Grodal, 2005) and that the people behind these networks matter, surprisingly, there are no detailed studies on the role of personal connections between individual venture capitalists (venture capitalist-to-venture capitalist network). In practice, anecdotal evidence indicates that informal, personal connections between venture capitalists also undergird these formal collaborations among VCs. Silicon Valley's "PayPal Mafia" illustrates how personal connections can shape the VC industry: Peter Thiel, a member of the Paypal Mafia, emphasizes that "the critical piece was that some incredibly deep friendships were forged" and, therefore, explicitly prefers the term "friendship over networks" (Forrest, 2014). Further anecdotal evidence includes the widespread use of relationship management systems in VC, specifically designed for relationship-driven industries. Finally, VC networking guides and VC conferences emphasize personal interactions and connections among venture capitalists. For instance, VC events like SuperVenture (2024) promote themselves with networking-centric slogans such as "Connections that matter. Relationships that last".

Therefore, we investigate *why venture capitalists collaborate with other venture capitalists (RQ 3a)*. Moreover, this study details *how venture capitalists use their connections to other venture capitalists (RQ 3b)* along the VC decision-making process. Our approach differs from the traditional VC network literature in two ways: First, instead of focusing on syndication between VC firms, we investigate how individual venture capitalists collaborate with one another. Second, collaboration extends beyond co-investments to include activities such

as sharing deal flow, seeking an informed second opinion on investment opportunities, and providing strategic support to portfolio companies, irrespective of co-investment.

The chapter continues with the following structure: Chapter 6.1 details methodology and data used. We investigate these research questions using a qualitative research design. We conduct an in-depth, multi-case study analysis, drawing from insights based on semi-structured interviews with 50 European venture capitalists from 42 different VC firms, totaling around 24 hours of recording and more than 550 pages of transcript.

Chapter 6.2 presents our findings. We find that venture capitalist-to-venture capitalist collaboration is motivated by industry-level, VC firm-level, and venture capitalist-level factors (RQ 3a): Due to industry-level mechanisms and practices (Chapter 6.2.1.1), venture capitalists expect high benefits of "taking" information from other venture capitalists, while "giving" information in return often incurs negligible costs. Therefore, a strong give-and-take mechanism governs the collaboration among venture capitalists. The VC firm-level characteristics (Chapter 6.2.1.2) influence the extent of collaboration and the types of resources that venture capitalists can "give-and-take". Collaboration tends to be limited among VC firms that have minimal overlap in geographic and industry focus or that differ substantially in reputation. For those VC firms where collaboration is feasible, we identify four archetypes of collaboration, which differ in their stage focus and the level of competition between the firms. Lastly, at the venture capitalist-level (Chapter 6.2.1.3), collaboration is shaped by the basic psychological needs of the venture capitalists involved. We identify that relatedness, the need to feel connected and a sense of belonging with others, often presents a boundary condition for the give-and-take mechanism among venture capitalists. Venture capitalists like to collaborate with venture capitalists they like. Moreover, the need for competence and benevolence further fosters collaboration.
The collaboration archetypes and personal relationship (relatedness) also impact how venture capitalists use their connections to other venture capitalists (RQ 3b). We present the distinct give-and-take mechanisms throughout the VC decision-making process in chapter 6.2.2.

Finally, chapter 6.3 presents our contributions to VC literature: First, we approach VC networks from a novel angle: the venture capitalist-to-venture capitalist relationships, whilst extant literature has focused on VC firm-to-VC firm or venture capitalist-to-entrepreneur relationships. Second, we propose a more nuanced definition of VC firm-to-VC firm networks, introducing four distinct types of collaboration ties. Previous literature has considered only one single co-investment network, regardless of financing round. Third, this study enhances our understanding of the VC decision-making process. We incorporate the - currently missing - social tie perspective into the study of VC decision-making. For practitioners, this study can serve as a networking guide. Investors learn how they can leverage their connections to other venture capitalists and how they can give back.

## 6.1 Methods and data

### 6.1.1 Sampling approach

Achieving representativeness is a crucial concern in qualitative research (Gobo, 2004). To ensure capturing a representative perspective of European venture capitalists, we employed a diversified sampling strategy. As is common in this research approach, we opted for criterion-i sampling, a form of purposeful sampling (Patton, 2002). Its objective is to "identify and select all cases that meet some predetermined criterion of importance" (Palinkas et al., 2015). In order to be able to shed light on our research questions, respondents were required to meet the following three criteria: First, respondents need to have more than one year of VC experience (preferably more[1]). Second, interview subjects need to be directly involved in investment and portfolio company-related activities. Together, these requirements ensure that interview subjects had ample opportunity to form connections with other venture capitalists while simultaneously gaining sufficient experience along the VC decision-making funnel. Third, we focused on venture capitalists based in Europe and investing in European companies. This geographic focus was chosen due to the distinct cultural and institutional differences between VC markets in Europe, the US, and China, likely impacting the way venture capitalists collaborate with other venture capitalists. We then combined this sampling approach with snowball sampling, a form of convenience sampling (Denzin & Lincoln, 2005). Initially, we utilized personal networks to identify suitable interviewees. We then expanded through the snowball technique, wherein interview subjects were asked to provide referrals to other potential interview subjects. Given the relationship-focused nature of the VC industry, we often relied on these warm introductions, particularly to venture capitalists in senior management with limited time. To mitigate bias and balance our sample, we intentionally sought heterogeneity among interview subjects by asking respondents to recommend individuals with different networking approaches ("Who could you recommend with a networking approach different from your own?"). Additionally, we requested specific referrals, such as an introduction to a female venture capitalist investing in Early Stage. Finally, we ensured a balanced interview sample through quota sampling via LinkedIn.

### 6.1.2 Data collection

The primary source of data is semi-structured interviews. We implemented several rigorous steps to ensure the validity and reliability of the interview data: First, we developed a detailed interview protocol to guide the semi-structured interviews (see Appendix A.4). Our interview protocol follows the recommended structure of Yin (2018). It consists of three main parts: 1) background information, 2) collaboration in the VC decision-

[1] Note that 86% of the interview subjects (43 interview subjects) have more than two years of VC experience, and 50% even have more than four years of VC experience.

making process, 3) networking strategy. Each interview opened with the interviewer broadly inquiring about the venture capitalist's background and the respective VC firm in Part 1, including questions about the preferred investment stage, geographic focus, and industry specialization. Part 2 involved a systematic exploration of the VC decision-making process, as depicted in Figure 2.1. For each step of the process, we inquired about the role of personal connections to other venture capitalists. Finally, Part 3 focused on the venture capitalist's strategy and practices for building and maintaining their VC investor networks. Most of the questions were pre-determined open-ended questions, which fits the exploratory character of this work. The interviewer followed up with questions that emerged from the conversation with the interviewees (Dicicco-Bloom & Crabtree, 2006). We then sought feedback from academic and industry experts to refine the interview guide (see Appendix A.4). This process ensured that the interview guide featured a clear, easy-to-follow structure, straightforward questions, and included relevant definitions for key terms. After the first five interviews, we further refined the interview protocol. For instance, we switched the order of Part 2 ("The role of investor networks in the VC decision-making process") and Part 3 ("The network strategy of the venture capitalist"), as a deeper understanding of the VC investor network (Part 2) facilitated a more meaningful conversation on the networking strategies employed by the venture capitalist (Part 3). Each interview was meticulously prepared with desk research on the venture capitalist (e.g., LinkedIn profile) and the respective VC firm (e.g., company website), enabling more in-depth and informed conversations. To provide consistency in interview style and protocol, only one of the authors then conducted the interviews. Before commencing the network-focused parts of the interview (Part 2 - Part 3), we explicitly sought permission to record the conversation. We also reassured the interviewees that their identities and all interview content would remain confidential. This practice was designed to foster a more comfortable interview environment and to promote deeper, more candid exchanges. Finally, two researchers independently coded the transcripts and then compared results to resolve discrepancies and enhance the validity of the data interpretation.

Our sample size was determined upon reaching theoretical saturation, the point at which no new information or themes emerge from additional cases (Charmaz, 2006). We collected several cases past that point to confirm that theoretical saturation was indeed reached. Therefore, we ceased data collection after 53 interviews (10-16 interviews per position of the venture capitalists). In our pursuit to comprehend "what's happening and why" (D. Gioia, 2021), combined with our focus on individual subjects, we ended up conducting interviews approaching the upper recommended limit. Consistent with our approach, textbooks on qualitative research methodology suggest conducting between 5 and 60 interviews (Hennink & Kaiser, 2022). The recommended sample size is generally larger for studying novel or under-explored phenomena, as we are doing. For instance, Creswell (2018) suggests at least 20 to 30 interview subjects and Denzin and Lincoln (2005) recommends 30

to 50 interviews for grounded theory studies. Moreover, Hennink, Kaiser, and Marconi (2017) highlights that achieving meaning saturation ("understanding it all") demands more interviews, while code saturation ("having heard it all") can already occur between 9 and 17 interviews (Hennink & Kaiser, 2022).

The interviews took place between April and June 2024 and ranged from 21 to 60 minutes, with most around 30-35 minutes in duration. Word-by-word interview transcripts were created in preparation for a subsequent coding process in MAXQDA24 (see Chapter 6.1.4). Overall, we collected 1431 minutes (around 24 hours) of recorded audio and more than 550 single-line pages of transcripts[2].

### 6.1.3 Interview sample

We conducted 53 semi-structured interviews with venture capitalists from 44 VC firms. We had to exclude three interviews due to technical issues with the recording or the venture capitalist not meeting our sampling criteria[3] (see Chapter 6.1.1).

Our final sample comprises 50 cases and includes a diverse set of venture capitalists across positions, VC experience, gender, home country, and investment focus in terms of preferred industry, region and stage. Table 6.1 presents a comprehensive overview of the venture capitalists and the corresponding VC firms in our interview sample [4]. We focused on mid- to senior-level positions. The sample consisted of 10 Analysts and Associates, 16 Investment Managers, 13 Principals, and 12 (Managing) Partners. On average, the venture capitalists interviewed had 4.3 years of experience in the VC industry and had worked for an average of 1.8 VC firms. Among these, 39 identified as male and 11 as female. By including European venture capitalists with a focus on European investments, our study aims to extrapolate insights that are relevant to the broader European VC market. We conducted interviews with venture capitalists from six European countries: Germany, the United Kingdom, France, Spain, Switzerland, and Finland. Most venture capitalists were based in Germany (35), followed by the United Kingdom (9), and France (3), which are the European countries with the highest levels of venture activity according to Pitchbook data. However, all of them invest in European-based companies and co-invest with other European-based VC firms. Only three investors had a narrower geographic focus (Germany, UK, DACH) and four investors had a broader, global mandate. In terms of industry focus, we included both generalists (22) and specialists (28), such as FinTech-investors, Games & Media-investors or impact investors. We included venture capitalists with an investment focus across stages, from Pre-Seed to IPO: nine venture

[2] Only the main part of the interview was recorded and transcribed, excluding introduction of the research, interviewer and interviewee as well as closing remarks.

[3] Two interviewees did not meet the criterion of actively being involved in investment- and portfolio-related activities. One focused on strategic partnerships and the other one was primarily fundraising for a new fund.

[4] To maintain anonymity, fictional names were assigned to the cases ("vc 01" to "vc 50" for the venture capitalists) and firms (e.g., "VC 1" for VC firm, "CVC 1" for corporate VC firm).

**Table 6.1** Overview of interview subjects.

| | | | | VC experience | | Investment focus | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Interview subject** | **Position** | **Gender** | **Home country** | **Years** | **Firms** | **Industry** | **Region** | **Country** | **Stage** | **Typical stage** | **VC firm** | **Top VC** |
| **vc 01** | Principal | m | Germany | 5.8 | 1 | Technology | - | Germany | Early Stage | Seed - Series B | VC 01 | - |
| **vc 02** | (Managing) Partner | m | Germany | 4.4 | 2 | Fintech | Europe | Germany | Early / Later Stage | Seed - IPO | VC 02 | Top 50 |
| **vc 03** | Investment Manager | m | Germany | 4.2 | 2 | Technology | Europe | - | Later Stage / Growth | Series B+ | VC 03 | - |
| **vc 04** | Investment Manager | m | Germany | 4.8 | 1 | Generalist | Europe | - | (Pre-)Seed | Pre-Seed - Seed | VC 04 | Top 100 |
| **vc 05** | Investment Manager | m | Germany | 4.4 | 1 | Impact investments (Education & Health) | Europe | - | (Pre-)Seed | Pre-Seed - Seed | VC 05 | - |
| **vc 06** | (Managing) Partner | m | Germany | 5.6 | 2 | Generalist | Europe | - | Later Stage / Growth | Series A+ | VC 06 | Top 100 |
| **vc 07** | Investment Manager | f | Germany | 5.8 | 2 | Generalist (Technology) | Europe | - | Early Stage | Seed - Series A | VC 07 | Top 100 |
| **vc 08** | (Managing) Partner | m | Germany | 3.4 | 3 | Generalist (Technology) | Europe | - | Early Stage | Seed - Series B | VC 08 | Top 50 |
| **vc 09** | Investment Manager | m | Germany | 3.7 | 1 | Generalist (Software) | Europe | - | (Pre-)Seed | Pre-Seed - Seed | VC 09 | - |
| **vc 10** | (Managing) Partner | f | Germany | 7.3 | 2 | Technoloy | Europe | - | Early Stage | Pre-Seed - Series A | VC 10 | - |
| **vc 11** | Investment Manager | f | Germany | 3.3 | 2 | Fintech | Europe | DACH | (Pre-)Seed | Pre-Seed - Seed | CVC 01 | - |
| **vc 12** | Analyst / Associate | f | United Kingdom | 4.8 | 2 | Fintech | Europe | UK | Later Stage / Growth | Series B+ | VC 11 | Top 200 |
| **vc 13** | Analyst / Associate | f | France | 1.8 | 1 | Financial Services | - | DACH | Early / Later Stage | Series A - C | VC 12 | - |
| **vc 14** | Principal | m | Germany | 2.7 | 1 | Generalist (AgriTech, Climate Tech, AI) | Global | DACH | Early Stage | Pre-Seed - Series B | VC 06 | Top 100 |
| **vc 15** | Investment Manager | m | Germany | 3.9 | 2 | Construction | Europe | DACH | (Pre-)Seed | Pre-Seed | VC 13 | - |
| **vc 16** | Investment Manager | m | Germany | 2.4 | 1 | Deep Tech | Europe | - | Early / Later Stage | Seed - IPO | VC 14 | Top 100 |
| **vc 17** | Principal | m | Germany | 2.3 | 1 | Deep Tech | Europe | - | Early Stage | Pre-Seed - Series A | VC 15 | - |
| **vc 18** | Principal | m | United Kingdom | 5.4 | 3 | Technology | Europe | - | Later Stage / Growth | Series B - D | VC 16 | - |
| **vc 19** | Investment Manager | m | Germany | 4.9 | 3 | Technology | Europe | DACH | Later Stage / Growth | Series B+ | VC 17 | - |
| **vc 20** | Investment Manager | m | United Kingdom | 7.4 | 3 | Generalist (Technology) | Europe | - | Early / Later Stage | Seed - Series C | CVC 02 | - |
| **vc 21** | Principal | m | France | 4.4 | 2 | Impact investments (EdTech) | Europe | France | Early Stage | Seed - Series B | VC 18 | - |
| **vc 22** | Investment Manager | f | Germany | 2.8 | 1 | Impact investment (Technology) | Europe | - | Early Stage | Pre-Seed - Series A | VC 19 | - |
| **vc 23** | Analyst / Associate | m | Germany | 2.6 | 5 | Generalist ((Deep) Tech) | Europe | - | (Pre-)Seed | Pre-Seed - Seed | VC 20 | Top 50 |
| **vc 24** | (Managing) Partner | m | Germany | 8.8 | 2 | Deep Tech | Europe | - | Early Stage | Seed - Series A | VC 21 | - |
| **vc 25** | Principal | m | Germany | 7.8 | 3 | Generalist (Deep Tech) | Europe | - | Early / Later Stage | Seed - Series C | VC 22 | - |
| **vc 26** | Principal | m | Germany | 3.5 | 1 | Technology | Europe | - | Early Stage | Pre-Seed - Series A | VC 23 | - |
| **vc 27** | Principal | m | United Kingdom | 5.4 | 2 | Generalist | Europe | - | Early / Later Stage | Series A - C | VC 24 | - |
| **vc 28** | Analyst / Associate | f | Germany | 1.4 | 1 | Health Tech | Europe | DACH | Early Stage | Pre-Seed - Series A | VC 23 | - |
| **vc 29** | Analyst / Associate | m | United Kingdom | 1.9 | 1 | Games & Media | Europe | - | Early / Later Stage | Seed - IPO | VC 14 | Top 100 |
| **vc 30** | Principal | m | Spain | 3.3 | 1 | Agri-Food | Europe | - | Early Stage | Seed - Series A | VC 25 | - |
| **vc 31** | Analyst / Associate | m | Germany | 2.7 | 2 | Generalist | Europe | - | Early Stage | Seed - Series A | VC 14 | Top 100 |
| **vc 32** | Analyst / Associate | m | Germany | 2.1 | 2 | Generalist ((Deep) Tech) | Global | - | Early Stage | Seed - Series A | VC 09 | - |
| **vc 33** | Principal | m | Germany | 6.4 | 1 | Technology | Europe | DACH | Later Stage / Growth | Series B+ | VC 26 | Top 50 |
| **vc 34** | Principal | f | Germany | 5.1 | 3 | Generalist | Europe | Germany | Early Stage | Pre-Seed - Series A | CVC 03 | - |
| **vc 35** | (Managing) Partner | m | Finland | 6.5 | 1 | Impact investment (EdTech) | Europe | Nordics | Early Stage | Pre-Seed - Series A | VC 27 | - |
| **vc 36** | (Managing) Partner | m | United Kingdom | 1.2 | 1 | Generalist | Europe | UK | Early / Later Stage | Series A - B | VC 28 | Top 50 |
| **vc 37** | (Managing) Partner | m | Germany | 1.6 | 1 | Generalist (Technology) | Europe | DACH | Early Stage | Seed - Series A | CVC 04 | - |
| **vc 38** | (Managing) Partner | m | Germany | 14.2 | 3 | Agri-Tech, Ed-Tech | Global | DACH | Early Stage | Seed - Series A | VC 29 | - |
| **vc 39** | Principal | m | Germany | 7.5 | 2 | Generalist (Technology) | Europe | DACH | Early Stage | Seed - Series A | VC 30 | Top 50 |
| **vc 40** | Investment Manager | m | Germany | 4.0 | 2 | Generalist (Technology, Energy) | Europe | - | Early Stage | Seed - Series A | VC 31 | - |
| **vc 41** | Investment Manager | m | Germany | 2.8 | 2 | Generalist (Resilience) | Global | DACH, Nordics | Early Stage | Pre-Seed - Series A | VC 08 | Top 50 |
| **vc 42** | Analyst / Associate | f | Germany | 2.2 | 1 | Food & Agriculture | Europe | - | (Pre-)Seed | Pre-Seed - Seed | VC 32 | Top 200 |
| **vc 43** | Principal | m | Germany | 1.7 | 2 | Technology | Europe | - | (Pre-)Seed | Pre-Seed - Seed | VC 33 | - |
| **vc 44** | Analyst / Associate | m | Switzerland | 2.9 | 2 | Generalist | Europe, US | - | Early Stage | Seed - Series A | VC 34 | - |
| **vc 45** | Analyst / Associate | m | United Kingdom | 2.4 | 3 | Fintech | Europe | UK | Early / Later Stage | Series A - C+ | CVC 05 | - |
| **vc 46** | (Managing) Partner | m | Germany | 6.4 | 1 | Consumer | Europe | Germany | Early / Later Stage | Series A+ | VC 35 | - |
| **vc 47** | (Managing) Partner | m | United Kingdom | 1.8 | 1 | Generalist | Europe | DACH | Early / Later Stage | Pre-Seed - IPO | VC 36 | Top 50 |
| **vc 48** | Principal | m | France | 5.4 | 4 | Generalist | Europe | France | (Pre-)Seed | Pre-Seed - Seed | VC 06 | Top 100 |
| **vc 49** | Investment Manager | f | Germany | 0.9 | 1 | Generalist ((Deep) Tech) | Europe | - | Early / Later Stage | Pre-Seed - IPO | VC 37 | Top 50 |
| **vc 50** | Investment Manager | f | United Kingdom | 1.9 | 1 | Healthcare | - | UK | Early Stage | Seed - Series B | VC 38 | Top 100 |

***Notes:*** The unit of analysis is the individual venture capitalist, i.e., the *investment focus* describes the focus of the venture capitalist, not the VC firm. For example, a venture capitalist can focus on Seed deals in Technology, while working at a generalist VC firm investing in deals across industries, countries and stages. *Positions* were mapped to four seniority levels: Analyst / Associate, Investment Manager, Principal and (Managing) Partner. For example, the Principal role was sometimes called Vice President or Senior Investment Manager. *VC firm* denotes VC firms as "CVC" for Corporate Venture Capital firms. *Top VC* describes the rank of the VC firm (Top 50, Top 100, Top 200) in the EMEA Combined Investor Ranking 2023 by Dealroom (available under https://dealroom.co/guides/vc-investor-ranking).

capitalists focused on Pre-Seed and Seed, 23 on Early Stage, six on Late Stage (series B onwards), and 12 venture capitalists invested in Early Stage and Late Stage companies. Our sample comprises a total of 42 VC firms, of which five were corporate VCs. We interviewed multiple venture capitalists working at the same VC firm for five VC firms in the sample. We cover eight (16%) of the Top 50 VCs and 13 (13%) of the Top 100 VCs, according to DealRoom's EMEA Combined Investor Ranking 2023.

### 6.1.4 Data analysis

To analyze our interview data, we employ the Gioia methodology (see e.g., D. A. Gioia et al. (2013)), which involves a rigorous coding process. Our data analysis begins with a within-case examination of interview transcripts to identify first-order categories directly from the interview data. Subsequently, we conduct a cross-case analysis to identify overarching patterns and themes, similar to Strauss and Corbin (1998)'s idea of axial coding. While first-order categories are information- and participant-centered, second-order themes are theory-centered, focusing on both participant data and existing theoretical concepts. We then further refine these themes and combine them into aggregate dimensions, which serve as the basis for developing our framework.

## 6.2 Findings

We present our findings along our two research questions: In Chapter 6.2.1, we begin by outlining three levels of motives that explain why venture capitalists collaborate with other venture capitalists (RQ 3a): industry-level motives (Chapter 6.2.1.1), VC firm-level motives (Chapter 6.2.1.2) and venture capitalist-level motives (Chapter 6.2.1.3). Figure 6.1 presents an overview of the motives.

In Chapter 6.2.2, we then continue with a detailed analysis of how venture capitalists use their connections along the VC decision-making process (RQ 3b). In line with D. Gioia and Chittipeddi (1991), we present our framework deductively in order to safe space.

### 6.2.1 Motives for collaboration among venture capitalists

#### 6.2.1.1 VC industry-level motives

Our interviews reveal that venture capitalists are motivated to collaborate with other venture capitalists to mitigate the information asymmetries inherent in financing new ventures. As a result, a strong give-and-take dynamic emerges in these collaborations. Given the valuable yet costly-to-obtain nature of information, obtaining ("taking") information from other venture capitalists often facilitates a more efficient identification and

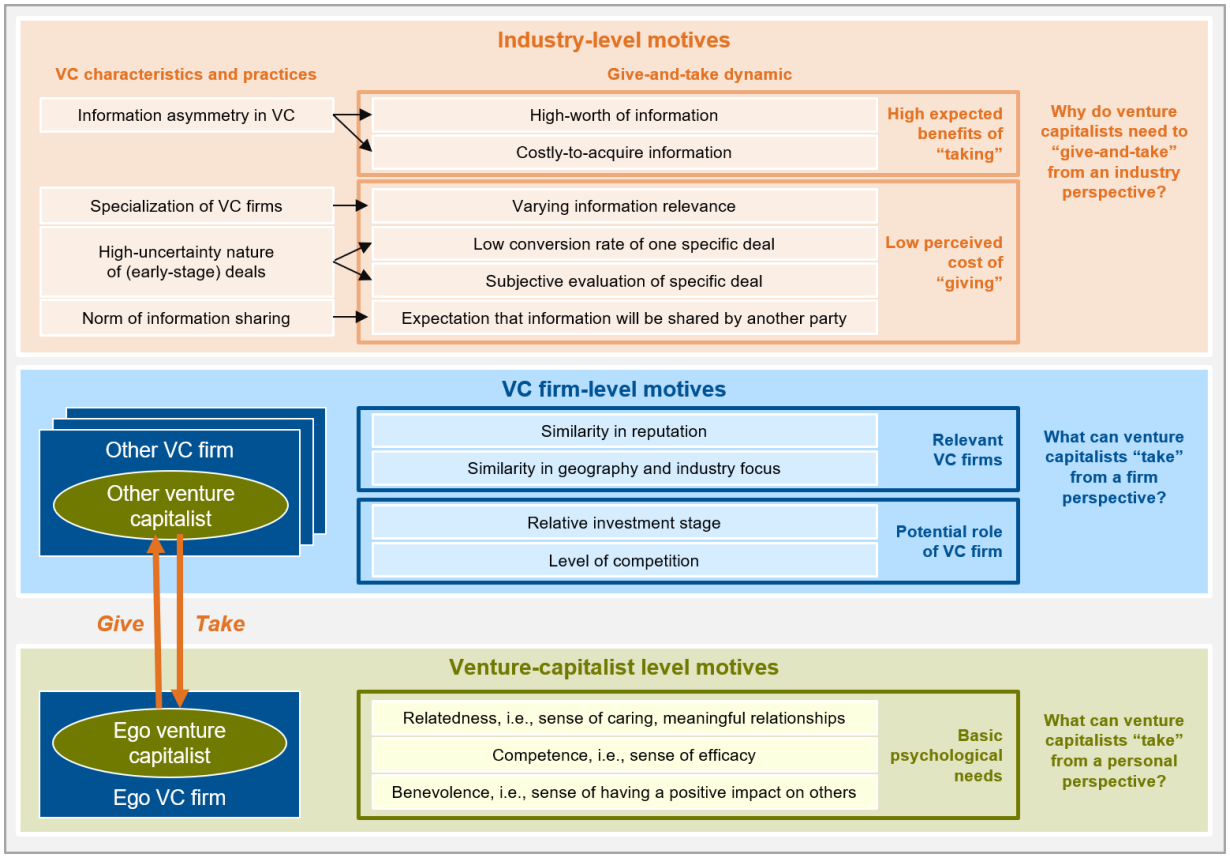



**Figure 6.1** Overview of industry-level (in orange), firm-level (in blue) and venture capitalist-level (in green) motives for collaboration between venture capitalists.

evaluation of potential investments. For example, venture capitalists share high-quality ventures and founder profiles, *"because one naturally doesn't always have a hundred percent overview of the market"* (vc10). They also flag low-quality ventures and founder profiles, as *"one must also manage time very intelligently, (...) [one] can't look at everything"* (vc40). Venture capitalists actively seek informed second opinions from other venture capitalists *"that made a comparable investment, or (...) that have looked at a lot of deals in that field"* (vc19) regarding founders and management teams, market conditions, and business models. Several investors highlighted the efficiency of this approach, for example: *"It makes a lot of sense because [the specialized VCs] have much deeper knowledge in that area. They can tell us within five minutes if something is nonsense, whereas it would take me hours to come to the same conclusion"* (vc08).

By obtaining ("taking") such information, a venture capitalist also sets the expectation of reciprocity ("giving") in the future, similar to the expectation established during syndication (Gulati, 1995; Lockett & Wright, 2001). An illustration of this expectation when "taking" information is reflected in the following quote: *"The person knows that I would do the same for them and that they have some goodwill"* (vc08). Similarly, when "giving" information, venture capitalists consider *"what [the other venture capitalist has] done for [them] before or what [they] think they will reasonably do for [them] if [they] were to ask them the same thing"* (vc 20). Another

venture capitalist illustrates the role of giving-and-taking as follows: *"[We] kind of give the relationship a score (...), like how much sort of in terms of credit, if we are more in the on the debt side or if we're more on the credit side. (...) Just assign plus and minus points, basically. So if I ask someone for something that gives me a minus. If I played them a deal and they liked it, that's a plus two. If it's a deal and they invested in it, that's a plus five. If we do an investment together, it's a plus ten"* (vc15).

As part of this give-and-take dynamic, venture capitalists are inclined to "give" information whenever the expected benefits (of receiving information in the future) surpass the associated costs (of sharing information). The practice of giving-and-taking is prevalent because sharing information valuable to another venture capitalist often incurs negligible costs, while offering potentially high benefits. Three industry factors contribute to these low costs: (1) the common practice of specialization among VC firms, resulting in varying relevance of information among investors; (2) the high-uncertainty nature and consequential low conversion rates of early stage deals, compelling VCs to broaden their investment funnels; and (3) the self-reinforcing norm of information sharing within the industry, where venture capitalists share information because they expect others to do the same ("people talk anyways").

Firstly, the relevance of information varies among venture capitalists due to differences in investment focus. VCs often specialize in specific industries, financing stages, and geographical regions. For instance, a Series B deal is highly relevant for a Series B investor but holds no value for a Seed investor[5]. Similarly, a life science deal is highly relevant for a life science investor, but holds no value for a software specialist. Consequently, sharing such information incurs negligible costs for the latter, while offering a potential upside, if the investors reciprocate the favor in the future by sharing valuable information, for example, a seed or software deal, respectively. Several venture capitalists expressed this view. For example, one explained: *"I get a lot of deals that are too late for me, which I find interesting, so I'll just send them over. It doesn't cost me anything. It just potentially gives me something. I don't benefit immediately, but it's a big matter of goodwill"* (vc15).

Secondly, the high-uncertainty nature of early-stage investments results in a low conversion likelihood of one specific investment opportunity, with many potential deals not advancing past the investment committee or even being blocked earlier in the decision-making process. Therefore, venture capitalists need to broaden the top-of-the-funnel, screening numerous potential investment opportunities until, ultimately, one deal leads to an investment. From the perspective of an individual VC firm, exchanging investment opportunities with other VCs is an efficient way to achieve this. As one VC explained: *"A deal has such a low conversion rate and it is simultaneously so difficult to see everything - [sharing information] simply makes sense from a holistic perspective: if I, being with Fund A, exchange deals with someone else from Fund B, we both end up not*

[5] Ventures typically require multiple rounds of fundraising. The initial venture capital investment is referred to as (Pre-)Seed investment, followed by rounds known as Series A, Series B, and so forth.

*with a subset of 50 deals, but 100. And if we exchange with others, instead of 50, we might have 500, and maybe one out of those 500 goes through. For us, the potential upside is significantly higher than if we were restrictive and didn't show our deals to anyone*" (vc08). This mechanism is similar to what Sorenson and Stuart (2001) identified in the literature on VC syndicates: by "giving" co-investments, venture capitalists can secure access to a greater number of high-quality deals in the future. From a holistic industry perspective, this exchange of investment opportunities also makes sense. Given the inherent uncertainty and limited availability of information, there is often no definitive right or wrong decision to invest. Each VC firm has its own investment criteria and biases. As another venture capitalist noted: *"Even when people share deals with you, they might not end up even being part of the round. They might choose to pass on the opportunity themselves. It's quite common. I think every investment committee is so different that deals get blocked for so many different reasons"* (vc 20). Consequently, another investor might still want to invest and find the information about a deal valuable, where one VC does not: *"If we pass on a deal, it doesn't mean that other VCs... We might have our own biases, we might have our own view of the market that the entrepreneur does not share, and that the other fund does not share. So you always try to be honest about what you liked, what you did not like, and also where we're coming from, coming from a position as a specialist. So some companies are failing in this space, for instance, and we don't want to do it. But that doesn't mean we are right. Like, look, this is our bias"* (vc21).

Finally, the VC industry is characterized by a prevalent practice of information sharing. Several venture capitalists mentioned that information *"can easily end up with the entire VC community in [city 1] and [city 2] within five minutes, because this exchange happens"* (vc14), leading to an industry where *"it's rare, very rare, that you don't hear about [a deal]"* (vc 23), because *"somehow you always get the information, via one way or the other"* (vc16), *"maybe you know the founder from somewhere, maybe you got it from someone"* (vc01). Moreover, getting access to truly proprietary information and deals is rare: *"the likelihood of finding a startup that is currently fundraising and hasn't talked to any other [...] investors is incredibly low"* (vc22). This norm leads to a self-reinforcing cycle, where venture capitalists share information because they expect others to do the same ("people talk anyways"), as the following quote illustrates: *"Word travels very fast. And there are people who are much more open than I am. And that's why []... it's also the case with a portfolio company: there are ten investors besides you in the same company. Then you can be super restrictive and not share anything about this portfolio company. The point is: it only takes one of the other ten to share something, and the whole market knows"* (vc08). Therefore, venture capitalists tend to pro-actively disclose information in order to capture the benefits and mitigate potential negative impacts on the relationships. In contrast, withholding information would mean forgoing potential future benefits, as it prevents the accumulation of goodwill with the other party and, thus, eliminates the need for reciprocation in the future. Moreover, the other party likely

discovers the information from an alternative source and, thus, may become aware that the information was intentionally withheld, which could prompt them to withhold information in the future as well.

#### 6.2.1.2 VC firm-level motives

In addition to industry factors, collaboration among venture capitalists is also significantly shaped by the characteristics and strategic focus of their respective VC firms. These VC firm-level attributes determine the resources that venture capitalists can "take" from one another from a firm perspective (see Figure 6.1). First, venture capitalists identify those who potentially hold (and, therefore, are able to "give") relevant information based on the reputation and investment focus of the VC firm, namely geography and industry focus of the VC firm (6.2.1.2.1). Second, among VC firms where collaboration is feasible, the types of resources they can give-and-take vary depending on their preferred investment stage and the level of competition between them. We identify four distinct collaboration archetypes, each characterized by the resources exchanged (6.2.1.2.2).

##### 6.2.1.2.1 Relevant VC firms

VC firms that share similarities in geographic focus, industry specialization, and reputation constitute a subset of VCs with whom collaboration is strategically beneficial due to VC-firm level motives. When there is no such overlap, there are limited firm-level motives for collaboration. As one venture capitalist summarized: *"In the end, it's less of a numbers game and more about understanding who are the few that a) see something interesting, b) have an overlap with what you also find interesting"* (vc47). In this quote, a) pertains to reputation, while b) relates to similarity in geographic and industry focus.

VC firms tend to collaborate with VC firms of similar reputation (tier). Firm-level collaboration motives tend to be limited when there is a tier difference. For example, a globally renowned VC firm will have limited firm-level incentives to engage in a give-and-take exchange with a lesser-known firm: *"You usually end up sticking with people from your tier; [...] the problem is they do not get to see the best things in the market. So I wouldn't actively source or reach out to people in these (lower tier) funds"* (vc32). Within these equal tier groups, VC firms more frequently exchange information: *"Certain deals are almost exclusively shared among Tier 1 investors and essentially never leave this circle"* (vc43). At the same time, the reputation of a VC firm influences how much a VC firm depends on collaborating with other VCs: *"If you are the tier one fund, you do not need the others as much as they need you, because already the best founders want to be part of your fund. So they do not have the same urge to share as people in your tier where you're actually collaborating together"* (vc32).

We propose an inverted U-shaped relationship between similarity in geography and industry focus and the level of collaboration. When VCs are too similar, their specific knowledge and skills are not complementary. The value-add rationale for syndication (e.g., Brander et al. (2002); Manigart et al. (2006) emphasizes that VCs syndicate because they bring complementary value-add to portfolio companies due to their differing information and skills, thereby benefiting from the exchange of their specific knowledge and expertise. However, being able to give-and-take necessitates some degree of overlap in *"geographical and thematic fit"* (vc 19). The main reason for this is the relevance of shared information. VCs with overlapping investment focuses can share more pertinent information and provide more informed opinions on market trends, deals, and companies. Syndicating with other VCs leads to an improved selection process, where the information received from syndicate partners may help to reach better decisions (Brander et al., 2002; Lerner, 1994). Conversely, differing investment focuses hinder the ability to share relevant information and, therefore, do not enhance the selection process: *"The problem is really that if they are too far away, they often see very little in your specific area that truly fits"* (vc22); *"I personally try to build a good relationship with especially the funds where I feel there is the most overlap, also in terms of content"* (vc 05). For example, an UK-focused healthcare VC firm will most likely not benefit from the exchange with a France-focused agriculture VC firm because they have little overlap in industry and geography.

#### 6.2.1.2.2 Potential role of the VC firm (collaboration archetypes)

Venture capitalists consider the potential role the other VC firm for an investment opportunity or portfolio company based on the preferred investment stage and level of competition: *"I very consciously consider what role someone can play in the deal. And if someone could become a threat to me, I think twice about [sharing cool things]"* (vc14); *"It's a fine line between being a competitor and a suitable partner as a VC fund. I rarely go into a deal alone; I prefer to join a syndicate with at least one, or maybe two, other institutional investors. This depends on the size of the round and how many spots are available for each investor. However, I do consider whether a potential partner is more of a syndicate partner or a competitor with a similar investment focus, against whom we might lose a deal"* (vc11). Our resulting framework (see Figure 6.2) categorizes connections between venture capitalists into four collaboration archetypes: Feeder VCs, Frenemy Peers, Friendly Peers, and Follow-on VCs.

Venture capitalists consistently differentiate between connections in their network based on the preferred investment stage of the VCs. Specifically, they consider what we define as the relative stage focus, i.e., whether the other VC firm invests at an earlier, concurrent, or later stage compared to their own preferred investment stage. This differentiation is either explicitly stated, such as *"I like to distinguish between funds that are traditionally*

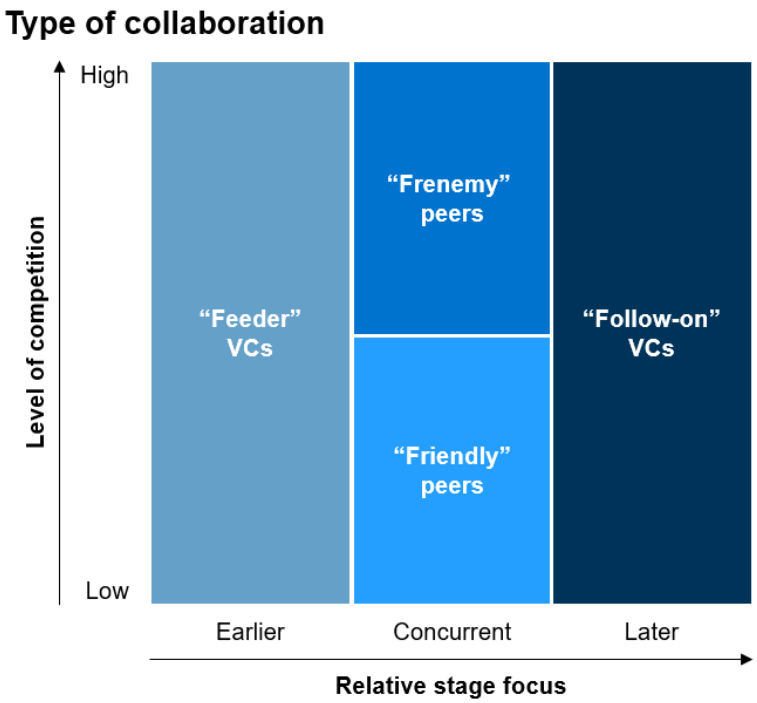



**Figure 6.2 Collaboration archetypes**. Four collaboration archetypes based on (1) the relative stage focus of the collaborator's VC firm compared to the preferred investment stage of the ego-VC firm, and (2) the level of competition between the two VC firms.

*positioned before us in stage, those that come after us, and those that are in the same stage"* (vc34) , or inferred through various scenarios described along the investment-decision funnel, where venture capitalists highlight engaging with VCs that focus on different stages. Therefore, based on the relative stage focus of the VC firm, we propose the following typology of connections:

1. **"Feeder" VCs**, which invest in earlier stages and whose portfolio companies constitute potential investment opportunities: *"Those [VC firms] that invest earlier are obviously relevant because their companies eventually reach this stage and then need investors for follow-on rounds"* (vc46). However, not all VC firms that invest earlier are natural "Feeder" VCs. Typically, VC firms benefit most from information exchange with investors that invest one or two rounds before them. As one late stage investor described: *"Everyone is pretty much earlier than me. Everyone is kind of relevant. But I don't really spend that much time with like the pre-seed, seed people because they're just less relevant. The companies are too small"* (vc18). For a Series A investor, the group of Feeder VCs constitutes of (Pre-)Seed investors.

2. **Peer VCs**, which invest in the same stage: *"And there are our peers. And they are people at funds like [VC firm 1], [VC firm 2], and [VC firm 3], who invest in the same stage as we do. Sometimes they are already invested in a company, and then we invest, or sometimes we are already invested, and then they*

*invest. But often, we are simply competing for the same deals"* (vc02). For a Series A investor, other Series A investors constitute the Peer group.

3. **"Follow-on" VCs**, which invest in later stages and constitute potential follow-on investors for a VC's portfolio companies: *"You tend to try and form deeper relationships with funds that you hope will be following on to a ton of your portfolio"* (vc50). For a Series A investor, Follow-On VCs begin with Series B investors.

There are very few pairs of VC firms, even among Peer VCs, that do not collaborate at all. In the following, we detail the nuanced nature of collaboration among Peer VCs, which we further categorize into **(2A) "Frenemy" Peers** and **(2B) "Friendly" Peers** based on the level of competition, because venture capitalists always consider the potential role of the other VC when sharing information. Venture capitalists collaborate with peers *"as long as [they are]] sure, that [they themselves] will be on the Cap Table"* (vc21). Hence, two VCs are less inclined to collaborate, the more they are *"both playing in the exact same space"* (vc29).

Still, there are some peers - Friendly Peers - that invest at the same stage and with whom the level of competition is low. Friendly Peers, therefore, consistently adopt a collaborative approach. This is often due to (1) complementary investment strategies, such as acting as follower and lead investor, (2) value-add stemming from different strategic focus, or (3) operating in a less competitive industry.

First, an investment strategy that allows for followers or co-investors fosters collaboration among venture capitalists by creating opportunities for mutual benefit and resource sharing: *"We typically look for syndicate partners for investments. From an outsider's perspective, you might say, 'Okay, you're competitors. You invest in exactly the same topics.' [...] However, if it's clear that having multiple investors at the table would be beneficial or if the ticket size is too large for just one investor, then it makes sense for multiple investors to collaborate. And that's what we do, even with our peers"* (vc17). When VCs adopt flexible roles, such as leading, co-leading, or following in investment rounds, they can accommodate varying deal sizes and stages, facilitating easier syndication of deals. As one investor notes: *"And because we can take on any role in this arrangement, I believe we are always a very appreciated partner. Perhaps that's also why many other VCs are keen to share deals with us. The micro funds that only take follower tickets send me opportunities because they say, '[vc09] takes the lead.' Similarly, the lead funds send me deals saying, '[vc09], look, I'm leading this round and there's still 500K available'"* (vc09). This flexibility also reduces the perception of competition: *"The good thing about us is that we don't always lead rounds. Many funds have clear ownership targets and typically want to lead to achieve those targets, often saying, 'Hey, you need to have at least 15%, at least 20%.'*

*But we are very flexible. Sometimes we only take a follower ticket; we can co-lead; and we can lead. We don't have these ownership targets. This means that for many funds, when they show us a deal, they don't see it as super competitive; instead, they might consider doing it together with us"* (vc06). This collaborative approach is particularly crucial for VCs that primarily follow, as they rely on partnerships with lead investors. A venture capitalist from a VC firm that typically leads rounds highlights the differing incentives for these investors: *"Let's say you're doing a seed stage investment and a seed stage fund recommends someone to you. [...] They'll say, 'Hey, I'm really excited about this company. We're going to follow for this portfolio company. We are looking for a lead, and we just want to introduce our network.' And then the incentives are a bit different at that point. Like they haven't invested but they're really keen to. They just don't typically price rounds. And so they need a lead like [us] to come in and price the round and lead it"* (vc50).

Second, venture capitalists *"share deals where [they] believe there is added value - beyond just money - from a syndicate"* (vc37). Venture capitalists strategically choose partners whose financial or managerial resources complement their own deficiencies (Brander et al., 2002), allowing them to leverage the diverse skills, investment expertise and access to information that different venture capitalists bring to the cap table (Hopp & Rieder, 2011). Similar to the value-adding rationale for syndication, the added value of collaboration may arise from collaborating with a specialized or local VC to gain more in-depth knowledge on a specific industry or market: *"[Since DeepTech] is new for long-standing investors, they naturally like to partner up to bring more knowledge into the cap table. This is currently quite advantageous for us because we receive a lot of high-quality opportunities, which are much better than randomly browsing through various sites, accelerators, and the like"* (vc24); *"For example, if I am looking at a specific industry - since we are agnostic, and this is precisely the difference between a sector specialist and an agnostic fund - I often know that there is someone in another fund who focuses solely on logistics, mobility, or fintech. So, I frequently ask them if they have seen this before, what they think about it, and if they have considered it. Often, there is a high success rate because startups tend to start with the right VCs. This means you get many, many references, actually"* (vc44); *"Geographical differentiation is also a big thing. If you're talking to French funds: 'Hey, if the company wins France and Germany, it's going to be a great company. Let's do a deal together'. So you always think in the consortium building mindset"* (vc15).

Third, some VC firms operate in less competitive industries and, therefore, do not regard their peers as competitors due to the unique dynamics of these industries. As one venture capitalist noted, when asked for the reasons of collaborating with competing peers: *"I don't see that we are competitors. Because the pool of investors is so small here in Europe. So I think we are forming more like a guild of few, specialist players"* (vc 35).

In contrast, Frenemy Peers are VCs investing at the same stage but in a competitive manner, leading to a more limited upside in collaboration: *"To have (a) relationship with purely competing funds... Say that we were a pure Series B fund, and the other fund was a pure Series A fund, and both funds are always lead investors, then there's probably not much use in that relationship"* (vc27). These Frenemy Peers often compete for the same deals, leaving little to no room for their competitors in the investment round if they succeed. Therefore, *"one is probably reluctant to share with them because you think, hey, they could take the entire deal away"* (vc 26). Still, there is some degree of collaboration among these competitors. For example, "frenemy" peers often share information about non-competitive deals, where they have chosen not to invest in or believe they have a low chance of winning: *"The second way, that is also non-competitive, is when you consistently show each other deals that aren't relevant to you for some reason. [...] For example, we didn't do any [industry] deals. So, if I show a [industry] deal to a [industry] investor and they come across a [Business-to-Business Software-as-a-Service] deal they can't do, they show it to me"* (vc08); *"sometimes they share top opportunities if they know they can't win them. You know, if top-tier US funds are already involved and you're a smaller player like [VC firm]. Then you probably know you're likely to lose, so you play it a bit tactical and share it, essentially to build some goodwill"* (vc47). In line with the "give-and-take" mechanism, they collaborate in the hope that the competing VC will reciprocate: *"This deal doesn't fit for us right now, but it might be perfect for them, and then maybe I'll get something from them in the future"* (vc46). Venture capitalists emphasized that sharing opportunities they have passed on does not imply they are sharing bad deals. Despite being competitors, there is often differentiation in their investment theses and rationale or the VC firm may be conflicted because of an earlier investment: *"Especially since every investor looks at the same company somewhat differently, values different aspects, and may have slightly different preferences. You can never rule out that a deal you pass on might still be a great fit for someone else"* (vc43); *"In case you decided to pass on that deal for a certain reason, let's say I pass on a lot of opportunities because we already have competing opportunities in our portfolio. So sometimes, even though the company is great, it doesn't make sense for us to invest in a mobility company for the second time, because we already have one in our portfolio. And in that case, I'll share it or other investors will share it with me. Even if we are competing to each other at other times"* (vc12). When sharing information on the way to deciding not to invest, they are seeking an informed second opinion to challenge their rationale, as exemplified by the following quote: *"I only actually did it last week for a company that I knew we were going to kill already, but just because we knew that probably these other guys saw it. And I wanted to validate that the reasons why we were going to kill it, over there, is was it is"* (vc30).

All together, we identify four distinct collaboration archetypes that differ in preferred investment stage and level of competition between VC firms: feeder VCs, friendly peers, frenemy peers, and follow-on VCs (see Figure 6.2). Investors disagreed on which type of connections is the most valuable. For some, it is the Feeders: *"I would say typically the stage right before you invest is the the stage that's most relevant"* (vc27). For others, Peers hold greater importance: *"Honestly, [my network is] probably 65% competitors or people at the same stage. [...] The quality of dealflow you get from someone at the same stage is just much higher than going through all the Seed funds and maintaining relationships with them"* (vc20). Yet for others, it is the Followers: *"Overall, we have more conversations with growth funds because we are constantly looking for new investors for the later stages of our portfolio companies"* (vc38).

#### 6.2.1.3 Venture capitalist-level (personal) motives

Finally, the give-and-take dynamic between venture capitalists is further shaped by the underlying human relationships and, ultimately, by the basic psychological needs of the individuals involved. As the venture capitalist quoted earlier (Chapter 6.2.1.2) went on to say: *"In the end, it's less of a numbers game and more about understanding who are the few that a) see something interesting, b) have an overlap with what you also find interesting, and c) you really need to vibe personally with the people. If you don't feel it, it's tough to enforce"* (vc47). We explore these venture capital-level motives for collaboration through the lens of Self-Determination Theory (see Chapter 2.4). Our findings indicate that the primary driver of collaboration between venture capitalists is the need for relatedness, followed by the needs for competence and beneficence. Our interviews did not yield evidence supporting autonomy as a significant factor in this context.

**Relatedness:** As the quote above illustrates, for venture capitalists the need for relatedness - the sense of caring, meaningful relationships - with other venture capitalists strongly shapes their venture capitalist network. The familiar adage "whom you know matters", which Y. Hochberg et al. (2007) use in the context of VC firm-to-VC firm networks, transforms into "whom you like and trust matters" in the context of venture capitalist-to-venture capitalist networks. All investors emphasized the role of relatedness, which was often described using terms like "good vibes," "chemistry," "close relationship," "liking each other," or "getting along well on a personal level": *"And partially it's a question of compatibility between people that leads to success"* (vc17); *"in the end, it's like a piggy bank. You have to put something in, either because you bond on a personal level or because you bring value to each other in some way"* (vc34); *"It's 150 people that I met over the last 12 months. And I met all of these people at least once. 20 I found out I like. And these are the people I try to hang out with - because I connect with them on a personal level"* (vc36); *"It's a people business, right. So it's really dependent*

*on your affinities in terms of industries, but also in terms of people. Like most people I speak with, it's people I like. I like to share deals and like discuss - it's with people that I like"* (vc48).

**Competence:** Competence - the sense of efficacy - motivates collaboration among venture capitalists through two mechanisms: the pursuit of validation from peers and the engagement in adaptive career behaviors.

Venture capitalists seek and value the opinions of their peers, receiving acknowledgment, appreciation, and affirmation, which enhances their sense of competence. For example, investors like to share their opinion because *"when someone asks [them], 'What do you think about this?' it also makes [them] feel like (...) [they] both value each other's input"* (vc42). This form of validation is particularly meaningful when it comes from investors whose opinions the venture capitalist holds in high regard.

Adaptive career behaviours, defined as "behaviors that people employ to help direct their own career (and educational) development" (Lent & Brown, 2013), are prevalent among venture capitalists. For example, adaptive career behaviors are evident through collaborative efforts focused on building and maintaining one's own reputation and network. As one investor noted, *"the longer you work in this industry, the more you're responsible for building your own reputation"* (vc31). This reputation and network proves valuable beyond the venture capitalists' current job: *"Even if you end up working for another fund or doing something completely different, like switching to the founder side, the one thing you really keep, in a sense, is your contacts and network"* (vc05). Furthermore, investors utilize their venture capitalist network for career-related coaching: *"I had a handful of people I could trustfully go to. Also with those typical questions, that you might have in the beginning, but that you maybe don't want to ask your general partner"* (vc02). Several investors highlighted the prevalence of adaptive career behaviors particularly among non-partner investors, indicating a shift in behavior as their careers progress and their roles and incentives evolve: *"Sometimes juniors tend to overshare. At some point, you realize you can't do that anymore. You have more carry in the fund, and your incentives are different"* (vc39). For non-partner investors, collaboration is often aimed at one's own or mutual professional growth: *"At least at the non-partner level, people are generally more focused on working on their own development or helping others work on their development"* (vc43); *"I think people on the other hand, usually want to help each other grow, because then if you have stronger allies, you're better"* (vc32).

**Beneficence:** Finally, beneficence - the sense of having a positive impact on others (Martela & Riekki, 2018) - fosters collaboration among venture capitalists. Several investors have expressed that assisting founders is their primary motivation for proactively sharing information within their investor network. Here, collaboration is driven by the investor's desire to assist the founders, rather than by any expectation of future reciprocation from other venture capitalists. For example, one investor noted, *"Because I find these founders so great, I think about*

*how I can help them and which investors might be a good fit for them"* (vc22). Another investor highlighted their commitment to helping underrepresented founders: *"And particularly for [...] overlooked founders. So if I say no, I'll always give feedback as to why I'm saying no. But then I'll also say, 'here's who I think you'd be a better fit for.' And then I'm happy to make like 2 or 3 intros [...]"* (vc50). The primary motivation for collaborating with other investors often remains the expectation of future reciprocation, with several investors emphasizing mutual support and the anticipation of receiving help in return for offering it. Nevertheless, assisting fellow investors also provides venture capitalists with a sense of satisfaction and positivity: *"If you can do someone a favor - or if you can ask someone for advice and they are happy to help you out - I think that's just something positive"* (vc42).

### 6.2.2 How venture capitalists use their connections in the VC decision-making process

In the following, we detail the resources that venture capitalists give-and-take throughout the VC decision-making process depicted in Figure 2.1 (RQ 3b), building on prior work of scholars such as Tyebjee and Bruno (1984) and Gompers et al. (2020). Specifically, we highlight the similarities and differences across the four collaboration archetypes. Figures 6.4 and 6.5 provide an overview of the resources that venture capitalists take and give, respectively. Moreover, we emphasize the advantages of having a strong relationship and foundation of trust with other venture capitalists throughout the decision-making process.

On the one side, there are several ways in which venture capitalists engage in give-and-take irrespective of firm-level motives. Here, the collaboration is rooted in scenarios that either present a "win-win" situation, where both venture capitalists equally benefit from giving and taking (e.g., when discussing market trends, both venture capitalists share and receive valuable insights), or a balanced reciprocity, where they can exchange equivalent information (e.g., both investors can refer relevant companies to each other).

In deal sourcing, venture capitalists engage in *"sharing notes"* (vc39) with other venture capitalists, discussing general industry trends, such as *"what technologies [the other VCs] are currently seeing develop or what business models are emerging"* (vc25). Additionally, they sometimes prepare *"deep dives"* (vc13) on specific topics to share with their investor network. One venture capitalist noted: *"And even if not deals, I have shared knowledge. I have written some articles that we published and I used them a bit as an anchor: Hey, I found this interesting, let's talk about it. And I'm super happy to share my hypotheses, etc."* (vc14). Sharing notes with differently focused funds allow venture capitalists to broaden their market perspective, as one venture capitalist explained: *"It's a way of understanding what the market's doing. Because as a specialised fund, you tend to see the market with your specific lens. You see a lot of EdTech companies, you see a lot of companies that are*

*Series A and Series B. And if you don't open your eyes to what's happening in adjacent markets, then you might miss out on opportunities"* (vc21). Ultimately, this exchange helps them to sharpen their investment hypotheses: *"You engage in a general exchange of content and ideas, which doesn't necessarily lead to something but rather contributes to building your thesis in a certain area. For example, asking "Hey, what is interesting in construction? What categories for building ventures could be generally interesting there?"* (vc08).

In the screening phase, there is little to none collaboration: *"It's more about whether there's a fit, whether we would make the investment, if it aligns with our criteria, like ticket size—so, quite high level. I don't use my network for that"* (vc42). However, referrals from other venture capitalists typically skip the initial screening: *"The network has an impact on the prioritization within the funnel (...). When a network deal comes in, meaning someone forwards the deal to me, the initial screening phase by our [screening team] is skipped, and I always take a look at it personally"* (vc10). This is attributed to the signal that comes with a recommendation. These deals have been pre-vetted by another venture capitalist who knows the VC's investment focus and preferences and, thus, are often of higher quality: *"That dealflow is usually the most progressed because someone else has filtered through it first. (...) When you speak to another investor, because we're talking so much and everyone knows everyone else's thesis, it kind of get pre-vetted; it really fits the thesis. And now it's just up to you to figure out if you have conviction or not"* (vc45).

Similarly, during evaluation, VC firms prioritize an independent assessment of the company. Sometimes they leverage their network to obtain proprietary information, for example, on a competing company that another VC has invested in: *"Exchange about certain similar investments, exchange about competitors they might be invested in. This means they know the market, they understand how the products stand relative to each other, and how the companies stand relative to one another"* (vc33). They try to find out: *"What their revenues are. Not exact numbers, but a good idea. (...) Whether things are going well or not. What they're currently working on with management. For example, if they're in the middle of international expansion and it's not going well in France for whatever reason. Those are valuable pieces of information for us"* (vc03).

When structuring a deal, venture capitalists also leverage their network for intelligence on competing funds, either indirectly through their contacts or directly from the competing VC firm itself: *"To some extent, I also use my network to get a sense of [the competition]. Maybe the person has heard which funds are looking at [the deal]. Because that way you can understand how competitive the deal will be and how quickly you need to come to an offer"* (vc04); *"Sometimes you use your network to find out, 'Have you already put in a term sheet? How much are you offering? At what valuation?'"* (vc42). Additionally, they seek details on the terms being offered by competing funds: *"If it's a competitive deal, you always try to find out through the grapevine: 'Hey, what deal terms has the other VC fund just offered?' So you can gauge your own offer and understand what the*

*other is offering. Who else is in the process? And often, if it's directly competitive and we're competing with [VC A], we might hear from [VC B] what [VC A] has done"* (vc16).

While monitoring and adding value to their portfolio companies, venture capitalists often seek advice for specific problems within their portfolio: *"In general, when it comes to portfolio work, it often happens that you have questions. If a specific problem arises, you turn to your network to find out if someone has been in a similar situation and has a solution. This happens quite frequently"* (vc43). Moreover, they continue to exchange insights on market trends with other investors: *"If an investor has invested in a competitor, you need to be a bit careful. However, if you notice any shifts or trends in the market, it can be quite interesting to exchange insights at a relatively high level"* (vc07).

On the other hand, the give-and-take dynamics of the venture capitalist-to-venture capitalist relationships vary across the four collaboration archetypes. In the following, we elaborate on these distinct differences from the perspective of one specific VC firm (ego VC firm) and relationships of one specific venture capitalist (ego venture capitalist) with the Feeder VCs, Friendly Peers, Frenemy Peers, and Follow-On investors relative to the ego VC (see Figure 6.3). Figure 6.4 presents an overview of what venture capitalists "take" from the collaborating VC (labeled as T1, T2, etc.), while Figure 6.5 illustrates what they "give" in return (labeled as G1, G2, etc.).

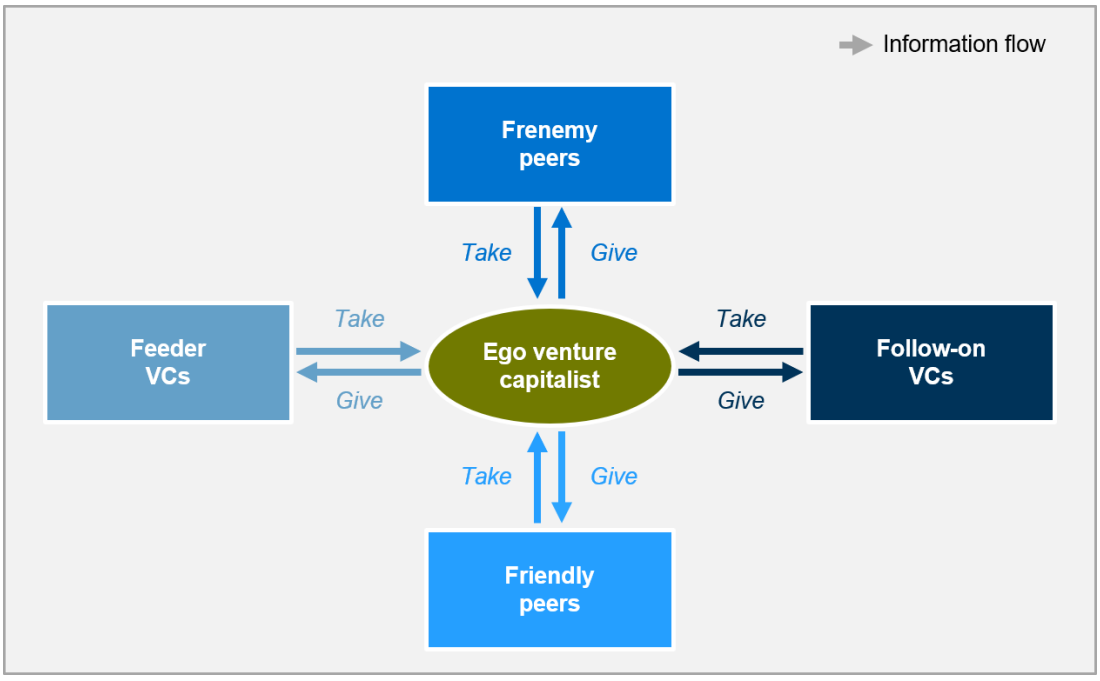



**Figure 6.3 Give-and-take dynamics across collaboration archetypes**

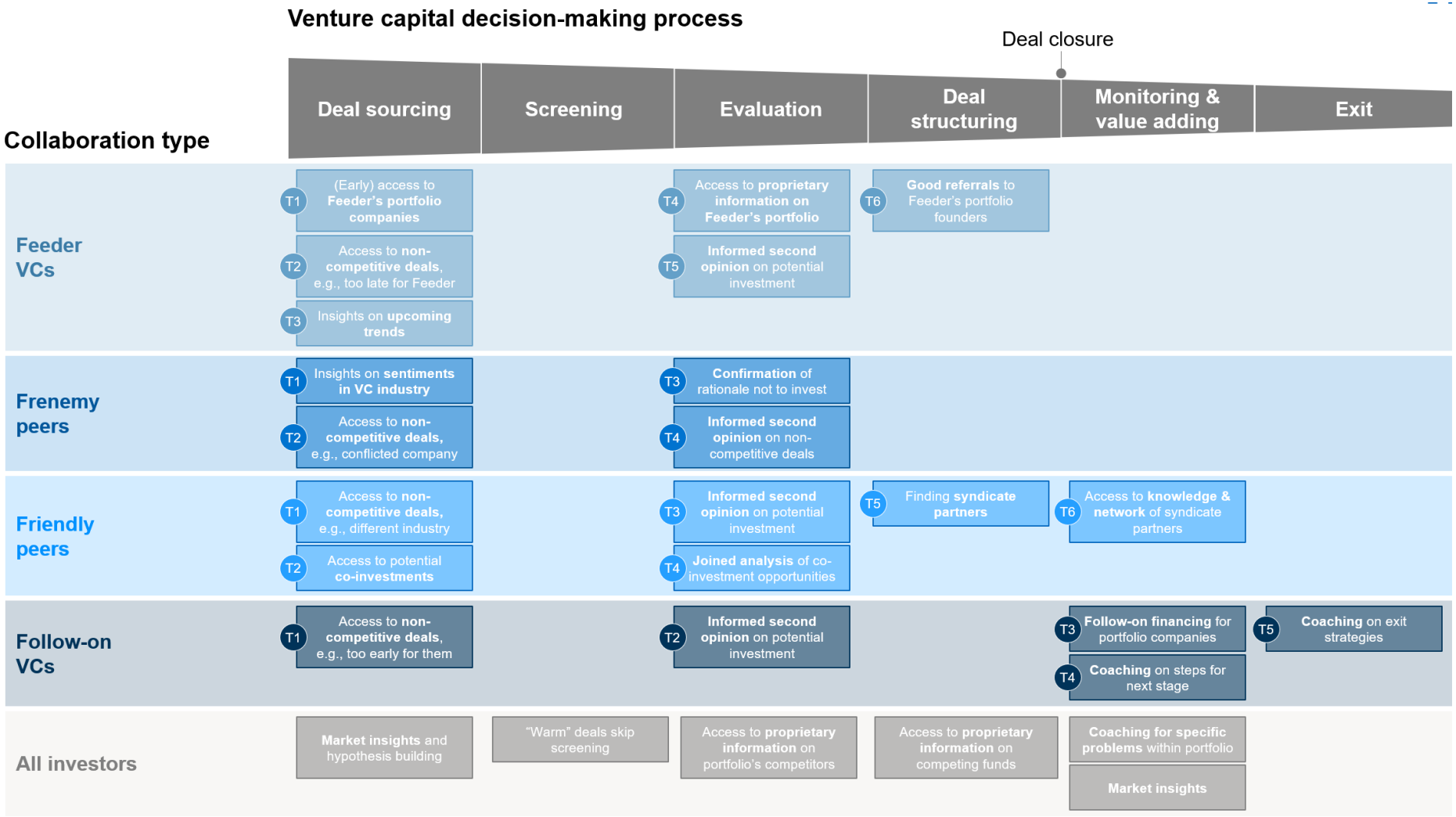



**Figure 6.4 Take mechanisms along the VC decision making process**

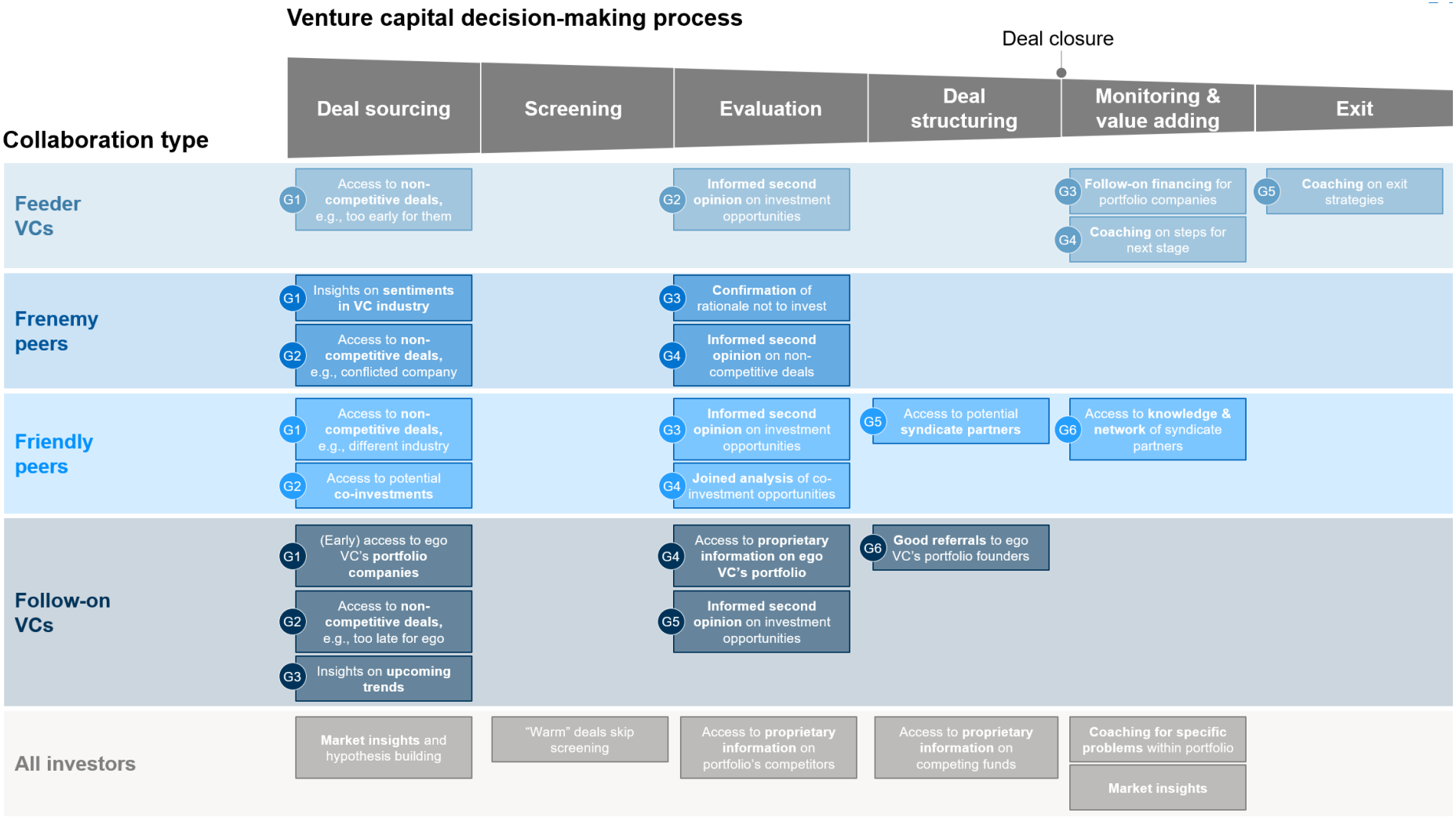



**Figure 6.5 Give mechanisms along the VC decision making process**

**Feeder VCs:** The primary objective for the ego VC is to gain access to high-quality deal flow from the earlier-stage Feeder VCs' portfolios (T1), and for the Feeder VC to secure follow-on financing for their portfolio (G3). Therefore, the incentives are well-aligned: *"It's a give-and-take relationship. They give us access to good deals, and then we invest in their companies at a higher valuation. So, it's a win-win"* (vc01). Strong upstream relationships enable the ego VC to stay informed about investment opportunities within the Feeder's portfolio. Specifically, venture capitalists leverage these connections to get introductions to the management team and to learn about upcoming fundraising timelines: *"So the number one thing that you want to ensure is that you are able to get an introduction upon asking. The next level is to be able to get an introduction to a hot company. So sometimes there are companies that only want to speak to 10 or 15 investors. (...) You want to make sure that you're part of those 10 or 15 funds. And so that I would say this is the next level (...): to be able to crack these companies - crack open an introduction. And then the closest level of relationship you can have is to get a heads up from a VC when a company goes out for fundraising. And again, VC is an outlier game, so in every VC fund there are probably only a third or so of their companies are actually really worth looking at (...). And so you want to make sure that you're getting a heads up for those. And that's probably the closest relationship you can have"* (vc27). Building strong upstream relationships is more efficient than independently tracking all of the Feeders' portfolio companies, as one venture capitalist explained: *"Because I can track their portfolio of 20 companies, but they will know, 'Hey, next month, we're raising a series B on this portfolio company', and there's no way that I would be able to know that myself. Because at any given time I'm tracking 100 companies to invest in"* (vc18). During evaluation, venture capitalist may also get detailed and proprietary information from the Feeder VCs on their portfolio companies (T4). They can get an informed, yet potentially biased, opinion from the previous investor on, for example, the management team, current business challenges, and valuation expectations: *"I will reach out to them and ask for more details in my [Due Diligence]. For instance: 'Hey, what do you think about this management team? Like, how easy are they to work with? (...) How are they doing in terms of traction? Why are they not yet achieving these revenue, as we would expect to see? What has been like hindering them to do so?'"* (vc12). And, ultimately, Feeder VCs can vouch for the later-stage ego VC, helping the latter to win the founders of their portfolio company over (T6): *"Your VC network can help you win deals. So if I put on a Term Sheet and there is a befriended VC on the cap table, I will definitely make sure that they will put in a good word for me. And typically their word is heard by the founder"* (vc27).

Moreover, Feeders may exchange non-competitive, yet exciting, deals with the ego VC. Earlier-stage Feeder VCs give deals that are too late for themselves (but fit the later-stage ego VC) (T2); the later-stage ego VC gives deals that are too early for themselves (but fit the earlier-stage Feeder VCs) (G1): *"[Seed investors] can form a very synergistic relationship with [series A and Series B] investors, they can say: look, these are all the good*

*stuff that we see moving up into the series A and series B space. And these later stage investors can say: look, this is all the stuff that's too early for us, but may be very interesting for you"* (vc29). Again, the relationship with Feeders is very collaborative: *"Sharing is a lot more open in this context because you're not stepping on each other's toes or worrying that a good deal will be taken by someone else"* (vc23).

Finally, the later-stage ego VC and its Feeder VCs also interact in ways that are not directly related to generating new deal flow. Content sparring is an integral part of the Feeder relationship, with the Feeder VC benefiting from a later-stage perspective and the ego VC benefiting from an earlier-stage perspective. The ego VC can provide their later-stage perspective on the necessary steps leading up to the next fundraising round, both for potential target companies (G2) and for the Feeder's current portfolio companies (G4): *"If the seed company is raising a Series A, I still look at it from a Series B perspective and say: Hey, the company needs to prove this in the Series A to be relevant for Series B"* (vc19). The ego VC may also provide guidance on the exit strategy of a portfolio company (G5): *"Later-stage investors naturally have much better contacts with potential exit channels. (...) You might say: 'Okay, listen, you've sold companies to this and that firm. What should we pay attention to? What was particularly convincing for them? And potentially, could you make an introduction?'"* (vc04). Feeder VCs, being involved earlier in the investment cycle, can offer valuable market insights and trends from their early-stage perspective, helping them to understand trends early on (T3): *"They get access to front-tier tech innovation earlier. So when you talk to them, you get an insight on where innovation is going. And we see it 6 or 8 months later when this topic continues to [our] stage. (...) But you can build your conviction very early on by talking to funds who are earlier in the process"* (vc21). Further, venture capitalists might seek an informed second opinion on an investment opportunity that falls within the industry expertise of either the Feeder VC (T5) or the later-stage ego VC (G2). Maybe the Feeder VC has already met the company in the past, and might be able to raise interesting points on why they did not decide to invest or share the research they have done on the industry. Feeder VCs may benefit from the ego VC's access to more detailed data and reports: *"Their field typically involves much more capital than ours, so naturally, they have much larger networks and often more in-depth reports. So, sometimes, they have interesting insights to share"* (vc13).

**Frenemy Peers:** Collaboration among Frenemy Peers is limited to sharing general insights on the VC industry (T1, G1), non-competitive deal flow (T2, G2) and seeking confirmation of their rationale not to invest (T3, G3).

Frenemy Peers can best gauge the overall sentiment in the VC industry through discussions with each other (T1, G1): *"With investors on the same level, you naturally get more insights into what's happening. It's like having many small sensors in the market"* (vc46). Multiple investors have explained that they also conduct regular

catch-ups with their competitors. One investor highlighted that these interactions are *"more about sentiment checking, like, 'How's your deal flow? Are you seeing a lot of deals? What are your current challenges? What's going well?' But you don't really talk about deal flow"* (vc03).

A VC firm is generally not incentivized to share hot deal flow with Frenemy Peers because *"on competitive deals, you don't want to tell people that you are looking at the space"* (vc36). Especially for top tier funds, there is a signaling risk: *"If you create the impression that you might put on a Term Sheet for something, you might have just increased the price for yourself. If other people know that you're a good fund, then if they decide to bid, then they need to bid more to win against you"* (vc 27). Consequently, *"when you're on the same level, there's the risk that you only get shown the deals that aren't really hot"* (vc23). While deal flow exchange with Frenemy Peers is often *"less transparent"* (vc31), VCs do share non-competitive deal flow (T2, G2). This exchange can be non-competitive for several reasons. A VC might find a target company an interesting investment opportunity, but ultimately not a fit for their own fund and investment criteria: *"Especially since every investor looks at the same company a bit differently, values different aspects, and maybe has slightly different preferences. You can never rule out that if you pass on a deal, it might actually be a perfect fit for someone else"* (vc43). For example, they may be conflicted because of an existing investment in a portfolio company. *"A lot of the times we have companies where we are conflicted. So there's a nice company, nice founder. And I'm like: 'Look, you should look into this company. It is a great space. We invested, look'"* (vc48). Alternatively, the timing of sharing influences the competitiveness of a deal. When a VC is confident they will be on the Cap Table, for example due to strong relationships with the founders, the downside of sharing and discussing the deal with competitors is lower: *"So the timing of sharing is obviously super important. If you're basically done with due diligence and you already have the term sheet, and the founder loves you and everything - it's probably a bit easier to say, 'Hey, the switching costs for the founder are obviously higher than before'"* (vc26). Conversely, a deal can become non-competitive if the VC believes they will likely loose the deal, for example, when competing with top-tier funds. In such cases, *"sometimes they share top opportunities when they know they can't win. Like if US top-tier funds are already involved. And if you're a [lower tier VC]. Then you probably know you'll lose, so you play it a bit tactically and maybe share it [with another high tier VC]. To have have some good will essentially"* (vc47).

Finally, sometimes, Frenemy Peers who believe the other one has likely seen the deal use each other as sounding boards during the evaluation phase. On the one side, they do this when they have doubts or are tempted to pass, seeking confirmation on their rationale not to invest (T3, G3): *"I only actually did it last week for a company that I knew we were going to kill already, but just because we knew that probably these other guys saw it. And I wanted to validate that the reasons why we were going to kill it, over there, is was it is"* (vc30). On the other

side, they may also seek an informed second opinion by VCs that have already invested in a competitor (T4, G4): *"And sometimes you also share stuff that you're looking at because you want to have a view from someone else. You know, like, maybe I'm looking at the FinTech deal. And I know a guy who's only FinTech - a fund that is competing with us, but they have a conflicted portfolio company. So I'm gonna ping him like: 'Hey, I'm looking into this space. I know you know. Can we have a discussion?'"* (vc48), or, *"It's more of using your sort of friends and your network as a sounding board. [...] Like: 'You guys invested in a similar company. How were you thinking about valuation?'"* (vc45).

**Friendly Peers:** Collaboration among Friendly Peers often originates from their limited overlap in industry focus. Several investors provided examples of discussing deals with peers at the same stage in a cooperative manner, either to gain access to non-competitive deal flow from other industries or to seek an informed second opinion on potential investments within their area of expertise. Friendly Peers may share a deal to obtain *"a valuable perspective. (...) It could be because of a very vertical or specialized focus of another fund. It could also be because of a very personal network of the other party, even if it's a more generalist fund"* (vc41). For instance, a Friendly Peer connection may exist between an AI-focused fund and an EdTech-focused fund: *"If I have a fund that I talk to and that invests in Pre-Seed and like very much AI and Deep Tech - the overlap with us is going to be fairly limited. But I know that if I see some company that is very AI-driven, that they might invest in it, I'll share it. And similarly, if they see something that is using AI for EdTech, they might send it over and have our insights into this market"* (vc21).

Moreover, collaboration with Friendly Peers is strongly characterized by co-investing. Friendly Peers provide access to potential co-investment opportunities (T2, G2), and serve as syndication partner (T5, G5): *"That's when the network is the most thankful. When I say: 'Look, we've already decided on this deal. I think it's great for the following reasons. These are our investment rationales. So, we're now looking for a co-investor'"* (vc09). During the evaluation phase, Friendly Peers may jointly conduct the due diligence (T4, G4): *"We quite actively exchange the views and our notes and our perceptions of these opportunities. So if there is a clear co-investment opportunity, we want to be as open and as candid as possible with them. (...) After deep diving or due diligence, then share the worries and risks that you see relevant regarding the opportunities or your views and opinions, how the investment rounds should be structured and executed"* (vc35). Additionally, once they have co-invested, investors often leverage the knowledge and network of their syndicate partners (T6, G6), for example for hiring talent for their portfolio companies: *"There's monitoring capital, intellectual capital, social capital, you name it. And all of that is essentially only made available to the common portfolio companies, not to third-party friendly VCs"* (vc26).

**Follow-on VCs:** The give-and-take relationship between the ego VC and a Follow-on VC mirrors the one between an Feeder VC and the ego VC. Essentially, the ego VC is an earlier-stage Feeder from the perspective of the later-stage Follow-on VC. The resources and opportunities that the Feeder VCs provide to the ego VC are similar to what the ego VC offers to the Follow-on VC. Conversely, the support and insights that the Feeder VCs seek from the ego VC are akin to what the ego VC seeks from the Follow-on VC. As one early stage investor noted: *"So I basically do the same thing with [later stage investors] that pre-seed investors do with me"* (vc49).

In addition to the four collaboration archetypes, relatedness also shapes how venture capitalists leverage their connections, as the give-and-take dynamic is built on a foundation of trust. This trust- and relationship-based approach is a recurring theme across interviews, with investors highlighting the importance of personal connections over purely strategic considerations: *"It runs more on personal connections, interests, and trust rather than purely strategic considerations"* (vc22); *"It's all about people, networks, and trust-based transactions"* (vc24); *"The most important thing by a long shot is having a deep network of people that trust you and aren't just very surface relationship"* (vc29). Generally, investors are more inclined to collaborate with those they trust and share a genuine relationship with. Specifically, we observe four effects that the strength of these relationships has on collaboration: a stronger connection leads to a higher signal, more efficient and consistent exchange, more open exchange, and a higher quality of exchange.

First, our findings indicate that the signal accompanying a proposal is influenced not only by the proposal's source (Fried & Hisrich, 1994; Gompers et al., 2020; Petty et al., 2023) but also by the individual relationship between the investors. One interviewee explained, *"If you show [a deal] to just any investor and try to get in touch with them, either you or the founder, there is no signal because they don't know you. Or if it's an investor you know but haven't built a close relationship with, the signal isn't strong. It's like, 'Okay, nice that you showed me the deal. I'll take a quick look, but there's no strong signal for me'"* (vc08).

Second, while venture capitalists frequently participate in formal, regularly scheduled catch-up calls with other investors, strong personal relationships facilitate more ad-hoc and opportunistic information exchanges. This enhances the efficiency of these interactions. For instance, one venture capitalist distinguished between institutionalized updates for weaker connections and more informal exchanges for stronger connections, describing the latter as follows: *"It's more opportunistic; if someone has something interesting, they just message the other person and say, 'Hey, I have a super exciting company, you should definitely take a look'"* (vc16). Moreover, strong relationships facilitate a consistent exchange of information, even when one investor lacks the time or relevant information to reciprocate. This, for example, helps alleviate investors' fear of missing out on good investment opportunities: *"At some point, when you know a fund and the person well, you know, 'Hey, I won't*

*miss out on anything; they'll let me know.' And you can only achieve this by (...) having a good relationship with them"* (vc19).

Third, strong relationships enable more open and transparent communication, even between competing VC firms: *"[The openness of exchange] really depends on the personal relationship you have with the specific investor. If I consider someone part of my close circle, I'm definitely more open with them than with someone from a competitive fund where we don't meet up outside of work for a drink or anything like that"* (vc07). Within this close circle, venture capitalists also share proprietary information. For example, information about competing companies can help VCs and their portfolio companies to position themselves better: *"There's a competitor (...) in a very similar stage, with a similar technology, going out for fundraising at the same time. In such cases, I try to find out for our portfolio company, 'Okay, what are they asking for in their funding round? How far along are they in terms of traction?'. (...) For things like that, personal relationships with other VCs are incredibly valuable because normally, another VC wouldn't share that kind of information"* (vc04). Further, they share honest feedback on potential investment opportunities: *"The relationship has really reached a good level when the other early-stage [Feeder] fund openly tells you, 'Hey, stay away from that asset. And take a look at this one instead'"* (vc19). Therefore, investors consider it to be *"more important to build five really deep relationships, where you might get shown something earlier or receive their honest opinion"* (vc06).

Finally, the strength of the relationship positively impacts the quality of information exchanged: *"Often, the quantity of deal flow doesn't matter. It's not helpful to talk to every possible company that does something new. In the end, it always comes down to the quality of leads your partner can bring you. This is often highly correlated with trust. (...) In my experience, the really value-driving topics are less likely to be shared in superficial relationships"* (vc41). Among competitors, the level of trust within the relationship can counterbalance the competitive nature of the deal: *"You don't share your highest quality deal flow with everyone. It's interesting — you only tell your closest buddies about those deals. But with many others, where the relationship isn't as strong, you typically show them deals you wouldn't invest in. Because you're worried that if you share it with too many people and want to win the deal, you'll create competition for yourself, especially if there's only room for one new investor"* (vc14). Closer relationships facilitate the acquisition of information not only of higher quality but also timelier in nature: *"I have — probably similar to others — I have a list of about two or three people I really like. When I hear something, I'd probably share it with them first. Maybe a week or two later, I'd share with others. Or maybe not at all, just with those one or two people. To keep it a bit proprietary"* (vc47).

## 6.3 Discussion and Conclusion

Building on case-based evidence, our study offers exploratory evidence about motives for collaboration among venture capitalists (RQ 3a). Collaboration can stem from VC industry-level (Chapter 6.2.1.1), VC firm-level (Chapter 6.2.1.2), and venture capitalist-level considerations (Chapter 6.2.1.3). Additionally, we offer a detailed analysis of how venture capitalists leverage their connections throughout the VC decision-making process (RQ 3b). We emphasize similarities and differences across four collaboration archetypes and highlight the advantages of building a strong relationship and foundation of trust with the other venture capitalist.

### 6.3.1 Contribution and relevance

In doing so, this study entails three main contributions to the VC and entrepreneurship literature: First, we add a new lens to the role of VC networks: we investigate the personal connections between venture capitalists (venture capitalist-to-venture capitalist network), while the bulk of prior VC network research has considered VC firm-to-VC firm (i.e., co-investment networks) or venture capitalist-to-entrepreneur relationships.
Second, we introduce a nuanced definition of VC networks. Based on the four collaboration archetypes, we propose examining four types of networks: (1) a Feeder VC network, relevant for sourcing other VCs' portfolio companies; (2) a Frenemy Peer network, relevant for co-investments but sometimes competitive; (3) a Friendly Peer network, relevant for co-investments and collaborative; and (4) a Follow-on VC network, relevant for follow-on funding and, thus, facilitating the growth of portfolio companies. Our approach differs from existing VC network literature, which often treats all connections as equal and considers ties being formed based on investments in the same company (e.g., Y. Hochberg et al. (2007)).
Third, we incorporate the - currently missing - social tie perspective into the study of VC decision-making. We shed light on how venture capitalists use their network to other venture capitalists along the steps in the VC decision-making process. Shane and Cable (2002) emphasized that "economic explanations for venture finance, which do not consider how social ties influence this process, are undersocialized and incomplete".

Our findings also entail high practitioner relevance for venture capitalists as well as entrepreneurs. First, our study underscores the critical role of social ties and a high level of information exchange among venture capitalists. On the one hand, VC firms should actively encourage networking to facilitate the flow of valuable information. This is particularly important for new employees who need to build and expand their venture capitalist network. Our interviews revealed that most VC firms lack a firm-wide networking strategy or institutionalized training on efficient VC networks. Instead, building a VC network is often a "learning by doing" process. Some venture capitalists, especially those with limited investing experience, did not leverage all

archetypes of connections. For example, one investor noted: *"I haven't tried it yet, but some of my colleagues say it's really cool that they talk to people in later stages"* (vc32). Therefore, we provide a compelling rationale for VC firms to explore hosting network-dedicated trainings. These events could be co-hosted with other friendly VC firms, highlighting synergies between the different archetypes and facilitating introductions among new employees, thereby strengthening inter-organizational bonds. On the other hand, VC firms should also cultivate a culture of independent and critical thinking among their employees, ultimately avoiding an - often criticised - herd mentality in investment decisions. As one participant noted: *"It's very common in the ecosystem (...) that you see a deal and then you just share it with a couple of friends. But the problem that happens is that you find people keep saying the same arguments about the deal, and no one has actually done the work, or maybe just one person done it and then they share it with everyone"* (vc32). Additionally, for entrepreneurs, our findings suggest the importance of making a strong, positive impression in initial interactions with the first couple of investors. Given the rapid circulation of information within the industry, making a negative impression has the potential to diminish the chances of securing funding also from other investors, as they rely on the judgement of these investors.

Second, our study serves as a networking guide for venture capitalists. We suggest ways that venture capitalists can use to identify white spots in their networks (e.g., do they have connections across all archetypes?) and identify the most promising relationship (e.g., with whom do they have a content overlap? Who sees and shares relevant information? With whom do they get along well on a personal level?). In contrast to networking guides that often advocate a universal approach (Galunic, Ertug, & Gargiulo, 2012), our study acknowledges the diverse characteristics of actors, specifically the four collaboration archetypes. By detailing how venture capitalists utilize their connections with each archetype (Chapter 6.2.2), we propose strategies through which they can engage in give-and-take interactions throughout the VC decision-making process. Further we emphasize that strategies may vary due to the unique personal relationships between individual venture capitalists. There are a few specific actions that practitioners may find useful: First, venture capitalists may "give" to the other venture capitalist first, without immediately seeking anything in return. They might offer in-depth analyses on topics that interest the other venture capitalist, share high-quality deal flow that aligns with the investment criteria of the other VC, or provide personal coaching and guidance. Ultimately, the norm of reciprocity and the resulting feelings of gratitude will compel the recipient venture capitalist to reciprocate (Bartlett & DeSteno, 2006; Cialdini & Goldstein, 2004). Additionally, the recipient venture capitalist is likely to develop a more favorable perception of the giver and perceive the costs associated with helping them as lower (Carlson, Charlin, & Miller, 1988; Grant & Dutton, 2012). Once the relationship is established, venture capitalists should continue to "give" to ensure mutual value and prevent the relationship from becoming one-sided. Second, considering that

establishing trustful relationships takes time, venture capitalists should pro-actively build their network early on. For instance, one should begin to develop a network of follow-on investors well before actively seeking follow-on fundraising for one's portfolio. Third, it may be advantageous to concentrate on close personal relationships and non-competitive funds for deal flow. Both have an incentive to share their best portfolio companies and investment opportunities, motivated either by the relationship itself or their own interests. Finally, given the importance of relatedness, venture capitalists should focus on nurturing genuine personal connections first. As one investor encouraged, *"Over time I realized how important it is to first build that personal connection. That's how you eventually get the best deals and honest opinions"* (vc19). For example, personal interactions and having informal, non deal-flow and portfolio related conversations can significantly strengthen the relationship. In the words of one interviewee, *"an anecdote is that sometimes the informal network and informal interactions yield more benefits than formal symposiums"* (vc17).

### 6.3.2 Limitations and further research

Our study has several limitations that, hopefully, can be turned into future avenues of research. First, despite our efforts to achieve representativeness (see Chapter 6.1.1), our inductively developed framework could benefit from being tested on a larger sample using deductive empirical methods, such as surveys.

Second, we acknowledge that this study is limited to the context of VC in Europe, which may exhibit unique patterns in relationship-building, leveraging connections, and conducting business. We call for future research to conduct comparative studies in other regions such as the US, Asia, and the Middle East to explore whether collaboration motifs differ from the European VC industry, as research suggests that VC practices vary across regions due to different economic, legal, institutional, and cultural factors (S. Kaplan, Martel, & Stromberg, 2003; Manigart, Fried, Bruton, & Sapienza, 2002; Sapienza, Manigart, & Vermeir, 1996). Additionally, our findings should be transferred to other industries with high caution, as the venture capital industry is unique in its focus on collaboration among firms.

Third, the VC network is one of many factors for success. Future research should consider the broader ecosystem, including business angels and founders, rather than focusing solely on connections among VC firms. Notably, more than half of the interviewees (29 out of 50) mentioned other networks to identify and assess potential deals, even though they were not specifically prompted to do so: *"In any case, your network is always gonna be the best source of deals. It could be other VC investors, could be people who are business angels, could be people who are great entrepreneurs"* (vc48). Practitioners should be cautious of over-relying on their network. Factors such as higher valuations, a well-executed deal process, or strong personal impressions can be more influential for founders than the network itself: *"I think there are always limits to how much your network*

*can ultimately help. For instance, last year there was a very prominent deal (...). I had invested in that company while at [my previous VC firm]. I still had a strong network connection with the founder and knew the board member very well (...). However, competing funds ended up bidding a much higher price, and (...) also executed a very effective deal motion process (...). So, despite arguably having a stronger network within the company and to co-investors, I ended up losing that deal"* (vc02).

Finally, our study provides a foundation for future research on collaboration among venture capitalists. For example, future research could focus on performance implications (Q1-Q3) and/or antecedents (Q3-Q5): (Q1) Does collaborating based on relatedness have performance implications for the VC firm?, (Q2) What is the more important for identifying and securing good deals: the venture capitalist-to-venture capitalist network, the venture capitalist-to-entrepreneur network, or the business angel network?, (Q3) Which networking strategies are successful for building effective give-and-take relationships?, (Q4) How do biases affect the way venture capitalist build and leverage their network with other venture capitalists? For example, female investors mentioned that *"the guys send each other the good deals, and [the women] kind of get left out"* (vc42), suggesting the presence of gender bias. Lastly, informing VC hiring processes, (Q5) how does a venture capitalist's personality influence their venture-capital level motives to collaboration?

# 7 Conclusion

This dissertation empirically analyzes the structure and role of networks in Venture Capital from three perspectives: (1) the overall structure of the VC networks in Europe, the United States, and China; (2) the VC firm's role and co-investor network embedded within the multi-national European VC network; and (3) the personal networks between individual venture capitalists. Together, these perspectives contribute to a more comprehensive understanding of VC networks.

A central contribution of this dissertation is its focus on multi-country VC networks, with particular attention to the European context. Europe - with its distinct cultural, infrastructural, and legal landscape - warrants a separate analysis because research on the European VC landscape remains limited (Christopoulos et al., 2022; Cumming et al., 2023) and findings from other VC markets often fail to extend (Manigart et al., 2006).

This thesis first presents novel empirical evidence to confirm the myth of Europe's fragmentation by analyzing the structure of the European VC market, and comparing its connectedness to that of the US and Chinese markets. The findings confirm the persistent fragmentation of the European VC ecosystem into regional startup ecosystems but also show that it has become more connected over the past two decades. These insights are particularly valuable for policymakers and investors aiming to foster greater integration within the European VC landscape. Beyond its practical relevance, this study advances the VC network literature by offering the first systematic regional comparison of VC networks over time, overcoming the limitations of prior studies that have largely focused on single regions (e.g., Kogut et al. (2007)) and specific points in time (e.g., Jin et al. (2016)). To facilitate comparability, the study introduces a framework based on five complementary SNA measures and, thus, lays the foundation for future research on network connectedness.

The analyses in Chapter 5 provide VC firms with strategic guidance on how to build relationships and position themselves in Europe's multi-country market. The findings demonstrate that a "best of two worlds" approach - combining co-investor closeness with unique network brokerage - is associated with better performance, both in terms of venture success and VC fund performance. Therefore, VC firms should foster strong relationships among their co-investors while also building relationships with VC firms from distant investor groups. By adopting a holistic view on co-investor networks, the study advances the VC brokerage debate, which has typically analyzed brokerage effects in isolation, either at the network level (e.g., Y. Hochberg et al. (2007))

or within the immediate co-investor network (e.g., Alexy et al. (2012); Bellavitis et al. (2017); Ter Wal et al. (2016)), rarely considering that the two layers interact (Kwon et al., 2020).

Lastly, this thesis introduces a relatively under-explored perspective to the study of VC networks by examining the interpersonal relationships between individual venture capitalists. So far, both VC network and VC decision-making literature have largely neglected the role of personal connections among venture capitalists. Based on 50 semi-structured interviews, this study outlines the extent to which, and the reasons why, venture capitalists use personal venture capitalist networks. It emphasizes the central roles of trust and reciprocity ("give-and-take"), introduces four collaboration archetypes, and identifies their strategic use along the VC decision-making process. These insights enable venture capitalists to assess and better leverage their venture capitalist network for activities such as deal sourcing, value-adding, and follow-on funding. Entrepreneurs, too, can draw on the insights to better navigate investor relationships by recognizing how informal relationships shape investment decisions. In addition, the study broadens the academic understanding of VC firm networks and, hopefully, inspires researchers to consider VC networks beyond one type of co-investment networks, such as sourcing ("feeder") networks.

In conclusion, this dissertation presents novel insights into VC networks in Europe. It sheds light on the fragmentation of the European VC network, analyzes how brokerage network structures and positions of VC firms influence their performance in the multi-country European setting and outlines the motifs and strategic use of venture capitalist networks along the VC decision-making process. Ultimately, this work hopefully encourages continued dialogue between academia and practitioners, and inspires future research that deepens our understanding of how networks shape the (European) venture capital ecosystem.

# A Appendix

## A.1 Descriptive statistics

**Table A.1** Average proportion of past investments by stage and community for the European VC network in 2023.

| Community | Stage | | | |
|---|---|---|---|---|
| | Seed | Early | Later | Other |
| 0 | 18.51 | 23.02 | 25.91 | 2.97 |
| 1 | 30.85 | 32.08 | 9.35 | 1.25 |
| 2 | 15.63 | 28.90 | 28.81 | 3.73 |
| 3 | 19.78 | 27.87 | 29.69 | 3.76 |
| 4 | 19.59 | 30.67 | 24.72 | 4.15 |
| 5 | 16.57 | 30.28 | 25.97 | 4.08 |
| 6 | 19.32 | 18.23 | 23.14 | 0.62 |
| 7 | 25.94 | 30.60 | 11.41 | 4.48 |
| 8 | 15.40 | 11.87 | 20.68 | 1.44 |
| 9 | 9.99 | 11.84 | 28.08 | 1.75 |
| 10 | 9.71 | 16.15 | 14.72 | 8.05 |

***Notes:*** Communities 11-23 are ommitted as they encompass less than 1% of all VC firms and, therefore, do not constitute a main community. All values are noted in percent (%).

**Table A.2** Geographical focus of VC firms in the European VC network 2023.

| Geographical focus | VC firms (#) |
|---|---|
| United Kingdom | 2667 |
| Germany | 1015 |
| France | 605 |
| Switzerland | 565 |
| Sweden | 450 |
| Spain | 380 |
| Netherlands | 364 |
| Finland | 219 |
| Italy | 169 |
| Norway | 162 |
| Estonia | 157 |
| Ireland | 139 |
| Denmark | 139 |
| Belgium | 123 |
| Poland | 116 |
| Austria | 89 |
| Portugal | 72 |
| Czech | 55 |
| Lithuania | 45 |
| Hungary | 30 |

***Notes:*** The geographical focus of a VC firms is the country, in which most of its portfolio companies are based. Malta, Bulgaria, Greece, Luxembourg, Romania, Cyprus, Iceland, Latvia, Slovakia, Croatia, Liechtenstein and Slovenia were ommitted, because less than 30 VC firms primarily invest in portfolio companies located in these countries.

**Table A.3 Descriptive statistics (venture success model)**

The sample consists of 18,218 ventures that received their first funding from 4,362 venture capital (VC) firms (i.e., all VC firms that made at least one investment in a European-based portfolio company and, thus, are part of the European VC network. We measure venture success as the dummy variable *follow-on funding or exit* (DV), equal to 1 if the venture received a second funding round or successfully exited via an Initial Public Offering (IPO) or Merger and Acquisition (M&A). Bridging measures (IV) are calculated for each investor-venture pair. The corresponding network graphs are constructed using all investments over the 5 years prior to the venture's first funding round (deal year). *Network constraint* focuses on the structure of the investor network and measures the bridging potential between an investor's direct syndicate partners. It is transformed into its complement ($B = 1 - C$) and normalized relative to a fully connected investor network with the same number of investors (network size). *Role* is a dummy variable, equal to 1 if the VC firm is classified as kinless hub, connector hub, provincial hub, or non-hub. It takes the position of the VC firm in its own community as well as the community membership of its syndicate partners into account. *Betweenness centrality* measures whether the brokerage opportunity is unique or shared with other investors. It is calculated based on betweenness centrality and normalized to the maximum value in the European VC network, such that a value of 1 indicates the VC firm with most unique brokerage opportunities. By definition, the network metrics are 0 for a VC firm that invests in a European-based company for the first time (within the last five years). *Syndicate size* captures the number of syndicate partners in the venture's first round. *Industry* denotes the industry of the portfolio company. Pitchbook classifies portfolio companies into the following seven industries: B2B, B2C, Energy, Finance, Healthcare, IT, and Materials Resources. *Foreign* is a dummy variable, indicating whether the VC fund is headquartered outside Europe (=1) or within Europe (=0). *CVC* is a dummy variable, denoting whether a VC firm is a corporate VC firm (=1). *VC age*, as proxy for the parent VC firm's experience, is calculated as of the year, when the venture received its first funding (deal year). *Stage focus* and *Industry focus* are vector-based measures constructed from the VC firm's investments. We proxy the *status* of a VC firm via the network metric eigenvalue centrality as of the year, when the venture received its first funding (deal year).

| | No. | Mean | Min | Median | Max |
|---|---|---|---|---|---|
| **Venture specific** | | | | | |
| Follow-on funding or exit | 18,218 | 0.84 | 0.00 | 1.00 | 1.00 |
| Deal year | 18,218 | 2014 | 2005 | 2014 | 2019 |
| Syndicate size | 18,218 | 1.30 | 1.00 | 1.00 | 12.00 |
| Industry B2B | 18,214 | 0.23 | 0.00 | 0.00 | 1.00 |
| Industry B2C | 18,214 | 0.22 | 0.00 | 0.00 | 1.00 |
| Industry Energy | 18,214 | 0.02 | 0.00 | 0.00 | 1.00 |
| Industry Finance | 18,214 | 0.02 | 0.00 | 0.00 | 1.00 |
| Industry Healthcare | 18,214 | 0.14 | 0.00 | 0.00 | 1.00 |
| Industry IT | 18,214 | 0.35 | 0.00 | 0.00 | 1.00 |
| Industry Materials Resources | 18,214 | 0.02 | 0.00 | 0.00 | 1.00 |
| **VC-firm specific** | | | | | |
| Network constraint ($B$) | 23,688 | 0.54 | 0.01 | 0.42 | 1.00 |
| Role: Kinless Hub | 23,688 | 0.02 | 0.00 | 0.00 | 1.00 |
| Role: Connector Hub | 23,688 | 0.11 | 0.00 | 0.00 | 1.00 |
| Role: Provincial Hub | 23,688 | 0.00 | 0.00 | 0.00 | 1.00 |
| Role: Non-Hub | 23,688 | 0.87 | 0.00 | 1.00 | 1.00 |
| Betwenness centrality ($C_B$) | 23,688 | 0.04 | 0.00 | 0.00 | 1.00 |
| Foreign firm | 4,362 | 0.30 | 0.00 | 0.00 | 1.00 |
| CVC | 4,362 | 0.08 | 0.00 | 0.00 | 1.00 |
| VC age | 23,184 | 7.71 | 0.00 | 5.00 | 201.00 |
| Stage focus Early Stage | 4,362 | 0.43 | 0.00 | 0.42 | 1.00 |
| Stage focus Later Stage | 4,362 | 0.22 | 0.00 | 0.17 | 1.00 |
| Industry focus B2B | 4,362 | 0.16 | 0.00 | 0.10 | 1.00 |
| Industry focus B2C | 4,362 | 0.19 | 0.00 | 0.10 | 1.00 |
| Industry focus Energy | 4,362 | 0.02 | 0.00 | 0.00 | 1.00 |
| Industry focus Finance | 4,362 | 0.03 | 0.00 | 0.00 | 1.00 |
| Industry focus Healthcare | 4,362 | 0.16 | 0.00 | 0.19 | 1.00 |
| Industry focus IT | 4,362 | 0.41 | 0.00 | 0.64 | 1.00 |
| Industry focus Materials Resources | 4,362 | 0.02 | 0.00 | 0.00 | 1.00 |
| Status | 23,184 | 0.07 | 0,00 | 0.01 | 1.00 |

## A.2 Empirical results

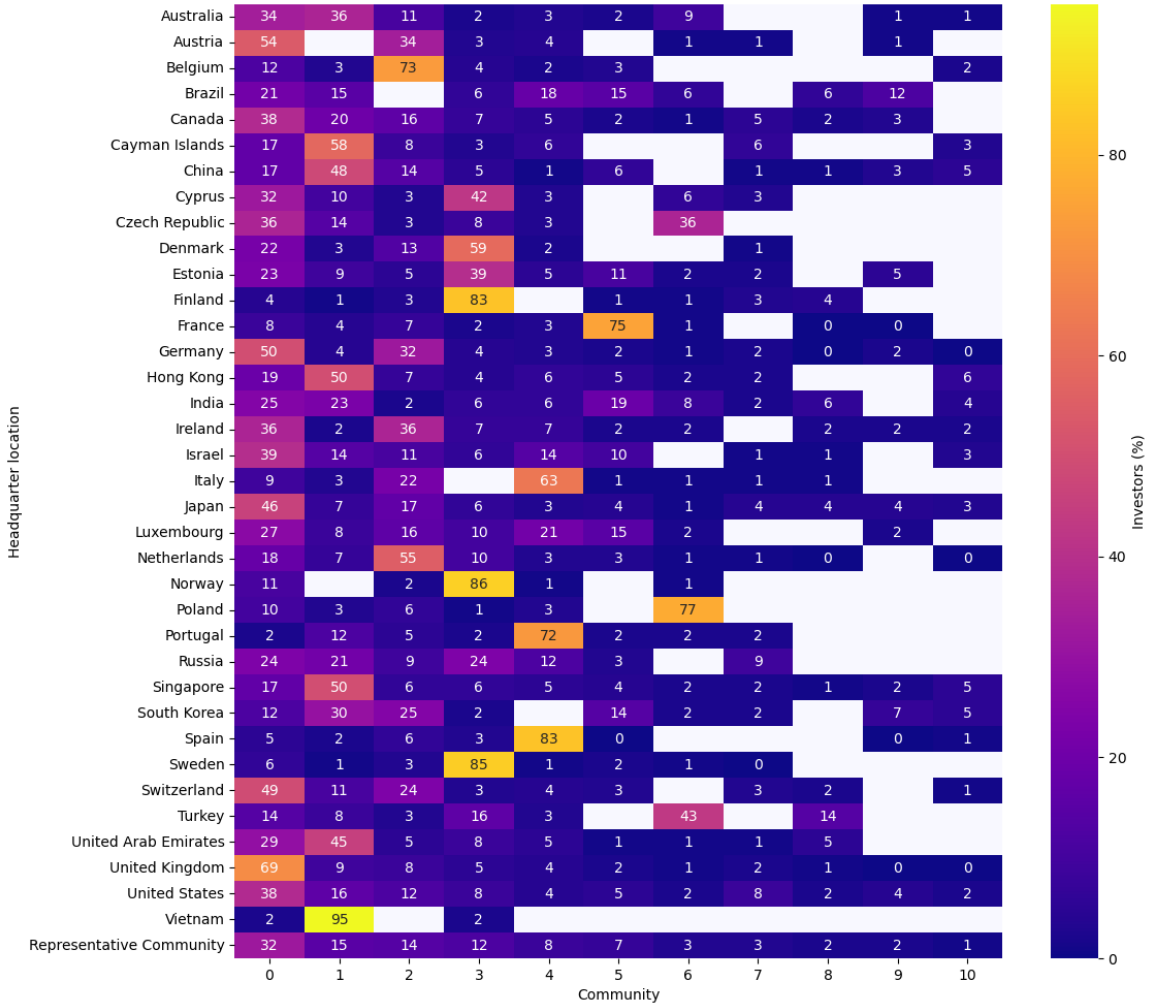



**Figure A.1** Illustration of headquarter location across communities. Each cell's color and value correspond to the proportion of VC firms associated with a specific community and headquartered in a particular country, relative to all VC firms with the same headquarter. Values are displayed as percentages. For example, 34% of VC firms headquartered in Australia belong to Community 0 (top left cell). Countries with less than 30 VC firms, such as Mexico, Chile, or Slovenia, were omitted.

**Table A.4** Goodness-of-fit for multinomial logistic regression models.

| Model | | Variables | | | | | Goodness of Fit | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | GEO | HQReg | HQEU | IND | ST | AIC | BIC | Log-Lik. | Pseudo R-Squ. | Accuracy |
| 1 | GEO + HQReg + IND + ST | x | x | | x | x | 17,859 | 21,197 | -8,450 | 0.45 | 63.10 |
| 2 | GEO + HQReg + IND | x | x | | x | | 18,159 | 21,357 | -8,619 | 0.44 | 62.10 |
| 3 | GEO + HQReg + ST | x | x | | | x | 19,631 | 22,552 | -9,396 | 0.39 | 59.30 |
| 4 | GEO + IND + ST | x | | | x | x | 18,428 | 21,488 | -8,774 | 0.43 | 62.40 |
| 5 | HQReg + IND + ST | | x | | x | x | 26504 | 27616 | -13092 | 0.15 | 42.60 |
| 6 | HQ + IND + ST | | | x | x | x | 21,729 | 25,623 | -10,304 | 0.33 | 56.20 |
| 7 | GEO + IND | x | | | x | | 18,757 | 21,539 | -8,979 | 0.42 | 61.40 |
| 8 | GEO + ST | x | | | | x | 20,393 | 22,897 | -9,837 | 0.36 | 58.10 |
| 9 | HQ + IND | | | x | x | | 22,452 | 26,207 | -10,686 | 0.31 | 53.70 |
| 10 | HQ + ST | | | x | | x | 23,665 | 27,142 | -11,332 | 0.27 | 53.00 |
| 11 | IND + ST | | | | x | x | 27,489 | 28,185 | -13,645 | 0.12 | 42.10 |
| 12 | GEO | x | | | | | 20,876 | 23,240 | -10,098 | 0.35 | 57.10 |
| 13 | HQ | | | x | | | 24,408 | 27,746 | -11,724 | 0.24 | 50.50 |
| 14 | IND | | | | x | | 28,168 | 28,724 | -14,004 | 0.09 | 38.70 |
| 15 | ST | | | | | x | 30,240 | 30,518 | -15,080 | 0.02 | 31.90 |

***Notes:*** AIC: Akaike's information criterion. BIC: Bayesian Information Criteria. Log-Lik.: Log-Likelihood. Accuracy is the percent (%) of correctly predicted values. GEO: geographical focus of the VC (vector). IND: industry focus of the VC (vector). ST: financing stage focus of the VC (vector). HQ: geographical location of the VC's headquarter. HQReg: geographical location of the VC's headquarter on a regional level and for non-European firms. CENT: Eigenvector centrality of the VC firm in the European VC co-investment network. All models include a dummy variable indicating whether the VC firm was a Corporate Venture Capital firm (CVC = 1, if the firm is a corporate venture capital firm. We use Community 0 (the largest community) as reference level.
The model yielding the lowest AIC is highlighted in bold.

**Table A.5 Results and marginal effects for Model 1 (GEO + HQReg + IND + ST) for Communities 1 until 4.** Significant parameter estimates (p<0.10) with a positive marginal effect (dy/dx>0) for the multinomial logistic regression of a VC firm's geographical focus (GEO), headquarter on a regional level (HQReg), industry focus (IND), financial stage focus (ST) and eigenvector centrality (CENT) as a measure for its reach and influence on the dependent variable community (Model 1). The model controls for the type of VC firm (CVC) and includes a constant.

| | coeff | std err | z | P>\|z\| | dy/dx |
|---|---|---|---|---|---|
| **Community = 1** | | | | | |
| ST_Seed | 2.90 | 0.29 | 10.02 | 0.00 | 0.15 |
| ST_Early | 3.28 | 0.30 | 10.98 | 0.00 | 0.16 |
| GEO_Switzerland | 3.55 | 0.38 | 9.34 | 0.00 | 0.22 |
| GEO_Spain | 2.38 | 0.67 | 3.56 | 0.00 | 0.12 |
| GEO_Netherlands | 2.66 | 0.55 | 4.86 | 0.00 | 0.11 |
| GEO_Sweden | 1.57 | 0.53 | 2.97 | 0.00 | 0.07 |
| GEO_Estonia | 3.77 | 0.84 | 4.51 | 0.00 | 0.23 |
| GEO_Italy | 4.13 | 1.31 | 3.17 | 0.00 | 0.22 |
| GEO_Lithuania | 4.61 | 1.07 | 4.31 | 0.00 | 0.50 |
| GEO_Portugal | 3.11 | 1.33 | 2.34 | 0.02 | 0.16 |
| HQReg_Africa | 0.82 | 0.41 | 2.01 | 0.05 | 0.11 |
| HQReg_Asia | 2.22 | 0.18 | 12.67 | 0.00 | 0.11 |
| HQReg_Middle East | 1.21 | 0.25 | 4.87 | 0.00 | 0.06 |
| HQReg_Oceania | 1.68 | 0.31 | 5.36 | 0.00 | 0.10 |
| HQReg_Canada | 0.93 | 0.39 | 2.38 | 0.02 | 0.05 |
| HQReg_United States | 0.82 | 0.14 | 5.88 | 0.00 | 0.05 |
| **Community = 2** | | | | | |
| ST_Early | 0.41 | 0.23 | 1.79 | 0.07 | 0.02 |
| IND_Business_Products_and_Services_(B2B) | 0.47 | 0.28 | 1.65 | 0.10 | 0.09 |
| IND_Energy | 2.99 | 0.72 | 4.15 | 0.00 | 0.35 |
| IND_Healthcare | 2.99 | 0.21 | 14.02 | 0.00 | 0.40 |
| IND_Materials_and_Resources | 3.68 | 0.60 | 6.17 | 0.00 | 0.45 |
| GEO_Netherlands | 4.03 | 0.47 | 8.55 | 0.00 | 0.42 |
| GEO_Belgium | 3.31 | 0.54 | 6.19 | 0.00 | 0.48 |
| GEO_Italy | 3.50 | 1.21 | 2.90 | 0.00 | 0.43 |
| **Community = 3** | | | | | |
| ST_Seed | 0.56 | 0.32 | 1.74 | 0.08 | 0.02 |
| ST_Early | 0.77 | 0.31 | 2.45 | 0.01 | 0.02 |
| IND_Consumer_Products_and_Services_(B2C) | 0.73 | 0.34 | 2.12 | 0.03 | 0.05 |
| IND_Healthcare | 1.14 | 0.34 | 3.34 | 0.00 | 0.05 |
| IND_Materials_and_Resources | 3.30 | 0.67 | 4.96 | 0.00 | 0.13 |
| GEO_Finland | 4.31 | 0.67 | 6.39 | 0.00 | 0.17 |
| GEO_Czech_Republic | -2.31 | 1.29 | -1.79 | 0.07 | 0.02 |
| GEO_Norway | 2.86 | 0.53 | 5.39 | 0.00 | 0.13 |
| GEO_Netherlands | 1.00 | 0.58 | 1.72 | 0.09 | 0.01 |
| GEO_Sweden | 4.41 | 0.42 | 10.56 | 0.00 | 0.17 |
| GEO_Denmark | 1.52 | 0.46 | 3.29 | 0.00 | 0.08 |
| GEO_Estonia | 1.69 | 0.90 | 1.88 | 0.06 | 0.09 |
| **Community = 4** | | | | | |
| GEO_Spain | 6.72 | 0.64 | 10.59 | 0.00 | 0.25 |
| GEO_Italy | 7.42 | 1.26 | 5.89 | 0.00 | 0.28 |
| GEO_Portugal | 6.30 | 1.26 | 4.99 | 0.00 | 0.24 |

***Notes:*** Community 0 was used as reference category.
Following Wiersema and Bowen (2009)'s guidelines, we evaluated the significance of the estimated coefficients and subsequently computed the marginal effects (MEM). Due to space constraints, geographic focus for Malta, Bulgaria, Greece, Luxembourg, Romania, Cyprus, Iceland, Latvia, Slovakia, Croatia, Liechtenstein and Slovenia were ommitted, because less than 30 VC firms primarily invest in portfolio companies located in these countries.

**Table A.6 Results and marginal effects for Model 1 (GEO + HQReg + IND + ST) for Communities 5 until 10.** Significant parameter estimates (p<0.10) with a positive marginal effect (dy/dx>0) for the multinomial logistic regression of a VC firm's geographical focus (GEO), headquarter on a regional level (HQReg), industry focus (IND), financial stage focus (ST) and eigenvector centrality (CENT) as a measure for its reach and influence on the dependent variable community (Model 1). The model controls for the type of VC firm (CVC) and includes a constant.

| | coeff | std err | z | P>\|z\| | dy/dx |
|---|---|---|---|---|---|
| **Community = 5** | | | | | |
| IND_Business_Products_and_Services_(B2B) | 1.33 | 0.51 | 2.59 | 0.01 | 0.02 |
| IND_Financial_Services | 1.63 | 0.74 | 2.19 | 0.03 | 0.03 |
| IND_Materials_and_Resources | 1.91 | 0.68 | 2.79 | 0.01 | 0.03 |
| GEO_France | 4.38 | 0.53 | 8.24 | 0.00 | 0.06 |
| HQReg_Africa | 0.83 | 0.47 | 1.77 | 0.08 | 0.03 |
| HQReg_Asia | 0.67 | 0.29 | 2.28 | 0.02 | 0.01 |
| **Community = 6** | | | | | |
| ST_Seed | 0.82 | 0.34 | 2.39 | 0.02 | 0.01 |
| IND_Healthcare | 3.02 | 0.35 | 8.72 | 0.00 | 0.04 |
| IND_Materials_and_Resources | 2.75 | 0.76 | 3.59 | 0.00 | 0.03 |
| GEO_Finland | 5.17 | 0.72 | 7.14 | 0.00 | 0.06 |
| GEO_Netherlands | 2.81 | 0.71 | 3.96 | 0.00 | 0.03 |
| HQReg_Asia | 1.10 | 0.36 | 3.03 | 0.00 | 0.01 |
| HQReg_Canada | 1.72 | 0.50 | 3.45 | 0.00 | 0.02 |
| HQReg_United States | 2.00 | 0.23 | 8.79 | 0.00 | 0.03 |
| **Community = 7** | | | | | |
| ST_Seed | 2.97 | 0.69 | 4.33 | 0.00 | 0.03 |
| ST_Early | 3.45 | 0.66 | 5.27 | 0.00 | 0.03 |
| IND_Energy | 4.19 | 1.26 | 3.33 | 0.00 | 0.04 |
| GEO_Poland | 4.10 | 1.06 | 3.88 | 0.00 | 0.05 |
| HQReg_Middle East | 1.37 | 0.34 | 4.04 | 0.00 | 0.01 |
| HQReg_Oceania | 0.94 | 0.48 | 1.97 | 0.05 | 0.01 |
| **Community = 8** | | | | | |
| GEO_Finland | 3.62 | 0.94 | 3.87 | 0.00 | 0.00 |
| GEO_Belgium | 2.17 | 0.96 | 2.26 | 0.02 | 0.00 |
| GEO_Portugal | 3.21 | 1.90 | 1.70 | 0.09 | 0.00 |
| HQReg_Africa | 3.30 | 0.40 | 8.22 | 0.00 | 0.00 |
| HQReg_Middle East | 1.06 | 0.44 | 2.40 | 0.02 | 0.00 |
| **Community = 9** | | | | | |
| IND_Financial_Services | 1.64 | 0.84 | 1.95 | 0.05 | 0.00 |
| IND_Consumer_Products_and_Services_(B2C) | 2.45 | 0.47 | 5.26 | 0.00 | 0.00 |
| GEO_Netherlands | 3.94 | 0.67 | 5.91 | 0.00 | 0.00 |
| HQReg_Asia | 1.14 | 0.43 | 2.66 | 0.01 | 0.00 |
| HQReg_United States | 0.80 | 0.37 | 2.13 | 0.03 | 0.00 |
| **Community = 10** | | | | | |
| GEO_Spain | 2.77 | 1.61 | 1.71 | 0.09 | 0.00 |
| GEO_Czech_Republic | 5.29 | 1.12 | 4.71 | 0.00 | 0.00 |
| GEO_Ireland | 1.78 | 1.03 | 1.74 | 0.08 | 0.00 |
| GEO_Estonia | 4.43 | 0.92 | 4.84 | 0.00 | 0.00 |
| GEO_Portugal | 3.56 | 1.68 | 2.12 | 0.03 | 0.00 |
| HQReg_Asia | 2.54 | 0.39 | 6.50 | 0.00 | 0.00 |
| HQReg_United States | 1.15 | 0.39 | 2.91 | 0.00 | 0.00 |

***Notes:*** Community 0 was used as reference category.
Following Wiersema and Bowen (2009)'s guidelines, we evaluated the significance of the estimated coefficients and subsequently computed the marginal effects (MEM).
Due to space constraints, geographic focus for Malta, Bulgaria, Greece, Luxembourg, Romania, Cyprus, Iceland, Latvia, Slovakia, Croatia, Liechtenstein and Slovenia were ommitted, because less than 30 VC firms primarily invest in portfolio companies located in these countries.

**Table A.7 The effect of bridging on venture success.**

The sample consists of 4,362 venture capital firms that made at least one investment in a European-based portfolio company and, thus, are part of the European VC network. The dependent variable (DV) is venture success. We measure venture success as the dummy variable *follow-on funding or exit* (DV), equal to 1 if the venture received a second funding round or successfully exited via an Initial Public Offering (IPO) or Merger and Acquisition (M&A). The bridging measures, our independent variables, are calculated for each investor-venture pair. The corresponding network graphs are constructed using all investments over the 5 years prior to the venture's first funding round (deal year). All bridging measures are mean-centered and scaled. *Network constraint* focuses on the structure of the investor network and measures the bridging potential between an investor's direct syndicate partners. It is transformed into its complement ($B = 1 - C$) and normalized relative to a fully connected investor network with the same number of investors (network size). *Role* refers to the role of the VC firm in the European VC network. It takes the position of the VC firm in its own community as well as the community membership of its syndicate partners into account. We take non-hub role as the reference category and include a set of three dummy variables, equal to 1 if the VC firm is classified as kinless hub, connector hub and provincial hub, respectively. *Betweenness centrality* measures whether the brokerage opportunity is unique or shared with other investors. It is calculated based on Freeman's betweenness centrality score and normalized to the maximum value in the European VC network, such that a value of 1 indicates the VC firm with most unique brokerage opportunities. By definition, the network metrics are 0 for a VC firm that invests in a European-based company for the first time (within the last five years). *Syndicate size* is the number of VC firms that co-invested in the venture's first round. *Industry* denotes the industry of the portfolio company. Pitchbook classifies portfolio companies into the following seven industries: B2B, B2C, Energy, Finance, Healthcare, IT, and Materials Resources. *Foreign VC* is a dummy variable, indicating whether the VC firm is headquartered outside Europe (=1) or within Europe (=0). *CVC* is a dummy variable, denoting whether the VC firm is a corporate VC firm (=1) or a traditional VC firm (=0). *Stage focus* and *Industry focus* are vector-based measures constructed from the VC firm's investments. Given the compositional nature of the variables (with all variables summing up to 1), we exclude the IT industry dimension for the industry focus and only include Early Stage and Later Stage focus for the stage focus. We proxy the *status* of a VC firm via the network metric eigenvalue centrality as of the year, when the venture received its first funding (deal year). Due to multicollinearity concerns, we include status only in models 1 and 5, as it is highly correlated with betweenness centrality and hub roles. *VC age*, as proxy for the parent VC firm's experience, is calculated as of the year, when the venture received its first funding (deal year). A set of year and industry dummies was included but omitted in reporting to preserve space. The mean variance inflation factor (VIF) of the variables included in the models is 1.31, indicating that multicollinearity is likely not a concern. We report the estimated coefficients ($beta$) in the regression table and use ***, **, and * to denote their significance ($p$) at the 1%, 5% and 10% level, respectively.

| | **Model IV** | **Model V** | **Model VI** |
|---|---|---|---|
| **Bridging measures (IV)** | | | |
| Network constraint ($B$) | -0.2896*** | | |
| Role Kinless Hub | | 1.5680*** | |
| Role Connector Hub | | 0.6386*** | |
| Role Provincial Hub | | 1.0071 | |
| Betweenness centrality ($C_B$) | | | 2.7510*** |
| **Controls** | | | |
| Deal year | x | x | x |
| Syndicate size | x | x | x |
| Venture industry | x | x | x |
| Foreign VC | x | x | x |
| CVC | x | x | x |
| VC age | x | x | x |
| Stage focus | x | x | x |
| Industry focus | x | x | x |
| Status | x | - | - |
| Pseud-$R^2$ | 15.4% | 14.8% | 15.1% |
| No. of observations | 23,688 | 23,688 | 23,688 |

## A.3 Illustration of graph-theoretical measures and algorithms

### Louvain method for community detection

The Louvain algorithm for community detection identifies communities in a network based on modularity optimization (Blondel et al., 2008). Modularity compares the actual density of edges within communities to what would be expected. In this sense, a community is defined as a cluster of nodes that is characterized by denser connections between its constituents than to other nodes outside the cluster. Initially, the Louvain method assigns each node to its own community (see a and b in Figure A.2). Then, it iteratively applies two steps until no further increase in modularity is possible:

- **Step 1: Modularity optimization.** Nodes are reassigned to neighboring communities if doing so increases the modularity of the network (see c and e in Figure A.2). Formally, modularity $Q$ is defined as:

$$Q = \frac{1}{2m} \sum_{i,j} \left( A_{ij} - \frac{k_i k_j}{2m} \right) \delta(c_i, c_j)$$

  , where $m$ is the total number of edges in the network, $A_{ij}$ is the element of the adjacency matrix for nodes $i$ and $j$, (1 if nodes $i$ and $j$ are connected, 0 otherwise), $k_i$ is the number of edges connected to $i$ (degree), $\frac{k_i k_j}{2m}$ is the expected number of edges between $i$ and $j$ in a random network with the same number of nodes and edges, and $\delta(c_i, c_j)$ indicates whether nodes $i$ and $j$ belong to the same community (1 if nodes $i$ and $j$ belong to the same community, 0 otherwise).

- **Step 2: Community aggregation.** Nodes belonging to one community are consolidated into one node. In the resulting new network, each community is represented as a single node (see d and f in Figure A.2).

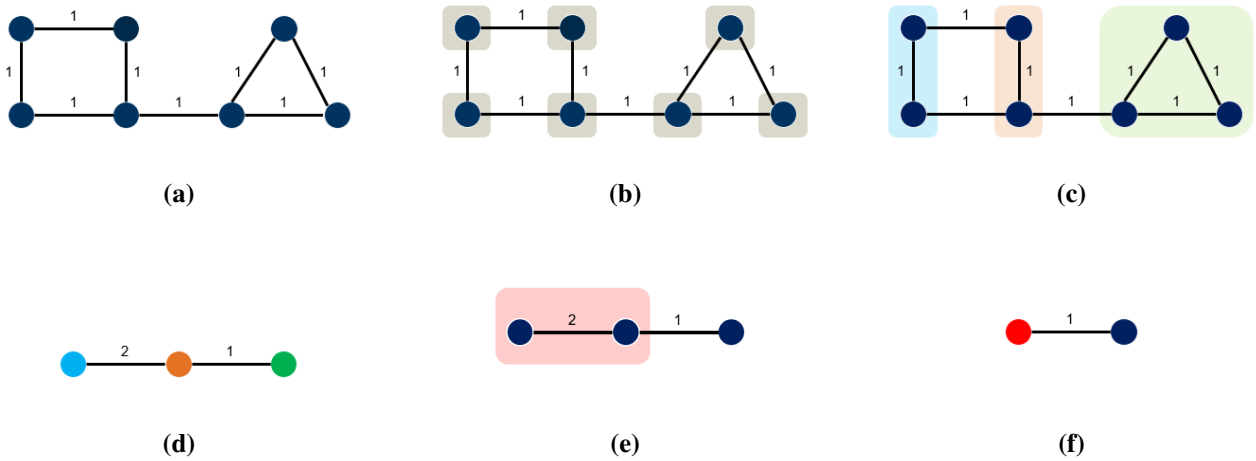
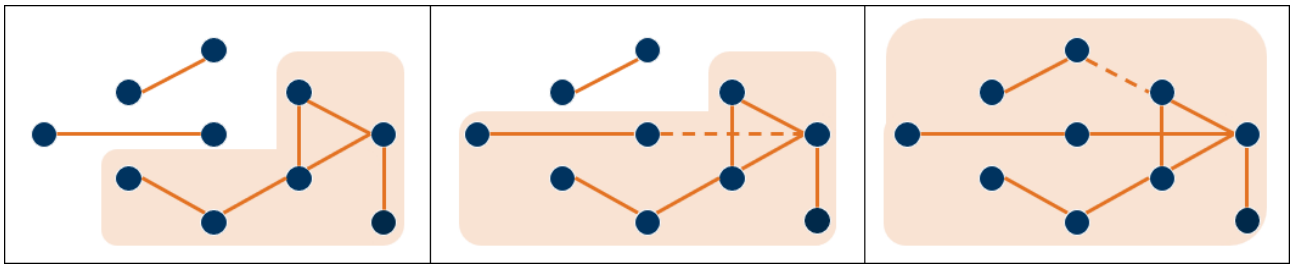
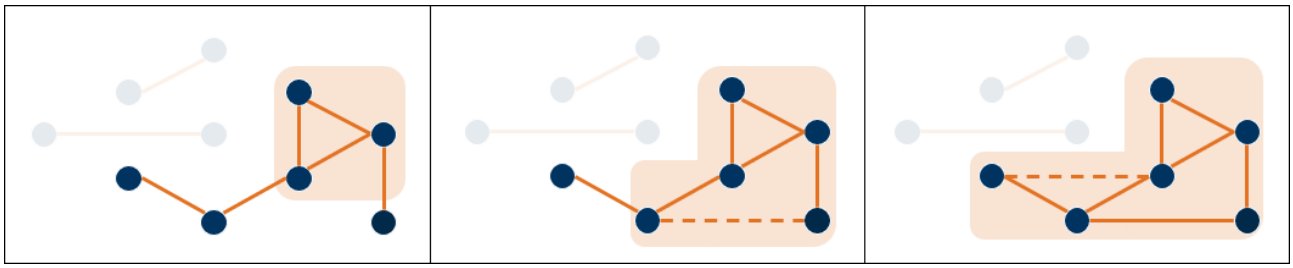



**Figure A.2 Louvain algorithm for community detection.** (a, b) Initially, the Louvain community sets each node as a separate community (highlighted in grey). (c) In the first step, the algorithm then optimizes modularity by moving nodes into neighboring communities (highlighted by distinct colors). (d) In the second step, the algorithm aggregates communities to nodes (colored by community). (e, f) These steps are repeated until no increase in modularity is possible.

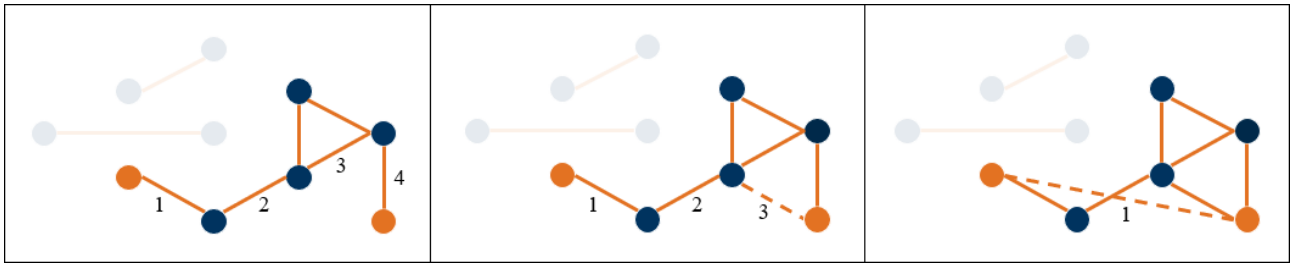
## Network connectivity measures



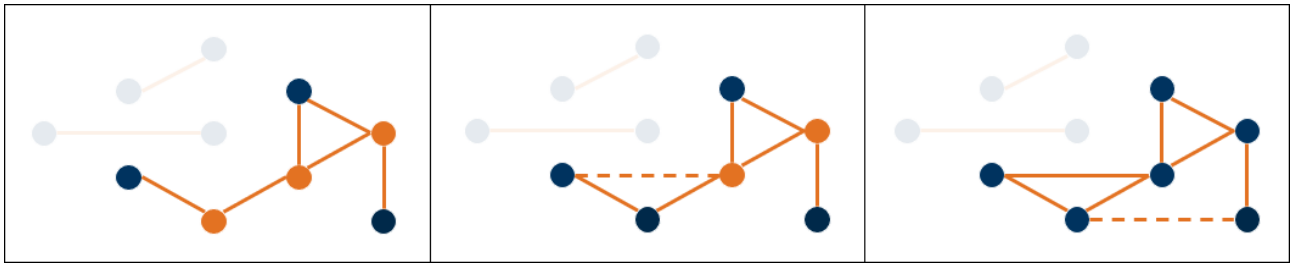
**(a)** The Giant Connected Component (GCC) is highlighted in orange. The size of the GCC increases from 60% of the nodes on the left, to 80% in the middle, and 100% on the right.



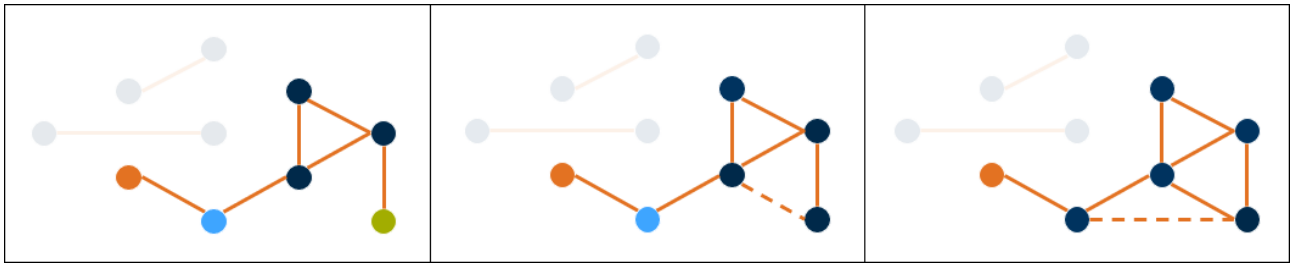
**(b)** The k-Core for k=2 is highlighted in orange. All nodes in the 2-Core have at least 2 connections within that Core. The size of the k-Core increases from 50% of the nodes on the left, to 83% in the middle, and 100% on the right.




**(c)** The shortest path between the two orange nodes denotes an existing connection with minimal involvement of intermediary nodes. Its length decreases from 4 on the left, to 3 in the middle, and 1 on the right, i.e., the connectivity from a shortest path perspective is increasing.



**(d)** Articulation points are colored in orange. Removing one of the articulation points, along with all its incident edges, would split the network. The share of articulation points decreases from 3 on the left, to 2 in the middle, and 0 on the right, i.e., the connectivity from an articulation point perspective is increasing.



**(e)** All nodes are colored according to the community they belong to. Nodes within one community have more connections within the community compared to other communities. For example, nodes in the dark blue colored community have 2 connections within and max. 1 connection outside the community. The number of communities decreases from 4 on the left, to 3 in the middle, and 2 on the right.

**Figure A.3** Illustration of network connectivity. Each sub-figure depicts a progressive increase in connectivity from left to right, with one connection added a time. Metrics in (b) to (e) are calculated for the Giant Connected Component (GCC).

## A.4 Interview protocol and guide

**Objective of the research study:** Identify why and how venture capitalists use their connections to other venture capitalists.

**Research team:** Sarah Stohrer (Doctoral Researcher, Chair of Entrepreneurial Finance at TUM); Reiner Braun (Professor, Chair of Entrepreneurial Finance at TUM)

### Research questions:

- How do venture capitalists use their personal connections to other venture capitalists throughout the venture capital decision-making process?
- Why do venture capitalists collaborate with other venture capitalists throughout the venture capital decision-making process?
- How do the venture capitalists build their personal networks?

### Semi-structured questionnaire:

1. **Introduction:**
   - Brief self-introduction of the researcher (academic and professional background, relevant research experience, and current research objectives)
   - Brief self-introduction of the interviewee (educational background, professional experience, and current role)
   - Explanation of the purpose of the study and the relevance of the interview
2. **Interview Questions Part 1:** Background of the venture capitalist and the VC firm (follow-up questions based on the self-introduction)
3. **Formalities:**
   - Explanation of the recording procedure and explicit request for the interviewee's consent
   - Clarification of data handling, confidentiality, and the next steps following the interview
   - Opportunity to clarify key definitions or terms prior to the start of the interview (in case of uncertainties)
4. **Interview Questions Part 2:** The role of investor networks in the VC decision-making process
5. **Interview Questions Part 3:** The network strategy of the venture capitalist
6. **Wrap-up:**
   - Invitation for additional comments or questions from the interviewee
   - Request for potential referrals to other relevant interviewees
   - Expression of gratitude and information on further contact

### Part 1 – Background of the venture capitalist and venture capital firm

*The intention of this section is to gather core information about the venture capital firm and venture capitalist.*

**General information – person**

- Educational and professional background, e.g., direct hire, startup experience, consulting, etc.

- VC experience, e.g., number of years in VC industry, number of VC firms worked for
- VC position, e.g., Analyst, Associate, Investment Manager, Principal, (Managing) Partner
- Investment focus in terms of industry, specific stage and/or type of company

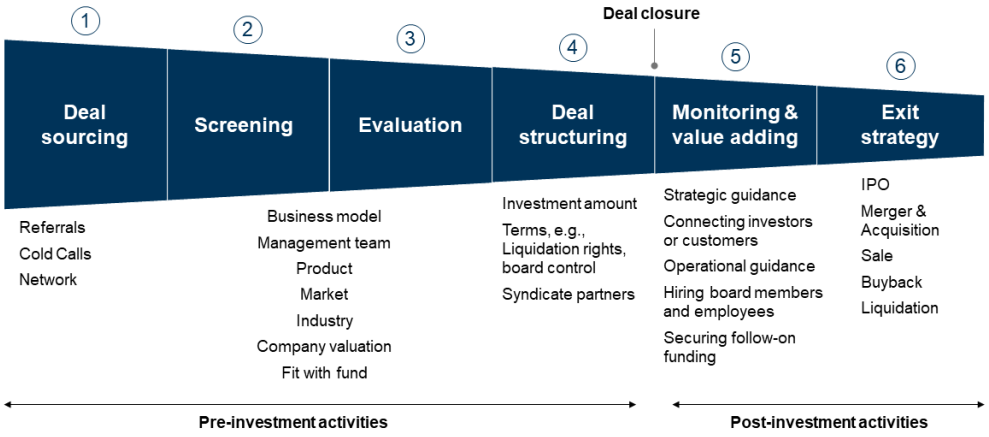
**General information – current VC firm**

- Main office location (country)
- Firm age
- Number of funds
- Typical deal size (in thousands EUR)
- Independent or corporate VC firm

### Part 2 – The role of investor networks in the VC decision-making process

*The intention of this section is to identify how venture capitalists use their personal connections to other venture capitalists along the VC decision-making process.*

**How do you use your connections to other venture capitalists (network) for investment activities?**




- How do you use your network during the deal sourcing phase (1)?
  - What are the different types of VCs that you collaborate with? Do different types of VCs provide different type of value to your deal sourcing?
  - Do you also interact with competing VCs, that invest in the same stage and industry? If yes, what are the benefits and drawbacks of collaborating with competitor?
  - What is the rationale for you and the other venture capitalist to share information about deals?
  - Do you share all opportunities with your counterparts, regardless of your internal assessment and conviction about their quality? If not, could you explain which types of deals you choose not to share and the rationale behind these decisions?
  - Have you ever analyzed your deal sources? If yes, how much of your deal flow comes through your (VC) network?
- How do you use your network during the screening and evaluation phase (2-3)?
- How do you use your network during structuring the deal, specifically for finding syndicate partners (4)?

- How do you use your network to a) your co-investors and b) your broader investor network to monitor and add value to your portfolio companies (5)?
- How do you use your network to craft and execute exit strategies (6)?

### Part 3 – The network strategy of the venture capitalist

*The intention of this section is to understand the criteria upon which the venture capitalist forms connections with other venture capitalist.*

**How do you actively build and maintain your network?**

- Where do you know the venture capitalists in your network from? E.g., shared education background, (former) co-investors, (former) colleagues
- Do you have regular, one-on-one catchups with venture capitalists?
  - What is the objective of these catchups?
  - How do you decide with whom to have these regular catchups?
- Do you go to networking events?
  - What is the objective of going to networking events?
  - How do you decide whom to approach during networking events?
- Do you reach out venture capitalists online, e.g., via LinkedIn?
  - What is the objective of these cold reach-outs?
  - How do you decide whom to target on LinkedIn?
- What alternative methods do you and others use to build and maintain their networks?

**How has your network and/or the way you use your network changed over time?**

- *(If applicable)* Has your employment switch impacted your network and the way you use your connections to other venture capitalists? If yes, how?

**Does your firm have a collective networking strategy, or do you primarily network on an individual basis?**

- How do you coordinate networking efforts across colleagues?
- Do you use a Customer Retention Management (CRM) system at your VC firm? How do you use it?
- Do you have any guidelines or best practices for colleagues to follow?

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