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The Strength of Strong Ties in an Emerging Industry: Experimental Evidence of the Effects of Status Hierarchies and Personal Ties in Venture Capitalist Decision Making

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ABSTRACT

Drawing from social network theory, scholars have identified two ways in which social ties influence venture capital investment decisions: directly through personal ties and indirectly through status hierarchies. Previous research has examined these effects independently. Our study is the first to perform a joint examination of the role of social ties and status hierarchies in venture capital decision making. We examine the relative importance of these two mechanisms through an adaptive choice-based conjoint experiment comprising of 3,132 investment decisions made by 86 venture capitalists from the United States and Europe. Our experimental context allows us to explore whether, under high levels of market uncertainty, strong personal ties exert more influence over investment decisions than the presence of a high-status investor in the deal. We also explore the moderating effects that market structure and experience play in shaping these decision processes. Our findings reveal that personal ties are more important in venture capital decision making when compared to the relative status of other venture capital firms participating in the investment syndicate. Building on our main findings, we show that the influence of personal ties is less pronounced in the European investment community, as compared to more densely networked U.S. investors. We also find a U-shaped relationship between venture capitalist experience and the influence of personal networks on investment decisions.
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You will become way less concerned with what other people think of you when you realize how seldom they do.


INTRODUCTION

Venture capital decision making has been a topic of longstanding scholarly interest. While the primary focus of this literature has been on the decision policies of individual venture capitalists (e.g., Franke *et al.*, 2006, 2008; Muzyka, Birley, and Leleux, 1996; Riquelme and Rickards, 1992; Shepherd, 1999; Shepherd and Zacharakis, 1999; Shepherd, Zacharakis, and Baron, 2003; Zacharakis, McMullen, and Shepherd, 2007), a complementary stream of research focuses on the role social networks play in influencing the relative weight and importance of those factors (Sorenson and Stuart, 2001; Shane and Cable, 2002; Hochberg, Ljungqvist, and Lu, 2007, 2010). Findings from these studies suggest that investment decisions can be influenced *directly* through personal ties (e.g., Shane and Cable, 2002; Hsu, 2007; Gompers, Mukharlyamov, and Xuan, 2012) and *indirectly* based on the relative status of other venture capital firms (e.g., Hochberg *et al.*, 2007; Ozmel, Reuer, and Gulati, 2012; Dimov, Shepherd, and Sutcliffe, 2007).

However, while these two mechanisms are known to influence investment decisions, they have been examined independently. As a result, surprisingly little is known about their joint influence or relative effect. And while we know that market structure and investor experience are important intervening factors in early-stage investment (Dimov and Shepherd, 2005; Sorenson and Stuart, 2001), we do not know how these elements interact to influence investment decisions. Questions about the role and relative influence of social ties and status hierarchies are an issue of increasing interest to entrepreneurship and strategy scholars (e.g., Folta, 2007), as
these factors influence investment decisions, firm organization, and control rights (Alvarez and Barney, 2007, 2008; Agarwal, Audretsch, and Sarkar, 2007; Stuart and Sorenson, 2007).

The purpose of this article is to improve our understanding of how social networks influence investment decisions by conducting a joint test for the influence of personal ties and status hierarchies. The context for our study is venture capital investment, where formal and informal social systems coordinate exchanges in environments characterized by high levels of uncertainty and information problems. The venture capital context, composed of dense interpersonal networks segmented by geography (Hochberg et al., 2010), allows us to explore the moderating effect of individual experience and market differences. In so doing, we aim to broaden our understanding of network governance (Jones, Hesterly, and Borgatti, 1997). We focus on the screening phase of the venture capital decision, where we employ an adaptive choice-based conjoint (ACBC) experiment involving 3,132 investment decisions made by a sample of 86 venture capital investors from the United States and Europe. Our experimental findings suggest that both direct and indirect social ties have a measurable influence on venture capital investment decision making; however, in the context of market uncertainty, for example, an emerging industry in which traditional risk/return parameters are more difficult to determine, personal ties—specifically, whether or not the deal came from a trusted referral in the investor’s network—are more important than the reputation of the lead investor present in the deal.

Building on our main findings, we also examine the influence of market structure (in particular, network density) and experience as moderating effects, finding that the influence of personal ties is less pronounced in the European investment community compared to more densely networked U.S. investors. We also find that experience plays a moderating role in this
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process. Our results show a U-shaped relationship between the experience of the venture capitalist and the influence of strong ties.

THEORY AND HYPOTHESIS DEVELOPMENT

There are two explanations for how social networks influence investment decisions. The first explanation, drawn from social network theory, explores an indirect mechanism for influence: the relative status of the lead investor in the deal. Results from previous studies suggest that the investments of highly reputable venture capital firms may convey information that influences the investment decisions of other firms (Lee, Pollock, and Jin, 2011). Venture capital firms evaluating a deal may infer information about the quality of the investment based on the network position or reputation of the venture capital firm (Hochberg et al., 2007; Hsu, 2004; Lynn, Podolny, and Tao, 2009; Washington and Zajac, 2005). Venture capital firms are accorded their status in two ways: through their social positions in the exchange network of syndicate partnerships (Hochberg et al., 2007; Gould, 2002; Wilson, 1985) and as a result of their investment performance (Lee et al., 2011). Social status, therefore, may simplify decision making for a prospective investor, who can piggyback on a higher-reputation firm’s decision processes, while also providing additional network benefits (Ozmel et al., 2012), such as signaling.

A second explanation for the influence of social networks on organizational outcomes draws from organizational theory and explores a direct mechanism: the personal network of the venture capital investor. This perspective emphasizes the role personal ties play in financial decision making (Shane and Cable, 2002), noting that venture capital investors select their
investments primarily from personal networks, in particular, repeat entrepreneurs and their previous syndication partners (Gompers et al., 2010; Wright, Robbie, and Ennew, 1997; Hsu, 2007).

In a venture capital context, scholars have investigated the effect of personal ties in investment decisions (Shane and Cable, 2002), syndicate composition (Gompers et al., 2012), and the post-investment relationship between entrepreneurs and investors (Landström et al., 1998; Sapienza, 1992; Sapienza and Korsgaard, 1996). Taken as a whole, these studies suggest that direct network ties influence investment decision making and post-investment outcomes through information transfer, a process in which investors exploit their personal ties to gather private information. In a venture capital context, direct ties develop through various forms of cooperation between investors. Investors transfer information through personal ties built through co-investment activity (Guler and Guillén, 2010a), board relationships (Hallen, Katila, and Rosenberger, 2014), and post-investment support for the portfolio firm such as recruiting or structuring the next round of investment (Gompers 1995; Hellman and Puri, 2002).

Studies investigating the role of social networks in investment decision making have also explored the influence of two moderating effects of particular interest to venture capital scholars: market structure and investment experience. Market structure, particularly, network density as a proxy for competitive rivalry, has been shown to influence investment activity at the level of the venture capital firm (Guler and Guillén, 2010b), as well as particular funds within the firm (Hochberg et al., 2010). Further, network density and associated proximity increases the likelihood of interactions between industry actors (Sorenson, 2003). Experience also plays a role in both the networks’ and organizations’ perspectives on venture capital investment, shaping both tie formation and exploitation (Hochberg et al., 2007, 2010) and learning (Busenitz, Fiet,
Moesel, 2004). While these studies have enriched our understanding of how market structure and experience influence venture capital activity, they only infer the underlying individual decision processes and, thus, provide only indirect evidence for the social ties that may sculpt those decisions.

Taken broadly, the literature on social networks and venture capital investment suggests that both status hierarchies and personal ties have a measurable effect on investment decisions; and drawing from their own theoretical frame, both perspectives suggest that the density of the local market and the experience of the individual investor may moderate those decision processes. But this begs some questions: which of the two effects is stronger and, in particular, which will be stronger in an investment context in which there is no prior art or best practice to draw from? Do the insights about local market density and investment experience found at the organizational level hold at the level of the individual decision maker?

Consider a thought experiment. In an emerging industry when trading off two deals with similar characteristics in all other respects, where one originates from within an investor’s personal network while the other represents an opportunity to co-invest with a high-status lead investor, which of the two options will a venture capitalist prefer? Then, keeping those same deal attributes constant, vary the density of the network in which the individual venture capitalist is situated or his/her level of previous investment experience. Which deal will the investor prefer?

The relative strength of strong ties

To answer the first question, we draw from theoretical and empirical work on network selection and change under conditions of uncertainty. The origins of this stream of research can
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be traced back to Mark Granovetter’s (1973) seminal strength of weak ties hypothesis, in which he argued that novel information is more likely to flow through loosely connected actors in a network than through strong ties (i.e., close personal contacts). Building on weak ties allows individuals and firms to expand their networks in order to reduce resource dependency (Burt, 1983) and to learn new technologies or practices (Kogut, 1988; Powell, Koput, and Smith-Doerr, 1996).

In a later review, however, Granovetter (1983: 209) concedes that his original hypothesis might have underemphasized the important role of strong ties, which 'have greater motivation to be of assistance and are typically more easily accessible.' When people need to take action in an uncertain context, they are more likely to resort to strong ties than to weak ties. Krackhardt (1992: 218) takes this a step further and points to 'the strength of strong ties in cases of severe change and uncertainty.' Complementary work examining firm-level networks finds that stability of network structure tends to prevail under conditions of high uncertainty; under these conditions, firms tend to reinvest in their present network rather than expand relationships (Wellman and Berkowitz, 1988). Beckman et al. (2004) suggest that the nature of uncertainty facing the firm drives network partner selection. They find that while firms broaden their networks in an attempt to mitigate firm-level uncertainty (Thompson, 1967; Pfeffer and Salancik, 2003; Burt, 1983), they tend to rely on existing networks when they are confronted with market-level uncertainty (Galaskiewicz and Shatin, 1981; Gulati, 1995). Market uncertainty—versus firm-specific uncertainty—is shared across all firms in a market and is influenced by sources such as ‘consumer demand, industry-level technology trajectories and standards, input costs, and the general competitive climate’ (Beckman et al., 2004: 262). The tendency toward the strength

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1 We define uncertainty as the 'difficulty firms have in predicting the future, which comes from incomplete knowledge' (Beckman, Haunschild, and Phillips, 2004: 260).
of strong ties in contexts of market uncertainty has also been demonstrated at the individual level in the case of a group closely related to venture capital investors, investment bankers (Podolny, 1994), who tended to interact with those with whom they had interacted in the past.

Venture capital investment is characterized by high firm-specific uncertainty, such as uncertainty related to the success of a specific technology and associated costs (Beckman et al., 2004), but typically it is also faced with uncertain market contexts. An emerging industry—one in which the technologies are unproven, the market has yet to mature, and investment best practice has yet to emerge—amplifies market-related uncertainty, leading us to conclude that venture investors in this context are more likely to reinforce their existing networks and choose trusted partners with whom they have previously worked. Thus, we hypothesize:

*Hypothesis 1: Under conditions of market uncertainty, personal ties have a higher relative influence than status hierarchies in venture capital investment decisions.*

**The moderating influence of network density**

How might the structure of the social network impact the relative influence of personal ties or status hierarchies on investment decision making? The venture capital context—densely networked and geographically concentrated—provides a useful laboratory to examine the interaction between social structure and economic action (Granovetter, 1983; Burt, 1995). Through co-investment relationships, which are most often geographically proximate, venture capital firms routinely cooperate by referring deals, providing introductions, and sharing resources such as in-house research or findings from due diligence activities (Bygrave, 1987).
Investments are embedded in a rich network of transactions that have been shown to play a crucial role in shaping co-investment relationships, and these same relationships are, in turn, influenced by both relational and geographic proximity (Hochberg et al., 2010; Sorenson and Stuart, 2001; Shane and Cable, 2002). In this view, relationships between venture capital investors in a local ecosystem create social obligations that influence investment decisions (Gulati, 1995). Building on these insights, Guler and Guillén (2010b) examine the foreign market entry of U.S. venture capital firms and find evidence for the transfer of social status advantage across markets, which demonstrates that both personal ties and status hierarchies influence investment decisions and underscores the broad findings in the finance, sociology, and management literatures describing venture capital investment embedded in an ecosystem dominated by a few densely networked regions.

Taken broadly, the influence of market structure on patterns of investment suggests that both status hierarchies and personal ties may influence investment decisions. To more deeply probe this question, we can use a feature of the market structure for venture-backed firms—geographic concentration (Stuart, Hoang, and Hybels, 1999)—and exploit the unusual level of geographic concentration in the venture capital market (Chen et al., 2010) by comparing a densely networked venture capital cluster (the United States) with a less densely networked cluster (Europe) (Martin, Sunley, and Turner, 2001). And to foreshadow the advantages of our methodological approach, a decision experiment, we can more effectively tease out the difference between status hierarchies and personal ties by examining investment decisions, rather than inferring them through analysis of firm- or fund-level investment patterns.

We expect that in a more densely networked market, venture capitalists have more opportunities to extract information about deal quality based on where the deal came from, i.e.,
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whether or not it originated from a personal network connection. Conversely, in a less densely networked market, such *socialized* signals are not as readily available and will, therefore, play a less important role in shaping venture capitalists’ investment decision making, suggesting the following hypothesis:

_Hypothesis 2: The relative influence of personal ties and status hierarchies in venture capital investment decisions under market uncertainty is moderated by (and positively related to) network density._

**The moderating effect of investment experience**

How would experienced venture capitalists differ from their less experienced counterparts in their reliance on status hierarchies or personal ties? While this question has not been addressed in prior literature, there are two neighboring streams to draw from: one related to experience effects in venture capital investment decisions and one focusing on network influences as a function of experience among entrepreneurs. Shepherd _et al._ (2003) provide evidence for a U-shaped relationship between venture investors’ experience and the quality of their decisions, initially suggesting that decision quality improves as venture investors gain experience and develop effective heuristics, but that this learning effect helps up to only a certain point. Beyond that point, very experienced venture capitalists become over-reliant on their heuristics, which may lead to a decline in decision quality. Franke _et al._ (2008) explore differences between experienced and inexperienced venture capital investors. While social ties among investors are not explicitly addressed, they demonstrate that experienced investors value
the existence of social ties among the entrepreneurial team that they invest in more than do inexperienced investors.

In related work exploring networks and entrepreneurial experience, Hite and Hesterly (2001) find that less experienced firm founders rely more on strong ties to attract resources during the early stages of firm formation and growth. As these individuals gain experience, they argue (and find) that their network evolves into a parsimonious and consciously managed network, with access to weak ties more conducive to success as the venture grows. Complementing this work on venture beginnings is a collection of studies exploring path dependence and lock-in at the other end of the organizational life cycle. Mature firms tend to be characterized by a cohesive network of close ties, which ultimately endangers their ability to adapt in a changing environment (Henderson and Clark, 1990; Tripsas and Gavetti, 2000). This pattern of initial reliance on strong ties, then increasing attention to weak ties, and eventually returning to denser network structure, has been found across networks of inter- and intrafirm partnerships (Hagedoorn and Frankort, 2008; Morrison 2002) and governance relationships (Carpenter and Westphal, 2001), and it has been the subject of extended inquiry in sociology and network theory (Meuleman et al., 2010; Uzzi, 1997). Despite the rich literature in the network paradigm across several different research streams (Borgatti and Foster, 2003), to our knowledge, the dynamic role of strong and weak ties in investment decision making has yet to be explored. Both at the firm level (Uzzi, 1997) and the individual level (Hite and Hesterly, 2001; Meuleman et al., 2010), strong ties are positively related to performance up to a certain experience threshold, at which time firms become over-embedded (for example, by becoming insulated from information that exists beyond their networks).
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Aligned with previous theoretical and empirical work, we argue that less experienced venture capitalists will initially rely on strong ties to reduce uncertainty (Hite and Hesterly, 2001) and monitor costs (Sorenson and Stuart, 2001), followed by a phase of growing experience and confidence in their own ability to evaluate the quality of deals, thus reducing the need to acquire informal information through personal ties. As noted by Sorenson and Stuart (2001: 1556-1557), ‘as [venture capital investors] gain confidence in their ability to evaluate investment opportunities…they might grow less dependent on trustworthy or redundant information sources to appraise the quality of investment candidates.’ Over time, however, venture capital investors further develop and strengthen their social networks, and this increasing embeddedness in social structures could eventually make them return to a focus on strong ties in a later part of their career (Henderson and Clark, 1990; Tripsas and Gavetti, 2000). We, therefore, hypothesize:

*Hypothesis 3: The relative influence of personal ties and status hierarchies in venture capital investment decisions under market uncertainty is moderated by (and curvilinearly related to) the experience of the investor.*

METHOD

Sample and data collection

We derived the list of potential participants for our experiment from Thomson ONE Private Equity (formerly VentureXpert), gathering investment partner contact information for all active venture capital firms from 1990 to 2010. We approached these contacts by a standardized
mass e-mailing (initial mailing, plus a reminder after two weeks). Our primary mechanism for gathering data for this study was a Web-based survey administered in March and April 2010. An e-mail address list that reached back to 1990 produced a large number of delivery failures due to outdated e-mail addresses (16,118 e-mails sent, with 6,227 delivery failures).

A total of 176 venture capitalists took part in our request to participate in the experiment, constituting a response rate of 1.8 percent. After cleaning our sample for 44 incomplete responses, 14 investors from outside of the United States and Europe, and two double entries, we retained 116 complete responses (86 independent and 30 corporate venture capital investors). As decision-making procedures of corporate and independent venture capitalists differ substantially in their investment decision criteria (Dushnitsky and Lenox, 2005), in this article, we exclusively report on the final sample of 86 independent venture capitalists. We present descriptive statistics for our sample in Table 1.

While our broad sampling strategy was not aimed at creating a statistically representative sample of the global venture capital industry, we managed to control for a mix of venture capitalists with regard to demographic characteristics (age and experience) as well as firm characteristics (main office location and number of employees). Table 1 also compares the demographic characteristics of our sample with statistics from the official North American and European venture capital industry associations (NVCA, EVCA), demonstrating that our sample represents the venture capital population well in terms of geographic location.² Related to firm size, the firms in our sample are larger than the average U.S. and European venture capital firm.³ The average firm age, number of funds, deal size, and investor information of our sample of venture capitalists looks reasonable compared to other studies (e.g., Franke et al., 2006, 2008).

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Our sample is of very high quality in terms of the average investor experience (7.43 years) and position of the respondent in the firm. Sixty-six percent of the sample represents senior investors (managing directors, general partners, partners) and only 21 percent of analysts took part in the survey.

Conjoint analysis

The conjoint design we employ in this study allows us to experimentally vary the characteristics of deals. Conjoint analysis continues to enjoy a surge in popularity in the domain of entrepreneurship research, in particular by venture capital scholars (e.g., Franke et al., 2006, 2008; Mitchell and Shepherd, 2010; Shepherd, 1999; Shepherd and Zacharakis, 1999; Shepherd et al., 2003; Zacharakis et al., 2007), and calls for its broader use continue (Dean, Shook, and Payne, 2007; DeSarbo, MacMillan, and Day, 1987; Lohrke, Holloway, and Woolley, 2010; Shepherd and Zacharakis, 1997).

Historically, preference measurement in the entrepreneurship and venture capital literature has used metric or conventional conjoint analysis in which respondents engage in a task and are asked to evaluate a series of hypothetical options (e.g., investment deals) with regard to their likelihood of action (e.g., investment). Part-worth utilities for each attribute can then be estimated using a decompositional approach, where the overall preference for an option expressed by its rating or ranking is broken down into the preferences of the particular attributes and attribute levels (e.g., Green and Rao, 1971; Green and Srinivasan, 1990; Louviere et al., 2003; Louviere et al., 2008; McFadden, 1986).
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Several recent advances have been made in the conjoint method, most of them originating from marketing research. Our study incorporates two important methodological advances. The first is our use of adaptive choice-based conjoint analysis in our experimental design (Johnson and Orme, 2007; Chapman et al., 2009; Sawtooth Software, 2009a). The second is our estimation technique, where we estimate part-worth values using a hierarchical Bayesian approach (Lenk et al., 1996; Orme, 2000; Moore, 2004).

Adaptive choice-based conjoint analysis

We used Sawtooth Software to design the adaptive choice-based conjoint experiment. Our Web-based choice experiment collects preference data in an interactive mode and through different approaches that increase the information gathered per respondent. The computer-administered interview consists of three sections that build on each other. The first section is called build your own (BYO), where respondents are asked to select their most preferred level for each of the attributes included in the design. In the second section, based on this first response, the software generates a pool of 24 alternatives, i.e., a customized, fractional factorial design. The alternatives are presented to the respondents in groups of four (screening section). Individuals have to indicate for each of the alternatives if they would consider it or not (construction of a consideration set). This section also includes multiple must have and unacceptable questions that are constructed based on the individual’s answers to the screening

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4 While the general process of a choice-based conjoint design is similar to metric conjoint analysis, the difference is that respondents are asked to indicate their choice among a set of options (typically three or four opportunities per choice task) instead of rating each of the options individually (Gustafsson, Hermann, and Huber, 2007).

5 These alternatives are generated as near-neighbors to the levels the respondent chooses in the BYO task, but still include the full range of levels of the attributes in the experiment (Sawtooth Software, 2009a).

6 The customized designs are near-orthogonal, generated by the software on-the-fly, based on the information provided by the respondent in the BYO section by following a controlled, randomized process. This process controls for a maximum possible balance of levels and statistical efficiency (Sawtooth Software, 2009a).
questions; (3) all alternatives that passed the screening task are transferred to the final section of
the survey where the alternatives are grouped into a series of choice tasks (choice tournament).
Respondents typically face three to four alternatives per choice task, and in each task, they have
to indicate their most favored option. The winning alternatives then compete in subsequent
rounds until the most preferred option is identified (Johnson and Orme, 2007).

Decision task

The venture capital investment decision is a multi-stage process with different criteria
employed depending on the stage (e.g., Payne et al., 2009; Petty and Gruber, 2011). An
important early step in a venture capitalist’s assessment of a new venture is the screening
process. More than 80 percent of new venture proposals are rejected at this initial stage (Roberts,
1991). A central consideration in this process is the deal sheet, which represents the
consolidation of the opportunity for review by the general partners of the venture capital firm.
This document, usually no more than one to two pages, provides a potential investor with the
information needed to determine whether to pursue the opportunity or not, i.e., to invite the
entrepreneur or start-up team for a project presentation (Dixon, 1991). Due to its importance and
in order to mitigate any biases in our experimental setting, we focus only on this first stage in the
venture capital evaluation process, the screening phase at which venture investors examine the
initial salience of a particular investment project. Respondents were asked to assume they were
screening through incoming business opportunities where the objective is to identify the
investment that they would be most likely to further investigate in a next stage (i.e., the decision
of whether to invite the founder for a project presentation).
Similar to laboratory experiments, conjoint analysis requires that researchers know *a priori* the most critical attributes and levels affecting respondent decision making. Thus, the selection of attributes is crucial, as they represent a *closed system* of assumptions upon which the experiment rests.

We drew from the rich literature on venture capital decision making to identify the standard attributes of investment opportunities, in particular, the comprehensive review of decision criteria by Petty and Gruber (2011). Venture capitalists pay particular attention to four broad categories: (1) product or service characteristics; (2) target market characteristics; (3) management team; and (4) return potential. We used these categories to formulate four measures that apply to the context of our experiment: technological maturity, regulatory exposure, founder experience, and return potential. (We later provide an in-depth discussion of each.) As for the second objective of our research approach, to capture the influence of *socialized* criteria on venture capital investment decision making, we extracted two additional attributes from the literature that have been shown to be of importance and would allow us to test our hypotheses: the lead investor (to measure the effect of status hierarchies) and the source of the deal (to measure effects of personal ties).

For each of the six attributes, we included four levels in our conjoint survey. To check for face validity of the attributes and attribute levels, we reviewed this list (cf. Table 2) with 20 professional venture capital investors. Based on the attributes and attribute levels selected, the choice tasks were composed on a random basis.
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We performed a pretest with six students and 20 professional venture capital investors (12 in the United States and eight in Europe). Figure 1 shows an example of a choice task presented to the venture capitalists in the survey.

[Insert Figure 1]

To avoid respondent cognitive overload on the one hand and to ensure realistic choice situations on the other hand, we chose a particular add-on feature of adaptive choice-based conjoint that allowed respondents to select a subset of the attributes included in the survey design. In our experiment, we asked respondents to indicate four out of the six attributes that were most relevant to their investment decision. Only those four attributes that were most relevant to each respondent were then included in the individual choice tasks. We next discuss how we operationalized the key variables.

Lead investor status and personal network ties. The focal variable in this study is the relative strength of strong ties, defined as the difference between two forms of social network influences, namely personal ties (deal source, representing strong ties) and status of the lead investor (weak ties). Using the attribute lead investor, we can examine the influence of high-status venture capital firms on other investors’ decisions to investigate a specific deal or not. We used different Web-based sources\(^7\) to identify high-status venture capitalists. Given the international scope of our study and because the venture capital industry in the United States is larger than anywhere else in the world, we picked three classic Silicon Valley venture capitalists,

\(^7\) For example, TheFunded.com, which provides reviews of venture capital firms by entrepreneurs and the results of a ranking of the Top 100 Venture Capitalists from Entrepreneur magazine.
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assuming that they had the highest chances of being known\(^8\) to respondents around the world: (1) Kleiner Perkins Caufield & Byers (also known as Kleiner Perkins), a very prominent venture capitalist famous for backing successful companies such as Amazon and Google; (2) Draper Fisher Jurvetson (DFJ), an early-stage investor in high-profile firms like Tesla Motors and Hotmail; and (3) Khosla Ventures, a prominent specialist in the clean energy space. To have a baseline against which we could compare those high-status firms, we added a fictional venture capital firm (Insight Capital Partners) representing the low end of the status hierarchy.\(^9\)

The attribute deal source was described along four levels: personal network, syndicate partner, met at venture fair, and received business plan by e-mail. This allowed us to measure the influence of strong personal ties on venture capitalists’ evaluations of deals.

**Market risk.** Venture capitalists seek markets or industries that are growing fast at high rates in order to maximize revenue streams and value creation (Hisrich and Jankowicz, 1990; MacMillan, Siegel, and Subba Narasimha, 1985; Tyebjee and Bruno, 1981; Zider, 1998). Petty and Gruber (2011) analyzed a large longitudinal set of data on decision-making criteria and revealed four categories of critical information specifically related to the market or industry dimension: (1) the existence and/or clarity of the market; (2) the character of the market (related to size, competitive environment, fragmentation, and maturity); (3) the acceptance of the products or services; and (4) regulations. In our conjoint experiment, we held the industry dimension constant to demonstrate market uncertainty through setting the context as clean

\(^8\) We controlled for this in the survey instrument by asking respondents to indicate their level of awareness of a range of venture capital firms. The three Silicon Valley firms selected for our experiment turned out to be among the top four well-known VCs among U.S. respondents and the top six well-known VCs among European respondents. We also controlled for any influence that the slight differences in awareness of the selected firms between the two subsamples could have had on our conjoint results, and we found no statistically significant difference.

\(^9\) We chose to use the names of real venture capital firms in our experiment for two reasons. Using real names of products and organizations is quite common in marketing research (e.g., Green, Krieger, and Wind, 2001) and we followed this strategy in order to make our choice tasks as realistic as possible.
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energy technology deals. We included the attribute *regulatory exposure* as an additional element related to the market dimension (Petty and Gruber, 2011) and ranging from very low to very high regulatory exposure.

*Product/technology risk.* Previous studies have operationalized this category in different ways, such as product feasibility (Bruno and Tyebjee, 1983, 1986), product (-market) differentiation or product (-market) uniqueness (Hisrich and Jankowicz, 1990; Hutt and Thomas, 1985; Riquelme and Rickards, 1992; Tyebjee and Bruno, 1984), product characteristics (e.g., related to the maturity of the product from prototype to proprietary rights protection) (MacMillan et al., 1985; Riquelme and Rickards, 1992), use of technology (Hisrich and Jankowicz, 1990), and (in a negative way) product development/design failures (Gorman and Sahlman, 1986; Meyer, Zacharakis, and De Castro, 1993). In our study, we operationalized this dimension through the attribute *technological maturity*, indicating the technology’s state of development at four levels: in production with customers, finished product, working prototype, works in laboratory.

*Management risk.* The management team of the start-up business plays an important role in the evaluation of venture capitalists (e.g., Franke et al., 2008; MacMillan et al., 1985; Muzyka et al., 1996; Silva, 2004; Wells, 1974). Zider (1998: 138), for instance, concludes that venture capitalists 'want to invest in proven, successful people.' Literature also shows that prior start-up experience positively relates to survival and performance of a venture (Batjargal, 2007; Chandler, 1996). By including the attribute *founder experience* in our experiment, we simulated a varying management and entrepreneurial experience level among the profiles shown to the
decision makers. We chose four experience levels corresponding to the ones identified in prior studies (e.g., Franke et al., 2008; Hsu, 2007; Matusik, George, and Heeley, 2008): (1) previous experience as a start-up founder; (2) general start-up experience; (3) executive experience; and (4) graduate student (indicating an inexperienced founder).

**Return potential.** Related to the fourth dimension, return potential, MacMillan and Subba Narasimha (1986) found in their study two criteria—financial projections and a balanced and professionally written business plan—to be most important for venture capitalists deciding whether or not to provide funding. Various other studies also report financial factors (or the expected risk associated with financial returns) to be important in venture capital investment decisions (e.g., Gompers and Lerner, 1999; MacMillan et al., 1985; Muzyka et al., 1996; Riquelme and Rickards, 1992). Thus, we included the parameter *return potential* with values ranging from five to 20 times the initial investment within five years.

**Post-experiment questionnaire.** After the conjoint experiment, we gathered firm- and fund-level information including: location (country); size (total number of employees); firm age; number of funds; deal size (in thousands USD); and whether the firm is an independent or corporate venture capital firm. We also gathered demographic information about the individual venture capital investors: the age of the investor; the number of years of experience in the venture capital industry and of direct investment responsibility; the domain experience of the investor in number of years as an active investor in that sector (related to seven industries: biotechnology, information and communication technologies, consumer related, clean energy,
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conventional energy, medical and health, and other products); number of boards served; and whether the respondent was a managing director, general partner, partner, or analyst.

Data analysis

We estimate the part-worth values for the attribute levels per individual respondent using a hierarchical Bayes procedure. Historically, entrepreneurship scholars using conjoint analysis have mainly estimated part-worth values by employing metric (rating-based) approaches and using standard ordinary least square (OLS) regression models. With the rise of choice-based conjoint designs, hierarchical Bayes, first introduced in 1995 (Allenby, Arora, and Ginter, 1995; Allenby and Ginter, 1995; Lenk et al., 1996), has gained popularity within the last decade, specifically in the field of marketing (Netzer et al., 2008; Rossi and Allenby, 2003). Different from standard OLS estimates, the hierarchical Bayes procedure consists of two levels—an upper or population level and a lower or individual level. This allows the hierarchical Bayes algorithm to borrow missing information on the individual level from the overall sample of respondents.¹⁰

A main advantage of this procedure is that it deals with the problem of preference heterogeneity by estimating individual-level part-worth values (Lenk et al., 1996). This is specifically important in the case of fractional factorial designs (Rossi, Allenby, and McCulloch, 2005)¹¹ where the application of standard OLS may lead to less precise coefficient estimates (Lenk et al.,

¹⁰ See Sawtooth Software (2009b) for more details on the hierarchical Bayes procedure.
¹¹ In a fractional factorial design, versus a full factorial design where all possible combinations of attribute levels are included, respondents usually receive a lower number of choice tasks compared to the overall number of part-worth values to be estimated. However, as full factorial designs would be too large for respondents to handle, it is widespread standard to use a fractional factorial design in various conjoint application fields, such as marketing (Green and Srinivasan, 1990), as well as venture capital and entrepreneurship research (e.g., Brundin, Patzelt, Shepherd, 2008; Mitchell and Shepherd, 2010).
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1996) or in choice-based conjoint where much less information is generated per respondent than by other methods.

Bayesian estimation, as with classical frequentist procedures, can basically be applied to any statistical model (Train, 2009). The advantage of using Bayesian analysis for discrete choice experiments is that it can deal with major drawbacks of classical procedures such as the maximization requirement of functions (e.g., of logit or probit models) (Train, 2009). In a conjoint context, comparisons show that rating-based conjoint analyses using hierarchical Bayes outperform frequentist-based estimations in terms of hit rate (e.g., Andrews, Ansari, and Currim, 2002; Lenk et al., 1996; Moore, Gray-Lee, and Louviere, 1998). In our study, we use a common approach for the analysis of discrete choice data (Train, 2009; Greene, 2011) by applying the Bayesian procedure to estimate the parameters of a multinomial logit model (Johnson, 2000; Sawtooth Software, 2009b).

While Bayesian analysis represents the most advanced estimation method for discrete choice experiments, Table 2 also presents the results of a simple multinomial logit (MNL) estimation of part-worth utilities to support analysis by readers who are less familiar with hierarchical Bayes estimation.¹²

RESULTS

Our results are based on the responses of 86 venture capital investors performing 3,132 choice tasks, an average of 36.4 tasks per respondent, which includes the build-your-own,

¹² We caution readers that a direct comparison of the hierarchical Bayes and MNL estimates is only of limited use due to an advance we applied in our conjoint experiment allowing respondents to deselect attributes that they feel are of minor importance in their investment decisions. The hierarchical Bayes algorithm we used is tailored to dealing with such deselected attributes and sets the final individual-level part-worths to zero to account for their lack of importance to the respective respondent.
screening, and choice tournament sections of the questionnaire. Descriptive statistics for our sample are displayed in Table 1.

The venture capitalists in our sample are nearly equally distributed between the United States and Europe (52% and 48%, respectively). On average, the firms in our sample have about 18 employees.

[Insert Table 1 About Here]

The main results of our conjoint experiment are reported in Tables 2 and 3. An analysis of the relative importance of the six attributes in explaining observed choices (reported in Table 3) shows that, aligned with previous studies, traditional venture capital investment criteria (return potential, technological maturity, and founder experience) are of highest importance to the average investor in our sample. The attributes representing the influence of social networks have a small, but significant, effect on the investment decision.

Our results also detail the average effect of a particular attribute level on the investment decision. The part-worth values are hierarchical Bayes estimates calculated on individual respondent preferences for a sample size of 86. We report effects-coded raw utilities in Table 2 (Orme, 2010). The average part-worth utility measures the influence of a change of the respective attribute level on choice. Positive values indicate an increase in the individual’s utility, implying higher desirability, while negative values indicate a decrease in utility, implying lower desirability. Since part-worth utilities are interval data, scaled to an arbitrary additive constant and summed to zero within each attribute, it is not possible to directly compare utility values across attributes.
The preferences for the attribute levels related to return potential, technological maturity, founder experience, and regulatory exposure all follow an obvious order, i.e., the levels indicating lowest return potential (five times in five years), highest product/technology risk (works in laboratory), highest management risk (graduate student), and highest market risk (very high regulatory exposure) have the lowest part-worth estimates. The results for the attribute lead investor show that the highest status venture capitalist in the experimental design (Kleiner Perkins) offers the highest part-worth utility, whereas the fictitious company (Insight Capital Partners, representing the bottom end of the status hierarchy) contributes the lowest value to overall investor utility. These results, in combination with the small but significant importance of this attribute as stated earlier, support prior research on the relationship between venture capitalist reputation and investment decisions.

A similar picture can be drawn for the influence of personal network ties. The attribute level representing the absence of a social tie between investor and entrepreneur (e-mail business plan) achieved the lowest part-worth utility estimate, whereas a deal originating in the respondents’ personal network (indicating a strong tie) is associated with the highest part-worth utility. With these results, we reinforce findings in previous work showing that the likelihood to invest in a deal is moderated by the deal source: a venture capitalist is less likely to invest in a deal originating from a distant source in his/her social network.

With regard to our first hypothesis, predicting that personal network ties dominate the effect of status hierarchies, the relative importance values show that our respondents perceive the attribute deal source (6.41%), measuring personal ties, as more important than lead investor (3.17%), measuring status. A two-sided Wilcoxon test for paired samples shows that the difference between the relative importance values of these two attributes is significant (p < 0.01).
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Therefore, we can confirm Hypothesis 1: in environments of market uncertainty, investors tend to resort to strong personal ties, and this effect is stronger than the influence of a high-status lead investor.

[Insert Table 2 About Here]

[Insert Table 3 About Here]

To test Hypotheses 2 and 3, in which we suggest that there will be variations in the relative strength of strong and weak ties in venture capital investment decision making between different types of respondents, we calculated the difference between the individual relative importance values for the attribute deal source and lead investor. Negative values of this variable means that the attribute lead investor is more important (lead investor > deal source), whereas positive values indicate a higher preference for strong over weak ties (deal source > lead investor). Table 5 displays the test results related to differences in our focal variable with respect to a number of descriptive factors from our sample. We transformed the continuous variables into three approximately equal-sized groups along two percentiles (33rd and 66th percentiles) based on a rank order of the particular variable from lowest to highest.

Testing for differences between U.S. and European venture capitalists, we find significant results (Mann-Whitney U test, p < 0.05). While investors on both sides of the Atlantic attach higher relative importance to the source of the deal than to the lead investor, our results show that the difference between the two is higher among U.S. venture capitalists (M = 5.22%) than among European venture capitalists (M = 1.07%), confirming our second hypothesis about the strength of strong ties in the densely networked North American venture capital industry.
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We test our third hypothesis about the U-shaped relationship between experience and strength of strong ties based on three measures of venture capital experience: investment experience, number of board seats, and position in the firm.\textsuperscript{13} If we measure experience as number of years that a venture capitalist has held responsibility for making investment decisions (0–2 years, 3–9 years, 10–30 years) or in terms of number of boards on which the venture capitalist has served (0–1 boards, 2–8 boards, 9–50 boards), we find slightly significant evidence for the hypothesized U-shaped relationship (Kruskal-Wallis test, p < 0.10). Segmenting respondents according to their position in the firm and investment experience (analysts, junior partners, senior partners) also leads to significant results (Kruskal-Wallis test, p < 0.05). With increasing experience, investors in our sample tend to rely more on the lead investor than on whether the deal came from a close source in their personal network, whereas after a tipping point the strength of weak ties seems to decrease again. Very experienced venture capitalists seem to return to their initial preference for stronger social ties over weak ones. This U-shaped relationship also holds true for the other two variables: number of boards served and position in the firm. We therefore find strong support for Hypothesis 3.

\textsuperscript{13}Cf. Table 4 for correlations between variables.

LIMITATIONS AND FUTURE RESEARCH

Our study has some limitations that provide starting points for further research on the role of social network ties in venture capital investment decisions. Our study is part of the growing
body of experimental approaches to research in entrepreneurship and venture capital and, as such, has to be conscious about possible gaps between experiment and reality. While choice-based conjoint experiments (as compared to rating-based conjoint experiments) better mimic comparative settings often present in real market behavior (Elrod, Louviere, and Davey, 1992; Franke et al., 2008; Huber, Ariely, and Fischer, 2002), this method produces less information than individually rating each option (Moore, 2004). We believe that by employing the most recent advances in conjoint analysis and considering how to best apply them to the field of entrepreneurship (Lohrke et al., 2010), we have contributed to the field by showing how adaptive conjoint-based approaches can provide more information per respondent through the combination of compositional and decompositional approaches. Yet, we cannot completely dismiss the possibility that our methodological design leads to an overestimation of traditional financial criteria, such as return potential, when compared to social network criteria, such as lead investor or deal source. Additionally, our results for social cues and reputation may be sensitive to the nature of the experimental task (deal screening) or the respondent’s demographic or experience profile. This may be due to an attribute-task compatibility effect (Nowlis and Simonson, 1997), where comparable attributes, like price or the potential financial return, are more important in choice-based tasks, whereas less comparable attributes, such as brand name, are more important in rating-based tasks. Future studies could try to further contribute to the emerging socialized view of venture capital investing by pursuing multimethod approaches, possibly including experimental methods that are tailored to capture the affective component of social network influences on investor decision making.

This study focuses only on the first step in the decision-making process of venture capital investors, i.e., the screening phase. It is important for future studies to investigate the joint
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influence of direct (personal network) and indirect (status hierarchies) social ties in a later stage of the decision-making process (such as due diligence) or the final stage prior to deal closure.

Our operationalization of the direct tie through the attribute-level personal network also includes second-order ties (e.g., friends of friends). This is a potential limitation. In future studies, researchers might also want to test differences in deal recommendations from different locations in the personal network, which would allow for a more fine-grained investigation of social network effects on investment decisions.

While the sample size of this study is well in line with previous conjoint experiments on venture capital investment criteria and professional venture investors are notoriously hard to access, our final sample size limits our ability to perform detailed subgroup analysis on venture investors based on criteria like investor type or domain-specific experience. Our initial sample included corporate venture capitalists and investors from other world regions, but their number was insufficient to perform systematic analysis of differences. It is, however, representative related to the geographic distribution of venture capital firms between the United States and Europe. We were not able to confirm the representativeness of the particular investors in our sample with regard to characteristics such as age, industry affiliation, etc., as such information is not publicly available. Future research could try to investigate whether significant differences between investor types or other world regions can be identified, for example, by working with a larger sample and/or further isolating the influence of social networks from other attributes of decision making.

When it comes to the moderating influence of experience on the reliance on social ties, we hypothesized (and found) a U-shaped effect based on measuring social ties with the attributes deal source and lead investor in our experiment. Given the cross-sectional nature of our data, we
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could not capture potential changes in investors’ network density over time. Further research could explore novel measures of network density or examine the multiple overlapping social networks in venture investment (syndicate partners, entrepreneurs, and professional contacts) to investigate whether changes in network density influence the extent to which an investor’s reliance on social ties changes over time and which/what networks matter, or matter most.

We operationalized uncertainty as market uncertainty by defining the context of the experimental choice task as an opportunity to invest in a newly emerging industry, namely clean energy. Further research could compare the importance of distant versus close network ties in firm-specific and market-related uncertainty contexts or in varying dimensions of market uncertainty (e.g., demand uncertainty, technology uncertainty, uncertainty related to competition). A promising approach would also be the application of a cross-industry design, comparing an emerging industry to a more mature venture capital sector, such as biotechnology or information technology. In a mature industry context, we expect strong personal ties to be of less importance than in the context of market-level uncertainty (Galaskiewicz and Shatin, 1981; Gulati, 1995) where standards and structures are still evolving and, thus, the value of personal information is higher.

Status hierarchies in social networks are built over time through interactions among the members of these networks and their roles and performance in specific engagements (Gould, 2002; Lee et al., 2011). As we test for both the effect of personal interactions and status hierarchies in our experiment, there might be a possible conflation between these two variables. However, we tested for any potential bias *ex post* by checking the respondents’ co-investments with the lead investors included in our conjoint design. Only a very small portion of the respondents in our sample had actual co-investment experience with one of these firms.
CONCLUSION

Our interest in this article has been to improve our understanding of how social networks influence investment decisions by conducting a joint test for the influence of personal ties and status hierarchies in a context of market uncertainty. When trading off two deals with similar characteristics in all other respects, where one originates within the venture capitalist’s personal network and the other represents an opportunity to co-invest with a high-status lead investor, which of the two options will a venture capitalist prefer? The present study is the first to answer this question, employing an experimental methodology that supports the joint test of the effects of status hierarchies and social ties with a sample of U.S. and European venture capital investors. Our results strongly support that social networks do exert a measurable influence on venture capital investment decisions. However, in a market uncertainty context (for example, in an emerging industry in which the traditional risk/return parameters are more difficult to determine), personal ties—specifically, whether or not the deal came from a trusted referral in the investor’s network—are more important than the reputation of the other investors in the deal. Our study deepens our understanding of venture capitalist decision making, and our experimental context—an emerging, uncertain industry—contributes more broadly to an emerging literature in entrepreneurship, distinguishing the theoretical and practical implications of decisions made in uncertain versus risky environments and the implications for firm organization (Alvarez and Barney, 2005) and control rights (Alvarez and Parker, 2009), which are central to high-impact entrepreneurship and venture finance.

Our experiment, conducted on a sample of venture capitalists from the United States and Europe, confirms Shane and Cable’s (2002) observation that aspects related to venture investors’
social network play a role in explaining investment decisions, while reflecting their finding that neither an over- nor an under-socialized view is warranted. Our results point to a more nuanced view of investment decisions. The venture capitalists we surveyed cannot be conceived as herd animals blindly following their peers, yet they are not completely free from the influence of others. The cross-continental context of our sample enables us to exploit a feature of the venture capital market—extreme geographic concentration and local bias—to compare how social networks that shape investment decisions are made in densely networked and less densely networked contexts. We show that the reliance on strong personal ties is more pronounced in the densely networked U.S. venture capital industry than among the European respondents in our sample.

Our findings also underscore the role experience plays as a moderating factor, adding depth and texture to Shepherd et al.’s (2003) evidence for a U-shaped relationship between venture investors’ experience and their decision making. Specifically, we show that inexperienced investors rely more on personal ties. This reliance decreases as venture capitalists gain experience, but only up to a point, after which the strength of the personal network increases again. The reliance on personal relationships in order to attain reliable information and resources has been shown in different contexts: strong ties can provide valuable information about new alliance and syndication partners (Hagedoorn and Frankort, 2008; Meuleman et al., 2010), and they further help generate necessary resources in the early stages of the firm (Hite and Hesterly, 2001). The mechanisms at play in our context, related to the source of an investment opportunity of sufficient quality, are similar to such interfirm contractual situations. The reliance on strong ties reduces risk and uncertainty through trustful, resilient, and easy accessible relationships (Meuleman et al., 2010; Sorenson and Stuart, 2001); however, as suggested by the findings of
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Gompers et al. (2012), relying on personal network referrals might lead to information redundancy over time and limited access to new information (Uzzi, 1997).

To put the results into context, our data also confirms that traditional venture investment criteria related to market, technology, and management risk, as well as return potential matter. Our study compliments existing work by examining the decision criteria of venture capitalists using conjoint experiments by applying a larger sample (86 professional venture capitalists conducting 3,132 experimental choices) with an international focus. Our study also makes important methodological contributions, especially through our use of ACBC, as one of the latest advances in the design of efficient choice experiments, and of hierarchical Bayes estimation, as a significant step forward in increasing the validity of conjoint analysis under conditions of preference heterogeneity and scarce information per respondent.

This study has important implications for entrepreneurs seeking venture funding by increasing their understanding about the factors most important to venture capitalists. Our research confirms that venture capital investors employ criteria designed to reduce risk in early-stage investment (Ruhnka and Young, 1991; Hall and Hofer, 1993). However, venture capital organizations, and venture capitalists in particular, are also uncertainty processing engines (Folta, 2007) that attempt to buffer an uncertain world by gathering information from social networks, both pre-investment (Shane and Cable, 2002) and post-investment (Sapienza and Gupta, 1994). We discerned a clear relationship between strong personal ties and the inclination to invest in a newly emerging industry, with deals originating from a more distant source in the venture capitalist’s network having lesser chances of getting funded. Entrepreneurs in new industries are, therefore, well advised to use and extend their personal networks, as the potential benefit from
this activity seems to be greater than seeking affiliation with a distant, but high-status venture capitalist.
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REFERENCES


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**Figure 1: Sample choice task from Web-based survey**

Out of these three investment opportunities in the Clean Energy industry, which one is the best option that you would investigate further?

<table>
<thead>
<tr>
<th>Lead investor</th>
<th>Draper Fisher Jurvetson</th>
<th>Kleiner Perkins</th>
<th>Draper Fisher Jurvetson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deal source</td>
<td>Personal network</td>
<td>Syndicate partner</td>
<td>Syndicate partner</td>
</tr>
<tr>
<td>Return potential</td>
<td>10x in 5 years</td>
<td>5x in 5 years</td>
<td>20x in 5 years</td>
</tr>
<tr>
<td>Technological maturity</td>
<td>Works in laboratory</td>
<td>Working prototype</td>
<td>Finished product</td>
</tr>
</tbody>
</table>

\[\text{\textcircled{O}} \] \quad \text{\textcircled{O}} \quad \text{\textcircled{O}}

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\* In an ACBC analysis, respondents have the opportunity to select a subsample of attributes, eliminating those that they perceive to be of lower relevance to them. This allows us to collect more fine-grained information about the most relevant choice attributes while reducing the complexity of the choice task and, hence, avoiding cognitive overload. In our experimental design, respondents were asked to select the four most relevant out of the six attributes included in the design before entering the conjoint experiment. In this example, the respondent chose the attribute's lead investor, deal source, return potential, and technological maturity.
### Table 1: Descriptive statistics

<table>
<thead>
<tr>
<th>Sample characteristics</th>
<th>N</th>
<th>%</th>
<th>Mean</th>
<th>Median</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Firm and fund information</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Firm location (N = 86)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe</td>
<td>41</td>
<td>48</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>47% (714)</td>
</tr>
<tr>
<td>United States</td>
<td>45</td>
<td>52</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>53% (791)</td>
</tr>
<tr>
<td>Firm size (number of employees)</td>
<td>86</td>
<td></td>
<td>18.01</td>
<td>10</td>
<td>24.78</td>
<td>1</td>
<td>150</td>
<td>9.91/8.00</td>
</tr>
<tr>
<td>Firm age (years)</td>
<td>86</td>
<td></td>
<td>12.76</td>
<td>10</td>
<td>8.31</td>
<td>1</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>Number of funds c</td>
<td>85</td>
<td></td>
<td>2.89</td>
<td>2</td>
<td>2.50</td>
<td>1</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Deal size (in thousands USD)</td>
<td>86</td>
<td></td>
<td>7,631.98</td>
<td>4,000</td>
<td>12,795.29</td>
<td>100</td>
<td>70,000</td>
<td></td>
</tr>
<tr>
<td><strong>Investor information</strong></td>
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<tr>
<td>Investor age (years)</td>
<td>86</td>
<td></td>
<td>43.37</td>
<td>42.50</td>
<td>11.22</td>
<td>23</td>
<td>70</td>
<td></td>
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<td>VC industry affiliation (years)</td>
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<td>9.00</td>
<td>8</td>
<td>7.52</td>
<td>1</td>
<td>35</td>
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<td>VC investment experience (years)</td>
<td>86</td>
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<td>7.43</td>
<td>5</td>
<td>6.98</td>
<td>0</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Number of boards</td>
<td>86</td>
<td></td>
<td>7.86</td>
<td>5</td>
<td>9.55</td>
<td>0</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td><strong>Position in firm (N = 86)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Managing director</td>
<td>28</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>General partner</td>
<td>12</td>
<td>14</td>
<td></td>
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<td></td>
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<tr>
<td>Partner</td>
<td>17</td>
<td>20</td>
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<tr>
<td>Analyst</td>
<td>18</td>
<td>21</td>
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<td>Other d</td>
<td>11</td>
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<tr>
<td><strong>Industry domain experience (years) c</strong></td>
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<tr>
<td>Biotechnology</td>
<td>38</td>
<td></td>
<td>7.50</td>
<td>5</td>
<td>7.34</td>
<td>1</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>ICT</td>
<td>50</td>
<td></td>
<td>8.74</td>
<td>7</td>
<td>7.73</td>
<td>1</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Consumer related</td>
<td>44</td>
<td></td>
<td>7.34</td>
<td>5</td>
<td>6.79</td>
<td>1</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Clean energy</td>
<td>45</td>
<td></td>
<td>5.09</td>
<td>3</td>
<td>5.85</td>
<td>1</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Conventional energy</td>
<td>19</td>
<td></td>
<td>8.47</td>
<td>10</td>
<td>7.02</td>
<td>1</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Medical/health</td>
<td>51</td>
<td></td>
<td>6.80</td>
<td>4</td>
<td>7.09</td>
<td>1</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Other (e.g., financial services)</td>
<td>11</td>
<td></td>
<td>9.64</td>
<td>6</td>
<td>7.93</td>
<td>2</td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>
THE STRENGTH OF STRONG TIES

a Active venture capital firms only (EVCA, 2011; EVCA, pers. comm., 2011; NVCA, 2011).
b Average number of employees per venture capital firm, Europe (714 firms, 7,077 employees) and U.S. (791 firms, 6,328 employees), respectively (EVCA, 2011; EVCA, pers. comm., 2011; NVCA, 2011).
\[ N = 85; \text{one respondent did not indicate the number of funds.} \]
\[ \text{E.g., associate, investment manager, etc.} \]
\[ \text{Multiple answers possible.} \]
## Table 2: Results of the hierarchical Bayes (HB) and multinomial logit (MNL) estimation for decision to further investigate the deal

<table>
<thead>
<tr>
<th>Attributes and levels</th>
<th>Hierarchical Bayes model</th>
<th>Multinomial logit model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient *</td>
<td>Standard deviation</td>
</tr>
<tr>
<td>Lead investor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kleiner Perkins</td>
<td>0.098</td>
<td>0.302</td>
</tr>
<tr>
<td>Draper Fisher Jurvetson</td>
<td>0.015</td>
<td>0.217</td>
</tr>
<tr>
<td>Khosla Ventures</td>
<td>-0.045</td>
<td>0.251</td>
</tr>
<tr>
<td>Insight Capital Partners</td>
<td>-0.068</td>
<td>0.211</td>
</tr>
<tr>
<td>Deal source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal network</td>
<td>0.396</td>
<td>0.524</td>
</tr>
<tr>
<td>Syndicate partner</td>
<td>0.197</td>
<td>0.346</td>
</tr>
<tr>
<td>Met at venture fair</td>
<td>-0.214</td>
<td>0.277</td>
</tr>
<tr>
<td>E-mail business plan</td>
<td>-0.380</td>
<td>0.507</td>
</tr>
<tr>
<td>Return potential</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20x in 5 years</td>
<td>1.704</td>
<td>0.932</td>
</tr>
<tr>
<td>15x in 5 years</td>
<td>0.896</td>
<td>0.605</td>
</tr>
<tr>
<td>10x in 5 years</td>
<td>-0.280</td>
<td>0.359</td>
</tr>
<tr>
<td>5x in 5 years</td>
<td>-2.320</td>
<td>1.299</td>
</tr>
<tr>
<td>Technological maturity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In production with customers</td>
<td>1.745</td>
<td>1.717</td>
</tr>
<tr>
<td>Finished product</td>
<td>0.818</td>
<td>0.851</td>
</tr>
<tr>
<td>Working prototype</td>
<td>-0.781</td>
<td>1.140</td>
</tr>
<tr>
<td>Works in laboratory</td>
<td>-1.782</td>
<td>1.452</td>
</tr>
<tr>
<td>Founder experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous start-up founder</td>
<td>1.261</td>
<td>0.688</td>
</tr>
<tr>
<td>Previous start-up experience</td>
<td>0.661</td>
<td>0.460</td>
</tr>
<tr>
<td>Previous executive experience</td>
<td>0.138</td>
<td>0.781</td>
</tr>
<tr>
<td>Graduate student</td>
<td>-2.060</td>
<td>0.790</td>
</tr>
<tr>
<td>Regulatory exposure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very high</td>
<td>-0.367</td>
<td>0.642</td>
</tr>
<tr>
<td>High</td>
<td>-0.215</td>
<td>0.431</td>
</tr>
<tr>
<td>Low</td>
<td>0.280</td>
<td>0.496</td>
</tr>
<tr>
<td>Very low</td>
<td>0.302</td>
<td>0.582</td>
</tr>
</tbody>
</table>
THE STRENGTH OF STRONG TIES

<table>
<thead>
<tr>
<th>Number of observations</th>
<th>3,132</th>
<th>3,132</th>
</tr>
</thead>
<tbody>
<tr>
<td>RLH value (^a)</td>
<td>0.685</td>
<td></td>
</tr>
<tr>
<td>Log-likelihood</td>
<td></td>
<td>-1940.548</td>
</tr>
<tr>
<td>Pseudo R(^2)</td>
<td>0.547</td>
<td>0.259</td>
</tr>
</tbody>
</table>

\(^a\) Coefficient estimates are equal to the posterior population means across the saved draws (as suggested by Train (2009), only every fifth was retained out of a total of 50,000 draws and used for calculation in order to reduce the correlation among draws from Gibbs sampling) reported with the standard deviation of the individual coefficients’ values (across the respondents in the sample) per attribute level in the subsequent column. Coefficient estimates are interval scaled and zero centered within attributes.

\(^b\) The 95 percent interval is calculated based on the population means drawn from the posterior distribution per parameter per iteration that were also used to calculate the coefficient estimates. The interval indicates how reliable the final coefficient estimates are across all draws over the iteration process.

\(^c\) Root likelihood (RLH) measures the goodness of fit of the hierarchical Bayes model in predicting respondent choices and is calculated by taking the nth root of the likelihood, where n is the total number of choices made by all respondents in all tasks. RLH is, therefore, the geometric mean of the predicted probabilities. The best possible value is 1.0 and the worst possible value is the reciprocal of the number of choices available in the average task, i.e., the expected RLH value for a chance model is 1/k, where k is the number of alternatives in each choice task, e.g., 1/3 = 0.33, for three alternatives (Sawtooth Software, 2009b). The RLH value reported in the table is the average of the RLH values over 500 iterations (We retained only every 100th value out of 50,000 iterations after burn-in in order to reduce correlation effects.)

\(^d\) Pseudo R\(^2\) (McFadden’s R\(^2\)) is defined as 1 – (LL\(_0\)/LL\(_1\)), where LL\(_0\) is the log likelihood of the intercept-only model (null model or base model) and LL\(_1\) is the log likelihood of the full model. Pseudo R\(^2\) is a common measure for discrete or limited dependent variable models (Veall and Zimmermann, 1996). The Pseudo R\(^2\) for the hierarchical Bayes model is the average of the Pseudo R\(^2\) values over the 500 iterations (see average RLH).

\(^e\) The results of the MNL model are comparable to the hierarchical Bayes estimates only to a limited extent because of a particular feature we applied in the conjoint experiment which allows respondents the possibility to deselect attributes they feel are of minor importance in their decision making. The hierarchical Bayes algorithm we used is tailored to deal with such deselected attributes and sets the final individual-level part-worths to zero to account for their lack of importance to the respective respondent. The simple MNL model treats them as missing values and, further, estimates part-worth utilities only on an aggregated level (not on the individual level), which does not allow any post-estimation corrections. Hence, the part-worth utilities in this model are based on data from those only respondents who did not deselect the attributes and, therefore, overstate the importance of those attributes for the average of the sample.

Note: \(\dagger p < 0.10; \ast p < 0.05; \ast\ast p < 0.01; \ast\ast\ast p < 0.001.\)
Table 3: Average relative importance values of attributes based on hierarchical Bayes model

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Importance % (^a)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return potential</td>
<td>30.38</td>
<td>14.64</td>
</tr>
<tr>
<td>Founder experience</td>
<td>27.03</td>
<td>10.60</td>
</tr>
<tr>
<td>Technological maturity</td>
<td>26.40</td>
<td>16.87</td>
</tr>
<tr>
<td>Regulatory exposure</td>
<td>6.61</td>
<td>11.29</td>
</tr>
<tr>
<td>Deal source</td>
<td>6.41</td>
<td>8.36</td>
</tr>
<tr>
<td>Lead investor</td>
<td>3.17</td>
<td>4.70</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) The relative importance values for each attribute are calculated by taking the difference between the highest and the lowest part-worth utility within each attribute and scaling this value to 100 percent across attributes (Orme, 2010).
## Table 4: Pearson correlation between variables (continuous variables only; $N = 86$)

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Difference of relative importances</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>deal source minus lead investor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Firm size</td>
<td>0.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Firm age</td>
<td>0.04</td>
<td>0.48**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Number of funds</td>
<td>-0.08</td>
<td>0.53**</td>
<td>0.39**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Deal size</td>
<td>0.03</td>
<td>0.29**</td>
<td>0.21</td>
<td>0.23*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Investor age</td>
<td>-0.01</td>
<td>0.01</td>
<td>0.31**</td>
<td>0.19</td>
<td>0.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. VC industry affiliation</td>
<td>0.00</td>
<td>0.04</td>
<td>0.44***</td>
<td>0.38**</td>
<td>0.05</td>
<td>0.68**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. VC investment experience</td>
<td>0.03</td>
<td>0.05</td>
<td>0.43***</td>
<td>0.38**</td>
<td>0.08</td>
<td>0.72**</td>
<td>0.95**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Number of boards</td>
<td>0.13</td>
<td>0.03</td>
<td>0.39***</td>
<td>0.20</td>
<td>0.11</td>
<td>0.58**</td>
<td>0.77**</td>
<td>0.80**</td>
<td></td>
</tr>
<tr>
<td>10. Clean energy experience</td>
<td>-0.10</td>
<td>0.18</td>
<td>0.15</td>
<td>0.54**</td>
<td>0.03</td>
<td>0.29**</td>
<td>0.33**</td>
<td>0.35**</td>
<td>0.12</td>
</tr>
</tbody>
</table>

*a N = 85; one respondent did not indicate the number of funds.

* Correlation significant at $p < 0.05$ (two sided); ** Correlation significant at $p < 0.01$ (two sided).
Table 5: Tests for differences between groups of moderator variables (N = 86)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Difference of relative importances deal source minus lead investor %</th>
<th>Test for differences between groups&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td><strong>Firm and fund information</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Firm location</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>45</td>
<td>5.22</td>
</tr>
<tr>
<td>Europe</td>
<td>41</td>
<td>1.07</td>
</tr>
<tr>
<td><strong>Firm size (number of employees)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–7 employees</td>
<td>29</td>
<td>3.43</td>
</tr>
<tr>
<td>8–14 employees</td>
<td>27</td>
<td>0.35</td>
</tr>
<tr>
<td>15–150 employees</td>
<td>30</td>
<td>5.67</td>
</tr>
<tr>
<td><strong>Firm age (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–8 years</td>
<td>27</td>
<td>0.52</td>
</tr>
<tr>
<td>9–13 years</td>
<td>32</td>
<td>5.14</td>
</tr>
<tr>
<td>14–38 years</td>
<td>27</td>
<td>3.73</td>
</tr>
<tr>
<td><strong>Number of funds</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 fund</td>
<td>27</td>
<td>2.72</td>
</tr>
<tr>
<td>2–3 funds</td>
<td>39</td>
<td>3.33</td>
</tr>
<tr>
<td>4–16 funds</td>
<td>19</td>
<td>4.70</td>
</tr>
<tr>
<td><strong>Deal size (in thousands USD)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100–1,500 TUSD</td>
<td>27</td>
<td>5.28</td>
</tr>
<tr>
<td>1,501–5,000 TUSD</td>
<td>36</td>
<td>2.00</td>
</tr>
<tr>
<td>5,001–70,000 TUSD</td>
<td>23</td>
<td>2.80</td>
</tr>
<tr>
<td><strong>Investor information</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Investor age (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23–37 years</td>
<td>29</td>
<td>5.32</td>
</tr>
<tr>
<td>38–58 years</td>
<td>27</td>
<td>0.51</td>
</tr>
<tr>
<td>49–70 years</td>
<td>30</td>
<td>3.70</td>
</tr>
<tr>
<td><strong>VC industry affiliation (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–3 years</td>
<td>31</td>
<td>3.61</td>
</tr>
<tr>
<td>4–10 years</td>
<td>31</td>
<td>2.07</td>
</tr>
</tbody>
</table>

<sup>a</sup> Significant at the 0.05 level.

<sup>b</sup> Significant at the 0.01 level.
THE STRENGTH OF STRONG TIES

<table>
<thead>
<tr>
<th>VC investment experience (years)</th>
<th>11–35 years</th>
<th>0–2 years</th>
<th>3–9 years</th>
<th>10–30 years</th>
<th>Groups 1 &amp; 2: p = 0.070</th>
</tr>
</thead>
<tbody>
<tr>
<td>11–35 years</td>
<td>24</td>
<td>25</td>
<td>31</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>11–35 years</td>
<td>4.29</td>
<td>3.95</td>
<td>0.36</td>
<td>5.64</td>
<td></td>
</tr>
<tr>
<td>11–35 years</td>
<td>10.42</td>
<td>9.23</td>
<td>10.10</td>
<td>10.96</td>
<td></td>
</tr>
</tbody>
</table>

- Groups 1 & 2: p = 0.097<sup>b</sup>
- Groups 2 & 3: p = 0.030<sup>b</sup>

<table>
<thead>
<tr>
<th>Number of boards</th>
<th>0–1 boards</th>
<th>2–8 boards</th>
<th>9–50 boards</th>
<th>Groups 1 &amp; 2: p = 0.067&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–1 boards</td>
<td>27</td>
<td>28</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>0–1 boards</td>
<td>4.74</td>
<td>-0.46</td>
<td>5.29</td>
<td></td>
</tr>
<tr>
<td>0–1 boards</td>
<td>10.31</td>
<td>8.04</td>
<td>11.48</td>
<td></td>
</tr>
</tbody>
</table>

- Groups 2 & 3: p = 0.042<sup>b</sup>
- Groups 1 & 3: p = 0.620<sup>b</sup>

<table>
<thead>
<tr>
<th>Position in firm&lt;sup&gt;d&lt;/sup&gt;</th>
<th>Analyst, other&lt;sup&gt;e&lt;/sup&gt;</th>
<th>Junior managing director, general partner, partner (VC investor &lt; 10 years)</th>
<th>Senior managing director, general partner, partner (VC investor &gt;= 10 years)</th>
<th>Groups 1 &amp; 2: p = 0.022&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–1 years</td>
<td>29</td>
<td>29</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>0–1 years</td>
<td>5.03</td>
<td>-0.88</td>
<td>5.66</td>
<td></td>
</tr>
<tr>
<td>0–1 years</td>
<td>10.05</td>
<td>8.52</td>
<td>11.26</td>
<td></td>
</tr>
</tbody>
</table>

- Groups 2 & 3: p = 0.017<sup>b</sup>
- Groups 1 & 3: p = 0.841<sup>b</sup>

<table>
<thead>
<tr>
<th>Clean energy experience (years)</th>
<th>0 years</th>
<th>1–2 years</th>
<th>3–25 years</th>
<th>Groups 1 &amp; 2: p = 0.948</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 years</td>
<td>41</td>
<td>17</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>0 years</td>
<td>3.26</td>
<td>4.72</td>
<td>2.33</td>
<td></td>
</tr>
<tr>
<td>0 years</td>
<td>11.05</td>
<td>12.61</td>
<td>7.57</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Kruskal-Wallis test.
<sup>b</sup> Mann-Whitney U test (two sided).
<sup>c</sup> N = 85; one respondent did not indicate the number of funds.
<sup>d</sup> Categories built based on position in firm and VC investment experience.
<sup>e</sup> E.g., associate, investment manager, etc.