Article

The contingent value of venture capitalist reputation

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Abstract

This study explores the signaling and substantive value of high-reputation affiliates to young firms, and the factors that moderate the nature of the value they provide. Specifically, the study examines the extent to which venture capitalist (VC) reputation is related to the first-day valuation and post-IPO operating performance of the firms they take public, and whether the value of a high-reputation VC is contingent on the timing of VC involvement in the portfolio firm, the VC firms' industry-specific experience and their geographic proximity. The authors develop a time-varying, multi-item composite index of VC reputation and use a sample of VC-backed IPOs between 1990 and 2000 to test their hypotheses. The results suggest that early involvement in an IPO firm's development significantly enhances the positive relationship between a VC's reputation and both initial market reactions and post-IPO operating performance. The study also finds that the industry specialization of early-round VCs, regardless of their reputation, is positively related to post-IPO operating performance, and that the relationship is even stronger when the VC has a high reputation and invests in the first round. Finally, while the geographic proximity of VCs to their portfolio firms has no effect on the relationship between their reputation and the firm's post-IPO operating performance, investors nonetheless discount the value of VC reputation when VCs are more geographically distant from their portfolio firm. However, when endogeneity associated with having greater access to high-potential start-ups is controlled for, geographic proximity significantly decreases the relationship between VC reputation and operating performance, but it no longer affects initial market valuation.

Keywords

initial public offerings, reputation, venture capitalists

It's better to hang out with people better than you. Pick out associates whose behavior is better than yours and you'll drift in that direction. (Warren Buffet)

Understanding how market participants manage their perceived uncertainties about each other is fundamental to studying the social construction of markets. A variety of mechanisms have been posited to reduce market actors' concerns; among those mechanisms, actors' reputations have emerged as a primary means to manage perceived uncertainties and facilitate market development and exchange (Fombrun, 1996; Kreps and Wilson, 1982; Milgrom and Roberts, 1982; Rindova et al., 2005). Organizational reputations are useful for reducing perceived uncertainties because they are based on observed histories of engaging in particular sets of behaviors or providing products and services with certain characteristics and a particular level of quality (Fombrun, 1996; Podolny, 2005; Rindova et al., 2005, 2006). As such, reputations can be used to infer the otherwise unobservable quality of a firm (Rindova et al., 2005).

However, reputations take time to develop. Many organizations, especially new ones, do not possess the substantive histories and track records of performance necessary to either confirm or allay other market participants' concerns. Because the survival and success of new organizations are laden with uncertainty and risk (Stinchcombe, 1965), market participants often rely on interorganizational endorsements via affiliations with prominent and highly reputable third parties as signals of a firm's quality and potential (e.g. Baum and Oliver, 1991; Beatty and Ritter, 1986; Carter and Manaster, 1990; Certo, 2003; Gulati and Higgins, 2003; Haunschild, 1994; Higgins and Gulati, 2003; Lee and Wahal, 2004; Megginson and Weiss, 1991; Podolny, 1994; Pollock et al., 2004; Stuart et al., 1999). Consistent with the quotation at the start of the article, the underlying assumption is that high-reputation affiliates certify that the new firm possesses attributes market participants would otherwise infer from an extensive performance history, and/or that these prominent actors will contribute their own skills and resources to enhance the firm's future prospects and potential (e.g. Gorman and Sahlman, 1989; Jain and Kini, 2000; Pollock and Gulati, 2007). Indeed, research has demonstrated that organizations often pay substantial premiums in order to garner these affiliations (Chen et al., 2008; Hsu, 2004), and investors are willing to pay more for the shares of companies that possess them (Carter and Manaster, 1990). However, recent research suggests that the signaling value of prominent affiliations is less durable than other potential signals of quality (Pollock and Gulati, 2007). Additionally, scholars rarely attempt to verify the nature and value of these affiliations (for recent exceptions, see Fitza et al., 2009; Sorensen, 2007). Yet, studies show that venture capitalists (VCs) affect the performance of their start-ups (Fitza et al., 2009); in this study, we begin to better understand the contingent nature of that value.

Little attention has been paid to how the context within which these affiliations occur influences the value they deliver. A rare exception is Gulati and Higgins's (2003) study of the contingent effects of different prominent affiliations on how investors value biotech firms at the time of their initial public offerings (IPOs). They found that investors focused on different types of uncertainty under different market conditions, and thus gave more emphasis to the prestige and reputation of those prominent affiliates whose involvement with the firm was more likely to assuage their concerns about a particular type of uncertainty. Their study highlights the importance of understanding how contextual features can shape the value of affiliations with prominent and highly reputable third parties. However, it focused on only one contingency – general market conditions – and did not consider how particular characteristics of the relationships can also affect the way a prominent affiliation is interpreted. Further, it focused only on the value these affiliations provided in reducing investors' perceived uncertainty at the time of the IPO. No research we are aware of has attempted to ascertain whether the conditions under which high-reputation affiliates can and do provide resources actually influence the operating activities of the organization.

In this study, we begin to untangle these issues using the context of VC-backed IPOs, and consider whether and when affiliations with high-reputation VC firms are actually accompanied by the superior long-term operating performance that should result from the substantive[1] benefits VCs presumably provide. We ask the following questions: (1) To what extent is VC reputation positively related to both the first-day market valuation (a signaling role) and post-IPO operating performance of the firms they take public (a substantive role)? (2) Does the level and timing of high-reputation VC firms' involvement with the portfolio firm, its geographic proximity and/or its industry specialization affect the value that VC firms provide? Focusing on the influence of high-reputation VCs can be particularly useful for unpacking the contingent value of high-reputation third-party affiliations because they serve a valuable signaling function and they also purportedly provide additional, substantive benefits to the entrepreneurial start-up firms they fund (Gompers, 1995; Jain and Kini, 2000; Lee and Wahal, 2004; Megginson and Weiss, 1991; Sahlman, 1990).

However, the means for operationalizing VC reputation are not well defined, and no commonly recognized and widely available measure exists. Prior research has relied on relatively crude proxies as single-item indicators to operationalize VC reputation (e.g. age of the lead VC, the mean age of all VCs invested in a company, size of the VC's most recent investment fund), thereby limiting the construct validity of the measure and the ability to compare results across studies (Boyd et al., 2005). Thus, a second contribution of this study is to develop and make available a multi-item composite index that scholars can use to study VC reputation.

Our study makes several contributions. First, we explicitly consider what has often been an implicit assumption about the relationship between affiliation with prominent and high-reputation actors and the likelihood that these relationships will result in the provision of substantive resources. Second, we identify some boundary conditions for this assumption by exploring whether investors differ in their reactions to associations with high-reputation VCs under different conditions, and whether firms with these associations achieve better operating performance. We emphasize the socially constructed nature of financial markets and consider different types of contingencies that investors attend to in assessing value, and the extent to which they capture or miss important cues that could lead to different perceptions and assessments. Finally, we make an empirical contribution to the strategy and entrepreneurship literatures by developing, testing and making available a comprehensive, time-varying, multi-item indicator of VC reputation that captures VC experience and performance. In the following sections, we develop our hypotheses and test our arguments using a sample of VC-backed IPOs from 1990 to 2000. Our results suggest that timing, geographic proximity and industry specialization are important contingencies, and the ways they effect both investors' expectations and a start-up's operating performance are interesting and complex.

Theory and hypotheses

The value of VC reputation

Organizational reputation is a valuable intangible asset, and firms can benefit from both their own reputations and the reputations of their close affiliates (Fombrun, 1996; Hall, 1992; Kreps and Wilson, 1982; Lange et al., 2011; Milgrom and Roberts, 1982; Rindova et al., 2005, 2007; Weigelt and Camerer, 1988). Based on an exhaustive literature review, Rindova and colleagues (Rindova et al., 2005) suggested that a firm's reputation may be best understood as an intangible asset based on broad public recognition of the quality of a firm's activities and outputs. This is the definition of reputation we use in this study. Because reputation is based on a firm's observable history of actions and performance, it serves as a proxy for its otherwise unobservable capabilities and

creates expectations about the firm's future performance (Rindova et al., 2005). Good reputations reduce stakeholders' uncertainties such that consumers pay more for the products and services of high-reputation firms, and suppliers and partners offer more opportunities on favorable terms and conditions (Fombrun, 1996; Rindova et al., 2005).

In the following sections, we develop the base-line argument that high-reputation VCs can both reduce investor uncertainty and provide resources to young start-ups that improve their operating performance. We then consider three contingent characteristics of the relationship – the timing of the VC's involvement, its geographic proximity to the start-up and its expertise in the start-up's industry – that may moderate a VC firm's ability to influence an entrepreneurial start-up's future. These three factors address key facets of a VC's ability to make substantive contributions to the start-up firm's development: possessing the time and opportunity to interact with the start-up intensely enough to influence its development and possessing the knowledge to be of the most help.

The substantive value of VC reputation

Many third parties, such as certifying agencies or the media, provide value simply by reducing perceived uncertainty via signaling that an individual or organization possesses certain characteristics (Baum and Oliver, 1991; Sauder and Espeland, 2009). However, these third parties do not actually contribute to the actor's skills or capabilities in any material way. In contrast, high-reputation VCs also provide direct benefits affecting firm operating activities. In addition to the provision of financial capital, VCs serve as valuable sounding boards for formulating and implementing corporate strategies, and are frequently involved in helping firms recruit experienced personnel and acquire needed resources (Jain and Kini, 2000). VCs also provide network contacts to experienced infrastructure providers, including accounting firms, law firms, management consulting firm, and executive search firms (Fried and Hisrich, 1995), and have knowledge about the technological landscape, market opportunities and capacity and the potential for integration or knowledge-sharing with other portfolio firms they manage (Hsu, 2006; Pollock and Gulati, 2007). Thus, high-reputation VCs can help their portfolio firms by acquiring resources and enhancing the quality of their strategy formulation, management teams and corporate partnerships. To the extent that high-reputation VCs have invested substantial amounts in a firm and hold substantial equity positions, they have a financial and reputational interest in seeing the start-up succeed. Consequently, they are likely to invest the time and resources necessary to make the firm successful. Thus, not only do we expect the market to react positively to high-reputation VC involvement, we also expect the firms in which they invest to experience higher operating performance following their IPOs.

It is difficult, if not impossible, to directly observe and measure the various resources a VC provides to its portfolio firms. However, the time intervals and temporal focus associated with a firm's initial market valuation and operating performance (Kelly and McGrath, 1988; Zaheer et al., 1999) can be used to indirectly assess this process. A firm's initial market valuation is inherently prospective, or forward-looking, reflecting the expectations investors have regarding the firm's future cash flows and profits (Figlewski, 1982; Westphal and Zajac, 1998). It is short-term in that it reflects initial expectations based on information available at the time of the IPO, including the signals provided by high-reputation affiliates. In contrast, operating performance is retrospective or backward-looking, reflecting the actual performance or profits and cash flows generated over the prior period (Brealey and Myers, 2000). It reflects the outcome of the firm's performance over a specified period of time. By looking at future performance expectations at the time of the IPO and

actual operating performance in the year following the IPO, we can begin to assess the nature of a high-reputation VC's effects by comparing the extent to which investors' initial expectations are corroborated by the firm's subsequent operating performance, and how VC reputation is positively related to both these outcomes.[2]

We develop our hypotheses based on the theoretically parsimonious assumption that the market will be efficient in recognizing the value high-reputation VCs provide; that is, we assume it will value their involvement more highly and VC reputation will have a positive relationship with post-IPO operating performance. However, even if one assumes a semi-strong form of market efficiency, research shows that markets tend to be less efficient in the short-term, especially when uncertainty and complexity are high (Thomas, 2002), and respond to signaling behaviors and certifications (Pfeffer, 1981; Porac et al., 1999; Westphal and Zajac, 1998) and taken-for-granted rules of thumb (Pollock et al., 2009; Wasserman, 2003) that may be decoupled from actions and quality. Thus, it is possible, and perhaps even likely, that our empirical results will deviate from efficient market expectations. A pattern of findings where VC reputation has a positive relationship with initial market valuation but has no relationship with subsequent operating performance would suggest that the value of VC reputation lies in its ability to reduce investors' perceived uncertainty based on assumed benefits that may be 'rationalized myths' (Meyer and Rowan, 1977; Wasserman, 2003). A finding that VC reputation is only positively associated with operating performance suggests that the relationship may yield substantive operating benefits that investors do not fully discern at the time of the IPO.

The contingent effects of timing, geographic distance and industry specialization

Although it is reasonable to assume that investors will value affiliation with high-reputation VCs in general, it is also possible that high-reputation VCs are valued differently depending on the circumstances of their involvement, and that factors particular to the relationship can influence the extent to which high-reputation VCs are able to provide strategic and operational resources to a start-up. In the following, we focus on three characteristics suggested by the prior literature that are likely to affect a VC's ability to provide substantive value to its portfolio firms and that can also affect investors' perceived uncertainty about the firm: the length of the VC's involvement with the start-up, its geographic proximity to the start-up and the extent of its experience with the start-up's industry.

Length of involvement. VCs invest in start-ups in multiple financing rounds. Each round is typically associated with different stages in the start-up's development. Some VCs specialize in early- or 'seed'-stage financing, where the risks (and potential rewards) are highest and the firm valuations are lowest. Other VCs specialize in later-stage financing, where the capital needs may be greater and the valuations are higher, but the risks are much lower. However, once a VC invests in a company, it is expected to continue to participate in all subsequent investment rounds (Guler, 2007). An early-stage investor can have the greatest potential impact on the firm's strategies and operations. Thus, the value a high-reputation VC brings may depend on its length of involvement with the start-up.

VCs that are involved in the earliest stages of a firm's development have the opportunity to influence both the selection and management processes of their portfolio firms (Fitza et al., 2009). By staying involved in the later stages, VCs are able to monitor the firm's progress, select board members and ensure that the start-up stays on a positive trajectory (Fitza et al., 2009). Further, if VCs have substantive effects on the firms they invest in, the length of time high-reputation VCs are involved with companies should have a positive relationship with the firms' post-IPO operating

performance. Prior research suggests that organizational and leadership decisions made early in an organization's development can have lasting consequences for its structure and performance (Baron et al., 1999). Early involvement by high-reputation VCs creates greater opportunities to put start-ups on a positive trajectory because they will not have to combat or undo any negative path dependencies, and the start-up firms will have greater opportunities to benefit from the full range of resources the VC can bring to bear. Thus, the longer the involvement of high-reputation VCs with firms, the more likely they are to provide substantive value to start-ups, and the more investors are likely to value their involvement:

> **HYPOTHESIS 1:** Early-round investment by high-reputation VCs will have a greater influence than late-round investment by high-reputation VCs on both initial market valuations and post-IPO operating performance.

Geographic distance. Geographic distance between VCs and the firms they fund can affect the degree of VC involvement in the start-up. VCs spend considerable time engaging in on-site activities[3] (Gorman and Sahlman, 1989). On-site activities stimulate frequent interactions and facilitate communication between the VCs and firm managers, thereby increasing the effectiveness and value of VC involvement (Sapienza, 1992). Frequent interactions between VCs and their portfolio firms also build trust, increase the degree of resource transfer (Fried and Hisrich, 1995; Westphal, 1999) and enhance the quality of learning by the portfolio firm (Busenitz et al., 2004). Because shorter geographic distances make it easier to escalate the intensity of interaction between VCs and their portfolio firms, geographic distance is likely to be inversely related to post-IPO operating performance if VCs provide substantive benefits. In fact, Sorenson and Stuart (2001) showed that the likelihood a VC invests in a target company is negatively related with the geographic distance between the company and the VC firm's headquarters. They argued that spatial limitations constrain information transmission and restrict VCs' abilities to engage in support and monitoring activities, and that this affected their decisions regarding which firms to fund.

Taken together, this suggests that the more geographically proximate a firm is to the VC, the easier it is for the VC to stay in touch with the company and make routine visits to meet face to face with executives and check out the company's operations. Firms that are located a substantial distance from the VC are less likely to receive the same level of attention as more proximal portfolio firms; as such, the VC is less likely to have a significant influence on their development and post-IPO operating performance, and their involvement will likely be valued less by investors:

> **HYPOTHESIS 2:** The more geographically distant the focal firm is from its VC, the lower the influence of VC reputation on initial market valuations and post-IPO operating performance.

Industry specialization. A VC's specialization in the start-up's industry can also affect its ability to provide useful and relevant advice. Organizational needs and competitive dynamics vary greatly by industry. Biotechnology companies, for example, require large amounts of capital to develop new products (Stuart et al., 1999), and product development and approval can often take more than 10 years. In contrast, software developers require fewer resources and can get products to market quickly, but they may face competition from a larger number of competitors that can rapidly copy key features and issue new versions of their own product. The more specialized a VC is in one or a few industries, the greater its expertise and connections within that industry, the better its advice and the greater the network ties and other resources it will be able to mobilize on the firm's behalf (Hsu, 2006). VC expertise also makes start-ups more receptive to the benefits that VCs provide

(Dimov and De Clercq, 2006). Not surprisingly, this expertise has been negatively related to the failure rates of start-ups (Dimov and De Clercq, 2006). Thus, we argue that, all else being equal, a high-reputation VC that specializes in the focal firm's industry will be able to provide more substantive value to a start-up than a less specialized high-reputation VC firm, which will have less ability to make these substantive contributions and whose involvement will be valued less by investors:

HYPOTHESIS 3: The greater the VC's specialization in the focal firm's industry, the greater the influence of VC reputation on initial market valuations and post-IPO operating performance.

Data and methods

Sample and data sources

Our initial sample comes from a dataset of IPOs provided by Jay Ritter (see http://bear.cba.ufl.edu/ritter/ipodata.htm). This dataset includes accumulated corrections that Ritter has made to IPO data from a variety of sources and is widely regarded among finance scholars as the cleanest and most accurate source of data available on the basic characteristics of IPOs. The data include offering dates, offering prices, file price ranges, closing prices, SIC codes and underwriter prestige rankings. We supplemented the IPO data with data on VC investments from Securities Data Corporation's (SDC) VentureXpert database (for a description of the data available, see Gompers, 1995, 1996; Lerner, 1995). We obtained data on the number of VC firms with an investment in each IPO at the time of the offering, the round dates and dollar value of each investment, the founding date and size of each VC firm, the number of funds managed, and the amount of capital raised by each VC firm annually from 1985 to 2000. VentureXpert includes data from VCs that invest in entrepreneurial firms and traditional private equity firms that engage in buyouts. We distinguish between VC and private equity firms by identifying the former as those whose investment takes place in rounds that are classified as Seed, Start-up, Start-up Financing, Early Stage, First Stage Financing, Expansion, Later Stage, Balanced, or Research and Development. Manual web searches on sample firms in all investment categories identified by VentureXpert confirm that these categories effectively include only VCs in our sample and exclude other types of private equity firms.

VCs backed 1798 firms that conducted IPOs during our period of study. The accounting data used for one of the dependent variables and the relevant control variables were obtained from the COMPUSTAT database. Missing data for one or more of the variables in our analysis reduced our final sample to between 536 and 548 IPOs when predicting initial market valuation and between 433 and 438 IPOs when predicting post-IPO operating performance.[4]

Dependent variables

Initial market valuation. Following previous research (Gulati and Higgins, 2003; Stuart et al., 1999), we calculated the initial market valuation of the firm as the natural logarithm of its market value at the end of the first day of trading, which was calculated by multiplying the shares outstanding by the stock price at the end of the first day of trading.[5]

Post-IPO operating performance. We operationalized post-IPO operating performance as the firm's industry-adjusted return on assets (ROA) adjusted for capital expenditures for the year following the IPO (Barber and Lyon, 1996). Prior research suggests that ROA can be manipulated (Burgstahler

and Eames, 2006; Dechow et al., 1998; Teoh et al., 1998; Yoon, 2005). Young firms about to go public are particularly prone to managing their operating performance, as these firms are more likely to have negative earnings and face substantial pressure to make their performance look as good as possible (Teoh et al., 1998). To address this issue, Jain and Kini (1994) recommend adjusting operating income for capital expenditures, which helps account for the use of aggressive accounting practices that inflate income. Thus, we use a firm's operating income before taxes, depreciation and special items, minus capital expenditures, divided by the firm's total assets as our measure of ROA. This measure is robust to a variety of adjustments to both the numerator and denominator (see Jain and Kini, 1994: 1704 for a detailed discussion). Prior research (Black, 1998) has demonstrated that operating cash flow (operating income minus capital expenditures) accurately represents the company's value, especially during the growth stage of its life cycle, which would include firms conducting IPOs. Operating cash flow is also a primary component of the numerator when net present value analysis is used to value a company (Jain and Kini, 1994; Kaplan, 1989). We further took into account industry differences in ROA by subtracting the IPO firm's ROA from the average ROA of all publicly listed companies in the firm's two-digit SIC code whose data were available from COMPUSTAT for that year.

Independent variables

VC reputation. There has been little consensus regarding how to measure VC reputation. Prior researchers (Gompers, 1996; Gompers and Lerner, 1999; Lee and Wahal, 2004) have used the age of the lead VC, the mean age of all VC firms invested in an IPO firm, VC ages weighted by the VCs' ownership stakes and the size of the investment fund raised by the VC as proxies for VC reputation. Arguably, each of these individual indicators captures some aspect of VC reputation. For instance, older VCs that have survived the vicissitudes of the industry and those that are able to raise large funds tend to possess longer and more distinguished performance records. However, firms may be able to survive for long periods and never perform at exceedingly high levels, or their abilities may have eroded, yet they continue to exist for a variety of reasons. Conversely, younger firms may be extremely capable, even if they are relatively new (e.g. Fund et al., 2008). And while the firms that raise the largest funds are generally quite capable and have demonstrated records of performance, other firms with equally strong reputations often choose to raise smaller funds. Large funds increase the pressure on firms to make more and larger investments, and require more VCs to oversee the firms in which they invest. Some venture capital firms wish to avoid those pressures. Thus, while these measures can be useful, each indicator is still only a rough proxy capturing one dimension of a VC firm's reputation.

To address these limitations we created a multi-item VC reputation index. A multi-item index increases the reliability of the measure and reduces the effects of random error, thereby generating estimates that are closer to the 'true value' of our construct (Boyd et al., 2005; Pedhazur and Schmelkin, 1991). Consistent with the empirical approach of Rindova and colleagues (Rindova et al., 2005, 2010) we created a composite measure using variables that capture the two dimensions of reputation identified by Rindova et al. (2005): prominence and quality of outputs. VC firms raise money from private investors such as foundations, pension funds, university endowments, insurance companies and wealthy individuals that they pool into a single fund to invest in new ventures. Possessing a reputation for successfully taking the companies in which they invest public – which generates the majority of the returns for their investment funds (Fenn et al., 1997; Guler, 2007) – is critical to the VC's ability to raise future investment funds and be able to invest in the most promising start-ups (Lee and Wahal, 2004). Thus, we focused on measures related to VCs'

abilities to raise investment capital and to successfully develop and take start-up companies public – the two performance dimensions most critical to VC firms. These measures (all based on the five years prior to the focal year) are the *total number of portfolio companies a VC invested in*; *the total funds invested in portfolio firms*; *the total dollar amount of funds raised*; *the number (count) of individual funds raised*; *the number of portfolio firms taken public*; and *VC age in the focal year* (calculated as the IPO year minus the year a VC firm raised its first fund).

The total number of portfolio firms a VC invested in and the total dollar amount of funds invested in portfolio firms capture the intensity of a VC's investment activity. The intensity of investment activity is an important component of a VC's reputation because it enhances the firm's visibility, or prominence in its industry (Rindova et al., 2007). Research shows that under conditions of incomplete information, familiarity and ease of recall are positively associated with perceptions of the firm's quality (Bromley, 1993; Dowling, 1986; Hawkins and Hoch, 1992; Pollock et al., 2008). Thus, the more active a VC firm is the more prominent and cognitively available it is likely to be. Active investing also brings the firm into contact with more market participants, which can facilitate the construction of the VC firm's reputation (Fund et al., 2008).

Our next three measures, the total investment dollars raised, the number of investment funds raised and VC firm age, demonstrate the VC's ability to acquire investment capital. A VC firm cannot exist if it is unable to raise investment capital, and investors will not give the firm large sums of money or invest in multiple funds raised by the VC if it cannot provide them with an acceptable return on their investments. Prior research confirms the positive relationship between a VC's past performance and its fundraising ability, suggesting only successful VCs are able to establish follow-on funds and achieve an enhanced deal flow (Lee and Wahal, 2004; Megginson and Weiss, 1991; Sahlman, 1990). Thus, the abilities to raise large sums of money, establish multiple funds and survive over time enhance the perceptions of a VC firm's quality and performance.

Our final variable is the number of portfolio companies a VC firm has taken public in the past five years. Taking a company public is the most visible, profitable and uncommon way VCs capture value from their investments (Fenn et al., 1997; Guler, 2007). This measure showcases 'a firm's capabilities and achievements and make the firm highly distinctive' (Rindova et al., 2007: 58) and has been used as the success outcome in prior studies (e.g. Hochberg et al., 2007; Sorensen, 2007).

We used a rolling five-year window to calculate each VC firm's reputation on an annual basis. Using a rolling window allowed us to capture the often substantial fluctuations in a VC's reputation over the course of the study, which was especially important since a large number of VC firms were founded during the 1990s. For firms that were fewer than five years old, we used all available data up to the current year. Thus the sample period used to create this variable ranged from 1985 to 1999.

To create the reputation index, we standardized all our measures by transforming them into *z*-scores so that scaling was comparable when the various measures were aggregated.[6] For the initial validation of items, we empirically appraised the underlying factor structure by means of exploratory factor analysis (EFA).[7] First, we evaluated the factorability of the correlation matrix by examining the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy. The KMO measures are over 0.70 each year, suggesting the correlation matrix is appropriate for factoring (Tabachnick and Fidell, 2001). Second, we investigated the number of factors to be extracted using parallel analysis, which is not subject to the problems associated with other methods (O'Connor, 2000; Sharma, 1996). This analysis shows that the six items consistently load on only one factor across all years. Third and finally, we examined item factor loadings to decide whether to retain all the initial items. All factor loadings achieved acceptable levels (Hair et al., 1979; Kellow, 2006). Thus, we decided to retain all six items for our index.

We also conducted a confirmatory factor analysis (CFA) to further verify the validity of the factor structure following Hu and Bentler's (1999) recommendations. The analysis showed that our factor model fit well across each year,[8] confirming the validity of the one factor model and enabling us to create a single measurement scale by aggregating all the items. To assess the reliability of the variables for each year, we computed a Cronbach's alpha. The Cronbach's alpha exceeded 0.80 every year, which is considered satisfactory for exploratory research (DeVellis, 1991; Nunnally, 1967).

Because we created measures for hundreds of VC firms that vary annually over a 10-year period and our study period ended several years before we began collecting data, we were unable to use expert raters in the traditional way to provide final face validation of our measure. However, we informally showed our listings of the top VC firms to several VCs who agreed that our list captured what they considered to be the highest-reputation VC firms during our period of study.

Finally, we wanted to create a measure that is comparable across years. To create an intuitive measure that could be compared across time, we normalized the scores within each year on a 100-point scale. Since our index scores can take on negative values, within each year we added a constant equal to 0.01 plus the lowest reputation index score calculated for that year to all VC reputation scores. We then divided each VC reputation score by the highest score observed that year. Thus, we created a measure that maintained the relative relationships among VCs within each year, while creating comparability in rank across years. Table 1 presents the reputation scores and rankings for the top 150 VCs in 1990, 1995 and 2000. Complete annual rankings on all VCs for the years 1990–2000 are available for public use at www.timothypollock.com.

First- and last-round VC reputation. Because multiple VCs frequently invest in a firm across different financing rounds, we needed to calculate the aggregate reputation of all the VCs associated with an IPO firm in a given round. We considered two[9] potential weighting approaches used in past research: (1) the reputation of the lead VC only (defined as the VC with the largest ownership stake); and (2) the simple average of the reputation of all VCs invested in the firm. The results of the different analyses showed the strongest effects of VC reputation were observed using the average of all VCs participating in a round, so this is the approach we used. *First-round VC reputation* equaled the average of the reputation scores of all VCs that invested in the IPO firm during the first round of venture financing. *Last-round VC reputation* equaled the average of the reputation scores for all VCs that invested in the last round of VC financing. Because VCs face pressures to continue investing in a company once they have made an initial investment (Guler, 2007), the investors in the last round frequently include investors from earlier rounds. Thus, using this raw measure would not necessarily capture the reputation of later investors only. In order to address this issue, we regressed last-round VC reputation on first-round VC reputation, and use the residual from this regression in our analysis[10] (Brown and Perry, 1994; Cohen et al., 2003: 613). This approach removes the common variance associated with the reputations of early-round VC investors who may still be actively investing in the later rounds (e.g. Cohen et al., 2003).[11]

Geographic distance. This variable was measured as the miles between a VC's headquarters and the portfolio firm's headquarters. In creating this measure, we followed the approach used by Sorenson and Stuart (2001). First, we calculated the angular distance of two points using the spherical law of cosines:

$$\Delta\sigma = \arccos\left(\sin\phi_1 \sin\phi_2 + \cos\phi_1 \cos\phi_2 \cos\Delta\lambda\right)$$

Table 1. Reputation ranking of VC firms (1990–2000)

VC name	Reputation score (2000)	Rep. ranking (2000)	Status ranking (2000)	Rep. ranking (1995)	Status ranking (1995)	Rep. ranking (1990)	Status ranking (1990)
New Enterprise Associates	100.00	1	2	1	1	1	1
Kleiner Perkins Caufield & Byers	80.78	2	1	2	2	2	3
Oak Investment Partners	70.16	3	3	4	5	3	4
Mayfield Fund	65.81	4	11	3	8	10	14
Accel Partners	65.40	5	20	6	260	29	
Sequoia Capital	59.63	6	6	5	4	5	10
Sprout Group	56.58	7	13	8	17	20	38
Institutional Venture Partners	54.82	8	10	7	3	7	6
U.S. Venture Partners	50.13	9	16	11	7	4	5
Intel Capital	48.11	10	4	412	246		
Atlas Venture, Ltd.	46.45	11	47	42	31	187	94
Brentwood Venture Capital	43.68	12	30	88	295	341	
Draper Fisher Jurvetson	43.26	13	25	99	120	147	59
Austin Ventures, L.P.	42.34	14	38	16	60	39	158
Menlo Ventures	41.02	15	29	12	16	17	15
Greylock Partners	40.84	16	22	21	21	36	39
Crosspoint Venture Partners	40.13	17	21	14	24	40	46
St. Paul Venture Capital, Inc.	40.11	18	23	53	20	89	127
Venrock Associates	38.01	19	17	23	10	32	12
Bain Capital	37.42	20	202	39	322	94	118
TL Ventures	35.22	21	42	178	364	359	350
Walden International	34.92	22	28	379		485	416
Mohr Davidow Ventures	33.79	23	48	13	22	68	40
Crescendo Venture Management LLC	33.53	24	68				
Partech International	33.15	25	27	82	79	54	108
First Analysis Corporation	33.12	26	213	28		110	
InterWest Partners	32.91	27	18	10	9	9	19
Charles River Ventures	32.83	28	93	57	156	23	156
Enterprise Partners Venture Capital	32.69	29	76	18	41	132	126
Mobius Venture Capital	32.59	30	78				
Vulcan Capital	32.18	31	34	334	224		
Meritech Capital Partners	32.04	32	81				
Advanced Technology Ventures	31.43	33	63	55	40	60	48
Battery Ventures, L.P.	31.27	34	66	38	58	62	29
Sevin Rosen Funds	30.90	35	37	31	32	46	47
Flagship Ventures	30.36	36	278	33		92	
Benchmark Capital	30.30	37	39				
Highland Capital Partners LLC	29.43	38	40	56	44	202	229
Canaan Partners	29.22	39	26	64	205	95	
Matrix Partners	29.08	40	52	30	11	31	24
Opus Capital	28.67	41		29		19	
Liberty Ridge Capital	27.78	42	179	337	380	479	
Sierra Ventures	27.77	43	79	40	46	78	85
Granite Ventures	27.74	44	58	293	27		2
Globespan Capital Partners	27.48	45	15	147	65	460	548
Comdisco Ventures	27.08	46	5	228	80		
Morgenthaler Ventures	26.15	47	31	19	19	42	26
Trinity Ventures	25.75	48	32	51	28	64	64
Delphi Ventures	25.58	49	46	46	29	241	190
North Bridge Venture Partners	25.55	50	87	169	130		

(Continued)

Table 1. (Continued)

VC name	Reputation score (2000)	Ranking (2000)	Status ranking (2000)	Status ranking (1995)	Ranking (1995)	Ranking (1990)	Status ranking (1990)
Sigma Partners	24.50	51	14	44	18	66	41
GE Equity	24.11	52	77	437	300		
Pequot Capital Management, Inc.	24.03	53	89				
Hummer Winblad Venture Partners	23.89	54	67	81	84	294	548
Edison Venture Fund	23.76	55	358	22	118	67	195
Centennial Ventures	23.56	56	113	25	83	11	50
General Atlantic LLC	21.59	57	315	139	335	201	207
ARCH Venture Partners	21.37	58	111	263	240	507	
Marquette Venture Partners	21.32	59	84	26	62	100	231
Sutter Hill Ventures	21.26	60	45	60	25	37	21
Vertex Management	21.22	61	41	165	96	498	
Bay Partners	21.17	62	35	52	33	86	52
El Dorado Ventures	21.10	63	154	62	85	112	180
TVM Capital	21.03	64	217	96	57	82	61
Sofinnova Partners	20.98	65	218	90	164	127	97
Zero Stage Capital Co., Inc.	20.45	66	126	152	110	107	213
@Ventures	20.24	67	88				
INVESCO Private Capital	19.91	68	124	54	383	134	
Associated Venture Investors	19.87	69	118	49	43	93	44
ONSET Ventures	19.84	70	82	109	50	268	191
Applied Technology	19.78	71	112	77	92	206	112
Vanguard Ventures	19.72	72	71	85	47	97	75
Korea IT Venture Partners Inc	19.66	73					
SVM STAR Ventures Management	19.62	74		262			
CID Equity Partners	19.07	75	219	270	338	185	548
Gilde Investment Management B.V.	18.91	76	240	393	313	316	281
Geocapital Partners, LLC	18.85	77	209	78	182	115	219
Rho Ventures	18.50	78	55	319	258	261	159
Mirae Asset Venture Investment	18.40	79					
Noro-Moseley Partners	18.29	80	120	48	179	69	211
Cordova Ventures	18.28	81	733	449		552	
Sequel Venture Partners	17.79	82	139				
Dominion Ventures, Inc.	17.68	83	98	404	55	529	366
Oxford Bioscience Partners	17.55	84	108	120	71		
Information Technology Ventures	17.21	85	50	655			
Ampersand Ventures	17.15	86	311	74	161	76	
Apex Venture Partners	17.03	87	189	102	140	168	520
Labrador Ventures	16.81	88	83	113	125	297	548
Charter Venture Capital	16.80	89	59	140	99	157	57
Cisco Systems, Inc.	16.56	90	62	357	264	390	280
Polaris Venture Partners	16.53	91	92	375			
J.P. Morgan Capital Corporation	16.43	92	123	135	141	465	
Sofinnova Ventures	16.27	93	182	114		247	
Prism Venture Partners	16.19	94	95				
New Atlantic Ventures	16.10	95	606				
Technology Partners	16.05	96	122	63	52	90	83
Woodside Fund	16.05	97	248	166	253	194	171
Mid-Atlantic Venture Funds	15.71	98	394	191	200	169	385
CORAL Ventures	15.70	99	207	186			

Table 1. (Continued)

VC name	Reputation score (2000)	Ranking (2000)	Status ranking (2000)	Status ranking (1995)	Ranking (1995)	Ranking (1990)	Status ranking (1990)
Foundation Capital	15.69	100	72				
Aberdeen Asset Managers Private Equity	15.64	101	441	277		151	
Commonwealth Capital Ventures	15.51	102	104				
OVP Venture Partners	15.48	103	110	80	61	79	93
Redpoint Ventures	15.41	104	296				
Johnson & Johnson Development Corporation	15.37	105	107	172	169	225	254
JK&B Capital	15.36	106	97				
Axiom Venture Partners, L.P.	15.23	107	115	185	361		
HealthCare Ventures LLC	15.21	108	169	159	197	179	276
Flatiron Partners	15.19	109	90				
Phillips-Smith Specialty Retail Group	15.17	110	145	87	129	123	283
Japan/America Ventures, Inc.	15.10	111	1079	145	139	34	189
Lion Capital	15.09	112	1079		387		
ABS Ventures	15.06	113	105	43	23	22	17
Aspen Ventures	14.99	114	177	17	14	41	23
eCompanies	14.98	115	684				
Chicago Growth Partners	14.85	116	80	66	93	56	69
Richland Ventures	14.83	117	106	58		74	
SV Life Sciences Advisers	14.82	118	146	315	193		426
Ticonderoga Capital, Inc.	14.71	119	282	149	121	50	88
Blue Chip Venture Company	14.46	120	148	399			
Gateway Associates, L.P.	14.42	121	367	36		49	
Innovacom	14.33	122	127	670			
Fidelity Investments	14.32	123	602	324		149	
Intersouth Partners	14.29	124	206	156	356	186	220
Ascent Venture Partners	14.22	125	305	116	255	143	320
Boston Millennia Partners	14.14	126	96				
Needham Asset Management	14.07	127	448	235			
CMEA Ventures	14.06	128	116	84	49	517	
IFCI Venture Capital Funds Ltd	14.05	129	638	104			
Crosslink Capital	13.85	130	286	234		314	
US Trust Private Equity	13.79	131	291				
Tullis–Dickerson & Co., Inc.	13.77	132	445	158	387	333	548
August Capital Management	13.74	133	834				
Permira Advisers Limited	13.68	134	343	274	70	416	32
Piper Jaffray Ventures	13.61	135	56	201	102	140	376
Focus Ventures	13.52	136	44				
Dream Venture Capital Corporation	13.51	137					
Brown Brothers Harriman & Co	13.34	138		325		496	
Cross Atlantic Capital Partners	13.31	139	163				
Asset Management Company Venture Capital	13.29	140	150	15	305	24	55
Keystone Venture Capital Management Co.	13.25	141	439	294	387	175	303

(Continued)

Table 1. (Continued)

VC name	Reputation score (2000)	Ranking (2000)	Status ranking (2000)	Status ranking (1995)	Ranking (1995)	Ranking (1990)	Status ranking (1990)
Abingworth Management, Ltd.	13.24	142	160	79	39	35	9
Kestrel Management LLC	13.20	143	338	396		317	
Altos Ventures	13.17	144	144				
BCI Partners	13.02	145	319	68	314	57	
River Cities Capital Funds	12.83	146	526	623			
Boston University Tech. Development Fund	12.64	147	185	223	290	160	218
Frazier Healthcare and Technology Ventures	12.56	148	125	123	108		
Pacific Venture Group	12.55	149	141				
Alta Berkeley Venture Partners	12.51	150	846	65	124	128	258

where ϕ_1, λ_1 and ϕ_2, λ_1 are the latitude and longitude of two points, respectively and $\Delta\lambda$ is longitudinal difference. We computed the real distance in miles by multiplying the longitudinal difference by the average great-circle radius of the earth (3,438.46 miles) to obtain the number of miles between each IPO firm and each VC firm invested in the company. We then developed three geographic distance measures to correspond with our three VC reputation measures. The early- and late-stage geographic distance measures were calculated as the average of the geographic distances of VCs investing in the first round and last rounds, respectively.

Industry specialization. Again building on the work of Sorenson and Stuart (2001), this measure equaled the percentage of the VC's previous successful investments (defined as the number of firms taken public) that were made in the focal firm's industry. This measure can be denoted using the formula:

$$industry\ specialization = \frac{\sum_{j,t} p}{\sum_{t} p}$$

where j denotes the industry of the start-up, and t stands for time period between the starting point of our dataset[12] and the start-up's IPO year, and p represents an array of the number of start-ups taken public by the VC. We categorized industries at the two-digit SIC code level. In calculating this measure, we summed the number of IPOs from the starting point of our dataset within each year rather than using a rolling average of the prior five years because the VC's experience and learning can accumulate across the whole investment time horizon. Again, we calculated the average of the VCs' industry specializations for the first round and last rounds, respectively.

Control variables

Underwriter prestige. Our underwriter prestige variable comes from the IPO dataset provided by Jay Ritter. Underwriter prestige is based on an amended version of the Carter and Manaster (1990)

and Carter et al. (1998) rankings and is described in Loughran and Ritter (2002). The rankings range in value from 0 to 9, with higher values indicating higher-status rankings. Preliminary analyses indicate high levels of correlation between underwriter prestige and VC reputation. This is not surprising, as prestigious underwriters are more likely to be attracted to, and willing to underwrite, the offerings of firms in which high-reputation VCs have invested (Higgins and Gulati, 2003; Pollock et al., 2010). In order to address this issue we created a new variable by regressing our underwriter prestige measure on our VC reputation measure, and used the residuals from the regression as the instrumental variable for underwriter prestige in our analyses (Brown and Perry, 1994; Cohen et al., 2003).

Firm quality. The underlying quality of the firm going public may also be a determinant of market valuation and performance. To control for the effects of firm quality we included several measures suggested by prior research (Gutterman, 1991; Pollock and Rindova, 2003): *Number of employees* (the natural logarithm of the number of employees at the time of the IPO),[13] *Sales growth rate* (sales in the quarter of the IPO, minus sales in the same quarter one year prior to the IPO divided by sales in the pre-IPO quarter), *Total number of rounds* (the number of rounds of VC investment in the firm), *Company age* (the natural logarithm of 1 plus the firm age at the time of the IPO) and *Investment period* (the natural logarithm of 1 plus the time from the first VC investment to the IPO).

Industry and year dummies. To control for industry effects, we included 23 industry dummies based on the IPO firms' two-digit SIC codes (87 was the omitted industry). To control for any potential year effects, we also included year dummies for the years 1990–1999 (2000 was the omitted year). In order to keep the size of our results tables manageable, we do not report the regression coefficients for these measures, although they were included in all analyses.

Model estimation technique

VCs invest in a large number of companies that never conduct IPOs (Gorman and Sahlman, 1989; Guler, 2007). Thus, there is the potential for sample selection bias due to unobserved factors if there are significant differences between those VC-backed firms that ultimately go public and those that do not, and these differences are also correlated with our dependent variables.

To account for this, we use the Heckman two-stage approach to correct for potential selection bias (Hamilton and Nickerson, 2003; Heckman, 1979). The first stage calculates the inverse of the Mills ratio, which is used to correct for selection biases in the second stage of the analysis. In order to calculate this measure we needed to first run a model predicting whether or not firms that were likely to go public did so during our period of study. To accomplish this, we used data collected from VentureXpert to identify 1374 VC-backed companies that could go public during our period of study but never conducted an IPO. These companies were identified using the following criteria: (1) they were in one of Venture Economics' industry codes (VEIC) represented in our sample; (2) they were not founded earlier than the earliest founding year in our final sample of IPO firms; (3) they had received at least one round of VC financing and did not go public between 1990 and 2000; and (4) they did not receive VC financing after 2000. We then collected the following variables and used them to predict the likelihood a firm would go public: (1) the number of rounds of IPO financing received; (2) the total venture funding raised; (3) the number of VC firms invested in the company; (4) three founding year dummies reflecting whether the firm was founded before 1990, between 1990 and 1994, or after 1995 (the excluded category); and (5) industry dummies. Because non-public firms are not assigned SIC codes, we created industry dummies using VentureXpert's VEIC sub-group 1 category.[14]

The first-stage model was highly predictive. All regressors except for the founding prior to 1990 dummy were significant in predicting the likelihood of conducting an IPO at $p < 0.001$. (We do not display the first-stage regressions to conserve space.) It is interesting to note that most industry dummies were highly significant in the first stage of the post-IPO operating performance models, but were not significant in the first stage of the initial market valuation models. The inverse of the Mills ratio was marginally significant in most of the second-stage models, indicating the presence of selection bias.

Results

Table 2 presents the descriptive statistics and correlations for all variables used in the analysis. In order to reduce non-essential collinearity, all variables used in the interactions were mean-centered (Cohen et al., 2003). For ease of interpretation, the non-centered variables were used to create the descriptive statistics.

Tables 3 and 4 present the results of the second-stage Heckman regressions testing our hypotheses. Table 3 includes the regressions predicting the IPO firm's market value at the end of the first day of trading, and Table 4 presents the regressions predicting operating performance. Models 1–4 include the results using first-round VC characteristics and models 5–8 present the results using last-round VC characteristics. Within each set of models, the first model presents the main effects, the second and third models test the interactions with geographic distance and industry specialization separately and the fourth model presents the fully specified model.

Hypothesis 1 predicted that the relationship between VC reputation and the two outcomes would be contingent on their length of involvement, and that first-round involvement would have a stronger relationship than last-round involvement with IPO valuations and performance. Our results provide strong support for Hypothesis 1. First-round VC reputation was positive and significant $p < 0.05$ in models 1–4 of both Tables 3 and 4, suggesting early involvement by high-reputation firms provides substantive value to IPO firms that is recognized by investors and reduces their uncertainty. In contrast, the coefficients presented in models 5–8 of Tables 3 and 4 testing the relationship in the last round are not significant. In order to ensure that these differences were not due to systematic differences in the reputations of VCs whose initial investments were in the first and last rounds, we conducted *t*-tests comparing the average reputation of the VCs that invested in the first round with the average reputation of the VCs that were new investors in the last round only (thus excluding VCs who also invested in earlier rounds). Our results showed there was no significant difference in reputation between the two groups of VCs. Thus, early-round involvement by high-reputation VCs provides substantive benefits that aid post-IPO operating performance, and investors appear to recognize these benefits, whereas late involvement by high-reputation VCs appears to add little value.

Hypothesis 2 predicted that the geographic distance between an IPO firm and its VCs reduced the relationship between VC reputation and both outcomes. We tested this hypothesis using both specifications of VC reputation (first round and last round). The interaction between geographic distance and VC reputation was negative and significant in both model specifications when predicting initial market valuation, but was not significant in the models predicting post-IPO operating performance. This suggests that while investors value the involvement of high-reputation VCs less when they are geographically distant from their portfolio firms, geographic distance does not appear to limit high-reputation VCs' abilities to provide these start-ups with resources that improve their operating performance. Overall, then, Hypothesis 3 was partially supported: while geographic distance reduced the relationship between VCs' reputation and investors' perceptions of uncertainty, it did not appear to influence the relationship with post-IPO operating performance.

Table 2. Descriptive statistics[a]

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Post-IPO operating performance	−0.083	0.034													
2. IPO market performance[b]	0.567	1.326	0.12												
3. Avg. VC reputation in first round	37.106	25.987	0.02	0.10											
4. Avg. VC reputation in last round	37.260	24.470	−0.01	0.08	0.65										
5. Avg. geographic distance in first round[c]	0.701	0.870	−0.07	0.01	−0.03	−0.01									
6. Avg. geographic distance in last round[c]	0.686	0.830	−0.07	0.06	−0.04	0.00	0.73								
7. Avg. industry specialization in first round	0.378	0.219	0.06	0.11	−0.43	−0.29	0.00	0.03							
8. Avg. industry specialization in last round	0.345	0.298	0.06	0.01	−0.46	−0.44	−0.01	0.00	0.69						
9. Number of employees[d]	0.385	1.531	0.37	0.40	0.11	0.11	0.06	0.08	−0.01	−0.06					
10. Sales growth rate	7.535	38.567	0.00	0.14	0.05	0.03	−0.01	0.00	−0.04	−0.02	0.03				
11. Total number of rounds	4.773	2.889	−0.11	0.02	0.07	0.11	0.00	0.00	−0.02	−0.03	−0.10	0.02			
12. Age at IPO	7.471	7.651	0.18	−0.25	−0.07	−0.04	0.01	−0.03	−0.10	−0.03	0.10	−0.11	0.06		
13. Investment period	4.638	2.980	0.01	−0.25	0.03	0.05	−0.04	−0.06	−0.19	−0.10	−0.06	−0.06	0.44	0.44	
14. Underwriter's prestige	8.200	1.335	0.09	0.49	0.12	0.10	0.05	0.04	0.00	−0.06	0.33	0.06	0.02	−0.13	−0.11

[a] Correlations of 0.10 or greater significant at $p < 0.05$ and correlations of 0.13 or greater are significant at $p < 0.01$.
[b] In billions of US dollars.
[c] In thousands of miles.
[d] In thousands.

Table 3. Results of Heckman regression for the effect of VC reputation on initial market valuation[a,b]

Variables	First round				Last round			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	6.7993**	6.7753**	6.7992**	6.7752**	7.2472**	7.2406**	7.2253**	7.2179**
	(0.3927)	(0.3906)	(0.3926)	(0.3906)	(0.3740)	(0.3715)	(0.3720)	(0.3694)
Number of employees	0.3297**	0.3289**	0.3299**	0.3291**	0.3467**	0.3394**	0.3486**	0.3411**
	(0.0448)	(0.0445)	(0.0448)	(0.0445)	(0.0447)	(0.0445)	(0.0445)	(0.0442)
Sales growth rate	0.2588**	0.2632**	0.2592**	0.2636**	0.2610**	0.2559**	0.2653**	0.2602**
	(0.0899)	(0.0894)	(0.0899)	(0.0894)	(0.0899)	(0.0893)	(0.0894)	(0.0888)
Total number of rounds	0.0099	0.0092	0.0099	0.0091	0.0113	0.0095	0.0100	0.0081
	(0.0136)	(0.0136)	(0.0136)	(0.0136)	(0.0137)	(0.0136)	(0.0136)	(0.0135)
Age at IPO	−0.2822**	−0.2786**	−0.2817**	−0.2781**	−0.2968**	−0.3038**	−0.2847**	−0.2914**
	(0.0786)	(0.0782)	(0.0787)	(0.0783)	(0.0787)	(0.0782)	(0.0784)	(0.0779)
Investment period of VCs	−0.2213*	−0.2212**	−0.2212*	−0.2211**	−0.2376**	−0.2280**	−0.2320**	−0.2217**
	(0.0863)	(0.0858)	(0.0863)	(0.0858)	(0.0852)	(0.0847)	(0.0847)	(0.0842)
Underwriter's prestige	0.2101**	0.2083**	0.2099**	0.2080**	0.2215**	0.2201**	0.2212**	0.2197**
	(0.0304)	(0.0303)	(0.0305)	(0.0304)	(0.0306)	(0.0304)	(0.0304)	(0.0302)
VC reputation (A)	0.7576**	0.7631**	0.7545**	0.7598**	−0.1546	−0.1301	−0.2585	−0.2375
	(0.1541)	(0.1532)	(0.1564)	(0.1555)	(0.1857)	(0.1847)	(0.1894)	(0.1882)
Geographic distance (G)	−0.0050	−0.0040	−0.0048	−0.0039	−0.0114	−0.0105	−0.0091	−0.0081
	(0.0151)	(0.0151)	(0.0152)	(0.0151)	(0.0185)	(0.0183)	(0.0184)	(0.0182)
Industry specialization (I)	0.0177	0.0510	0.0116	0.0445	−0.1981	−0.1907	−0.3028*	−0.2996*
	(0.1789)	(0.1784)	(0.1864)	(0.1859)	(0.1227)	(0.1220)	(0.1293)	(0.1284)
(A) × (G)		−0.1542*		−0.1542*		−0.1871**		−0.1938**
		(0.0632)		(0.0632)		(0.0698)		(0.0694)
(A) × (I)			−0.0856	−0.0897			−1.4548*	−1.5167*
			(0.7256)	(0.7217)			(0.5933)	(0.5894)
Correction for selection bias (λ)	−0.1004+	−0.0994+	−0.1008+	−0.0998+	−0.1169*	−0.1187*	−0.1108+	−0.1124+
	(0.0601)	(0.0598)	(0.0602)	(0.0599)	(0.0593)	(0.0589)	(0.0590)	(0.0586)
Observations	536	536	536	536	538	538	538	538
Wald χ^2	845.15**	860.47**	845.18**	860.50**	832.82**	851.04**	848.31**	868.31**

[a] Two-tailed coefficient tests. Unstandardized coefficients are presented with standard errors in parentheses.
[b] + significant at 10%; * significant at 5%; ** significant at 1%.

Table 4. Results of Heckman regression for the effect of VC reputation on operating performance[a,b]

Variables	First round				Last round			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	−0.0846**	−0.0839**	−0.0848**	−0.0840**	−0.0782**	−0.0771**	−0.0782**	−0.0769**
	(0.0126)	(0.0126)	(0.0126)	(0.0126)	(0.0119)	(0.0119)	(0.0119)	(0.0119)
Number of employees	0.0025	0.0025+	0.0024	0.0024	0.0028+	0.0029+	0.0028+	0.0029+
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)
Sales growth rate	0.0058*	0.0057*	0.0056+	0.0055+	0.0057*	0.0057*	0.0058*	0.0058*
	(0.0029)	(0.0029)	(0.0029)	(0.0029)	(0.0028)	(0.0028)	(0.0028)	(0.0028)
Total number of rounds	−0.0004	−0.0003	−0.0003	−0.0003	−0.0003	−0.0003	−0.0003	−0.0004
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Age at IPO	0.0099**	0.0099**	0.0099**	0.0099**	0.0091**	0.0092**	0.0092**	0.0092**
	(0.0026)	(0.0026)	(0.0026)	(0.0026)	(0.0026)	(0.0026)	(0.0026)	(0.0026)
Investment period of VCs	−0.0003	−0.0004	−0.0005	−0.0006	−0.0003	−0.0003	−0.0002	−0.0002
	(0.0029)	(0.0029)	(0.0029)	(0.0029)	(0.0028)	(0.0028)	(0.0028)	(0.0028)
Underwriter's prestige	0.0023*	0.0023*	0.0024*	0.0024*	0.0026**	0.0026**	0.0026**	0.0027**
	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)
VC reputation (A)	0.0096*	0.0097*	0.0114*	0.0115*	−0.0055	−0.0064	−0.0070	−0.0080
	(0.0049)	(0.0049)	(0.0049)	(0.0049)	(0.0057)	(0.0057)	(0.0059)	(0.0059)
Geographic distance (D)	0.0002	0.0000	0.0001	−0.0000	0.0000	−0.0000	0.0000	−0.0000
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Industry specialization (G)	0.0103+	0.0101+	0.0138*	0.0136*	0.0094*	0.0095*	0.0091*	0.0091*
	(0.0059)	(0.0058)	(0.0061)	(0.0061)	(0.0039)	(0.0039)	(0.0039)	(0.0039)
(A) × (D)		0.0023		0.0023		0.0040		0.0043
		(0.0019)		(0.0018)		(0.0031)		(0.0031)
(A) × (G)			0.0460*	0.0460*			−0.0210	−0.0236
			(0.0234)	(0.0234)			(0.0219)	(0.0220)
Correction for selection bias (λ)	0.0031	0.0031	0.0032+	0.0031+	0.0025	0.0024	0.0025	0.0024
	(0.0019)	(0.0019)	(0.0019)	(0.0019)	(0.0019)	(0.0019)	(0.0019)	(0.0019)
Observations	431	431	431	431	433	433	433	433
Wald χ^2	642.78**	646.45**	652.40**	656.16**	653.20**	657.54**	655.52**	660.45**

[a] Two-tailed coefficient tests. Unstandardized coefficients are presented with standard errors in parentheses.
[b] + significant at 10%; * significant at 5%; ** significant at 1%.

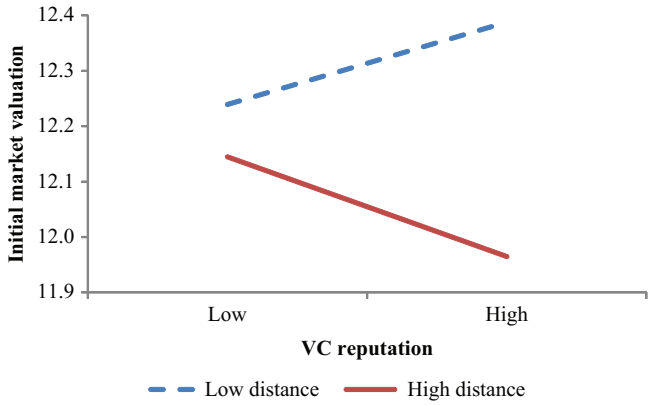

Figure 1. Interaction of VC reputation and geographic distance on initial market valuation

To further illustrate this effect, we graphed these interactions in Figure 1 using values one standard deviation above and below the mean for each measure. When VC reputation was low the geographic distance discount was relatively small; only 0.8 percent for first-round VC reputation. However, when VC reputation was high the discount was much greater, equaling 3.4 percent. Thus, assuming a firm has a first-day market valuation of US$169.3 million (the median for our sample) and the support of high-reputation VCs who are geographically proximal, a comparable firm whose high-reputation VCs are geographically distant will have a market value that is approximately US$5.8 million less. These findings further illustrate the high expectations investors have regarding the benefits of high-reputation VC involvement and their concerns when high-reputation VCs are not actively involved with a company.

Hypothesis 3 predicted that a VC's prior experience in the IPO firm's industry would enhance the effects of VC reputation on both performance outcomes. The interaction between industry specialization and VC reputation was not significant in the first-round models predicting market valuation and was negative and significant in the last-round models, failing to provide support for the hypothesis. The interaction also failed to achieve significance in the last-round models predicting operating performance. However, the interaction between industry specialization and first-round VC reputation was positive and significant at $p < 0.05$ in models 3 and 4 of Table 4, predicting operating performance. Thus, Hypothesis 3 is partially supported. We graphed this interaction in Figure 2. When VC reputation was low, high industry specialization yielded a 1.4 percent improvement in operating performance over low industry specialization; when VC reputation was high, this increased to an 8.3 percent improvement. Further, although the interaction was only significant in the first-round models predicting operating performance, the main effect of industry specialization was positive and significant in the two first-round models that included the interaction term and in all four last-round models. This suggests that, all else being equal, the more specialized the VC firms are in the portfolio company's industry, the better the portfolio company is likely to perform post-IPO. This is true regardless of when the VC becomes involved with the company, but appears to be greatest when high-reputation VCs with substantive industry experience become involved early on. Investors, however, do not appear to recognize this benefit.

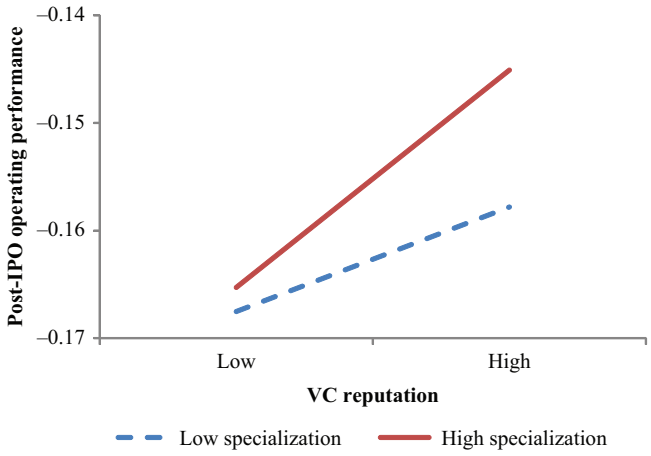

Figure 2. Interaction of VC reputation and industry specialization on operating performance

Related constructs and alternative explanations

VC firm status. Related intangible assets such as status and celebrity, can, like reputation, act as signals of unobservable firm quality. VC status, in particular, has received prior attention in the literature (e.g. Hallen, 2008; Hochberg et al., 2007; Podolny, 2001; Rider, 2009). These studies use VC status to predict the likelihood that a VC will use a broker to raise an investment fund, the average stage at which a VC invests, the likelihood that a portfolio firm will go public and the likelihood a new venture and a VC will form a tie with each other. However, as other scholars have articulated, status has a different theoretical and empirical basis than reputation (Podolny, 2005; Rindova et al., 2006; Washington and Zajac, 2005). Whereas reputation is based on a past history of behaviors and performance (Podolny, 2005; Rindova et al., 2005), status is based on an actor's position in a hierarchical social order (Podolny, 2005: 13) Further, a firm can possess one of these intangible assets without possessing the other (i.e. a firm might have a strong reputation for reliable performance, but may not be a member of the industry's highest status class). Podolny and colleagues (Lynn et al., 2009; Podolny, 2005) have also expressly stated that status is less useful as an indicator of quality when there is little uncertainty about other indicators of quality and performance outcomes. Our reputation index comprises multiple, unambiguous indicators of VC firms' prior performance, thereby providing a better indicator of VC firm quality and expected future performance than a related status measure is likely to offer.

Nonetheless, to explore this issue further we calculated a five-year rolling average status measure for each VC firm using an approach similar to that employed by Podolny (2001),[15] although he only used a single year of data. VC firms' status rankings are included in Table 1. Although the status rankings correlate with our reputation rankings at $r = 0.7$, there nonetheless are distinct differences for some VC firms across the two rankings (see Table 1). We included both measures in our models and re-ran our analyses. Tables 5 and 6 present the results of our analysis. Including both measures simultaneously created excessive levels of collinearity (condition indices > 30), so these results are presented just for illustration, and should be interpreted with extreme caution. Although our sample size was reduced due to the availability of data used to calculate the status measure, the results of this post hoc analysis showed that the effects of reputation on initial market

Table 5. Results of Heckman regression for the effect of VC reputation and status on initial market valuation[a,b]

Variables	First round				Last round			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	6.8671**	6.8094**	6.7877**	6.7222**	7.3722**	7.3387**	7.3138**	7.3122**
	(0.4069)	(0.4057)	(0.4080)	(0.4056)	(0.3973)	(0.3928)	(0.3976)	(0.3947)
Number of employees	0.3409**	0.3416**	0.3460**	0.3574**	0.3738**	0.3644**	0.3573**	0.3678**
	(0.0497)	(0.0495)	(0.0496)	(0.0493)	(0.0500)	(0.0494)	(0.0502)	(0.0500)
Sales growth rate	0.2203*	0.2261*	0.2208*	0.2271*	0.2261*	0.2254*	0.2245*	0.2268*
	(0.0905)	(0.0901)	(0.0902)	(0.0894)	(0.0911)	(0.0899)	(0.0904)	(0.0899)
Total number of rounds	0.0017	0.0005	0.0034	0.0018	0.0021	−0.0030	0.0020	−0.0028
	(0.0149)	(0.0149)	(0.0149)	(0.0148)	(0.0151)	(0.0150)	(0.0150)	(0.0150)
Age at IPO	−0.2681**	−0.2597**	−0.2706**	−0.2528**	−0.2971**	−0.2954**	−0.2982**	−0.2919**
	(0.0845)	(0.0842)	(0.0842)	(0.0835)	(0.0851)	(0.0840)	(0.0845)	(0.0842)
Investment period of VCs	−0.2362*	−0.2395**	−0.2347*	−0.2452**	−0.2402*	−0.2144*	−0.2242*	−0.2127*
	(0.0932)	(0.0929)	(0.0930)	(0.0924)	(0.0934)	(0.0924)	(0.0930)	(0.0925)
Underwriter's prestige	0.2006**	0.1984**	0.2017**	0.1997**	0.2119**	0.2133**	0.2099**	0.2117**
	(0.0333)	(0.0332)	(0.0332)	(0.0329)	(0.0338)	(0.0334)	(0.0337)	(0.0335)
Reputation (A)	0.5277*	0.5582**	0.5605**	0.6070**	−0.0020	−0.0033	−0.0023	−0.0038
	(0.2133)	(0.2167)	(0.2137)	(0.2178)	(0.0024)	(0.0025)	(0.0024)	(0.0026)
Status (B)	0.2751+	0.2501+	0.2906*	0.2431+	0.1977	0.2024	0.1991	0.2289
	(0.1464)	(0.1461)	(0.1462)	(0.1469)	(0.1513)	(0.1509)	(0.1505)	(0.1558)
Geographic distance (C)	−0.0044	0.0032	−0.0038	0.0025	−0.0102	0.0035	−0.0079	0.0024
	(0.0165)	(0.0167)	(0.0167)	(0.0166)	(0.0209)	(0.0209)	(0.0207)	(0.0212)
Industry specialization (D)	−0.0487	−0.0176	0.0739	0.1442	−0.2445	−0.3250*	−0.2869+	−0.3073+
	(0.2048)	(0.2047)	(0.2128)	(0.2122)	(0.1522)	(0.1570)	(0.1608)	(0.1601)
(A) × (C)		−0.1666*		−0.2744**		−0.0025**		−0.0022+
		(0.0724)		(0.0969)		(0.0008)		(0.0013)
(A) × (D)		−0.0794		−1.2693		−0.0162*		−0.0204*
		(0.8301)		(0.9767)		(0.0073)		(0.0099)
(B) × (C)			−0.0156	0.1012			−0.1272*	−0.0280
			(0.0475)	(0.0636)			(0.0524)	(0.0830)
(B) × (D)			1.1076*	1.5286*			−0.3836	0.3109
			(0.5522)	(0.6486)			(0.3789)	(0.5134)
Correction for selection bias (λ)	−0.1176+	−0.1143+	−0.1117+	−0.1161+	−0.1386*	−0.1377*	−0.1300*	−0.1369*
	(0.0638)	(0.0635)	(0.0637)	(0.0630)	(0.0648)	(0.0639)	(0.0645)	(0.0641)
Observations	454	454	454	454	438	438	438	438
Wald χ^2	765.2**	779.1**	776.0**	802.3**	742.9**	777.9**	760.3**	779.2**

[a] Two-tailed coefficient tests. Unstandardized coefficients are presented with standard errors in parentheses.
[b] + significant at 10%; * significant at 5%; ** significant at 1%.

Table 6. Results of Heckman regression for the effect of VC reputation and status on operating performance[a,b]

Variables	First round				Last round			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	−0.0866**	−0.0849**	−0.0853**	−0.0810**	−0.0806**	−0.0794**	−0.0775**	−0.0770**
	(0.0132)	(0.0132)	(0.0133)	(0.0132)	(0.0125)	(0.0126)	(0.0125)	(0.0125)
Number of employees	0.0019	0.0018	0.0019	0.0015	0.0022	0.0022	0.0015	0.0013
	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)
Sales growth rate	0.0052+	0.0049+	0.0053+	0.0050+	0.0048+	0.0050+	0.0050+	0.0048+
	(0.0029)	(0.0029)	(0.0029)	(0.0028)	(0.0028)	(0.0028)	(0.0028)	(0.0028)
Total number of rounds	−0.0004	−0.0004	−0.0005	−0.0004	−0.0005	−0.0005	−0.0005	−0.0005
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Age at IPO	0.0096**	0.0094**	0.0096**	0.0095**	0.0098**	0.0099**	0.0098**	0.0096**
	(0.0028)	(0.0028)	(0.0028)	(0.0027)	(0.0028)	(0.0027)	(0.0027)	(0.0027)
Investment period of VCs	−0.0001	−0.0005	0.0000	−0.0004	−0.0009	−0.0005	−0.0002	−0.0005
	(0.0031)	(0.0031)	(0.0031)	(0.0031)	(0.0030)	(0.0031)	(0.0030)	(0.0030)
Underwriter's prestige	0.0032**	0.0033**	0.0032**	0.0033**	0.0035**	0.0036**	0.0038**	0.0038**
	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)
Reputation (A)	0.0116+	0.0137+	0.0111	0.0142*	−0.0001	−0.0002*	−0.0001+	−0.0001
	(0.0070)	(0.0072)	(0.0071)	(0.0072)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Status (B)	0.0017	0.0013	0.0014	0.0003	0.0139**	0.0147**	0.0128*	0.0112*
	(0.0048)	(0.0048)	(0.0048)	(0.0049)	(0.0050)	(0.0050)	(0.0050)	(0.0051)
Geographic distance (C)	0.0002	0.0000	0.0002	−0.0000	0.0003	0.0003	0.0003	0.0002
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0006)	(0.0007)	(0.0006)	(0.0007)
Industry specialization (D)	0.0180**	0.0184**	0.0156*	0.0123+	0.0167**	0.0148**	0.0115*	0.0119*
	(0.0068)	(0.0068)	(0.0071)	(0.0071)	(0.0049)	(0.0051)	(0.0051)	(0.0051)
(A) × (C)		0.0023		0.0039		0.0000		0.0000
		(0.0023)		(0.0030)		(0.0000)		(0.0000)
(A) × (D)		0.0479+		0.0948**		−0.0003		0.0004
		(0.0274)		(0.0331)		(0.0002)		(0.0003)
(B) × (C)			−0.0001	−0.0014			0.0005	0.0002
			(0.0015)	(0.0020)			(0.0016)	(0.0025)
(B) × (D)			−0.0202	−0.0565**			−0.0356**	−0.0520**
			(0.0182)	(0.0219)			(0.0118)	(0.0167)
Correction for selection bias (λ)	0.0027	0.0028	0.0026	0.0025	0.0035+	0.0035+	0.0034+	0.0034+
	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)
Observations	351	351	351	351	336	336	336	336
Wald χ^2	591.1**	602.0**	594.4**	621.7**	615.2**	619.8**	640.3**	645.8**

[a] Two-tailed coefficient tests. Unstandardized coefficients are presented with standard errors in parentheses.
[b] + significant at 10%; * significant at 5%; ** significant at 1%.

valuation and operating performance, as well as the moderating effects of geographic distance and industry specialization, are essentially the same as those reported in Tables 3 and 4.[16] Status also has a positive, although weaker, relationship with initial market valuation in the first-round models, but it does not have a significant relationship with post-IPO operating performance in the first-round models, although this relationship becomes significant in the last-round models. Thus, although the measures are related they demonstrate distinct patterns of effects when included in our models.

Better access to 'good' companies. Another alternative explanation for our findings is that high-reputation firms have better access to the most promising start-ups, and/or are better at 'picking winners'. There are a number of reasons why it is unlikely they are better at picking winners. As noted earlier, most VC investments result in failures, and only a small percentage make it to IPO, with an even smaller percentage accounting for the bulk of a venture fund's returns. There is no evidence we can find that these experiences are substantially different for high-reputation VCs. Further, we included a number of controls in our model to address the issue of differences in firm quality, and we control for the bias associated with the fact that the highest performing portfolio companies are the ones most likely to go public. Further, our empirical results are inconsistent with this explanation. If it were simply a matter of picking winners then the stage of investment would not matter. Other research has also failed to find support for this explanation (e.g. Sorensen, 2007).

However, prior research has suggested that more experienced VCs have greater access to high potential start-ups, and also that more experienced VCs add value independent of any advantages they may have in accessing higher potential firms (Sorensen, 2007). Fitza et al. (2009) also found evidence of VC ownership effects independent of industry, firm age, year and stage effects in their study assessing the change in start-up firms' values between rounds of VC financing. Thus, although superior deal flow may explain part of our results (at least for early-stage investments by high-reputation VCs), Sorensen's analysis suggests it is far from the whole story, and high-reputation VC firms add additional value.

To explore this issue more thoroughly in our own data, we conducted an additional analysis, employing two-stage least squares (2SLS) to test for possible endogeneity associated with high-reputation VCs' better access to more promising companies (Bascle, 2008; Greene, 2008). This analytical method uses exogenous instrumental variables that are correlated with the endogenous explanatory variable in question, but are uncorrelated with the error term, to correct for the potential endogeneity bias resulting from an omitted variable that affects both the independent and dependent variables (Greene, 2008). The instruments should be correlated with VC reputation, but uncorrelated with the error term in the models predicting our outcomes. We identified four instrumental variables at the time of investment that met the necessary criteria identified by Bascle (2008): (1) industry sales growth; (2) the eight-firm concentration ratio (both calculated at the two-digit SIC code level); (3) the number of trade associations the VC is a member of; and (4) the number of states in which a VC's portfolio firms that have gone public are located in minus 1 (to remove the focal firm's state).[17] These last two measures were based on the most recent 10 years of activity, and were averaged across participating VC firms.

We followed Bascle's (2008) assessment approach to determine if these variables were reasonable instruments. First we examined the relevance condition. According to Stock and Yogo's critical values, the relevance condition was not initially achieved. Following Bascle's recommendation, we corrected for the potential bias from weak instruments by adopting Fuller's limited information maximum likelihood estimation technique using the fuller(4) option in STATA and also

reported the results of Moreira's conditional likelihood ratio (Moreira's CLR). These methods are robust using this technique (Bascle, 2008). We then explored the exogeneity condition and confirmed that each instrument was uncorrelated with the error term according to difference-in-Sargan statistics (or C-statistics) together with Hansen's J-statistics. This condition was met for all instruments except for the industry concentration ratio in the last-stage models. We therefore excluded this instrument from these analyses. The test statistics are reported in Tables 7 and 8. In sum, our instruments satisfy both the relevance and exogeneity conditions, indicating that our 2SLS results are reliable (Bascle, 2008).

Tables 7 and 8 present the results of our analysis. For first-round investments, the 2SLS analysis showed that the main effect of VC reputation predicting operating performance remained positive and significant in all first-round models, as did the main effect of industry specialization and its interaction with VC reputation. However, the interaction effect of geographic distance was negative and significant, suggesting that once the endogeneity associated with greater access to high-quality start-ups was removed, geographic distance affected high-reputation VCs' abilities to provide substantive value. Further, VC reputation no longer had a significant relationship with initial market valuation in the first-round models, and the main and interaction effects of industry specialization were no longer significant. When 2SLS was used to predict the effects of VC reputation in the last round, our analysis revealed that there was no relationship between VC reputation and operating performance, although industry specialization continued to have a positive main effect relationship, and there was a negative, significant relationship between both VC reputation and industry specialization and initial market performance. These findings are provocative, in that when combined with our original findings they suggest the market undervalues the substantive benefits early investment by high-reputation VCs and more specialized VCs can have for operating performance. Further, the market does not value, and even penalizes, late-round investments by high-reputation and more specialized VCs. Our results regarding the role of geographic location are more mixed. We consider the implications of these findings in more detail in the discussion section.

Effects of individual indicators of VC reputation. Finally, it is possible that one of the variables included in our index could be driving our results. In order to assess this possibility we re-ran all of our models using each component of our index separately as proxies for VC reputation.[18] All six components of the index were significant predictors of initial market valuation, but none of the individual items were significantly better predictors than the index measure. Of the six items, the total dollar amount of funds raised by the VCs appeared to be the strongest individual predictor of initial market valuation. However, when we predicted operating performance, only five of the six items were significant; the total amount of investment funds raised, which was the strongest individual predictor of initial market valuation, was not significant. Again, none of the individual items appeared to be significantly better than our index, although the number of companies a VC had invested in appeared to be the strongest individual predictor. These findings suggest that while the VCs' experience working with companies had the greatest effect on the portfolio firm's operating performance, the size of the firm, as reflected in the investment funds they control, was unrelated to the firm's operating performance, although this VC firm characteristic appeared to have the most influence on investors' perceptions. It is possible that this variable is more reflective of the VC firm's prominence than it is of its capabilities, because it makes the firm more visible to the general investing public (Rindova et al., 2005). Future research should continue to explore the relationship among the different dimensions of a VC firm's reputation, as well as their relationships with different dimensions of portfolio firm performance.

Table 7. Results of 2SLS regression for the effect of VC reputation on initial market valuation[a,b,c]

	First round			Last round				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	5.5149**	5.4148**	5.6793**	5.5642**	5.7077**	5.6579**	5.8129**	5.7242**
	(0.5261)	(0.5316)	(0.5455)	(0.5425)	(0.4456)	(0.4430)	(0.4561)	(0.4517)
Number of employees	0.3009**	0.2978**	0.3132**	0.3100**	0.3463**	0.3363**	0.3573**	0.3435**
	(0.0499)	(0.0498)	(0.0518)	(0.0512)	(0.0465)	(0.0466)	(0.0474)	(0.0474)
Sales growth rate	0.2377**	0.2455**	0.2445**	0.2543**	0.2630**	0.2550**	0.2735**	0.2623**
	(0.0920)	(0.0916)	(0.0930)	(0.0926)	(0.0932)	(0.0922)	(0.0936)	(0.0921)
Total number of rounds	0.0241	0.0227	0.0260	0.0241	0.0233+	0.0201	0.0207	0.0180
	(0.0162)	(0.0162)	(0.0162)	(0.0162)	(0.0140)	(0.0141)	(0.0141)	(0.0140)
Age at IPO	−0.3194**	−0.3143**	−0.3360**	−0.3276**	−0.4037**	−0.4099**	−0.3935**	−0.4017**
	(0.0947)	(0.0945)	(0.0948)	(0.0944)	(0.0852)	(0.0841)	(0.0854)	(0.0838)
Investment period of VCs	−0.2754**	−0.2756**	−0.2824**	−0.2801**	−0.2101*	−0.1932*	−0.2006*	−0.1857*
	(0.1037)	(0.1032)	(0.1037)	(0.1032)	(0.0909)	(0.0905)	(0.0911)	(0.0902)
Underwriter's prestige	0.2116**	0.2033**	0.2147**	0.2044**	0.2329**	0.2291**	0.2331**	0.2287**
	(0.0348)	(0.0352)	(0.0348)	(0.0354)	(0.0325)	(0.0323)	(0.0325)	(0.0321)
Reputation (A)	0.4943	0.6112	0.1856	0.3211	−0.6310+	−0.5214	−0.8796*	−0.6735
	(0.4430)	(0.4579)	(0.5294)	(0.5148)	(0.3612)	(0.3795)	(0.4293)	(0.4467)
Geographic distance (G)	−0.0048	0.0056	−0.0049	0.0065	−0.0047	0.0011	−0.0027	0.0027
	(0.0169)	(0.0180)	(0.0169)	(0.0184)	(0.0197)	(0.0198)	(0.0198)	(0.0198)
Industry specialization (I)	0.0864	0.1798	−0.0490	0.0544	−0.3899*	−0.3541*	−0.6522*	−0.5337*
	(0.2743)	(0.2848)	(0.3032)	(0.3015)	(0.1694)	(0.1723)	(0.2632)	(0.2641)
(A) × (G)		−0.3093+		−0.3263+		−0.2462		−0.2515
		(0.1817)		(0.1923)		(0.1675)		(0.1680)
(A) × (I)			−1.2594	−1.6838			−2.7314	−1.9549
			(2.7805)	(2.6940)			(1.8511)	(1.8020)
No. of endogenous variables	1	2	2	3	1	2	2	3
No. of instruments	4	8	8	12	3	6	6	9
First-stage *F*-statistics	17.62	6.50	4.88	3.63	39.85	12.77	9.63	5.98
Stock–Yogo critical value (10%)	5.72	4.03	4.03	–	7.18	4.90	4.90	–
Hansen's J-statistic (*p*-value)	5.661	6.763	11.420	12.759	0.637	1.479	1.964	3.720
	(0.13)	(0.34)	(0.08)	(0.17)	(0.73)	(0.83)	(0.74)	(0.71)
Test of difference-in-Sargan statistic	passed	passed	passed	passed	passed	passed	passed	passed
Moreira's CLR (*p*-value)	[−0.48, 1.50]	–	–	–	[−1.47, −0.08]	–	–	–
	(0.31)				(0.08)			
Observations	451	451	451	451	522	522	522	522

[a] Fuller's LIML estimation ($\alpha = 4$) is employed for robust inference with weak instruments.
[b] Two-tailed coefficient tests. Unstandardized coefficients are presented with standard errors in parentheses.
[c] + significant at 10%; * significant at 5%; ** significant at 1%.

Table 8. Results of 2SLS regression for the effect of VC reputation on operating performance[a,b,c]

	First round				Last round			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	−0.1298**	−0.1460**	−0.1460**	−0.1605**	−0.1008**	−0.1047**	−0.1012**	−0.1084**
	(0.0225)	(0.0263)	(0.0251)	(0.0280)	(0.0152)	(0.0162)	(0.0157)	(0.0175)
Number of employees	0.0000	−0.0008	−0.0013	−0.0021	0.0022	0.0020	0.0022	0.0017
	(0.0019)	(0.0022)	(0.0022)	(0.0024)	(0.0016)	(0.0016)	(0.0016)	(0.0017)
Sales growth rate	0.0058+	0.0060+	0.0046	0.0046	0.0058*	0.0057+	0.0058*	0.0054+
	(0.0031)	(0.0035)	(0.0035)	(0.0038)	(0.0029)	(0.0030)	(0.0029)	(0.0031)
Total number of rounds	−0.0011+	−0.0012+	−0.0013+	−0.0014*	−0.0006	−0.0006	−0.0006	−0.0006
	(0.0006)	(0.0007)	(0.0007)	(0.0007)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Age at IPO	0.0141**	0.0156**	0.0163**	0.0178**	0.0125**	0.0130**	0.0126**	0.0131**
	(0.0037)	(0.0042)	(0.0041)	(0.0045)	(0.0029)	(0.0030)	(0.0029)	(0.0030)
Investment period of VCs	0.0006	0.0004	0.0004	0.0005	−0.0020	−0.0018	−0.0020	−0.0019
	(0.0037)	(0.0042)	(0.0040)	(0.0044)	(0.0029)	(0.0030)	(0.0030)	(0.0031)
Underwriter's prestige	0.0019	0.0016	0.0018	0.0015	0.0023*	0.0022*	0.0023*	0.0020+
	(0.0012)	(0.0013)	(0.0013)	(0.0014)	(0.0010)	(0.0010)	(0.0010)	(0.0011)
Reputation (A)	0.0403*	0.0562**	0.0698**	0.0866**	0.0164	0.0236	0.0174	0.0331
	(0.0161)	(0.0194)	(0.0220)	(0.0244)	(0.0122)	(0.0146)	(0.0165)	(0.0217)
Geographic distance (G)	0.0003	0.0009	0.0000	0.0003	−0.0001	0.0001	−0.0001	0.0001
	(0.0006)	(0.0007)	(0.0006)	(0.0008)	(0.0006)	(0.0007)	(0.0006)	(0.0007)
Industry specialization (I)	0.0309**	0.0416**	0.0432**	0.0524**	0.0159**	0.0183**	0.0163	0.0246*
	(0.0102)	(0.0124)	(0.0124)	(0.0138)	(0.0055)	(0.0063)	(0.0099)	(0.0125)
(A) × (G)		−0.0167*		−0.0083		−0.0038		−0.0061
		(0.0072)		(0.0079)		(0.0065)		(0.0074)
(A) × (I)			0.2282*	0.2623*			0.0013	0.0461
			(0.1123)	(0.1200)			(0.0681)	(0.0801)
No. of endogenous variables	1	2	2	3	1	2	2	3
No. of instruments	4	8	8	12	3	6	6	9
First-stage *F*-statistics	12.24	4.62	2.67	2.18	27.35	6.93	5.56	2.86
Stock–Yogo critical value (10%)	5.72	4.03	4.03	–	7.18	4.90	4.90	–
Hansen's J-statistic (*p*-value)	2.188	6.662	4.52	9.622	1.99	8.042	7.855	12.264
	(0.53)	(0.36)	(0.61)	(0.38)	(0.37)	(0.09)	(0.10)	(0.06)
Test of difference-in-Sargan statistic	passed	passed	passed	passed	passed	passed	passed	passed
Moreira's CLR (*p*-value)	[0.01, 0.09]	–	–	–	[−0.01, 0.05]	–	–	–
	(0.01)				(0.18)			
Observations	354	354	354	354	421	421	421	421

[a] Fuller's LIML estimation ($\alpha = 4$) is employed for robust inference with weak instruments.
[b] Two-tailed coefficient tests. Unstandardized coefficients are presented with standard errors in parentheses.
[c] + significant at 10%; * significant at 5%; ** significant at 1%.

Discussion

In this study, we considered the nature and strength of high-reputation VCs' value under different conditions. We explored this issue by examining the role that VC firms play as both a signaling mechanism and as a source of substantive influence on the value creation activities of entrepreneurial firms. We accomplished this by empirically examining the relationship among VC reputations, their portfolio firms' valuations on the day of their initial public offerings and their one-year post-IPO operating performance. Our study begins to parse out the contingent effects of timing, geographic proximity and industry specialization on the relationship between VC reputation, investor perceptions and performance, and suggest that these relationships are more complex than anticipated. These findings have both theoretical and practical implications and suggest a number of future research directions.

Theoretical contributions

First, our results highlight the extent to which timing matters. Surprisingly little research has explored the issue of the timing of VC involvement in general (for exceptions, see Fitza et al., 2009; Kortum and Lerner, 2000; Sapienza, 1992), and no research we are aware of has considered the timing of investment with respect to VC reputation. Our results show that while a high-reputation VC's early involvement can contribute significantly to a firm's post-IPO operating performance, late-round involvement does not appear to yield a similar benefit. Further, investors appear to view later involvement by high-reputation VCs negatively and to discount the value of IPO firms in which they invest. Little research we are aware of has attempted to explore how the timing of affiliations with reputable third parties affects their ability to provide different kinds of value.

Our findings are a bit more mixed when assessing investors' sophistication in assessing the value of high-reputation VCs' contributions to an IPO firm's success. The results of our analysis correcting for selection biases inherent in studying only public companies suggest investors appear to recognize that early involvement by high-reputation VCs increases the likelihood that a young start-up will receive the knowledge, social capital and financial resources it needs to grow and become a successful public company. At the same time, they place little value on high-reputation VCs who make low-risk, late-round investments in companies to capture a quick gain while contributing little to the firm's development. However, our post hoc analysis using 2SLS analysis to correct for the endogeneity associated with the likelihood that high-reputation VCs select portfolio firms from a stronger pool of prospects adds an interesting twist to the story. Once this potential source of endogeneity is controlled for, our results suggest that investors do not recognize the substantive value high-reputation VCs provide. One interpretation of this finding is that they instead perhaps view them primarily as a 'filter' that signals the unobservable potential of the young firm. In other words, they assume that the endogeneity we controlled for in the 2SLS analysis is all that is going on. While our results and this interpretation must be treated as speculative, it suggests that future research should continue endeavoring to untangle the different types of value different stakeholders assume high-reputation affiliates provide, and how they affect the value and performance of the firm both in this and other contexts.

Our results also suggest that investors' expectations can lead them to misperceive the benefits and costs of other important relationship contingencies. Our results with respect to the moderating effects of geographic proximity highlight the complexity of this issue. One interpretation of our findings across the different analyses is that if high-reputation VCs have greater access to more promising start-ups, the distance between the VC and the start-up does not matter as much;

however, once this source of endogeneity is controlled for, geographic proximity does affect a high-reputation VC's ability to provide value. Further, if investors primarily view high-reputation VCs as filters that signal which start-ups are the most promising, then their concerns about geographic proximity may have less to do with the VC's ability to provide value than it does with their ability to identify and gain access to the most promising start-ups outside their local areas. This interpretation is highly speculative, and should be taken with caution. Future research should continue to explore this issue, as well as how VCs are able to effectively support portfolio firms at a distance, and how taken-for-granted assumptions can create persistent inefficiencies in markets (Zajac and Westphal, 2004). This issue is also significant because VCs are not only making investments further from home within the US, they are also expanding internationally (Gompers and Lerner, 2004; Guler and Guillen, 2010). Future research should thus continue to explore the extent to which the value of a VC's experience and resources can be extended across national borders.

Finally, our results suggest that investors fail to adequately value a VC's specialization in the IPO firm's industry. Industry specialization had a positive and significant moderating effect on first-round VC reputation, suggesting that high-reputation VCs are even more valuable during the early stages of a firm's development when they also have in-depth knowledge about the firm's particular industry environment. Our results also indicate that involvement by VCs who specialize in a firm's industry, regardless of their reputation or the timing of their involvement, is likely to improve the portfolio firm's post-IPO operating performance. This suggests that even if a VC does not have a prominent record of success, it can nonetheless be a valuable addition to the young firm's network if it has extensive experience in the industry. Future research should continue to tease out the relationships among the different resources that VCs can bring to bear in developing start-ups.

Practical implications

Our findings offer several practical implications for both entrepreneurs and investors. In a recent study, Hsu (2004) found that start-up firms accepted first-round valuations offered by high-reputation VCs that were 10–14 percent lower than the valuations accepted from VC firms that did not possess high reputations. Our results suggest that it may be worthwhile for entrepreneurs to pay such a premium for early involvement by high-reputation VCs, as there are substantive benefits down the road. However, our results also suggest that the value of these high-reputation VCs declines in later rounds; thus firms should resist paying similar premiums to high-reputation VCs that do not invest until the later rounds of financing. This finding is particularly relevant given that Chen et al. (2008) found firms with a 'prestige deficit' are more likely to pursue and pay for prestigious executives and directors the closer they get to their IPO filing date. Although Chen and his colleagues were studying the recruitment of executives and directors, it stands to reason that the 'dressing up' process they observed could apply to other types of prominent affiliates as well. Future research should continue to explore the extent to which the value of prominent and high-reputation affiliates varies over time.

Another important implication of our findings for entrepreneurs is that the degree to which VCs specialize in the firm's industry can have beneficial consequences for the firm's performance, even if investors do not recognize it at the time of the IPO. Thus, while attracting funding from high-reputation VCs is important for putting the firm on a positive trajectory, entrepreneurs should also carefully consider whether or not their VCs, regardless of their reputation, specialize in their industry.

Finally, for investors, our results confirm the wisdom of paying a premium for firms in which high-reputation VCs invest only when they become involved early on. Our results also suggest that they should pay more attention to VCs' industry specialization than they currently do.

Additional future research directions

Like any study, this one required trade-offs that create future research opportunities. One set of opportunities arises from the fact that we have to infer investors' interpretations and motivations from their observed behaviors. Although this practice is common in strategy and organization studies that employ archival data, it nonetheless leaves open the possibility that both VC reputation and the market outcomes we observe are due to some omitted variable. Future research could use finer-grained methods, such as qualitative research or policy capturing studies (Zacharakis and Meyer, 1998; Zacharakis and Shepherd, 2005) to tease out these issues, or study the effects of high-reputation affiliations in other contexts where different kinds of data are more available.

A second opportunity arises from our use of an accounting measure of performance to infer whether VCs made substantive contributions that positively affected their portfolio firms' operations. Although we have adjusted this measure to guard against attempts at manipulation, accounting measures can still nonetheless be managed (Teoh et al., 1998). Profits are only one possible performance metric that can be considered; indeed, in some industries, such as biotechnology, firms may not even have products until years after their IPOs, let alone profits. Further, because we focused on backward-looking indicators of the firms' actual operating performance in order to compare them to investors' initial performance expectations, we did not consider the relationship between our variables of interest and post-IPO market performance. To explore these issues a bit further, in analyses not reported here we re-ran our models using one-year sales growth following the IPO and post-IPO market performance calculated as the one-year buy and hold abnormal return from one month to 13 months following the IPO as our dependent variables. The results showed that VC reputation was largely unrelated to sales growth, but was positively related to post-IPO market performance for first-round VC investments. Future research should continue to explore these issues and identify the dimensions along which high-reputation affiliates are and are not likely to add substantive value. Future research could also begin to consider how high-reputation affiliates affect other dimensions of a firm's development, such as its organizational structure, top management team composition and social networks.

A third opportunity comes from the fact that our two dependent variables are unlikely to be independent of one another. To explore this issue further, in models not reported here we added initial market valuation as a control in our models predicting operating performance. Although this increased the collinearity in our models to unacceptable levels, the results were extremely similar to those presented in Tables 3 and 4. Nonetheless, future research should continue to explore this issue. A better understanding of the dynamics of reputation and its benefits is an increasingly important research area. We have only begun to uncover the complexities of those relationships.

A final opportunity arises from our post hoc analysis of the relative effects of status and reputation. Although they displayed distinct patterns of relationships with initial market valuation and post-IPO operating performance, they are nonetheless highly correlated with each other. This may be in part due to the fact that both measures contain components that reflect a VC firm's relative level of activity in the market. We also found it puzzling that status had a significant positive relationship with post-IPO operating performance in the last-round models. Since some of the highest-status VCs also intend to invest in later rounds, it is possible that this relationship is due to the endogeneity associated with access to a stronger pool of start-ups. To explore this issue further,

in analyses not reported here we re-estimated our last-round 2SLS models predicting operating income substituting status for reputation. The relationship between status and operating income largely disappeared. Future research should continue to explore the relationship between reputation and status, and how these two intangible assets co-evolve.

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Notes

1. In order to use consistent terminology throughout the article, we use the terms 'substantive benefits' and 'substantive value' to refer to those benefits and resources that enhance the operating performance of the firm. We acknowledge that these benefits can be direct or indirect (i.e. in that they encourage others to provide the firm with resources or opportunities that enhance their operating performance). We contrast these sources of value with their value in reducing investors' short-term perceptions of uncertainty, such as taking a firm public.
2. Because our focus in this study is on confirming investors' initial expectations rather than exploring their ongoing future performance expectations, we do not theorize about the relationship between VC reputation and post-IPO market performance. However, we do discuss this issue and the results of some post hoc analyses exploring this relationship in the discussion section.
3. Gorman and Sahlman (1989) report that a lead VC shows up 1.5 times a month and spends 80 hours conducting on-site activities per year, on average.
4. The missing data were associated with companies that had smaller initial market valuations and received fewer rounds of VC financing. *t*-Tests using data available for all firms showed some systematic differences between those IPO firms included in and excluded from our sample. However, correcting for this source of sample bias did not affect our substantive results, so we do not include the correction in our subsequent analyses. Of more concern as a potential source of bias is the fact that VCs also invest in a significant number of companies that never go public. As we discuss later, we address the potential sample bias issue associated with studying only IPO firms using the Heckman procedure.
5. In analyses not reported here, we re-ran our models predicting another frequently used measure of initial market valuation – underpricing. With some small variations, the results are essentially the same as those presented here. We have elected to focus on the total market value of the stock and the end of the first day of trading because it captures the value ascribed to the firm by its initial investors as well as those who participated in the secondary trading of the stock.
6. To test the measure's robustness, in analyses not reported here we also created reputation indices using principal component scores and confirmatory factor scores. The alternate measures yielded the same substantive pattern of results.
7. Following Sharma (1996), we used the principal axis factoring (PAF) technique as an EFA, which adopts an iterative procedure to estimate the communalities and the factor solution.
8. SRMR < 0.08; RMSEA < 0.06; and CFI and TLI > 0.95. Bollen (1989) pointed out that EFA does not allow correlated errors of measurement. In our CFA model, we allowed the errors of 'total dollar amount

of funds raised in the past five years' and 'the total funds invested in portfolio firms in the past five years' to co-vary in order to improve the model fit. Given the nature of these two items, it is more reasonable to allow the co-variation of errors.

9. A third method would be to create a weighted average based on the amount of money each VC invested in the round. Unfortunately, VentureXpert only reports this kind of break out for total investments by VCs across all rounds. It does not break out this information on a round by round basis.
10. The untransformed scores were used to create the descriptive statistics reported in Table 2.
11. Using the untransformed last-round average reputations generates the same results.
12. To calculate this measure, we collected data on the IPOs in which VCs held investment stakes from 1980 to 2000. The earliest VC investment in our data is Bevis Industries, Inc., which dates back to 1960. The company was taken public in 1986. This suggests there should be less concern with left-censoring in calculating VC experience using our approach, given that we are primarily interested in IPOs during the 1990–2000 time period.
13. We chose to use this measure rather than total assets as an indicator of firm size, since total assets are a component of our dependent variable in some analyses.
14. The VEIC sub-group 1 category consists of the following 18 industries: (1) agriculture, forestry, fishing, etc., (2) biotechnology, (3) business services, (4) communications, (5) computer hardware, (6) computer other, (7) computer software, (8) construction and building products, (9) consumer related, (10) finance, insurance, real estate, (11) industrial/energy, (12) internet specific, (13) manufacturing, (14) medical/health, (15) other products, (16) semiconductor/electronics, (17) transportation and (18) utilities. Our sample does not include categories 1, 6, 8 and 15. Industry categories 3, 11, 15 and 17 were excluded in some analyses, depending on the model specification.
15. It is important to recognize that Podolny's status measure is a network centrality measure based on a VC's centrality and the centrality of its partners in horizontal co-investment networks. Thus, it is unlike prior status measures calculated using Bonacich centrality, such as underwriter status, which is calculated based on asymmetric relations from tombstone ads that reflect an actor's hierarchical ranking (e.g. Podolny, 1993), because VC status is based on symmetric relations from syndicate investments (e.g. Podolny, 2001). Bonacich (1987) noted that when symmetric relations are used, this measure should be treated as a measure of an actor's centrality, rather than its status. Thus, while this measure may reflect a VC's relative power in gaining access to deals, it does not necessarily reflect VC firms' hierarchical status positions, although prior research has used it for this purpose. In order to be consistent with the network literature (e.g. Wasserman and Faust, 1994), we calculated binary adjacency matrices, rather than weighting each relationship by the frequency of interaction, as Podolny (2001) did, since this creates unnecessary noise in the measure.
16. The only difference is that the moderating effect of geographic distance is no longer significant in the first stage predicting initial market valuation.
17. The first two instruments were selected based on the assumptions that high growth and less concentrated industries are more desirable, and that high-reputation VCs have a greater ability to select start-ups located in attractive industries. Moreover, these instruments were unlikely to be correlated with the error terms, particularly in our models with operating performance where the DV is industry-adjusted. The last two instruments capture the intensity of VC investment-related activities that were likely to be correlated with VC reputation, but uncorrelated with the error terms. Mere membership in multiple trade associations does not facilitate access to a specific company. Given that information about potential investment opportunities tends to circulate within more local geographic spaces, information from outside this region is less helpful in identifying good investment opportunities (Sorenson and Stuart, 2001).
18. In the interest of brevity, we do not report the results of all these analyses here.

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