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The causes and consequences of venture capital stage financing☆

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ABSTRACT

This paper examines the causes and consequences of venture capital (VC) stage financing. Using information about the physical location of an entrepreneurial firm and the geographic distance between the VC investor and the firm, I show that VC investors located farther away from an entrepreneurial firm tend to finance the firm using a larger number of financing rounds, shorter durations between successive rounds, and investing a smaller amount in each round. However, VC investors' propensity to stage is independent of whether the firm is located in a close-knit community. I also find that VC staging positively affects the entrepreneurial firm's propensity to go public, operating performance in the initial public offering (IPO) year, and post-IPO survival rate, but only if the firm is located far away from the VC investor. However, the effect of VC staging on entrepreneurial firm's performance is independent of whether it is located in a close-knit community. The findings are robust to a variety of alternative proximity measures, instrumental variables, and econometric approaches for dealing with endogeneity problems.

1. Introduction

The staging of capital infusions by venture capital (hereafter VC) investors is the stepwise disbursement of capital from VC investors to entrepreneurial firms. Although various theoretical models have been developed to explain the causes and consequences of VC stage financing, empirical studies of VC staging are relatively sparse. The objective of this paper is to disentangle the alternative hypotheses developed by the existing theoretical literature regarding the causes and consequences of VC stage financing. I empirically investigate the conditions under which VC investors tend to engage in stage financing of their portfolio firms and examine the situations in which VC staging helps to improve the entrepreneurial firm's subsequent performance.

The prevailing view from the existing literature is that VC staging is a way to mitigate agency problems. This is because the VC investor retains the option to abandon the entrepreneur's project if it fails to meet stage targets, leading to more efficient investment decisions and better investment outcomes (e.g., Admati and Pfleiderer, 1994; Gompers, 1995; Kaplan and Stromberg, 2003, 2004).[1]

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[1] As Sahlman (1990, p. 506) has noted, "The most important mechanism for controlling the venture (by the venture capitalist) is staging the infusion of capital."

The seminal empirical analysis of Gompers (1995) finds that VC staging occurs more frequently in industries that have a higher level of asset intangibility, a higher market-to-book ratio, and a greater intensity of research and development (R&D) activities, and that are therefore characterized by more severe agency problems. However, since Gompers' (1995) analysis focuses only on the determinants of VC staging and is limited to industry-level variables, there is a need to better understand the causes and consequences of VC stage financing at the entrepreneurial firm level.

I build on agency models of VC staging and argue that monitoring by VC investors and the staging of capital infusions are substitutes, hereafter referred to as the "monitoring hypothesis." While it is costly for the VC investor to monitor the entrepreneur, staging is also costly. First, staging incurs negotiation and contracting costs. Before each round of capital infusion, VC investors need to commit significant time and resources to negotiating and writing new contracts. Second, staging could induce the entrepreneur to aim for short-term success rather than long-term value creation, that is, "window dressing," to secure the VC investor's next round of capital infusion.[2] Third, lags in the implementation of projects due to divided capital infusions can increase costs for the entrepreneurial firm. Finally, staging could incur underinvestment problems, as suggested by Wang and Zhou (2004). Therefore, the VC investor will balance the costs of monitoring the entrepreneur and the costs of staging specified above, and will engage in stage financing of the entrepreneurial firm only if effective monitoring of the entrepreneur is too costly.

Alternative theoretical models suggest that VC stage financing can help to mitigate the hold-up problem by the entrepreneur [see, e.g., Neher (1999), who builds on the idea of the inalienability of human capital discussed by Hart and Moore (1994)], hereafter referred to as the "hold-up hypothesis." This stream of literature argues that once the VC investor invests in the entrepreneurial firm, the entrepreneur has the ability to hold-up the VC investor by threatening to leave the firm for a better career. Staging mitigates such a hold-up problem because it reduces the amount of the VC investor's investment in the entrepreneurial firm at any given time and therefore allows the gradual embodiment of the entrepreneur's human capital in the venture's physical capital, i.e., the build-up of collateral, which reduces the entrepreneur's incentives to leave the firm.

A third stream of theoretical literature argues that staging allows the VC investor to learn about the entrepreneurial firm over time (see, e.g., Bergemann and Hege, 1998; Fluck, Garrison, and Myers, 2007), hereafter referred to as the "learning hypothesis." The learning hypothesis suggests that staging creates value by generating a real option for the VC investor to abandon financing the project at each financing round, depending on what the VC investor learns between rounds about the venture or the entrepreneur.

To empirically disentangle the implications of the above three streams of theoretical models regarding the causes and consequences of VC staging, I make use of geographic location information about the entrepreneurial firm and the distance between the VC investor and the firm. Specifically, I calculate the geographic distance between the VC investor and the entrepreneur and use it as a proxy for the VC investor's monitoring costs.[3] Based on the monitoring hypothesis, if the entrepreneurial firm is located close to the VC investor such that it is less costly to monitor the entrepreneur, the VC investor will tend to reduce the number of financing rounds to save the costs of staging. On the other hand, if the entrepreneurial firm is located far away from the VC investor such that effective monitoring of the entrepreneur is very costly, the VC investor will have to rely instead on staging to mitigate agency problems. The same logic applies to the impact of VC stage financing on the entrepreneurial firm's subsequent performance. If it is less costly for the VC investor to monitor the entrepreneur, that is, the geographic distance between them is short, less staging should be associated with better firm performance. However, if effective monitoring of the entrepreneur is too costly due to a greater distance between them, financing in a larger number of rounds helps to mitigate agency problems and improves firm performance.

Based on the hold-up hypothesis, the VC investor is more likely to stage investment in the entrepreneurial firm if the firm is located in a close-knit community where many entrepreneurial firms are clustered together. This is because when many peer entrepreneurial firms are located close by, the entrepreneur's threat to leave the firm for a better career is more credible and his ability to hold-up the VC investor is greater. Therefore, VC staging will be able to mitigate this hold-up problem and improve the entrepreneurial firm's performance to a greater extent when the hold-up problem is more severe, that is, when the entrepreneurial firm is located in a close-knit community.

Finally, the learning hypothesis predicts that there will be no relationship between geographic distance and the VC investor's propensity to stage. This implication is based on the assumption that there is no relationship between the VC investor's ability to learn about the firm and the distance between them. The learning hypothesis

[2] Sahlman (1988) describes how the entrepreneur may try to improve short-term performance to ensure that the project will be refinanced.

[3] One may think that modes of transportation and communications have developed rapidly in the last few decades, decreasing the costs of collecting and transmitting information. However, this has not made it easier for VC investors to collect soft information about the entrepreneurial firm from a distance. Soft information is, by definition, difficult to put down on paper, store electronically, or communicate to others (see, e.g., Petersen and Rajan, 2002), but it is especially critical to a venture's success because significant risks are associated with information asymmetries between the entrepreneur and the VC investor in venture projects. Collecting soft, as well as hard, information through on-site monitoring and face-to-face meetings with the entrepreneur is an effective way for the VC investor to reduce the information gap, monitor the entrepreneur, and improve a project's viability. Therefore, the geographic distance between the VC investor and the entrepreneur directly determines the VC investor's monitoring costs.

does not have any clear prediction regarding the relationship between the number of financing rounds and the entrepreneurial firm's subsequent performance, because the number of financing rounds under this hypothesis depends only on the VC investor's uncertainty regarding the entrepreneurial firm's hard information and not on its soft information (e.g., intrinsic quality).

One concern in this study, however, is that the geographic distance between the entrepreneur and the VC investor may not be exogenous. The entrepreneur endogenously chooses the optimal distance from the VC investor at startup, or even later, based on characteristics of the entrepreneurial firm and VC investment requirements that may not be observable to the econometrician. For example, the famous "20-minute rule" adhered to by many VC investors claims that a startup firm should not be funded if it is not within a 20-minute drive of the VC firm's offices.[4] Many VC investors force entrepreneurs seeking VC funding to move closer to them even before the first round financing.[5] Meanwhile, VC investors may also make their staging decision to finance the entrepreneurial firm based on the same unobservable firm characteristics that affect the entrepreneurial firm's optimal choice of distance from VC investors. This can introduce endogeneity into the analysis. To control for this potential endogeneity problem, I construct an instrumental variable for distance and conduct two-stage least square (2SLS) regressions. Since the exclusion restriction of the instrument is not directly testable, I construct alternative instruments and use alternative econometric approaches for dealing with this endogeneity problem to ensure that my findings are robust.

My findings on the causes of VC stage financing are as follows. First, I find that a VC investor who is located farther away from an entrepreneurial firm tends to finance the firm with a larger number of financing rounds, with a shorter duration between successive rounds, and invest a smaller amount in each round. This provides evidence that supports the monitoring hypothesis but contradicts the learning hypothesis. Second, the propensity for a VC investor to engage in staging does not increase when the entrepreneurial firm is located in a close-knit community that has a number of other entrepreneurial firms. This last finding is inconsistent with the hold-up hypothesis.

My findings on the consequences of VC stage financing are as follows. First, for an entrepreneurial firm located farther away from a VC investor, the number of VC financing rounds is positively related to the entrepreneurial firm's propensity to go public (rather than to be acquired or written off), operating performance in the initial public offering (IPO) year, and post-IPO survival rate. On the other hand, for a firm located closer to a VC investor, the number of VC financing rounds is negatively related to the firm's propensity to go public, operating performance in the IPO year, and post-IPO survival rate. Second, the effect of VC stage financing on an entrepreneurial firm's performance is not related to whether or not the firm is located in a close-knit community. The first finding above provide evidence that supports the monitoring hypothesis but contradicts the learning hypothesis, while the last finding contradicts the hold-up hypothesis.[6]

This paper contributes to two streams in the existing literature. One is the literature on the VC firm's investment structure in entrepreneurial firms. This literature has remained largely theoretical, for example, Admati and Pfleiderer (1994), Bergemann and Hege (1998), Neher (1999), Wang and Zhou (2004), and Fluck, Garrison, and Myers (2007). I discuss the relevant theoretical models on VC staging in detail when I develop testable hypotheses in Section 2. On the empirical research side, Gompers (1995), followed by other researchers, investigates how the existence of agency and information problems affects the structure of staged VC investments. Gompers uses industry average ratios as proxies for agency costs and shows evidence about the determinants of VC staging that is consistent with agency theory. The current paper pushes this line of inquiry forward by empirically disentangling the alternative hypotheses developed by the existing theoretical literature and examining the causes and consequences of VC stage financing at the entrepreneurial firm level.

The other stream of literature this paper contributes to is on the role of geography in corporate finance. Lerner (1995) shows that proximity is an important determinant of the VC firm's board membership in the private firms. Coval and Moskowitz (1999, 2001) find that money managers perform better when investing in the stocks of nearby companies. Sorenson and Stuart (2001) examine how inter-firm networks in the VC market affect the spatial distribution of VC investments. Petersen and Rajan (2002) and Berger, Miller, Petersen, Rajan, and Stein (2005) study how distance between borrowers and lenders affects banks' lending business. Malloy (2005) explores how proximity affects the accuracy and investment value of equity analysts' forecasts and recommendations. Kang and Kim (2008) and Kedia, Panchapagesan, and Uysal (2008) examine the role of geographic proximity in mergers and acquisitions.

The VC literature on the role of geography is small but fast growing. Bengtsson and Ravid (2008) show that geographic elements and regional culture play essential roles in contract design between VC investors and entrepreneurs. Butler and Goktan (2008) find that VC-backed companies located close to their lead VC investor have substantially lower IPO underpricing. Chen, Gompers,

[4] "It's not the people you know. It's where you are," *The New York Times*, October 22, 2006.

[5] The recent anecdote of Facebook is a good example: Facebook, a social networking Web site, was launched on February 4, 2004 by Mr. Mark Zuckerberg, a Harvard University undergraduate student. In June 2004, Facebook moved its base of operations from Cambridge, MA, to Palo Alto, CA. One year later, it received its first round of VC financing of about $12.7 million from Accel Partners, located just four blocks away from it.

[6] However, my findings cannot rule out the possibility of real options being generated through staging. One possibility is that the value of real options generated through staging depends on the distance between the VC investor and the entrepreneurial firm.

Kovner, and Lerner (2010) document three metropolitan areas—San Francisco, Boston, and New York—where both VC firms and startup companies are clustered together and find that VC firms based in these centers outperform their rivals. Cumming and Dai (2010) find that VCs exhibit strong local bias in their investments.

The rest of the paper is organized as follows: Section 2 develops testable hypotheses. Section 3 discusses sample selection procedures and presents descriptive statistics. Section 4 reports the results on the causes of VC stage financing. Section 5 discusses the results on the consequences of VC staging. Section 6 concludes.

2. Hypothesis development

Section 2.1 first discusses the theoretical literature modeling why VC firms engage in stage financing and lays out related testable hypotheses. Section 2.2 then discusses the implications of these theoretical models regarding the consequences of VC staging and develops testable hypotheses for my empirical analysis.

2.1. The causes of VC stage financing

As discussed earlier, the monitoring hypothesis argues that the staging of capital infusions is a substitute for intensive monitoring by the VC investor. Effective monitoring of entrepreneurs is very costly for VC investors (see, e.g., Sahlman, 1990; Lerner, 1995; Kaplan and Stromberg, 2003, 2004; Bottazzi, Da Rin, and Hellmann, 2008), because VC investors are not only financers, but also active monitors who need to spend considerable time visiting the firm, talking with the entrepreneurs, sitting in board meetings, and working with the firm's top management on day-to-day operations [see Chemmanur, Krishnan, and Nandy (2009) for evidence regarding how VC investors improve the efficiency of entrepreneurial firms].

On the other hand, the mechanism of staging is very costly as well. First, staging incurs negotiation and contracting costs (Kaplan and Stromberg, 2003). VC investors must commit significant time and resources to negotiating and writing new contracts before each new round of capital infusions. This includes (but is not limited to) detailed evaluations of the different aspects of the firm such as its management team, products, technology, and the industry in which it competes. Second, staging can induce the entrepreneur to aim for short-term success rather than long-term value creation, that is, entrepreneurs have incentives to engage in "window dressing" or short-termism to secure the VC investor's next round of capital infusion (Sahlman, 1988; Baker, 2000). Third, lags in the implementation of projects due to divided capital infusions can increase costs for the entrepreneurial firm through forgone economies of scale, longer development cycles, and delays in market entry. Finally, staging can incur underinvestment problems. Wang and Zhou (2004) show that staging can be inferior to upfront financing, since VC investors may underinvest in a project in the early stages when a viable project does not look promising ex ante.

Therefore, the monitoring hypothesis predicts that the VC investor will balance the costs of intensively monitoring entrepreneurs with the costs of staging specified above, and try to reduce the costs of staging by reducing the number of financing rounds if monitoring costs are low. In other words, the VC investor uses staging as a substitute for intensive monitoring of the entrepreneur. Thus, the higher the monitoring costs, the larger the number of financing rounds. This hypothesis also implies that, the higher the monitoring costs, the shorter the time interval between successive rounds and the smaller the amount of investment provided per round. Using the geographic distance between an entrepreneurial firm and the VC investor as a proxy for the VC investor's monitoring costs, the predictions of the monitoring hypothesis regarding the causes of VC stage financing can therefore be summarized as follows.

The monitoring hypothesis: The geographic distance between the VC investor and the entrepreneurial firm will be positively related to the number of financing rounds, and negatively related to the duration between successive investment rounds and the investment amount per round.

The second hypothesis, the hold-up hypothesis, produces different implications. In a world of incomplete contracting, the theory of Hart and Moore (1994) on the inalienability of human capital suggests that an entrepreneur cannot contractually commit to staying with a firm in which the entrepreneur's unique human capital is critical to achieving the venture's full potential. Close-knit communities where entrepreneurial firms are clustered (e.g., places like Silicon Valley and Massachusetts Route 128) provide entrepreneurs with good opportunities for pursuing better careers if they leave the firm in which they are initially employed. Neher (1999) suggests that this allows the entrepreneur to hold-up the VC investor and the staging of capital infusions is a good mechanism to mitigate this hold-up problem. This is because the gradual embodiment of the entrepreneur's human capital in the venture's physical capital is equivalent to the build-up of collateral, which reduces the entrepreneur's incentives to leave the firm. Therefore, the VC investor should use stage financing more often when the entrepreneurial firm is located in a close-knit community. This hypothesis also implies that the more severe the hold-up problem, the shorter the time interval between successive rounds and the smaller the amount of investment provided per round. The predictions of the hold-up hypothesis regarding the causes of VC stage financing can therefore be summarized as follows.

The hold-up hypothesis: The number of VC financing rounds will be larger, the duration between successive financing rounds will be shorter, and the investment amount per round will be smaller, for an entrepreneurial firm that is located in a close-knit community.

The third hypothesis, the learning hypothesis, is based on the model of Bergemann and Hege (1998) that highlights the importance of learning by VC investors in their staging decisions.[7] Bergemann and Hege (1998) argue

[7] I thank an anonymous referee for suggesting the learning hypothesis.

that, while both the entrepreneur and the VC investor have the same initial information about the entrepreneurial firm's prospects, the VC investor can learn more about the entrepreneur and the firm over time and choose to either further fund or abandon the firm at each financing round, depending on what is learned between rounds. In other words, staging increases the real option value of the project (see also Fluck, Garrison, and Myers, 2007, for similar arguments). While the model predicts that the optimal financing of venture projects in this dynamic learning setting is a combination of equity and debt instead of pure equity investments, it would imply no relationship in general between the geographic distance between the VC investor and the entrepreneurial firm and the VC investor's propensity to stage. This is because the above implication assumes that the VC investors' ability to learn about the entrepreneur and the firm is independent of the distance between the VC investor and the entrepreneurial firm.[8] The predictions of the learning hypothesis regarding the causes of VC stage financing can therefore be summarized as follows.

The learning hypothesis: The geographic distance between the VC investor and the entrepreneurial firm will be independent of the number of financing rounds, the duration between successive investment rounds, and the investment amount per round.

2.2. The consequences of VC stage financing

The monitoring hypothesis argues that the staging of capital infusions is a substitute for monitoring by the VC investor. If an entrepreneurial firm is located closer to its VC investor and the VC investor can monitor the entrepreneurial firm at a lower cost, fewer rounds of capital infusions will positively impact the entrepreneurial firm's subsequent performance. This is because fewer financing rounds reduce the entrepreneur's incentives to engage in "window dressing" activities and also allow the firm to achieve economies of scale and early market entry. All the above-mentioned advantages of fewer divided capital infusions are able to help improve the efficiency of VC investments and the entrepreneurial firm's performance. On the other hand, if an entrepreneurial firm is located farther away from the VC investor, effective monitoring of the firm by VC investors will be more costly. Then VC investors would need to increase the number of financing rounds to keep the entrepreneur on a tight leash. Therefore, in this case, a larger number of rounds of VC financing will help to discipline the entrepreneur and improve the firm's performance. The predictions of the monitoring hypothesis regarding the consequences of VC stage financing can therefore be summarized as follows.

The monitoring hypothesis: The number of VC financing rounds will be negatively related to the entrepreneurial firm's subsequent performance if the geographic distance between the VC investor and the firm is short; on the other hand, the number of VC financing rounds will be positively related to the firm's subsequent performance if the geographic distance between the VC investor and the firm is long.

As discussed earlier, the hold-up hypothesis suggests that VC staged capital infusions help to mitigate the incentives of the entrepreneur to hold-up the VC investor. If the entrepreneurial firm is located in a community where many startup firms are clustered together (i.e., the hold-up problem is more severe), a larger number of VC financing rounds will help to reduce the entrepreneur's incentives and ability to hold-up the VC investor, which should improve the firm's performance. Therefore, a larger number of rounds of VC financing will be positively related to the firm's performance when the firm is located in a close-knit community. The predictions of the hold-up hypothesis regarding the consequences of VC stage financing can therefore be summarized as follows.

The hold-up hypothesis: The number of VC financing rounds will be positively related to the entrepreneurial firm's subsequent performance if the firm is located in a close-knit community.

The learning hypothesis argues that VC investors choose to either further fund or abandon financing the firm at each stage, depending on what they learn between two successive rounds. Since the number of VC financing rounds under this hypothesis depends only on the VC investor's uncertainty regarding the entrepreneurial firm's hard information and not on the firm's soft information, it would imply no relationship in general between the number of VC financing rounds and the entrepreneurial firm's subsequent performance.[9] The predictions of the learning hypothesis regarding the consequences of VC stage financing can therefore be summarized as follows.

The learning hypothesis: The number of VC financing rounds will be independent of the entrepreneurial firm's subsequent performance, regardless of the geographic distance between the VC investor and the entrepreneurial firm.

3. Data and sample selection

3.1. Round financing and geographic distance

I obtain data from the Thomson VentureXpert database on round-by-round investments by VC investors for entrepreneurial firms that received their first VC financing between January 1, 1980 and October 31, 2006. I exclude

[8] This seems to be a reasonable assumption, given that the learning here is based on hard information such as the entrepreneurial firm's performance in each round, rather than soft information as in the case of monitoring.

[9] However, the model of Bergemann and Hege (1998) implies that since the VC investor cannot observe whether or not the entrepreneur is diverting funds and underinvesting in the entrepreneurial firm, the VC investor may falsely interpret lack of progress from a project as bad news (i.e., the firm's prospects for success are not good) and terminate the project even if it is a promising one. Therefore, Lerner (1998, p. 737) argues in his published comment on the model of Bergemann and Hege (1998) that the model implies that "if the firm is refinanced, then it is more likely that the firm has poor prospects." The implication of Lerner's (1998) interpretation is that the number of financing rounds will be negatively related to the firm's subsequent performance based on the Bergemann and Hege (1998) model.

non-U.S. firms and those with missing or inconsistent data, leaving 27,461 distinct U.S. entrepreneurial firms. I update and cross-reference the information provided by the VentureXpert database with other databases. Specifically, for the subset of firms that went public, I update and fill in the missing observations for the date the firm was established by using Professor Jay Ritter's database (http://bear.cba.ufl.edu/ritter/ipodata.htm). For the subset of firms that remained private, I use the Factiva, LexisNexis, Dun & Bradstreet, and CorpTech databases. Furthermore, I collect information about VC firms as well as venture round-by-round disbursements from the VentureXpert database. I also correct VentureXpert's overreporting problem by following the procedures discussed in Appendix A.

The VentureXpert database provides detailed information on the date and type of the eventual outcome for each entrepreneurial firm (i.e., IPO, acquisition, or write-off). However, the database does not mark all written-down firms as write-offs. Therefore, based on the fact that the VC industry requires investment liquidation within 10 years from the inception of the fund in the majority of the cases, in addition to the write-offs marked by the VentureXpert database, I classify a firm as a write-off firm if it did not receive any financing within a 10-year span after its very last financing round.[10]

I obtain the address information where the entrepreneurial firm is headquartered and the VC firm has its branch offices from the VentureXpert database. Since VentureXpert just gives a contemporary snapshot of a VC firm's location and some VC firms frequently open up and/or close down a variety of offices, I track the branch office address information of each VC firm at each round year using Pratt's Guide to Venture Capital Sources (Venture Economics (2002 and earlier), Pratt's Guide to Private Equity Sources (Venture Economics (2007 and earlier), and the VC firm's Web site. I also supplement entrepreneurial firm address data with a hand-collected data set from CorpTech that tracks changes in the location of the entrepreneurial firm's headquarters over time. By tracking changes in the locations of the VC and entrepreneurial firms, I ensure that the distance calculated reflects the true proximity.

To calculate the geographic distance between the entrepreneurial firm and the VC investor, I match the latitude and longitude data for each individual zip code of the entrepreneurial firm's headquarters and the closest branch office of the VC firm using the U.S. Census Bureau's Gazetteer city-state files.[11] For each zip code pair between an entrepreneurial firm and the closest branch office of its VC investor, I then compute the geographic distance between them. The detailed algorithm for calculating the distance between two zip codes is discussed in Appendix B. The sample contains 10,125 individual entrepreneurial firms and 22,948 pairs of entrepreneurial firms and their VC investors for which distance information is available.[12] In addition to the continuous variable for distance, I construct four dummy variables to distinguish driving and non-driving distance by using the following four thresholds: 25 miles, 50 miles, 100 miles, and 150 miles. The 25-mile dummy (that equals one if the distance is equal to or greater than 25 miles, and zero otherwise) is meant to capture the idea of the "20-minute rule" adhered to by many VC investors, and the 150-mile dummy is meant to capture a one-day trip distance.

Most often, VC investments are syndicated, and the lead VC investor usually plays a more important role monitoring the entrepreneurial firm and making investment decisions. Therefore, I choose to use the geographic distance between the entrepreneurial firm and the lead VC investor as the main variable of interest in the analysis. Following the previous literature (e.g., Lee and Wahal, 2004; Nahata, 2008), I define the lead VC investor as the one that makes the largest total investment across all rounds of funding in an entrepreneurial firm.

3.2. Sample of IPO firms

I obtain the list of equity IPOs between 1980 and 2005 from the Securities Data Company (SDC) Global New Issues database. I then use the standard exclusions and corrections in the IPO literature (see Appendix C) and merge this IPO list with the VentureXpert database. I find that 14 IPO firms have venture investments as reported by the VentureXpert database but are classified as non-VC backed in the SDC Global New Issues database. I consider these firms to be funded by VC firms. Similarly, 243 are classified as backed by VC firms in the SDC Global New Issues database, but not recorded in VentureXpert. I exclude these IPO firms from consideration if the identities of the investing VC firms are unavailable through the SDC database. This process leaves 2,216 VC-backed IPOs. I then further exclude 104 IPO firms for which I could not identify either the number of financing rounds or the number of investing VC firms, resulting in 2,112 firms for my final IPO sample. Among them, 1,884 IPO firms have information about distance.

In addition to the data sets obtained from VentureXpert and SDC Global New Issues, I obtain complementary data from various databases, including Compustat, I/B/E/S,

[10] An alternative cutoff is used for classifying write-off firms if the entrepreneurial firm did not receive any follow-on financing within a 5-year span after its very last financing round. Results are robust to such modification.

[11] I exclude VC firms' branch offices located outside of the United States from the sample because the latitude and longitude information is not available for non-U.S. zip codes. For example, Sequoia Capital, the VC firm that provided venture financing for both Google and YouTube, has five branch offices as of 2009. Only one of the five is located in the United States, namely, Menlo Park, the others being in China (two), India, and Israel. In this case, I only include Sequoia Capital's Menlo Park office in the sample.

[12] In an unreported analysis, I compare entrepreneurial firm and VC investor characteristics (the entrepreneurial firm's age, development stage, industry, assets, number of VC investors, and number of financing rounds it receives, as well as the investing VC firm's age, total investment amount, and reputation measures) between the two samples, both with and without available distance information, and find that these characteristics are not systematically different across the two samples. It is therefore reasonable to believe that the observations with information missing about distance are randomly dropped out, and concerns about sample selection bias due to missing information about distance could be minimized.

and the Thomson Financial 13f Institutional Holdings database. The constructions and sources of variables used in the following analysis are discussed in Appendix D.

3.3. Summary statistics

Table 1 presents the descriptive statistics of the geographic distribution of entrepreneurial firms and VC firms across the United States. I report the top five states where most entrepreneurial firms/VC firms are concentrated and the largest amount of venture investments are received/made. Panel A of Table 1 shows that about 58% of entrepreneurial firms are located in California, Massachusetts, Texas, New York, and Pennsylvania, and 60% of total VC investment amounts are received by entrepreneurial firms located in California, Massachusetts, Texas, New York, and New Jersey. Panel B of Table 1 reports the geographic distribution of VC firms. California, New York, and Massachusetts are the top three states in which over 50% of VC firms are clustered. Those VC firms located in New York, followed by California and Massachusetts, invested the largest amounts, a combined 68% of the total $746 billion that had been contributed to the VC market between 1980 and 2006.

Table 2 reports the summary statistics for distance, VC staging characteristics, as well as VC investment and entrepreneurial firm characteristics. The main distance measure, *Distance*, is the weighted-average distance between the entrepreneurial firm and the lead VC investors. If the firm has more than one lead VC, the weight is the investment amount provided by a lead VC investor as a fraction of the total VC investment received by the entrepreneurial firm. The mean distance is 412 miles, and the minimum is zero miles, which is the case when both the entrepreneurial firm and its lead VC investor share the same zip code (although the actual distance between them could be greater than zero miles). The distribution of distance is, not surprisingly, right-skewed. Moreover, from an economic perspective, there is a large difference between an entrepreneurial firm being one mile from its VC investor rather than 50 miles away, but probably little difference between it being 2,001 miles versus 2,050 miles away. Both the skewness and the likely nonlinearity of the economic impact of distance suggest that using the natural logarithm of one plus the distance between a firm and its lead VC investors is a more favored measure of distance.

In addition to the distance between the entrepreneurial firm and lead VC investors, I construct two alternative measures of distance for robustness. One alternative measure, *Distance 2*, is the firm's distance to the closest VC firm in the VC syndicate. VC investors can add a syndicate partner with a smaller stake but proximate to a more distantly located entrepreneurial firm to facilitate day-to-day involvement and value-add. Therefore, the presence of a local VC could be sufficient to provide good monitoring and governance. Half of the closest VC firms are located within 73 miles away from the entrepreneurial firm, and the mean distance is only 258 miles. The other alternative measure of distance, *Distance 3*, is the weighted-average distance between the firm and all its VC investors. Relative to *Distance*, *Distance 3* moves away

Table 1
Summary statistics for entrepreneurial firms and VC investors' location and investment distribution across the United States.
This table reports the summary statistics for the sample of entrepreneurial firms that received their first VC financing and the VC firms that made investments between January 1, 1980 and October 31, 2006. Panel A presents the summary statistics for the geographic distribution of entrepreneurial firms across the United States. Panel B presents the summary statistics for the geographic distribution of VC firms across the United States. Data about entrepreneurial firms and VC firms are obtained from the VentureXpert database.

Panel A: Geographic distribution of entrepreneurial firms across the United States.

	Number of entrepreneurial firms			Total investment amount received		
	State	Number	Percentage	State	Amount (bil.)	Percentage
1st	California	8,730	31.29	California	226.41	35.64
2nd	Massachusetts	2,575	9.38	Massachusetts	53.45	8.41
3rd	Texas	1,850	6.74	Texas	44.06	6.94
4th	New York	1,757	6.40	New York	41.74	6.57
5th	Pennsylvania	1,003	3.65	New Jersey	24.32	3.83
Rest of U.S.		11,546	42.05		254.27	40.03
Total		27,461	100		635.25	100

Panel B: Geographic distribution of venture capital firms across the United States.

	Number of venture capital firms			Total investment amount made		
	State	Number	Percentage	State	Amount (bil.)	Percentage
1st	California	971	24.54	New York	269.25	36.09
2nd	New York	706	17.84	California	148.85	19.95
3rd	Massachusetts	333	8.42	Massachusetts	92.02	12.33
4th	Texas	244	6.17	Connecticut	34.94	4.68
5th	Illinois	185	4.68	Texas	34.79	4.66
Rest of U.S.		1,518	38.36		166.17	22.27
Total		3,957	100		746.02	100

Table 2
Summary statistics for entrepreneurial firms and VC investors' characteristics.

This table reports the summary statistics for the distance variables, VC stage financing characteristics, entrepreneurial firm characteristics, and VC investment characteristics for a sample of entrepreneurial firms that received their first VC financing between January 1, 1980 and October 31, 2006. *Distance* is the weighted-average distance between the entrepreneurial firm and the lead VC investors. *Distance 2* is the geographic distance between the entrepreneurial firm and the firm's physically closest VC investor. *Distance 3* is the weighted-average distance between the entrepreneurial firm and all its VC investors. Definitions of all other variables are discussed in Appendix D. Data about entrepreneurial firms and VC firms are obtained from the VentureXpert database.

Variable	25%	Median	Mean	75%	S.D.
Distance variables					
Distance (miles)	15.74	165.91	412.38	685.53	551.40
Distance 2 (miles)	12.90	72.74	257.78	403.27	333.52
Distance 3 (miles)	56.06	575.98	862.58	1432.77	883.18
VC stage financing characteristics					
Number of financing rounds	2	3	3.64	5	2.71
Inter-round duration (months)	6	14	19.70	21	34.01
Funding amount per round (mil.)	0.59	2.50	19.20	8.98	81.14
Total funding across all rounds (mil.)	2.60	13	72.74	37.56	406.19
VC investment and entrepreneurial firm characteristics					
Number of VC investors	1	3	4.87	7	4.65
Firm age at round one	1	2	4.02	8	8.35
Early stage at round one	0	1	0.77	1	0.38
Firm assets (thousand)	17.57	62.35	775.62	414.93	3419.25
Investment amount at round one (mil.)	1	4	14.67	13	67.16
Industry market/book ratio	1.57	2.80	4.68	4.21	8.51
Industry R&D/assets (%)	1.80	2.58	17.67	11.13	81.32
Industry asset tangibility (%)	32.36	51.07	55.57	47.42	0.19

from zero and becomes less right-skewed. I use the above two alternative measures of distance in all multivariate analyses. The results (not reported) are qualitatively similar and do not alter my conclusions.

Table 2 also reports the summary statistics of VC staging and investment characteristics. On average, an entrepreneurial firm receives 3.6 rounds of VC financing, with an inter-round duration of 20 months and a total VC investment amount of $72.7 million. On the date when the entrepreneurial firm receives the first round of VC financing, about half of them are less than 2 years old, they receive $4 million of VC funding, and they are at the early development stage of their life cycles. On average, each entrepreneurial firm receives investments from a syndicate consisting of 4.9 VC investors and they conduct business in industries in which the industry market-to-book ratio is 4.7, the industry R&D/assets ratio is 17.7%, and the industry asset tangibility ratio is 55.6%.

4. Empirical analysis of the causes of stage financing

This section presents empirical results for the causes of VC stage financing. Specifically, I examine how distance and the geographic location of an entrepreneurial firm affect the number of financing rounds, the duration between successive financing rounds, and the investment amount per round.

4.1. Baseline results on the number of financing rounds

Table 3 reports the baseline regression results in which the dependent variable is the number of financing rounds. In addition to the continuous distance variable, Ln(1+Distance), in column 1, Table 3 includes four distance dummy variables as the main independent variables in columns 2 through 5. I control for the number of investing VC firms, entrepreneurial firm characteristics, investment characteristics, and VC firm reputation. I follow Gompers (1995) to include three dummy variables to represent the outcomes of venture financing in the regressions: the IPO dummy, the acquisition dummy, and the write-off dummy. Finally, dummies for the first round investment year, the entrepreneurial firm's industry, the entrepreneurial firm's state, and the lead VC firm are included to absorb any variables that vary only by year, industry, state, or lead VC firm. Heteroskedasticity-robust standard errors are reported in parentheses.

The monitoring hypothesis suggests that the VC investor tends to reduce the number of financing rounds to avoid the costs of staging if the monitoring costs are low (i.e., the entrepreneurial firm is located close to the VC investor), while the learning hypothesis predicts that the VC investor's propensity to stage is independent of its geographic distance to the entrepreneur. Table 3 reports the ordinary least squares (OLS) regression results. The coefficient estimate of Ln(1+Distance) in column 1 of Table 3 is positive and significant at the 1% level, suggesting that a longer distance between the VC investor and the entrepreneurial firm leads to a larger number of financing rounds. In columns 2 through 5 of Table 3, the main independent variable is replaced with distance dummy variables. The coefficient estimates of the distance dummies are positive and significant at the 1% or 5% level. According to the estimate reported in column 2 of Table 3, the entrepreneurial firm located outside of a 25-mile radius from the VC investor receives, on average, 0.2 more rounds of financing compared with its counterpart that is located within a 25-mile radius of the VC investor. The evidence is consistent with the monitoring hypothesis.

With regards to control variables, the number of investing VC firms is positively related to the number of VC

Table 3
Relationship between number of financing rounds and distance between the VC and entrepreneurial firm.

This table reports the baseline regressions for the determinants of the number of financing rounds for a sample of entrepreneurial firms that received their first VC financing between January 1, 1980 and October 31, 2006. The dependent variable is the number of financing rounds. The independent variables are the natural logarithm of one plus the weighted-average distance between the entrepreneurial firm and the lead VC investors, the *25-mile dummy*, the *50-mile dummy*, the *100-mile dummy*, the *150-mile dummy*, the *number of VC investors*, the natural logarithm of *firm assets*, the natural logarithm of *firm's age* when it receives the first round of *VC financing*, *the earlier-stage dummy*, *industry average market-to-book ratio*, *industry average R&D intensity*, *industry average tangibility of assets*, the natural logarithm of the *first round VC investment amount*, *the IPO dummy*, *the acquisition dummy*, *the write-off dummy*, and VC reputation variables. Definitions of variables are discussed in Appendix D. Data about entrepreneurial firms and VC investors are obtained from the VentureXpert database. Heteroskedasticity-robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable: number of financing rounds					
	(1)	(2)	(3)	(4)	(5)
Ln(*1+Distance*)	0.030***				
	(0.011)				
25-mile dummy		0.202***			
		(0.053)			
50-mile dummy			0.164***		
			(0.053)		
100-mile dummy				0.124**	
				(0.053)	
150-mile dummy					0.132**
					(0.053)
Number of investing VCs	0.362***	0.362***	0.362***	0.362***	0.362***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Ln(*Firm age at round one*)	−0.008***	−0.008***	−0.008***	−0.007***	−0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Earlier-stage dummy	−0.245***	−0.242***	−0.245***	−0.243***	−0.243***
	(0.088)	(0.088)	(0.088)	(0.088)	(0.088)
Industry market/book ratio	−0.000	−0.000	−0.000	−0.000	−0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Industry R&D/assets ratio	0.074***	0.075***	0.075***	0.074***	0.074***
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
Industry asset tangibility	−0.031*	−0.031*	−0.031*	−0.031*	−0.031*
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Ln(*Firm assets*)	0.035***	0.035***	0.034***	0.034***	0.035***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Ln(*Investment amount at round one*)	−0.182***	−0.182***	−0.182***	−0.182***	−0.182***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
IPO dummy	−1.251***	−1.249***	−1.253***	−1.249***	−1.250***
	(0.112)	(0.112)	(0.112)	(0.112)	(0.112)
Acquisition dummy	−0.758***	−0.755***	−0.758***	−0.757***	−0.757***
	(0.102)	(0.102)	(0.102)	(0.102)	(0.102)
Write-off dummy	−0.866***	−0.859***	−0.866***	−0.867***	−0.866***
	(0.110)	(0.111)	(0.110)	(0.110)	(0.110)
Constant	3.214***	3.214***	3.264***	3.297***	3.297***
	(0.348)	(0.346)	(0.345)	(0.345)	(0.345)
VC reputation controls	Yes	Yes	Yes	Yes	Yes
Year, ind., and state fixed effects	Yes	Yes	Yes	Yes	Yes
Lead VC fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	8,928	8,928	8,928	8,928	8,928
R^2	0.572	0.572	0.572	0.572	0.572

financing rounds. Younger entrepreneurial firms and firms with more assets tend to receive more financing rounds. Consistent with Gompers (1995), firms in industries where more R&D is conducted and few tangible assets are used tend to receive a larger number of rounds of capital infusions from their VC investors. However, I do not find that industry market-to-book ratio significantly affects the staging of VC investments. Due to the discrete nature of VC financing rounds, I run Poisson regressions (not reported here) for robustness, and the baseline results hold.

Table 4 shows the results of regressions conducted to test the hold-up hypothesis. The hold-up hypothesis predicts that the VC investor is more likely to engage in stage financing of the entrepreneurial firm if the firm is located in a close-knit community, such that it is easier and more creditable for the entrepreneur to hold-up the VC investor by threatening to leave the firm for a better career (e.g., work for another firm). To test the implication of the hold-up hypothesis, I repeat the baseline regressions with the main independent variables replaced with four close-knit community variables. Chen, Gompers, Kovner, and Lerner (2010) identify three metropolitan areas of geographic concentration by startup firms: San Francisco, Boston, and New York. I use this finding and create three dummy variables, each corresponding to one of these three metropolitan areas. I also create a fourth dummy variable, the metropolitan dummy, which equals one if the entrepreneurial firm is located in any one of the three metropolitan

Table 4
Relationship between number of financing rounds and location of entrepreneurial firms.

This table reports the regressions for the determinants of the number of financing rounds for a sample of entrepreneurial firms that received their first VC financing between January 1, 1980 and October 31, 2006. The dependent variable is the number of financing rounds. The independent variables are the *San Francisco dummy*, the *Boston dummy*, the *New York dummy*, the *metropolitan dummy*, the number of VC investors, the natural logarithm of *firm assets*, the natural logarithm of *firm's age* when it receives the first round of VC financing, the *earlier-stage dummy*, *industry average market-to-book ratio*, *industry average R&D intensity*, *industry average tangibility of assets*, the natural logarithm of the *first round VC investment amount*, the *IPO dummy*, the *acquisition dummy*, the *write-off dummy*, and VC reputation variables. Definitions of variables are discussed in Appendix D. Data about entrepreneurial firms and VC investors are obtained from the VentureXpert database. Heteroskedasticity-robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable: number of financing rounds				
	(1)	(2)	(3)	(4)
San Francisco dummy	0.014			
	(0.070)			
Boston dummy		−0.070		
		(0.114)		
New York dummy			0.006	
			(0.110)	
Metropolitan dummy				−0.006
				(0.060)
Number of investing VCs	0.357***	0.357***	0.357***	0.357***
	(0.009)	(0.009)	(0.009)	(0.009)
Ln(*Firm age at round one*)	−0.006***	−0.006***	−0.006***	−0.006***
	(0.001)	(0.001)	(0.001)	(0.001)
Earlier-stage dummy	−0.151	−0.151	−0.151	−0.151
	(0.092)	(0.092)	(0.092)	(0.092)
Industry market/book ratio	−0.001*	−0.001*	−0.001*	−0.001*
	(0.001)	(0.001)	(0.001)	(0.001)
Industry R&D/assets ratio	0.073***	0.073***	0.074***	0.074***
	(0.027)	(0.027)	(0.027)	(0.027)
Industry asset tangibility	0.019	0.019	0.019	0.019
	(0.015)	(0.015)	(0.015)	(0.015)
Ln(*Firm assets*)	0.029***	0.029***	0.029***	0.029***
	(0.008)	(0.008)	(0.008)	(0.008)
Ln(*Investment amount at round one*)	−0.144***	−0.144***	−0.144***	−0.144***
	(0.013)	(0.013)	(0.013)	(0.013)
IPO dummy	−1.012***	−1.012***	−1.010***	−1.010***
	(0.113)	(0.113)	(0.113)	(0.113)
Acquisition dummy	−0.764***	−0.764***	−0.763***	−0.763***
	(0.112)	(0.113)	(0.112)	(0.112)
Write-off dummy	−0.805***	−0.806***	−0.805***	−0.805***
	(0.115)	(0.115)	(0.115)	(0.115)
Constant	2.270***	2.277***	2.269***	2.271***
	(0.390)	(0.391)	(0.390)	(0.391)
VC reputation controls	Yes	Yes	Yes	Yes
Year and industry fixed effects	Yes	Yes	Yes	Yes
Lead VC fixed effects	Yes	Yes	Yes	Yes
Observations	8,928	8,928	8,928	8,928
R^2	0.607	0.607	0.607	0.607

areas. In all columns, none of the coefficient estimates of the close-knit community dummies are statistically significant. The evidence appears to suggest that locating in a metropolitan area where entrepreneurial firms concentrate (and therefore the hold-up problem is more severe) is independent of the VC investor's propensity to stage. Overall, the hold-up hypothesis is not supported by the data.

4.2. Identification

Table 3 shows a positive relation between the entrepreneurial firm's geographic distance from the VC investor and the number of financing rounds the firm receives, but the correlation could be spurious. A first-order concern is that the distance between the entrepreneurial firm and the VC investor may not be exogenous due to the omitted variables problem; that is, the entrepreneur could endogenously choose an optimal distance from the VC investor based on firm characteristics that are unobservable to the econometrician. The famous "20-minute rule" forces an entrepreneur seeking VC funding to move closer to a VC investor. Additionally, being geographically close to the VC investor is also beneficial to the entrepreneur, because it significantly reduces the entrepreneur's costs of meeting with VC investors and increases the possibility of her projects getting funded.[13] Meanwhile, the fact that many startup firms possess relatively few

[13] Anecdotal evidence suggests that entrepreneurs, on average, need to have three to eight face-to-face meetings with a VC investor before being funded, and may have to go through a similar process with five to ten VC investors before finding one that will approve the funding request.

tangible assets also facilitates an entrepreneur's moving. Therefore, estimation of the impact of distance on VC stage financing could be seriously biased if endogeneity in distance is not appropriately addressed.

While it is very difficult to address the omitted variable concern in the absence of a natural experiment, I control for endogeneity in distance by constructing an instrumental variable for distance and conducting 2SLS regressions within the limitations of the data (see Section 4.2.1). Since the exclusion restriction of the instrument is not directly testable, I conduct a rich set of robustness checks. First, I construct an alternative instrument based on two different subsamples. Second, I use two alternative econometric approaches for dealing with the endogeneity problem: the Ackerberg-Botticini (2002) approach and the Sørensen-Heckman approach (see Section 4.2.2).

4.2.1. The instrumental variable approach

The main instrument for distance is the lead VC firm's geographic distance from the biggest public firm in its entrepreneurial firm's industry. For example, if a software development entrepreneurial firm located in Dallas, TX obtains financing from a lead VC firm located in Santa Clara, CA then the geographic distance between Dallas, TX and Santa Clara, CA is the main variable of interest in the analysis. However, as I discussed before, the distance could be endogenous. Since Microsoft, located in Redmond, WA is the biggest market player in the software development industry, I then use the geographic distance between Santa Clara, CA and Redmond, WA as the instrument for the distance between Dallas, TX, and Santa Clara, CA.

The rationale behind this instrument is that an acquisition is one avenue of successful exit for the entrepreneurial firm (see, e.g., Gompers and Lerner, 2000; Brander, Amit, and Antweiler, 2002; Sørensen, 2007; Bottazzi, Da Rin, and Hellmann, 2008; Nahata, 2008). In particular, being acquired by a large firm increases the entrepreneurial firm's viability and hence the returns of its VC investor. Being geographically closer to large firms in the industry potentially increases the VC investor's interactions with these big market players and facilitates acquisitions of the VC investor's portfolio firms. Expecting such advantages from the VC investor located closer to big market players in the industry, the entrepreneurial firm tends to choose to locate near such VC investors to increase the chances of being acquired. Therefore, the proposed instrument satisfies the relevance requirement. It is also reasonable to believe that a VC firm's proximity to the market leader is not correlated with the VC investor's investment structure for her own portfolio firms, and therefore the instrument satisfies the exclusion restriction.

I choose the public firm that has the biggest assets in the same financing round year and is in the same three-digit standard industrial classification (SIC) industry as the entrepreneurial firm. I then obtain the firm's address information from Compustat and calculate its geographic distance from the VC investor using the same algorithm discussed in Appendix B. If the above intuition of instrument construction is supported, I expect to observe a significantly positive coefficient estimate of the constructed instrument in the first-stage regressions.

In the analysis of the causes of VC stage financing, an important variable is the number of investing VC firms.[14] Because the number of investing VC firms and VC staging are co-determined by unobservable characteristics of both VC firms and entrepreneurial firms, the number of investing VC firms may be endogenous in the regressions as well (Tian, 2011). I construct an instrument for the number of investing VC firms that reflects the investment concentration within a lead VC's portfolio. Previous literature (see, e.g., Lerner, 1994; Brander, Amit, and Antweiler, 2002)) has suggested that risk diversification is one of the most important motivations for VC firms to co-invest in an entrepreneurial firm. If a VC firm already has a lot of exposure to a particular industry, it will have a strong incentive to syndicate with other VC firms to remain diversified. Otherwise, the VC firm might want to fund the whole deal alone. Following the VC literature, I construct an investment concentration index for each VC firm in each year based on VentureXpert's industry classification (I discuss the detailed variable construction in Appendix D). The investment concentration index measures how much a VC investor's portfolio deviates from the VC hypothetical market portfolio that consists of all entrepreneurial firms in the industry in which a VC investor could have invested. This index equals zero if the VC firm's portfolio has exactly the same industry composition as the VC hypothetical market portfolio, and increases as a VC firm's portfolio becomes more concentrated in a few industries. I therefore expect the coefficient estimates of the VC investor's investment concentration index to be positive and significant in the first-stage regressions.

Panel A of Table 5 presents the results of the first-stage regressions with the natural logarithm of one plus the entrepreneurial firm's distance from its lead VC investors (column 1), four distance dummy variables (columns 2 through 5), and the number of investing VC firms (column 6) as the dependent variable. The main independent variables of interest are the two constructed instruments. All other control variables are the same as those in the baseline regressions.

Consistent with the intuition for the instrument construction, the coefficient estimates for the VC investor's distance to the biggest industry player are positive and significant at the 1% level across all regressions when distance is the dependent variable in columns 1 through 5 of Panel A. The results suggest that entrepreneurs do tend to choose VC investors who are closer to the biggest player in the industry. In addition, a firm's industry affects its distance to the lead VC investors. The coefficient estimates of industry average R&D/assets ratio are negative and significant and those of industry asset tangibility are positive and significant in all regressions in columns 1 through 5. The results suggest that the entrepreneurial

[14] Previous literature has shown the important role of VC syndication on the venture investment: See, e.g., Lerner (1994), Brander, Amit, and Antweiler (2002), and Tian (2011).

Table 5
Relationship between number of financing rounds and distance between the VC and entrepreneurial firm—2SLS analysis.

This table reports the 2SLS regressions for the determinants of the number of financing rounds for a sample of entrepreneurial firms that received their first VC financing between January 1, 1980 and October 31, 2006. Panel A reports the first-stage regression results. The dependent variables are the natural logarithm of one plus the weighted-average distance between the entrepreneurial firm and the lead VC investors, the *25-mile dummy*, the *50-mile dummy*, the *100-mile dummy*, the *150-mile dummy*, and the number of VC investors, respectively. Panel B reports the second-stage regression results. The dependent variable is the number of financing rounds. The instrumental variables are the natural logarithm of one plus the lead VC investor's distance from the biggest public firm in its portfolio firm's industry and the lead VC investor's investment concentration index. All other control variables are the same as those in Table 3. Definitions of variables are discussed in Appendix D. Heteroskedasticity-robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: First-stage regressions

Dependent variable	Ln(*1+Distance*)	*25-mile dummy*	*50-mile dummy*	*100-mile dummy*	*150-mile dummy*	*Number of VCs*
	(1)	(2)	(3)	(4)	(5)	(6)
Ln(*1+lead VC's distance to the biggest player*) z_1	0.175***	0.035***	0.038***	0.032***	0.030***	−0.098
	(0.048)	(0.012)	(0.011)	(0.010)	(0.010)	(0.092)
Lead VC's investment concentration index z_2	−0.038	0.021	0.016	0.029	0.029	4.013***
	(0.150)	(0.029)	(0.031)	(0.031)	(0.031)	(0.309)
Ln(*firm age at round one*)	0.005***	0.001***	0.001*	0.000	0.000	−0.044***
	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)
Earlier-stage dummy	0.054	0.002	0.014	0.003	0.008	−1.122***
	(0.065)	(0.013)	(0.014)	(0.014)	(0.014)	(0.158)
Industry market/book ratio	−0.001	−0.000	−0.000	−0.000	−0.000	0.000
	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)
Industry R&D/assets ratio	−0.059**	−0.012**	−0.016***	−0.016***	−0.015***	−0.009
	(0.024)	(0.006)	(0.005)	(0.005)	(0.005)	(0.040)
Industry asset tangibility	0.782***	0.113**	0.096*	0.225***	0.216***	−4.273***
	(0.293)	(0.056)	(0.051)	(0.063)	(0.062)	(0.562)
Ln(*firm assets*)	0.003	0.001	0.002	0.003*	0.002	0.015
	(0.007)	(0.001)	(0.001)	(0.001)	(0.001)	(0.016)
Ln(*investment amount at round one*)	0.051***	0.010***	0.008***	0.035	0.011***	0.162***
	(0.013)	(0.002)	(0.003)	(0.083)	(0.003)	(0.027)
IPO dummy	0.154	0.023	0.040**	0.027	0.023	−1.631***
	(0.097)	(0.019)	(0.020)	(0.020)	(0.020)	(0.229)
Acquisition dummy	−0.045	−0.015	−0.012	−0.018	−0.022	−1.036***
	(0.086)	(0.017)	(0.018)	(0.018)	(0.018)	(0.202)
Write-off dummy	−0.149	−0.052***	−0.027	−0.024	−0.030	−2.286***
	(0.092)	(0.018)	(0.019)	(0.019)	(0.019)	(0.212)
Constant	3.937***	0.684***	0.632***	0.619***	0.368***	6.150***
	(0.449)	(0.080)	(0.083)	(0.083)	(0.094)	(1.236)
F-statistics (z_1=z_2=0)	13.91***	8.92***	12.79***	10.08***	11.95***	84.75***
VC reputation controls	Yes	Yes	Yes	Yes	Yes	Yes
Year, ind., and state dummy	Yes	Yes	Yes	Yes	Yes	Yes
Lead VC fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,626	8,626	8,626	8,626	8,626	9,010
R^2	0.088	0.072	0.096	0.105	0.106	0.412

Panel B: Second-stage regressions

Dependent variable: number of financing rounds					
	(1)	(2)	(3)	(4)	(5)
Ln(*1+Distance*)	0.302**				
	(0.131)				
25-mile dummy		1.529**			
		(0.659)			
50-mile dummy			1.424**		
			(0.600)		
100-mile dummy				1.697**	
				(0.741)	
150-mile dummy					1.731**
					(0.762)
Number of investing VCs	0.568***	0.562***	0.565***	0.558***	0.558***
	(0.038)	(0.037)	(0.037)	(0.038)	(0.038)
Ln(*firm age at round one*)	−0.003*	−0.004*	−0.003	−0.003	−0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Earlier-stage dummy	−0.360***	−0.333***	−0.357***	−0.334***	−0.347***
	(0.099)	(0.098)	(0.099)	(0.099)	(0.100)
Industry market/book ratio	−0.001	−0.000	−0.001	−0.001	−0.001

Table 5. (*continued*)

	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Industry R&D/assets ratio	0.088***	0.090***	0.093***	0.097***	0.097***
	(0.027)	(0.027)	(0.028)	(0.029)	(0.028)
Industry asset tangibility	0.018	0.020	0.020	0.021	0.021
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Ln(*firm assets*)	0.036***	0.036***	0.035***	0.034***	0.035***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Ln(*investment amount at round one*)	−0.247***	−0.243***	−0.241***	−0.248***	−0.248***
	(0.022)	(0.021)	(0.021)	(0.022)	(0.022)
IPO dummy	−0.863***	−0.853***	−0.876***	−0.873***	−0.876***
	(0.157)	(0.155)	(0.157)	(0.158)	(0.159)
Acquisition dummy	−0.439***	−0.434***	−0.440***	−0.427***	−0.422***
	(0.135)	(0.134)	(0.135)	(0.137)	(0.138)
Write-off dummy	−0.256	−0.238	−0.268	−0.269	−0.253
	(0.170)	(0.170)	(0.168)	(0.170)	(0.172)
Constant	0.753	0.964	1.129	1.267*	1.518**
	(0.847)	(0.765)	(0.714)	(0.686)	(0.645)
VC reputation controls	Yes	Yes	Yes	Yes	Yes
Year, ind., and state fixed effects	Yes	Yes	Yes	Yes	Yes
Lead VC fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	8,276	8,276	8,276	8,276	8,276
R^2	0.453	0.463	0.457	0.447	0.444

firm is located closer to the VC investor if it operates in industries where more R&D is conducted and less tangible assets are used. Finally, the coefficient estimates of the firm's age are positive in all five regressions and statistically significant in regressions 1 through 3, suggesting that younger firms at the initial financing round are typically located closer to VC investors.

Column 6 reports the first-stage regression results, with the number of investing VC firms as the dependent variable. Consistent with the rationale of VC diversification, the coefficient estimate of the lead VC investor's investment concentration index is positive and significant at the 1% level, suggesting that VC firms with relatively undiversified portfolios tend to co-invest with other VC firms.

Although the above regressions suggest that the instruments are relevant, it is still possible to have biased estimates due to weak instruments. I report the *F*-statistics for the test of joint significance of two proposed instruments. The values of the *F*-test are quite large. I also conduct the Stock and Yogo (2005) weak instrument test. The *F*-statistics are much larger than their critical values for the Stock and Yogo (2005) weak instrument test based on 2SLS size. Therefore, I reject the null hypothesis that the instruments are weak.

Panel B of Table 5 reports the second-stage regression results, with the number of VC financing rounds as the dependent variable and the predicted values of the distance variable and the number of VC investors as the independent variables. The coefficient estimates of distance variables across all columns are positive and statistically significant at the 5% level, supporting the monitoring hypothesis. The economic significance of the coefficient on distance is large. According to the estimate in column 1 of Table 5 Panel B, an increase in distance from the 25th to the 75th percentile increases the number of financing rounds from 2.1 to 6.8 rounds, a change of 224%.

Comparing results obtained from the OLS regressions (Table 3) with those obtained from the 2SLS regressions (Panel B of Table 5), it is interesting to observe that the magnitudes of the 2SLS coefficient estimates are larger than those of the OLS estimates (even though the coefficient estimates from both approaches are positive and statistically significant), suggesting that OLS regressions bias the coefficient estimates downward due to endogeneity in distance. This finding suggests that the omitted variables simultaneously make VC staging more desirable and the distance shorter. The entrepreneurial firm's technology complexity could be an example of an omitted variable. For instance, a startup firm in the early stages of developing a new drug is, by nature, difficult for the VC investor to monitor due to the complex technologies involved. The entrepreneur optimally chooses to be located closer to the VC investor because of the firm's opaqueness. On the other hand, being in the early stage of development, the firm will receive multiple rounds of capital infusions from its VC investor. This observation does not necessarily reflect a causal consequence of distance on the number of financing rounds because of the endogeneity problem inherent in the optimal choice for the distance. However, the negative correlation caused by the omitted variable is the main driving force that biases the coefficient estimates of distance downward. Once I use the instruments to clean up the correlation between the entrepreneur's optimal distance choice and the residuals (the firm's unobservable characteristics) in the structural equations, the endogeneity of the entrepreneur's optimal distance choice is removed and the coefficient estimates increase, that is, become more positive.

In an untabulated analysis, I repeat the regressions in Table 4 that are used to test the hold-up hypothesis within the 2SLS regression framework. I continue to find statistically insignificant coefficient estimates of the entrepreneurial firm's headquarter metropolitan dummies, suggesting that firms located in metropolitan areas where many other entrepreneurial firms concentrate do not receive more rounds of VC financing. Therefore, the hold-up hypothesis is not supported, even after the endogeneity problem is controlled.

4.2.2. Robustness tests with alternative instruments and econometric approaches

Since the exclusion restriction of an instrument is inherently untestable and an instrument has to be conceptually motivated, I conduct two sets of robustness checks. The first set of robustness tests is to construct an alternative instrument. The alternative instrument is the entrepreneurial firm's minimum distance to all available VC firms (regardless of whether the VC firm actually invests in the entrepreneurial firm) when it receives the first round of VC financing. In order to have the new instrument reasonably satisfy the exclusion restriction, I consider a sample of entrepreneurial firms with very high moving costs (or strong local ties) such that these firms are initially located randomly.[15] Therefore, their distance to the closest available VC firm is exogenous, that is, it does not vary with unobserved firm heterogeneity. In the spirit of the above argument, I create a subsample of entrepreneurial firms that satisfy the following three criteria: (a) the entrepreneurial firm's average distance to its lead VC firms exceeds that of the third quartile of the full sample reported in Table 2, namely, 685.5 miles; (b) there are no VC investors within a 300-mile radius of the entrepreneurial firm's headquarters; and (c) the entrepreneurial firm's location does not change throughout the sample period. Since entrepreneurial firms satisfying the three criteria have very high moving costs and are located randomly, their minimum distance to all available VC firms should satisfy the exclusion restriction.

The constructed instrument satisfies the relevance requirement because some entrepreneurial firms obtain financing from the closest VC firm. Therefore, the instrument is correlated with the endogenous variable (i.e., the actual distance between the firm and its lead VC firms). In an untabulated analysis, I examine the relevance of the constructed instrument in the first-stage regressions. As expected, the coefficient estimate of the instrument is positive and significant at the 1% level. The *F*-statistics of the joint significance of the two instruments (I continue to use the lead VC firm's investment concentration index as the instrument for the number of VC investors throughout all robustness checks) is 32.6. It is much larger than the critical values of the Stock and Yogo (2005) weak instrument test based on 2SLS size, and therefore, the null hypothesis that the instruments are weak is rejected.

Panel A of Table 6 reports the 2SLS regression results for the subsample with the newly constructed instrument for distance. As one of the sample construction criteria is that there be no VC firm within a 300-mile radius of the entrepreneurial firm's headquarters, I drop the four distance dummies (the 25-, 50-, 100-, and 150-mile dummies), because they do not vary within the subsample. I continue to observe a positive and significant coefficient estimate of distance. The results reinforce the monitoring hypothesis that distance has a positive impact on the number of financing rounds.

To further examine the robustness of the baseline results, I construct the same instrument based on a different subsample that contains entrepreneurial firms in industries with very high fixed assets. The rationale of the instrument construction is the same, that is, firms with very high moving costs (proxied by high fixed assets) are initially located randomly. Entrepreneurial firms are chosen in industries with an asset tangibility ratio exceeding that of the third quartile of the full sample's industry tangibility distribution, 0.82. Firms in this subsample are typically operated in industries such as biotechnology, manufacturing, and utilities. In untabulated regressions, once again, I find that the coefficient estimates of distance variables are positive and significant, consistent with the implications of the monitoring hypothesis.

The second set of robustness tests involves adopting two alternative econometric methods to deal with endogeneity problems. Following Bottazzi, Da Rin, and Hellmann (2008), I use the Ackerberg-Botticini (2002) approach and the Sørensen-Heckman approach to examine whether the baseline results continue to hold under alternative econometric models for dealing with the endogeneity in distance problem.[16]

Ackerberg and Botticini (2002) propose an alternative method for dealing with the endogeneity problem and derive a richer identification strategy, where the optimal distance choice depends on all potential relevant characteristics of the VC investors and entrepreneurial firms that may be unobserved, partially observed, or observed with error by the econometrician. The authors suggest using market fixed effects as well as fixed effects for each type of firm–market interaction. My data set contains 18 industries and 50 states, resulting in a large number (900) of interaction terms. In addition, I add the state dummy variables to control for local market fixed effects. I use all these to instrument the geographic distance between the entrepreneurial firm and the VC investor. Panel B of Table 6 presents the results. The coefficient estimates of the distance variables are positive and significant across all columns, supporting the implications of the monitoring hypothesis.

The second econometric approach dealing with the endogeneity problem is based on the Sørensen-Heckman approach that combines insights from the recent work of Sørensen (2007) and the Heckman (1979) sample selection model. An important implication of the Sørensen-Heckman approach is that it helps to separate out the effect of proximity on deal selection. I first construct the sample of all possible entrepreneurial firm-VC matches, ending up with 117,834 potential matches. I include entrepreneurial firm state dummies, state-pair fixed effects, as well as firm characteristics and VC characteristics in the selection equation. In untabulated regressions based on the Sørensen-Heckman approach, once again,

[15] Moving costs for entrepreneurs include not only monetary costs associated with their moving to VC investors, but also some strong ties that prevent them from moving. Ties are the various aspects of people's lives that bind them to their residence: possessions, religion, social and family relationships, and so forth.

[16] See Bottazzi, Da Rin, and Hellmann (2008) for a detailed description of the Ackerberg-Botticini (2002) approach and the Sørensen-Heckman approach.

Table 6
Relationship between number of financing rounds and distance between the VC and entrepreneurial firm—alternative instruments and econometric approaches.

Panel A reports the second-stage regression results from the 2SLS regressions for the determinants of the number of financing rounds with the alternative instrument in the subsample where the sample entrepreneurial firms satisfy the three criteria specified in Section 4.2.2. The dependent variable is the number of financing rounds. The instrumental variable is the entrepreneurial firm's minimum distance to all available VC firms regardless of whether the VC firm actually invests in the entrepreneurial firm. The independent variables are the natural logarithm of *one plus the weighted-average distance between the entrepreneurial firm and the lead VC investors*, the *number of VC investors*, the natural logarithm of *firm assets*, the natural logarithm of *firm's age* when it receives the first round of VC financing, the *earlier-stage dummy*, *industry average market-to-book ratio*, *industry average R&D intensity*, *industry average tangibility of assets*, the natural logarithm of the *first round VC investment amount*, the *IPO dummy*, the *acquisition dummy*, the *write-off dummy*, and VC reputation variables. Definitions of variables are discussed in Appendix D. Data about entrepreneurial firms and VC investors are obtained from the VentureXpert database. Heteroskedasticity-robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel B reports the regressions for the determinants of the number of financing rounds with the Ackerberg-Botticini (2002) approach for a sample of entrepreneurial firms that received their first VC financing between January 1, 1980 and October 31, 2006. The dependent variable is the number of financing rounds. The independent variables are the natural logarithm of one plus the weighted-average distance between the entrepreneurial firm and the lead VC investors, the *25-mile dummy*, the *50-mile dummy*, the *100-mile dummy*, the *150-mile dummy*, the *number of VC investors*, the *natural logarithm of firm assets*, the natural logarithm of *firm's age* when it receives the first round of VC financing, the *earlier-stage dummy*, *industry average market-to-book ratio*, *industry average R&D intensity*, *industry average tangibility of assets*, the natural logarithm of the *first round VC investment amount*, the *IPO dummy*, the *acquisition dummy*, the *write-off dummy*, and VC reputation variables. Definitions of variables are discussed in Appendix D. Data about entrepreneurial firms and VC investors are obtained from the VentureXpert database. Heteroskedasticity-robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Alternative instruments

Dependent variable: number of financing rounds	
Ln(*1+Distance*)	3.002**
	(1.440)
Number of investing VCs	0.380***
	(0.023)
Ln(*firm age at round one*)	0.069
	(0.164)
Earlier-stage dummy	0.001
	(0.008)
Industry market/book ratio	−0.017*
	(0.009)
Industry R&D/assets ratio	0.062*
	(0.038)
Industry asset tangibility	−0.150***
	(0.029)
Ln(*firm assets*)	−0.006***
	(0.002)
Ln(*investment amount at round one*)	−0.024
	(0.016)
IPO dummy	−0.244
	(0.210)
Acquisition dummy	−0.052
	(0.205)
Write-off dummy	−0.238
	(0.203)
Constant	−20.347*
	(10.987)
VC reputation controls	Yes
Year, industry, and state dummy	Yes
Lead VC fixed effects	Yes
Observations	1,296
R^2	0.426

Panel B: Alternative econometric approach

Dependent variable: number of financing rounds					
	(1)	(2)	(3)	(4)	(5)
Ln(*1+Distance*)	0.106**				
	(0.046)				
25-mile dummy		0.471*			
		(0.242)			
50-mile dummy			0.627***		
			(0.200)		
100-mile dummy				0.668***	
				(0.189)	
150-mile dummy					0.667***

Table 6 (*continued*)

Panel B: Alternative econometric approach					
Dependent variable: number of financing rounds					
	(1)	(2)	(3)	(4)	(5)
					(0.181)
Number of investing VCs	0.445***	0.447***	0.449***	0.448***	0.447***
	(0.013)	(0.012)	(0.012)	(0.012)	(0.013)
Ln(*firm age at round one*)	−0.007***	−0.006***	−0.007***	−0.007***	−0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Earlier-stage dummy	−0.174**	−0.169*	−0.168*	−0.158*	−0.160*
	(0.086)	(0.086)	(0.087)	(0.087)	(0.087)
Industry market/book ratio	−0.000	−0.000	−0.000	−0.000	−0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Industry R&D/assets ratio	0.057**	0.056*	0.059**	0.059**	0.060**
	(0.029)	(0.029)	(0.029)	(0.029)	(0.028)
Industry asset tangibility	0.033**	0.034**	0.034**	0.034**	0.034**
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Ln(*firm assets*)	0.018**	0.019**	0.018**	0.018**	0.018**
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Ln(*investment amount at round one*)	−0.223***	−0.222***	−0.223***	−0.226***	−0.226***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
IPO dummy	−1.081***	−1.069***	−1.078***	−1.067***	−1.072***
	(0.117)	(0.116)	(0.117)	(0.116)	(0.116)
Acquisition dummy	−0.677***	−0.676***	−0.673***	−0.662***	−0.661***
	(0.109)	(0.109)	(0.110)	(0.110)	(0.110)
Write-off dummy	−0.673***	−0.667***	−0.666***	−0.659***	−0.656***
	(0.118)	(0.119)	(0.119)	(0.119)	(0.119)
Constant	2.307***	2.446***	2.420***	2.462***	2.487***
	(0.367)	(0.348)	(0.330)	(0.323)	(0.321)
VC reputation controls	Yes	Yes	Yes	Yes	Yes
Year, ind., and state fixed effects	Yes	Yes	Yes	Yes	Yes
Lead VC fixed effects	Yes	Yes	Yes	Yes	Yes
	Identification in the first stage				
State-industry interactions	Yes	Yes	Yes	Yes	Yes
Observations	8,307	8,307	8,307	8,307	8,307
R^2	0.512	0.512	0.510	0.508	0.509

the coefficient estimates of distance in all regressions are positive and significant. Given that the Sørensen-Heckman model uses a very general structure to account for the firm-VC matching process, this test is a powerful robustness check.

Overall, the evidence suggests that an entrepreneurial firm's geographic distance from its VC investors positively impacts the number of financing rounds, while a firm's close-knit community location has no effect. The evidence is consistent with the monitoring hypothesis that lower monitoring costs reduce the VC investor's propensity to stage financing the firm to save the costs of staging.

4.3. Results on round duration, round size, and total financing

This section explores how the entrepreneurial firm's location and distance from its VC investors affects other aspects of VC staging patterns (financing duration between successive rounds, round financing size, and total investment amount across all rounds), and disentangles the monitoring hypothesis, the hold-up hypothesis, and the learning hypothesis. To save space, I only report the 2SLS regression results with the main instrument for distance, that is, the lead VC firm's geographic distance to the biggest market player in its entrepreneurial firm's industry. The results are generally similar whether the OLS, 2SLS with the alternative instrument, Ackerberg-Botticini (2002), or Sørensen-Heckman approach is used.

Table 7 shows how distance affects the investment duration between successive rounds. The dependent variable is the duration in months of a particular venture financing round. If the entrepreneurial firm eventually goes public or is acquired, I calculate the last investment duration as the time interval in months between the last financing round date and the exit event date.

It is important to note that the duration data are right-censored, because I can observe the duration of financing rounds only when a subsequent financing round occurs. Subsequent financing rounds could be unobservable for two possible reasons. First, firms that have exited the venture stage by going public, being acquired, or being written off have no subsequent financing rounds. Second, firms may be in the middle of an ongoing round. To avoid

Table 7
Relationship between inter-round duration and distance between the VC and entrepreneurial firm.

This table reports the regressions for the inter-round duration of financing rounds. The dependent variable is the duration in months from a funding date to the next funding date. The independent variables are the natural logarithm of one plus the weighted-average distance between the entrepreneurial firm and the lead VC investors, the *25-mile dummy*, the *50-mile dummy*, the *100-mile dummy*, the *150-mile dummy*, the *number of VC investors*, the natural logarithm of *firm assets*, the natural logarithm of *firm's age* when it receives the first round of VC financing, the *earlier-stage dummy*, *industry average market-to-book ratio*, *industry average R&D intensity*, *industry average tangibility of assets*, the natural logarithm of the *first round VC investment amount*, and VC reputation variables. Definitions of variables are discussed in Appendix D. Data about entrepreneurial firms and VC investors are obtained from the VentureXpert database. Heteroskedasticity-robust standard errors clustered by the entrepreneurial firms are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable: duration of financing rounds					
	(1)	(2)	(3)	(4)	(5)
Ln(*1+Distance*)	−3.789**				
	(1.821)				
25-mile dummy		−4.389**			
		(1.818)			
50-mile dummy			−4.910**		
			(1.973)		
100-mile dummy				−4.689**	
				(1.970)	
150-mile dummy					−5.826**
					(2.376)
Number of investing VCs	−0.552**	−0.906***	−0.906***	−0.894***	−0.896***
	(0.215)	(0.088)	(0.089)	(0.087)	(0.081)
Ln(*firm age at round one*)	0.227	−0.288*	−0.294*	−0.277*	−0.258*
	(0.336)	(0.166)	(0.167)	(0.165)	(0.142)
Earlier-stage dummy	2.749**	0.934**	0.918**	0.875**	0.985***
	(1.173)	(0.370)	(0.364)	(0.359)	(0.371)
Industry market/book ratio	0.000	−0.002	−0.001	−0.001	0.001
	(0.011)	(0.008)	(0.008)	(0.008)	(0.008)
Industry R&D/assets ratio	−0.406	−0.095	−0.101	−0.106	−0.083
	(0.274)	(0.161)	(0.161)	(0.161)	(0.166)
Industry asset tangibility	0.092**	0.072***	0.075***	0.074***	0.076**
	(0.038)	(0.022)	(0.022)	(0.022)	(0.030)
Ln(*firm assets*)	0.692***	0.558***	0.553***	0.554***	0.563***
	(0.115)	(0.064)	(0.063)	(0.063)	(0.062)
Ln(*investment amount at round one*)	0.390	−0.068	−0.058	−0.059	−0.032
	(0.276)	(0.069)	(0.071)	(0.072)	(0.076)
Constant	18.986***	13.869***	14.472***	13.454***	13.719***
	(5.687)	(3.720)	(3.804)	(3.641)	(3.334)
VC reputation controls	Yes	Yes	Yes	Yes	Yes
Year, ind., and state fixed effects	Yes	Yes	Yes	Yes	Yes
Lead VC fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	15,462	15,462	15,462	15,462	15,462
R^2	0.165	0.164	0.156	0.161	0.144

the data censoring problem discussed earlier, I examine duration between successive financing rounds for entrepreneurial firms that have already exited.[17] Unlike the analysis conducted in the previous section in which the observation unit is an entrepreneurial firm, the observation unit in this study is a financing round. If an entrepreneurial firm receives more than one round of VC financing, it appears in the sample multiple times. I then cluster standard errors by entrepreneurial firm, since the residuals could be correlated across observations of the same firm.

The coefficient estimate of the continuous distance variable is negative and significant at the 5% level, as reported in column 1 of Table 7. Columns 2 through 5 of Table 7 report the regression results if distance dummy variables are used instead as the main explanatory variables. Consistent with the findings reported in column 1, the coefficient estimates of distance dummies are negative and significant at the 5% level across all four regressions. According to the coefficient estimate reported in column 2 of Table 7, if an entrepreneurial firm is located within a 25-mile radius from its lead VC investor, it receives successive financing rounds 4.4 months sooner than its counterpart located outside of the 25-mile radius of the VC investor.

The regression results reported in Table 7 support the implications of the monitoring hypothesis. Specifically, a greater distance between the entrepreneurial firm and the VC investor implies a shorter financing duration between successive rounds. This finding suggests that VC investors tend to "keep a tight leash" (Gompers, 1995) by shortening the duration between successive rounds when entrepreneurial firms are located far away from them.

[17] In an untabulated analysis, I use a duration model with the Weibull distributed hazard ratio that incorporates entrepreneurial firms still under active investment into the analyses. I find qualitatively similar results.

Table 8
Relationship between funding amount per round and distance between the VC and entrepreneurial firm.

This table reports the regressions for funding amount per round for a sample of entrepreneurial firms that received their first VC financing between January 1, 1980 and October 31, 2006. The dependent variable is the natural logarithm of the financing amount in millions in the round. The independent variables are the natural logarithm of one plus the weighted-average distance between the entrepreneurial firm and the lead VC investors, the *25-mile dummy*, the *50-mile dummy*, the *100-mile dummy*, the *150-mile dummy*, the *number of VC investors*, the natural logarithm of *firm assets*, the natural logarithm of *firm's age* when it receives the first round of VC financing, the *earlier-stage dummy*, *industry average market-to-book ratio*, *industry average R&D intensity*, *industry average tangibility of assets*, the natural logarithm of the *first round VC investment amount*, and VC reputation variables. Definitions of variables are discussed in Appendix D. Data about entrepreneurial firms and VC investors are obtained from the VentureXpert database. Heteroskedasticity-robust standard errors clustered by the entrepreneurial firms are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable: Ln(*financing amount in the round*)					
	(1)	(2)	(3)	(4)	(5)
Ln(*1+Distance*)	−0.377**				
	(0.186)				
25-mile dummy		−2.771*			
		(1.430)			
50-mile dummy			−2.549**		
			(1.244)		
100-mile dummy				−3.171*	
				(1.783)	
150-mile dummy					−2.762**
					(1.385)
Number of investing VCs	0.090***	0.076***	0.073***	0.087***	0.079***
	(0.025)	(0.020)	(0.018)	(0.026)	(0.020)
Ln(*firm age at round one*)	−0.008	−0.032	−0.037	−0.018	−0.018
	(0.034)	(0.026)	(0.023)	(0.034)	(0.030)
Earlier-stage dummy	0.171	0.214	0.163	0.196	0.171
	(0.112)	(0.137)	(0.107)	(0.140)	(0.112)
Industry market/book ratio	−0.000	−0.001	−0.000	−0.001	0.000
	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
Industry R&D/assets ratio	−0.001	0.018	0.014	0.009	0.025
	(0.027)	(0.029)	(0.027)	(0.030)	(0.024)
Industry asset tangibility	0.018***	0.017***	0.018***	0.019***	0.018***
	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)
Ln(*firm assets*)	0.097***	0.095***	0.089***	0.095***	0.093***
	(0.015)	(0.014)	(0.012)	(0.016)	(0.013)
Constant	0.075	0.616	0.668	0.429	0.087
	(0.570)	(0.821)	(0.797)	(0.812)	(0.590)
VC reputation controls	Yes	Yes	Yes	Yes	Yes
Year, ind., and state fixed effects	Yes	Yes	Yes	Yes	Yes
Lead VC fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	15,977	15,977	15,977	15,977	15,977
R^2	0.492	0.445	0.513	0.351	0.466

Table 8 shows how distance affects the VC financing round size. The dependent variable is the natural logarithm of the round size in millions of dollars. Since the observation unit in this exercise is a financing round, standard errors are clustered by entrepreneurial firm. I find negative coefficient estimates of distance in all specifications, confirming the argument that a shorter distance between the VC investor and the entrepreneurial firm lowers the VC investor's monitoring costs and allows the VC investor to become more comfortable investing a greater amount in each round. The economic significance of the coefficient estimates on distance is great. According to the coefficient estimate of distance reported in column 1 of Table 8, the elasticity of the round amount with respect to distance is −0.38, that is, increasing distance by 10% decreases the round financing size by 3.8%. The coefficient estimates of the number of VC investors are positive, suggesting that the more VC investors co-invest in a firm, the larger the investment amount per round the firm receives.

So far, I have found that the entrepreneurial firm that is proximate to the VC investor receives fewer financing rounds and a larger investment amount per round. A natural question is whether distance affects the VC total financing across all rounds. Neither the monitoring hypothesis nor the learning hypothesis has predictions regarding this question, but I intuitively expect to observe no significant correlation between distance and total investment amount. This is because the VC total investment amount should only be affected by the venture's financing demand that is a function of the venture's characteristics rather than its geographic distance from the VC investors. In an untabulated analysis for VC total funding, the coefficient estimates of distance variables are not statistically significant. Therefore, the null hypothesis that distance does not affect the VC total financing amount cannot be rejected.

In untabulated analyses of the hold-up hypothesis, I study the impact of an entrepreneurial firm's close-knit community location on the inter-round investment

duration, the investment amount per round, and total VC funding. I do not find that a firm's close-knit community location significantly affects the above aspects of VC staging patterns. In summary, the results presented in this section suggest that an entrepreneurial firm's shorter distance from VC investors lengthens the time interval between successive financing rounds and increases the round investment size. The evidence supports the monitoring hypothesis.

5. Empirical analysis of the consequences of stage financing

This section investigates the consequences of VC stage financing in terms of the entrepreneurial firm's subsequent performance. Specifically, Section 5.1 looks at how VC staging affects the entrepreneurial firm's propensity to go public, Section 5.2 examines the entrepreneurial firm's operating performance in the IPO year (if the firm goes public), and Section 5.3 investigates the entrepreneurial firm's post-IPO survival (if the firm goes public).

The monitoring hypothesis predicts that if the monitoring costs are low (an entrepreneurial firm's distance from its VC investors is short), fewer financing rounds are related to better firm performance because of the reduced costs of staging. If, however, the entrepreneurial firm is distant from the VC investor, it becomes too costly for VC investors to effectively monitor the entrepreneur and the VC investor has to increase the number of financing rounds to better discipline the entrepreneur, which helps to improve the entrepreneurial firm's performance. Put differently, the monitoring hypothesis implies that the relationship between staging and the entrepreneurial firm's performance depends on the geographic distance between the entrepreneur and the VC investor. However, the learning hypothesis predicts that the number of VC financing rounds is independent of the firm's subsequent performance, regardless of the distance. Finally, the hold-up hypothesis predicts that VC staging helps to improve the entrepreneurial firm's subsequent performance only if the firm is located in a close-knit community where the hold-up problem is more severe.

5.1. The propensity to go public

Although both IPO and acquisition have been considered as successful exit pathways by previous studies (e.g., Gompers and Lerner, 2000; Brander, Amit, and Antweiler, 2002; Sørensen, 2007; Bottazzi, Da Rin, and Hellmann, 2008; Nahata, 2008), existing literature suggests that going public is a more desirable exit pathway than acquisition for both entrepreneurs and VC investors. For example, Brau, Francis and Kohers (2003) show that IPO firms enjoy a 22% "valuation premium" relative to firms that are acquired, and Sahlman (1990) argues that almost all of the returns for VC investors are earned on companies that eventually go public. Bayar and Chemmanur (forthcoming) suggest that only the best-quality firms can access the public capital markets through an IPO. Therefore, I construct two success measures for entrepreneurial firms. The first measure is an IPO versus acquisition dummy that equals one if the firm goes public, and zero if it is acquired by another firm. The second one is an IPO exit dummy that equals one if the firm exits by going public, and zero if it is acquired by another firm or written off by the VC investors.[18]

Table 9 reports the probit regression results for the exit outcomes of the entrepreneurial firm with the IPO versus acquisition dummy as the dependent variable. I report the marginal effects of independent variables, since the coefficients of probit models are usually hard to interpret. In Panel A of Table 9, I test the predictions of the monitoring hypothesis as well as the learning hypothesis. The main independent variable is the number of financing rounds an entrepreneurial firm receives. In addition, to distinguish the impact of distance on the VC staging's effect on the firm's performance, I include two additional variables in each regression: the distance variable used in the previous sections and an interaction term between the distance variable and the number of financing rounds.[19] If the monitoring hypothesis is supported, I expect the coefficient estimates of the number of financing rounds to be negative and those of the interaction terms to be positive. If the learning hypothesis is supported, I expect the coefficient estimates of the number of financing rounds and the interaction terms not to be statistically significant.

The coefficient estimates of the number of financing rounds in Panel A of Table 9 are all negative and statistically significant at the 1% level, and those of the interaction terms are all positive and significant at the 1% level. The evidence suggests that when the entrepreneurial firm's distance to the VC investor is long, VC staging helps to increase the firm's probability of going public relative to being acquired. However, if the VC investor is proximate to the entrepreneur, a larger number of VC financing rounds reduces the firm's probability of going public. To be more concrete, for example, the coefficient estimates reported in column 2 suggest that if a firm is located within a 25-mile radius from its lead VC investor, an additional round of capital infusions on average reduces its probability of going public instead of being acquired by 30.4%. However, if the firm is located outside of the 25-mile radius, one more round of VC investment increases its probability of going public instead of being acquired by 10.4% ($0.104 = -0.304 + 0.408$).

The implications of the hold-up hypothesis are tested in Panel B of Table 9. The main independent variables are

[18] Because entrepreneurial firms that are still under active investment are not included in the analysis, the sample size drops.

[19] One possible concern about including the distance variables in the exit outcome regressions is that the main instrument for distance constructed earlier, the lead VC's proximity to the largest firm in the entrepreneurial firm's industry, may not satisfy the exclusion restriction. This is because the entrepreneurial firm may explicitly choose to move closer to the VC investor who is located closer to the biggest market player in the industry, and is subsequently acquired by the biggest market player. In other words, the instrument may affect an entrepreneurial firm's exit outcome through subsequent acquisitions. To address this concern, I drop entrepreneurial firms that are acquired by the same biggest firm used for constructing the instrument. This procedure leads to the removal of 0.57% of the sample.

Table 9
Relationship between exit choices and financing rounds.

This table reports the regressions for the entrepreneurial firm's propensity to go public relative to be acquired by another company for a sample of entrepreneurial firms that received their first VC financing between January 1, 1980 and October 31, 2006. The dependent variable is the IPO versus acquisition dummy. In Panel A, the independent variables are the number of financing rounds, the interaction term between the number of financing rounds and the natural logarithm of *one plus the weighted-average distance between the entrepreneurial firm and the lead VC investors*, the natural logarithm of *one plus the weighted-average distance between the entrepreneurial firm and the lead VC investors*, the interaction term between the number of financing rounds and the *25-mile dummy*, the *25-mile dummy*, the interaction term between the number of financing rounds and the *50-mile dummy*, the *50-mile dummy*, the interaction term between the number of financing rounds and the *100-mile dummy*, the *100-mile dummy*, the interaction term between the number of financing rounds and the *150-mile dummy*, the *150-mile dummy*, the number of VC investors, the natural logarithm of *firm assets*, the natural logarithm of *firm's age* when it receives the first round of VC financing, the *earlier-stage dummy*, *industry average market-to-book ratio*, *industry average R&D intensity*, *industry average tangibility of assets*, and VC reputation variables. In Panel B, the independent variables are the number of financing rounds, the interaction term between the number of financing rounds and the *San Francisco dummy*, the *San Francisco dummy*, the interaction term between the number of financing rounds and the *Boston dummy*, the *Boston dummy*, the interaction term between the number of financing rounds and the *New York dummy*, the *New York dummy*, the interaction term between the number of financing rounds and the metropolitan dummy, the metropolitan dummy, the *number of VC investors*, the natural logarithm of *firm assets*, the natural logarithm of *firm's age* when it receives the first round of VC financing, the *earlier-stage dummy*, *industry average market-to-book ratio*, *industry average R&D intensity*, *industry average tangibility of assets*, and VC reputation variables. Definitions of variables are discussed in Appendix D. Data about entrepreneurial firms and VC investors are obtained from the VentureXpert database. Heteroskedasticity-robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable: IPO versus acquisition dummy									
	Panel A					Panel B			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
No. of rounds	−0.245***	−0.304***	−0.207***	−0.150***	−0.128***	0.006***	0.006***	0.006***	0.006***
	(0.064)	(0.060)	(0.050)	(0.042)	(0.039)	(0.002)	(0.002)	(0.002)	(0.002)
*No. of rounds*Ln(1+Distance)*	0.048***								
	(0.011)								
Ln(1+Distance)	−0.304***								
	(0.052)								
*No. of rounds*25-mile dummy*		0.408***							
		(0.076)							
25-mile dummy		−0.188***							
		(0.053)							
*No. of rounds*50-mile dummy*			0.310***						
			(0.068)						
50-mile dummy			−0.131***						
			(0.039)						
*No. of rounds*100-mile dummy*				0.243***					
				(0.059)					
100-mile dummy				−0.144***					
				(0.032)					
*No. of rounds*150-mile dummy*					0.219***				
					(0.057)				
150-mile dummy					−0.143***				
					(0.028)				
*No. of rounds*San Francisco dummy*						0.002			
						(0.001)			
San Francisco dummy						−0.002			
						(0.001)			
*No. of rounds*Boston dummy*							0.003		
							(0.002)		
Boston dummy							−0.009		
							(0.007)		
*No. of rounds*New York dummy*								−0.003	
								(0.003)	
New York dummy								0.031**	
								(0.013)	
*No. of rounds*Metropolitan dummy*									0.002
									(0.001)
Metropolitan dummy									0.002
									(0.005)

Table 9 (*continued*)

Dependent variable: IPO versus acquisition dummy

	Panel A					Panel B			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
No. of investing VCs	0.003	0.004	0.004	0.004	0.004	0.004***	0.005***	0.004***	0.004***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(*firm age at round one*)	0.050***	0.050***	0.048***	0.052***	0.054***	−0.010***	−0.010***	−0.010***	−0.010***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.001)	(0.001)	(0.001)	(0.001)
Earlier-stage dummy	0.067*	0.069	0.091**	0.078**	0.085**	−0.018***	−0.017***	−0.018***	−0.018***
	(0.037)	(0.048)	(0.042)	(0.039)	(0.037)	(0.004)	(0.004)	(0.004)	(0.004)
Industry market/book ratio	−0.003*	−0.003*	−0.003*	−0.003*	−0.003*	−0.000*	−0.000*	−0.000*	−0.000*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Industry R&D/assets ratio	−0.086**	−0.088**	−0.080**	−0.086**	−0.093**	−0.003	−0.003	−0.003	−0.003
	(0.043)	(0.037)	(0.037)	(0.038)	(0.039)	(0.003)	(0.003)	(0.003)	(0.003)
Industry asset tangibility	0.202*	0.120	0.083	0.136	0.146	0.034**	0.032**	0.032**	0.034**
	(0.119)	(0.140)	(0.124)	(0.116)	(0.114)	(0.015)	(0.015)	(0.015)	(0.015)
Ln(*firm assets*)	0.025***	0.026***	0.024***	0.025***	0.024***	0.007***	0.007***	0.007***	0.007***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)
VC reputation controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year, ind., and (state) fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lead VC fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,792	4,792	4,792	4,792	4,792	4,792	4,792	4,792	4,792
Pseudo-R^2	0.458	0.458	0.455	0.456	0.456	0.453	0.453	0.454	0.453

the interaction terms between the number of VC financing rounds and the close-knit community variables. If the hold-up hypothesis is supported, the coefficient estimates of the interaction terms should be positive and significant, that is, VC staging increases the entrepreneurial firm's probability of going public instead of being acquired if the firm is located in a close-knit community. In column 6 of Table 9, the coefficient estimate of the interaction term between the number of financing rounds and the San Francisco dummy is positive but not statistically significant, which suggests that the marginal effect of VC staging on the firm's propensity to go public is not different for firms located in the San Francisco area and those in other areas. Similar results are found in columns 7 through 9 of Table 9, which show the interaction of the number of financing rounds with the Boston dummy, the New York dummy, and the metropolitan dummy, respectively. Overall, the evidence is not consistent with the implications of the hold-up hypothesis.

In untabulated regressions, I replace the dependent variable with the IPO exit dummy and examine the consequence of VC staging on an entrepreneurial firm's exit choice between IPO and acquisition or write-off. Similar to the findings reported in Panel A of Table 9, the coefficient estimates of the number of VC financing rounds are negative and significant at the 1% level, and those of the interaction terms are positive and significant at the 1% level in all columns. The evidence suggests that a larger number of rounds of VC financing decreases an entrepreneurial firm's probability of going public (rather than being acquired or being written off) if it is located close to the VC investor, but the effect of VC staging on the firm's probability of going public is the opposite if it is located far away from the VC investor. For example, if the firm's distance to its VC firms is closer than 25 miles, increasing one more round of financing reduces its probability of going public instead of being acquired or being written off by 14%. On the other hand, if the firm is located outside of the 25-mile radius from its VC investors, one more round of financing increases its probability of going public by 5%. I also find similar results regarding the tests for the hold-up hypothesis. The coefficient estimates of the interaction terms between the number of rounds and the close-knit community dummies are not statistically significantly different from zero, suggesting that the marginal effect of staging on a firm's propensity to go public instead of being acquired or written off is not different for firms located in a close-knit community relative to other areas.

5.2. *Operating performance*

In this and the following sections, I restrict my sample, due to data availability, to the entrepreneurial firms that exit by going public. The current section examines how VC staging affects their operating performance in the IPO year. The monitoring hypothesis predicts a positive impact of staging on the firm's operating performance if the firm is far away from the VC investor, and a negative impact of staging if the firm is located close to the VC investor. On the other hand, the learning hypothesis

Table 10
Relationship between IPO year operating performance and financing rounds.

This table reports the regressions for the operating performance of VC-backed IPO firms in the IPO year for a sample of VC-backed IPO firms that went public between 1980 and 2005. The dependent variables are an IPO firm's ROA, ROE, and Sales margin in the IPO year, respectively. In Panel A, the independent variables are the *number of financing rounds*, the interaction term between the *number of financing rounds* and the natural logarithm of *one plus the weighted-average distance between the entrepreneurial firm and the lead VC investors*, the natural logarithm of *one plus the weighted-average distance between the entrepreneurial firm and the lead VC investors*, the *number of VC investors*, the natural logarithm of *IPO size*, the *VC incubation period*, the natural logarithm of *firm age* in the IPO year, the natural logarithm of *VC total investment*, the *number of analysts* following the IPO firm, the *number of institutional investors investing in the IPO firm*, the *underwriter reputation*, the *IPO firm's R&D intensity*, the *IPO firm's capital expenditure*, and *VC reputation variables*. In Panel B, the independent variables are the *number of financing rounds*, the interaction term between the *number of financing rounds and the metropolitan dummy*, the *metropolitan dummy*, the *number of VC investors*, the natural logarithm of *IPO size*, the *VC incubation period*, the natural logarithm of *firm age* in the IPO year, the natural logarithm of *VC total investment*, the *number of analysts* following the IPO firm, the *number of institutional investors investing in the IPO firm*, the *underwriter reputation*, the *IPO firm's R&D intensity*, the *IPO firm's capital expenditure*, and *VC reputation* variables. Definitions of variables are discussed in Appendix D. Data about entrepreneurial firms and VC investors are obtained from the VentureXpert database. Heteroskedasticity-robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Panel A			Panel B		
Dependent variable	ROA	ROE	Sales margin	ROA	ROE	Sales margin
	(1)	(2)	(3)	(4)	(5)	(6)
No. of rounds	−0.123***	−0.125***	−0.094***	0.005	0.030	−0.008
	(0.022)	(0.033)	(0.032)	(0.004)	(0.062)	(0.059)
*No. of rounds**Ln(*1+Distance*)	0.021***	0.022***	0.017***			
	(0.004)	(0.006)	(0.005)			
Ln(*1+Distance*)	−0.131***	−0.026	−0.026			
	(0.013)	(0.019)	(0.019)			
*No. of rounds*Metropolitan dummy*				−0.001	0.038	0.058
				(0.004)	(0.059)	(0.057)
Metropolitan dummy				−0.030**	−0.050	−0.068
				(0.013)	(0.194)	(0.187)
No. of investing VCs	−0.301***	−0.214***	−0.205***	−0.340***	−1.493***	−1.641***
	(0.024)	(0.035)	(0.034)	(0.021)	(0.312)	(0.300)
Ln(*IPO size*)	−0.115***	−0.014	−0.016	−0.090***	−0.322***	−0.265**
	(0.009)	(0.014)	(0.013)	(0.008)	(0.123)	(0.118)
VC incubation period	0.021***	0.007***	0.006**	0.011***	0.028	0.030
	(0.002)	(0.003)	(0.003)	(0.002)	(0.023)	(0.022)
Ln(*firm age at IPO year*)	0.010***	0.003*	0.003**	0.006***	0.046***	0.042***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.016)	(0.015)
Ln(*VC total investments*)	0.069***	0.419***	0.406***	0.705***	3.062***	3.376***
	(0.014)	(0.071)	(0.069)	(0.044)	(0.647)	(0.623)
No. of analysts	0.002	−0.006	−0.003	−0.022***	0.046	0.027
	(0.004)	(0.007)	(0.006)	(0.003)	(0.046)	(0.044)
No. of institutional investors	−0.000	0.000	0.000	−0.000	0.006	0.004
	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.004)
Underwriter reputation	0.110***	−0.008	−0.002	0.082***	0.020	0.023
	(0.007)	(0.010)	(0.010)	(0.006)	(0.088)	(0.085)
R&D/assets	−0.186***	−0.254***	−0.205**	−0.161**	−2.307**	−1.899**
	(0.063)	(0.095)	(0.092)	(0.066)	(0.957)	(0.921)
Capital expenditure/assets	0.184*	0.235	0.408***	−0.398***	3.597***	4.552***
	(0.100)	(0.151)	(0.145)	(0.077)	(1.126)	(1.084)
Constant	0.135*	0.218*	0.171	−0.338***	−0.032	−0.020
	(0.078)	(0.116)	(0.112)	(0.060)	(0.870)	(0.837)
VC reputation controls	Yes	Yes	Yes	Yes	Yes	Yes
Year, ind., and (state) fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Lead VC fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,692	1,692	1,692	1,692	1,692	1,692
R^2	0.056	0.072	0.074	0.042	0.059	0.068

predicts that VC staging is independent of a firm's operating performance in the IPO year, regardless of the geographic distance. Finally, the hold-up hypothesis implies that VC staging is positively related to an entrepreneurial firm's operating performance if the firm is located in a close-knit community.

Table 10 reports the regression results. Panel A is meant to disentangle the implications of the monitoring hypothesis and the learning hypothesis. In column 1, the dependent variable is an IPO firm's return on assets (ROA) in the IPO year. The main variables of interest are the number of financing rounds and the interaction term between the number of financing rounds and the natural logarithm of the IPO firm's distance from its lead VC investors. Consistent with the monitoring hypothesis, the coefficient estimate of the number of financing rounds is negative and significant at the 1% level, and that of the interaction term is positive and significant at the 1% level. The evidence suggests that VC staging positively affects an IPO firm's operating performance in the IPO year only if

the VC investor's monitoring costs are high (i.e., the VC investor's distance to the entrepreneurial firm is long). If it is less costly for the VC investor to monitor the firm, fewer financing rounds will positively affect the IPO firm's operating performance. For example, based on the coefficient estimates reported in column 1 of Table 10, the impact of VC staging on the IPO firm's ROA in the IPO year is negative initially but turns positive when the value of Ln(1+Distance) is greater than 5.86 (5.86=0.123/0.021), which is equivalent to *Distance* being greater than 350 miles. In the untabulated regressions, I find similar results if the driving distance dummies and the interaction terms between the number of financing rounds and the driving distance dummies are used instead in the regressions.

For robustness, I construct two alternative operating performance measures for the IPO firms, that is, return on equity (ROE) and sales margin in the IPO year, and replace the dependent variable with these two operating performance measures in the regressions. I report the regression results in columns 2 and 3, respectively, of Table 10. The coefficient estimates of the number of financing rounds continue to be negative and significant, and those of the interaction term are positive and significant at the 1% level. The results, once again, are consistent with the monitoring hypothesis.

I test the predictions of the hold-up hypothesis in Panel B of Table 10. The structure of Panel B is parallel to that of Panel A, with the main independent variables replaced with the metropolitan dummy and the interaction term between the number of financing rounds and the metropolitan dummy. If the hold-up hypothesis is supported, I expect to observe a positive and significant coefficient estimate of the interaction term. However, in columns 4 through 6 of Table 10, none of the coefficient estimates of the interaction terms are statistically significant. Therefore, I cannot reject the null hypothesis that VC staging does not affect a firm's operating performance in the IPO year differently, regardless of whether or not the firm is located in a close-knit community area. In untabulated regressions, I replace the metropolitan dummy with the San Francisco, Boston, and New York dummies and find similar results.

5.3. Post-IPO survival

This section studies the consequences of VC stage financing by examining long-term post-IPO performance. Specifically, I focus on the firm's post-IPO survival rate. Bhattacharya, Borisov, and Yu (2010) show that the first 3 years after a firm goes public are critical to its long-term survival. They find that the death rates of U.S. public firms increase with age, peak at 3 years with a death rate of 6%, and then decrease with age. Therefore, if the monitoring hypothesis is supported, I expect that VC stage financing increases an IPO firm's long-term survival rate if the entrepreneurial firm is located far away from the VC investor, and decreases its survival rate if the firm is located close to the VC investor. On the other hand, the learning hypothesis predicts that VC staging is independent of a firm's post-IPO survival rate, regardless of distance. Finally, the hold-up hypothesis implies that VC staging is positively related to an entrepreneurial firm's post-IPO survival rate if the firm is located in a close-knit community.

Based on the finding reported in Bhattacharya, Borisov, and Yu (2010), I construct a delisting dummy that equals one if an IPO firm is delisted due to liquidation (the Center for Research in Security Prices (CRSP) delisting code DLSTCD between 400 and 499 or between 520 and 600) within 3 years after the IPO date, and zero otherwise. Table 11 reports the probit regression results, with the delisting dummy as the dependent variable. Once again, I report the marginal effects of independent variables.

Panel A of Table 11 tests the predictions of the monitoring hypothesis as well as of the learning hypothesis. The main independent variables are the number of financing rounds and the interaction term between the number of financing rounds and distance variables. Consistent with the monitoring hypothesis, the coefficient estimates of the number of financing rounds are positive and significant at the 1% level, while those of the interaction terms are negative and significant at the 1% or 5% level. The evidence suggests that VC staging reduces an IPO firm's probability of delisting from stock exchanges due to liquidation 3 years after the IPO only if the VC investor's monitoring costs are high (i.e., the VC investor's distance to the firm is long). On the other hand, if it is less costly for the VC investors to monitor the firm, fewer financing rounds reduce the firm's probability of delisting. For example, based on the coefficient estimates reported in column 2 of Table 11, if the firm's distance to its VC firms is closer than 25 miles, increasing one more round of financing increases its probability of delisting by 0.3%. However, if the firm is located outside of the 25-mile radius from its VC investors, one more round of financing decreases its post-IPO delisting probability by 0.1% ($-0.001=0.003-0.004$).

Panel B of Table 11 tests the predictions of the hold-up hypothesis. The main independent variables are the interaction terms between the number of financing rounds and the close-knit community variables. If the hold-up hypothesis is supported, that is, VC staging improves the entrepreneurial firm's performance if the firm is located in a close-knit community, I expect the coefficient estimates of the interaction terms to be negative and significant. Although three out of four coefficient estimates of the interaction terms in columns 6 through 9 in Table 11 are negative, none of them are statistically significant. Overall, there is no support for the implications of the hold-up hypothesis.

In summary, the reported evidence in this section suggests that the impact of VC staging on the entrepreneurial firm's performance depends on the monitoring costs of the VC investor. The evidence is consistent with the implications of the monitoring hypothesis.

6. Conclusion

This paper examines the causes and consequences of VC stage financing. Using information about the geographic location of an entrepreneurial firm and the distance between the VC investor and the firm, I distinguish between three different hypotheses: the monitoring hypothesis, which argues that the VC staging and

Table 11
Relationship between post-IPO delisting probability and financing rounds.

This table reports the regressions for the entrepreneurial firm's probability of being delisted from stock exchanges within three years after the IPO date. The dependent variable is the delisting dummy. In Panel A, the independent variables are the *number of financing rounds*, the interaction term between the *number of financing rounds and the natural logarithm of one plus the weighted-average distance between the entrepreneurial firm and the lead VC investors*, the natural logarithm of *one plus the weighted-average distance between the entrepreneurial firm and the lead VC investors*, the interaction term between the *number of financing rounds and the 25-mile dummy*, the *25-mile dummy*, the interaction term between the *number of financing rounds and the 50-mile dummy*, the *50-mile dummy*, the interaction term between the *number of financing rounds and the 100-mile dummy*, the *100-mile dummy*, the interaction term between the *number of financing rounds and the 150-mile dummy*, the *150-mile dummy*, the *number of investing VC investors*, the natural logarithm of *IPO size*, the *VC incubation period*, the natural logarithm of *firm age* in the IPO year, the natural logarithm of *VC total investment*, the *number of analysts* following the IPO firm in the IPO year, the *number of institutional investors investing in the IPO firm in the IPO year*, the *underwriter reputation*, the *IPO firm's R&D intensity in the IPO year*, the *IPO firm's capital expenditure in the IPO year*, and *VC reputation* variables. In Panel B, the independent variables are the *number of financing rounds*, the interaction term between the *number of financing rounds and the San Francisco dummy*, the *San Francisco dummy*, the interaction term between the *number of financing rounds and the Boston dummy*, the *Boston dummy*, the interaction term between the *number of financing rounds and the New York dummy*, the *New York dummy*, the interaction term between the *number of financing rounds and the metropolitan dummy*, the *metropolitan dummy*, the *number of investing VC investors*, the natural logarithm of *IPO size*, the *VC incubation period*, the natural logarithm of *firm age in the IPO year*, the natural logarithm of *VC total investment*, the *number of analysts* following the IPO firm in the IPO year, the *number of institutional investors investing in the IPO firm in the IPO year*, the *underwriter reputation*, the *IPO firm's R&D intensity in the IPO year*, the *IPO firm's capital expenditure in the IPO year*, and *VC reputation* variables. Definitions of variables are discussed in Appendix D. Data about entrepreneurial firms and VC investors are obtained from the VentureXpert database. Heteroskedasticity-robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable: delisting dummy									
	Panel A					Panel B			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
No. of rounds	0.003***	0.003***	0.002***	0.002***	0.002***	0.000	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
*No. of rounds*Ln(*1+Distance*)	−0.001**								
	(0.000)								
Ln(*1+Distance*)	0.001								
	(0.001)								
*No. of rounds*25-mile dummy*		−0.004***							
		(0.001)							
25-mile dummy		0.005							
		(0.009)							
*No. of rounds*50-mile dummy*			−0.003***						
			(0.001)						
50-mile dummy			0.005						
			(0.007)						
*No. of rounds*100-mile dummy*				−0.003**					
				(0.001)					
100-mile dummy				0.005					
				(0.007)					
*No. of rounds*150-mile dummy*					−0.003**				
					(0.001)				
150-mile dummy					0.005				
					(0.005)				
*No. of rounds*San Francisco dummy*						0.000			
						(0.000)			
San Francisco dummy						0.001			
						(0.001)			
*No. of rounds*Boston dummy*							−0.001		
							(0.001)		
Boston dummy							0.007		
							(0.008)		
*No. of rounds*New York dummy*								−0.003	
								(0.003)	
New York dummy								0.001	
								(0.000)	
*No. of rounds*Metropolitan dummy*									−0.000
									(0.000)
Metropolitan dummy									0.000
									(0.001)
No. of investing VCs	−0.001	−0.001	−0.001	−0.001	−0.001	0.007	0.010*	0.009	0.009
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)	(0.006)	(0.006)	(0.006)
Ln(*IPO size*)	0.001**	0.002**	0.002**	0.002**	0.001**	0.001	0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
VC incubation period	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000*	−0.000**	−0.000**	−0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln(*firm age at IPO year*)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Table 11 (*continued*)

Dependent variable: delisting dummy

	Panel A					Panel B			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
No. of analysts	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
No. of institutional investors	−0.000***	−0.000*	−0.000*	−0.000**	−0.000***	−0.000***	−0.000***	−0.000***	−0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Underwriter reputation	−0.000	−0.000	−0.000	−0.000	−0.000	−0.001***	−0.001***	−0.001**	−0.001**
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R&D/assets	−0.002	0.000	0.001	−0.002	−0.002	−0.001	−0.000	−0.000	0.000
	(0.005)	(0.003)	(0.003)	(0.003)	(0.005)	(0.002)	(0.002)	(0.003)	(0.003)
Capital expenditure/assets	0.016**	0.022**	0.017**	0.017**	0.016**	0.016***	0.015***	0.020***	0.021***
	(0.007)	(0.011)	(0.009)	(0.009)	(0.007)	(0.004)	(0.004)	(0.005)	(0.005)
VC reputation controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year, ind., and (state) fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lead VC fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,692	1,692	1,692	1,692	1,692	1,692	1,692	1,692	1,692
Pseudo-R^2	0.675	0.684	0.686	0.681	0.682	0.550	0.557	0.530	0.532

monitoring of entrepreneurial firms are substitutes; the hold-up hypothesis, which argues that staging is a mechanism for mitigating the hold-up problem between the VC investor and the entrepreneur; and the learning hypothesis, which argues that staging creates value through the real options generated by learning by VC investors between financing rounds.

My findings on the causes of VC stage financing are as follows: A VC investor who is located farther away from an entrepreneurial firm tends to finance the firm with a larger number of financing rounds, a shorter duration between successive rounds, and with a smaller amount in each round. However, the VC investor's propensity to stage is independent of whether or not the entrepreneurial firm is located in a close-knit community. My findings on the consequences of VC staging are as follows. First, the number of VC financing rounds positively affects the entrepreneurial firm's propensity to exit through an IPO, but only if the entrepreneurial firm is located far away from the VC investor. Second, the number of VC financing rounds is positively related to the entrepreneurial firm's operating performance in the IPO year, but only if the firm is located far away from the VC investor. Third, the number of VC financing rounds positively affects the entrepreneurial firm's post-IPO survival rate, but only if the firm is located far away from the VC investor. Finally, the effect of VC staging on entrepreneurial firm's propensity to go public, operating performance in its IPO year, and post-IPO survival rate is not related to whether or not it is located in a close-knit community. These findings are robust to a variety of alternative proximity measures, instrumental variables, and econometric approaches for dealing with endogeneity problems. Overall, the evidence supports the monitoring hypothesis but is inconsistent with the hold-up and learning hypotheses.

Appendix A. Correcting the over-reporting problem of the VentureXpert database

Gompers and Lerner (2004) show that the VentureXpert database reports 28% more financing rounds than actually occurred because Thomson frequently splits financing rounds. This leads to a single financing round that could be presented as several separate financing rounds by different VC firms on different (but proximate) dates. To correct VentureXpert's over-reporting problem, I collect financial information from IPO prospectuses and S-1 registration statements for the entrepreneurial firms that go public. For the entrepreneurial firms that are acquired by public firms, I search their financial information from the acquirers' proxy, 10-K, or 10-Q statements from the Securities and Exchange Commission's (SEC) EDGAR database. For the entrepreneurial firms that are written off or still remain private, I eliminate repeated rounds within 3 months if they share the same amount of round financing. I then create a new financing round and add investing VC firms from these spurious rounds to the new financing round.

Appendix B. Distance calculation between zip codes

For each zip code in which the entrepreneurial firm is headquartered or the VC firm has a branch office, I obtain the pair of latitude and longitude coordinates (measured in degrees of decimal) to the zip code's center. Because of the Earth's near-spherical shape (technically an oblate spheroid), calculating an accurate distance between two points requires the use of spherical geometry and trigonometric math functions. I therefore convert the latitude or longitude from decimal degrees to radians by dividing the latitude and longitude values by $180/\pi$, or approximately 57.296. Because the radius of the Earth is assumed to be 6,378.8 kilometers, or 3,963 miles, I use the great circle distance formula to calculate mileage between two pairs of latitudes and longitudes:

$$3963 \times \mathrm{Arccos}[\mathrm{Sin}(Lat1)\mathrm{Sin}(Lat2) + \mathrm{Cos}(Lat1)\mathrm{Cos}(Lat2)\mathrm{Cos}(Long2-Long1)],$$

where $Lat1$ and $Long1$ represent the center of the entrepreneurial firm's zip code and $Lat2$ and $Long2$ represent the center of the VC firm's zip code.

Appendix C. Cleaning the VC-backed IPO data from the SDC Global New Issues database

Following the IPO literature, I exclude from the initial IPO sample spin-offs, closed-end funds, Real Estate Investment Trusts (REITs), American Depositary Receipts (ADRs), unit offerings, reverse Leveraged Buyouts (LBOs), foreign issues, offerings in which the offer price is less than $5, finance (SIC code between 6000 and 6999), and utilities (SIC code between 4900 and 4999). I also exclude firms with missing identities of their investing VC investors. I correct for mistakes and typos in the SDC database following Professor Jay Ritter's "Corrections to Security Data Company's IPO database," which is available on his IPO data Web site: http://bear.cba.ufl.edu/ritter/ipodata.htm.

Appendix D. Variable definitions and data sources

Number of financing rounds equals the number of VC financing rounds an entrepreneurial firm receives.

Ln(1+*Distance*) equals the natural logarithm of one plus the entrepreneurial firm's weighted-average distance from its lead VC investors. The weight used in the calculation is the investment amount provided by the VC investor.

25-*mile dummy* equals one if the weighted-average distance between the entrepreneurial firm and the lead VC investors is equal to or greater than 25 miles and zero if the distance is less than 25 miles.

50-*mile dummy* equals one if the weighted-average distance between the entrepreneurial firm and the lead VC investors is equal to or greater than 50 miles and zero if the distance is less than 50 miles.

100-*mile dummy* equals one if the weighted-average distance between the entrepreneurial firm and the lead VC investors is equal to or greater than 100 miles and zero if the distance is less than 100 miles.

150-*mile dummy* equals one if the weighted-average distance between the entrepreneurial firm and the lead VC investors is equal to or greater than 150 miles and zero if the distance is less than 150 miles.

Number of investing VCs equals the number of VC firms co-investing in an entrepreneurial firm.

Ln(*Firm assets*) equals the natural logarithm of an entrepreneurial firm's assets.

Ln(*Firm age at round one*) equals the natural logarithm of one plus an entrepreneurial firm's age when it receives the first round of VC financing. An entrepreneurial firm's age is constructed as the number of years between the firm's inception year and the first financing round year.

Earlier-stage dummy is a dummy variable that equals one if the entrepreneurial firm is in its seed/startup or early stage, and zero if the entrepreneurial firm is in its expansion, late, or buyout/acquisition stage when it receives the first round of VC financing.

To construct industry average ratios, the data collection process follows Gompers (1995). I collect annual SIC industry average from Compustat for each firm that receives VC financing. The data are matched by date and industry to each firm. The three industry average ratios are calculated as follows:

Industry market-to-book ratio is the average industry ratio of the market value of equity (Compustat item 199 multiplied by item 25) to book value of equity (item 216).

Industry R&D/assets ratio equals the average industry ratios of R&D (Compustat item 46) to assets (item 6).

Industry asset tangibility equals the average ratio of property, plant, and equipment (Compustat item 8) to total assets.

IPO dummy equals one if the entrepreneurial firm goes public and zero otherwise.

Acquisition dummy equals one if the entrepreneurial firm is acquired or merged with another firm and zero otherwise.

Write-off dummy equals one if the entrepreneurial firm is written off and zero otherwise.

I obtain the list of VC investors from the VentureXpert database. The data set contains 3,957 U.S. VC investors that invest in entrepreneurial firms during the sample period with address information available. I construct three different reputation measures employed by Hochberg, Ljungqvist, and Lu (2007) and Chemmanur, Loutskina, and Tian (2010) and two other VC reputation measures suggested by Nahata (2008) for robustness.

Ln(*Total fund under VC's management*) equals the natural logarithm of the total dollar amount raised by the VC firm since 1965.

Ln(*Total rounds the VC has participated in*) equals the natural logarithm of the total financing rounds the VC firm has participated in since 1965.

Ln(*VC firm age at round one*) equals the natural logarithm of a VC firm's age when the entrepreneurial firm receives the first round of financing from the VC firm. A VC firm's age is constructed as the number of years between the VC firm's founding year and the venture round year.

IPO capitalization share is the dollar market value of all companies taken public by the VC firm from the beginning of calendar year 1980 until a given calendar year then normalized by the aggregate market value of all VC-backed companies that went public from the beginning.

VC investment share is the dollar investment from year 1980 until a given year, then normalized by the overall aggregate investment in the VC industry in those years.

San Francisco dummy equals one if the entrepreneurial firm is located in San Francisco or San Jose and zero otherwise.

Boston dummy equals one if the entrepreneurial firm is located in Boston and zero otherwise.

New York dummy equals one if the entrepreneurial firm is located in New York City and zero otherwise.

Metropolitan dummy equals one if the entrepreneurial firm is located in San Francisco/San Jose, Boston, or New York City and zero otherwise.

Lead VC's distance to the biggest player equals the lead VC investor's geographic distance to the biggest public firms (in assets) in the entrepreneurial firm's industry.

Investment concentration index is constructed based on VentureXpert's industry classification. The VentureXpert database classifies all entrepreneurial firms into 18 industries: Agriculture/Forestry/Fish, Biotechnology, Business Services, Communications, Computer Hardware, Computer

Other, Computer Software, Construction, Consumer-Related, Financial Services, Industrial/Energy, Internet-Specific, Manufacture, Medical/Health, Other, Semiconductor/Electronics, Transportation, and Utilities. Suppose that in year t, VC firm j has $w_{i,t,j}$ portfolio firms in industry i (scaled by the total number of entrepreneurial firms in year t), and there are a total of $\overline{w}_{i,t}$ entrepreneurial firms in industry i (also scaled by the total number of entrepreneurial firms in year t). The investment concentration of VC firm j is defined as the sum of the squared deviations of $w_{i,t,j}$ relative to $\overline{w}_{i,t}$: $\sum_{i=1}^{18}(w_{i,t,j}-\overline{w}_{i,t})^2$. If the entrepreneurial firm has more than one lead VC investor, I then calculate the weighted-average investment concentration index for the entrepreneurial firm. The weight is the investment by a lead VC investor as a fraction of the total VC investment received by the entrepreneurial firm.

ROA equals net income including extraordinary items (Compustat item 172) divided by total assets.

ROE equals net income including extraordinary items divided by book value of equity.

Sales margin equals earnings before interest, taxes, depreciation and amortization (EBITDA) (Compustat item 13) divided by sales (item 12).

Ln(*IPO Size*) equals the natural logarithm of proceeds from the IPO in which proceeds equal the number of IPO shares multiplied by the offering price.

VC incubation period is the duration in years from the VC firm's first round financing date to the exit date.

Number of analysts equals the number of analysts following the IPO firm in the IPO year.

Number of institutional investors equals the number of institutional investors investing in the IPO firm in the IPO year.

Underwriter reputation equals the investment banks' reputation measure available from Professor Jay Ritter's Web site at http://bear.cba.ufl.edu/ritter/ipodata.htm.

R&D/assets equals the share of research and development in the IPO firm's total assets.

Capital expenditure/assets equals the IPO firm's capital expenditure (Compustat item 128) divided by the firm's total assets.

Delisting dummy equals one if an IPO firm is delisted due to liquidation (CRSP delisting code DLSTCD between 400 and 499 or between 520 and 600) within 3 years after the IPO date and zero otherwise.

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