Managing Performance Signals Through Delay: Evidence from Venture Capital

Indraneel Chakraborty and Michael Ewens*

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Abstract

This paper examines whether agency problems during venture capital fundraising impact investment behavior. Due to data constraints, earlier research focuses on observable fund-level actions to test for agency conflicts. However, studying actions observable to principals cannot definitively rule out the existence of agency conflicts. Using novel investment-level data, we find that venture capitalists (VCs) take actions hidden to their investors that delay revealing negative information until after raising a new fund. After fundraising is complete, writeoffs double and reinvestments in relatively worse entrepreneurial firms increase. Reputation does not mitigate this unobservable delay strategy as it is not confined to first-time funds or VCs unable to raise a new fund. The delay requires VCs to invest additional time and capital, which is costly for fund investors.

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The evaluation of managerial talent can be difficult, particularly when managers control dissemination of information. This problem is especially acute in the venture capital (VC) industry, where investment characteristics are difficult for outside investors to observe. Investors' assessment of managerial talent impacts the VC's future fundraising ability (see Chung, Sensoy, Stern, and Weisbach (2012) and Hochberg, Ljungqvist, and Vissing-Jörgensen (2014)). VCs typically raise funds from limited partners (LPs) every three to four years where a newly raised fund guarantees a performance-insensitive fee for up to ten years. This setting provides incentives to manipulate fund valuation, which may lead to inefficient capital allocation among managers. The venture capital market is an excellent laboratory to study agency problems, because researchers can observe manager's individual investment decisions in ways unavailable in most other settings. Such actions have yet to be investigated in the context of fundraising, yet they are central to understanding the extent and consequence of agency frictions.

Despite a large literature studying portfolio activity around fundraising in VC and private equity, it is still unresolved whether agency issues manifest themselves in fundraising and how reputation mitigates their effects. A major tool available to VCs is at the center of the extant studies: active inflation of the portfolio prior to fundraising. The collection of evidence bodes well for the efficiency of VC and private equity fundraising: reputation attenuates the agency costs and principals (here, LPs) discipline most bad behavior (e.g. Brown, Gredil, and Kaplan (2015) and Barber and Yasuda (2014)). Most studies show that these actions are confined to a set of low reputation, young managers. However, this active inflation or quickening of exits (Gompers (1996)) are observable actions. Such actions should rarely be used by agents given that principals can punish them for observable manipulation. Tests of whether capital providers punish observable manipulation are in fact tests of investor sophistication and information asymmetry of observable actions.

Motivated by these observations, we argue that the unit of analysis and data constraints in earlier work cannot rule out the existence of all agency costs. Instead, we explore investment-level actions that can separate out plausibly observable window-dressing actions – such as NAV inflation – from alternatives such as strategic delay. This paper asks whether reputation and experience attenuate agency issues in VC fundraising with this broader set of strategies and what if any, are the costs of such actions.

Several papers investigate how fundraising incentives relate to observable features of VC portfolios. In Gompers (1996), the more rapid exit rates of portfolio companies (i.e. grandstanding) by young VCs shows that VCs with low reputation take actions to improve the signal of their quality at a cost to their investors. Brown, Gredil, and Kaplan (2015) similarly find that any manipulation through inflation of NAVs is confined to a set of low-reputation, poor funds. Their results suggest that the reputation costs are so high for manipulation that in fact the top-performing funds *under-report* their returns to limit partners. This under-reporting is an attempt at ensuring a separating equilibrium with the low-type manipulators. Barber and Yasuda (2014) explore the timing of fundraising and current fund performance, finding that fund closings tend to occur at the peaks of investment performance. Again, low reputation GPs drive much of these patterns. We argue that these important results are evidence of investor sophistication and a lack of information asymmetry regarding observable actions rather than evidence against agency frictions.

Two issues arise in an analysis of NAV over the fundraising cycle. First, NAV summarizes the value of the unrealized portion of the portfolio that can be marked to market or kept at book value. Active manipulation manifests itself in repricing of part of the portfolio. However, investments held at book value comprises a large fraction of the NAV. Passive manipulation may simply require a manager to keep valuation stale at book value to avoid disseminating bad news. Our investment-level analysis shows that this indeed is the case, whereas fund-level analysis could not have shed light on this issue. Second, there are strong time trends in fund investments, as shown by Barrot (2014), that cannot be controlled for in a fund-level analysis. This may confound fund age effects and other exogenous characteristics with manipulation. Investment-level analysis again allows us to separate such mechanical issues from economic decisions made by managers.

This paper's main insight is that investment level actions that alter a VC's talent signal can best reveal the existence and costs of fund performance manipulation. We investigate a set of actions plausibly hidden at the time of fundraising and ask whether they change in a manner consistent with the presence of agency conflicts between VCs and investors. Next, since VCs may attempt to manage performance signals, they could be stuck in "signal-jamming" equilibrium where investors are unable to distinguish talent.[1] In the case of good performance, VCs will disclose information to bolster their assessment by investors. Thus, any hidden actions that attempt to alter performance signals should involve delaying news, specifically negative information. Also, strategies that delay revelation of negative information provide a much larger boost to reported unrealized returns than most observable strategies.[2]

The paper uses venture capital financing and fund data from VentureSource that covers the period of 1992 to 2013. The financing data include entrepreneurial firm characteristics and the relationship between the firm and each of its venture capital investors. The main sample includes 776 VC firms and 1473 funds, with investments in 7860 entrepreneurial firms and 15,688 financing events. We observe both the dates of fund closings and the size of funds over a VC's lifetime. Our sample of VCs funds for this time period are comparable to other samples used in Barber and Yasuda (2014) and Brown, Gredil, and Kaplan (2015). Multiple funds within a VC firm allow us to remove VC firm-level fixed effects, allowing comparison of fund investment within VC across funds.

To test for agency problems by delaying bad news, we focus on two strategies: (i) the timing of writing off a failed firm, and (ii) the timing of reinvestment in firms in the VC portfolio. We test for a discontinuity in VCs' incentives to alter talent signals around a fundraising event. For example, we estimate how writeoffs and investments in lower quality entrepreneurial firms changes after fundraising compared to before fundraising. To infer the quality of investments, we track the outcomes of entrepreneurial firms financed before and after fund closing. Several discontinuities emerge. After funding is secured, VCs writeoff investments more often — the rate doubles in years subsequent to fundraising. There is also delayed reinvestment in a subset of the fund's portfolio firms until after the next fund closes. These investments are done in relatively worse firms after a fund closing. The average difference in investment returns between firms in which VCs invest before

[1]See Holmstrom (1982) and Fudenberg and Tirole (1986) for a general discussion and Stein (1989) for a discussion in the context of earnings management.

[2]A common observable strategy of valuation inflation has a limited impact, since the mean Internal Rate of Return (IRR) of firms in VC fund is 14.1% in our sample. Thus, very high writeups on investments to boost fundraising potential will be met with skepticism by investors. In contrast, delaying negative information about a writeoff (i.e., -100% return) improves reported returns seven times more than a doubling of an investment's book value (for a hypothetical ten investment fund). With nearly 50% of entrepreneurial firms in our sample failing, delaying an investment writeoff provides a large boost to reported, unrealized performance.

their own funding and the firms in which they invest after fund closing is approximately 15%. The results use variation across funds and within VC firms, thus controlling for unobserved heterogeneity of VCs. Overall, agency problems exist between VCs and their investors. The problems manifest themselves through VCs selectively delaying reinvestment in worse firms and writeoff decisions.

The delayed writeoffs and reinvestments are costly to VCs and ultimately LPs through suboptimal allocation of additional resources (VC effort and capital). If a VC delays shutting down an entrepreneurial firm, then that firm should fail after a longer period of time and use more capital and financings to reach failure. Entrepreneurial firms written off immediately after fund closings indeed raise 21% more capital and more financing rounds than similar firms written off immediately prior. The capital equates to almost 2% of the median fund size for the delay of one investment, and average delay of writeoff is nearly six months, which is 16% longer than average. The additional costs provide evidence for deadweight loss to investors. This also demonstrates that increases in writeoffs and reinvestments after fund closing are driven by incentives to delay rather than bundling of bad news or portfolio size constraints.[3]

Next, we empirically characterize the VC talent-signaling equilibrium in the presence of hidden actions. Delay strategies are not limited to VCs who fail to raise their next fund. Similarly, VCs continue to pursue delay strategies over time, even after they have established a reputation through multiple fund closings. Thus, there is little evidence that reputation mitigates delay strategies. Such patterns are consistent with "signal-jamming equilibrium." Here, investors are unable to distinguish talent in the face of negative signals, and thus it is optimal for all managers to employ hidden actions to improve talent signals. The cost of delay to VC funds suggests that investors and VCs are stuck in a situation similar to a prisoner's dilemma (see Stein (1989)). VCs face a tradeoff: suffer deadweight losses due to the signal-jamming strategy or risk getting branded as a less talented VC by LPs — ultimately lowering fundraising potential. The average VC in our sample chooses the former at a cost of fund capital.

The evidence does not imply inefficient capital allocation in VC markets in the long run. An analysis of longer term response to fund performance reveals that as delayed news is revealed, LPs

[3]See Rajan (1994) and Grenadier, Malenko, and Strebulaev (2014) for a discussion of bundling bad news in two different contexts.

can distinguish VC talent. Delayed writeoffs have a real impact on total fund N performance, which is observable to LPs when Fund $N+2$ is raised. More writeoffs events and less writeups in Fund N predict a lower probability of successfully raising the next fund ($N+2$), and if raised, it is smaller. Thus, even though there is signal jamming in the short run, a separating equilibrium emerges in the long run. The presence of both is likely a result of noisy nature of signals (e.g., performance, initial public offerings) and the limited number of fundraising interactions between investors and VCs.

The results are robust to several alternative explanations. Fundraising often follows market cycles, with VCs raising more funds at market peaks. Market timing could result in mean reversion and thus mechanical increases in writeoffs and reinvestments in worse investments absent agency frictions. We find that the results are robust to excluding funds raised in "hot" markets. VC funds tend to alter their investment strategy as they age and could thus be a confounding factor in our analysis (e.g., Barrot (2014)). We address this first with a hazard specification suited for any basic trends of failure or reinvestment for entrepreneurial firms. In addition, the estimation include a robust set of controls for fund age trend and any breaks in trends.

This paper contributes to the literature on VC performance management and reputation.[4] Researchers have investigated observable actions by VCs to alter talent signals, such as valuation inflation or performance management, and any response by LPs. Brown, Gredil, and Kaplan (2015) show that some PE funds inflate valuation during fundraising; however, LPs see through the behavior. In contrast, Jenkinson, Sousa, and Stucke (2013) argue that PE funds are conservative except during fundraising. We confirm that observable actions that could improve fund valuation are indeed rare. At the same time, we expand the set of strategies available to VCs, to search for manifestations of agency conflicts between VCs that are fundraising and their LPs. Gompers (1996) considers potentially unobservable quickening of exits; however, such actions occur before the next fund closes. The new strategies of delayed writeoffs and reinvestment in this paper show that hidden actions can be a powerful tool for VCs.

In contemporaneous work, Barber and Yasuda (2014) find that small, young, and low-reputation

[4] Information management is also found in other sectors of the economy. See Cohen, Lou, and Malloy (2014) for a study of strategic selection of analysts by managers.

firms time fundraising activities with periods of peak performance. Our contribution is to highlight the specific investment-level actions taken within funds and unobservable to LPs that can explain both the lack of inflation and post-closing changes. We can identify strategic delay due to agency conflicts as the reason behind observable fund characteristics, while also revealing the costs of these actions. Studies demonstrate changes in investments around fund cycles that mimic patterns studied here. Barrot (2014) investigates how VC fund horizon affects the age and riskiness of its investments, while Robinson and Sensoy (2013) study how distributions from VCs to LPs interact with fee timing to reveal additional agency problems between investors and fund managers. This paper focuses on how investment behavior maps to fundraising incentives and the resulting signaling equilibrium.

1 Hypothesis development

Consider a venture capital firm raising its next fund. It provides performance data on its earlier and current fund to prospective investors (LPs). We ask whether current fund investment strategy responds to the fundraising activity of the investor's next fund. Chung, Sensoy, Stern, and Weisbach (2012) and Hochberg, Ljungqvist, and Vissing-Jörgensen (2014) show that these investors respond to both realized and unrealized performance metrics. The latter metrics — the value of investments in the current fund that have yet to realize a return — are potentially subject to manipulation by the VC. There are two classes of strategies available to alter the signals of their performance. The first class involves direct inflation of the current portfolio net asset value (NAV) through marking up investments on the books or reinvesting at higher valuations. Importantly, the outcome of each is observable to the limited partner during the fundraising process. The literature discussed above finds that these actions are confined to low-reputation managers, which supports the Hölmstrom (1979) argument that the optimal policy of the principal (LPs) depends on all available information about an agent's actions. A second class of strategies more closely maps to the hidden actions in a standard principal-agent problem (e.g., Holmstrom and Milgrom (1987)). Here, VCs take unobservable actions that indirectly and temporarily inflate the unrealized portion of the portfolio. The information is revealed after the fundraising decision.

The portfolio strategies we consider impact the timing of the revelation of "bad news." Consider a case where the VC has positive information about fund performance. Here, it is optimal for the VC to reveal any truthful good news before fundraising. LPs may discount unreliable or non-market increases in valuation before fundraising, while sophisticated LPs may even punish VCs who alter NAV.[5] Suppose that the VC receives a private negative signal about portfolio performance such as a failing entrepreneurial firm. If delayed revelation is possible and unobservable by their investors, VCs may delay to avoid this signal about their talent. As this delay is observable only to the VC, they should avoid contemporaneous punishment. Such behavior benefits the agent (VC) at the expense of the LP, and is thus an agency conflict.

What strategies emerge when VCs control the timing of revelation of information, and LPs know that there are at least two types of VCs? If a talented VC discloses bad news about the portfolio before fundraising, an LP cannot differentiate such a signal as a negative shock to a good VC, compared to a rather expected performance signal of a lesser talented VC.[6] Thus, no VC will find it optimal to disclose bad news during fundraising. The result is a pooling equilibrium where all VCs delay signals about bad news to avoid being classified as low types. As in Stein (1989), investors infer that this is the information disclosure regime during fundraising and presumably discount all investors in some manner. Such a conclusion does not imply that LPs cannot identify talent levels. Instead, VC types are revealed eventually by verifiable signals sent after fundraising.

Throughout this section, we make two assumptions regarding (i) limited partners' ability to ascertain talent and (ii) the typical VC fund's portfolio composition.

A1: *Limited partners incorporate all observable signals in performance evaluation and can punish manipulation.*

As shown by Sahlman (2010), a small fraction of VC investments drive fund returns, while most investments earn less than capital invested. We assume that at each investment decision, the VC invests rationally (i.e. only in positive NPV project) but has a ranking of quality in her portfolio prior to investment exits.

A2: *The average VC fund has investments of varying quality.*

[5] Lerner, Schoar, and Wong (2007) show a hierarchy in the set of LPs investing in private equity.
[6] This holds because it is not costlier for less talented VCs to also reveal bad news.

1.1 Active valuation inflation

The first strategy that we consider is inflation of the unrealized portion of the portfolio, which is reflected in aggregate NAV. These increases typically require a new investment in an entrepreneurial firm and often the presence of a new investor.[7] Without a writeup, investments are typically kept at or near the prior valuation. Earlier work using quarterly NAV changes includes both these reevaluations from new investment and other book reevaluations, which cannot be separated empirically. Under assumption (A1), we formulate the major hypothesis thus far tested in the literature concerning inflation and reputation for investment-based inflation:

H1: *Venture capital funds with high reputation do not actively increase valuations of investments in their fund prior to fundraising.*

Here, only low reputation firms benefit from manipulation, presumably with the hope that they can avoid punishment in the short-run.

1.2 Strategically timed writeoffs

Positive changes in valuation of investments are not the only tool available to a VC fund. The most common outcome for a VC-backed entrepreneurial firm is failure. For example, in our data of 20,600 returns, 12,069 returned less than 25 cents to the dollar invested.[8] VCs have partial control on the timing of bad outcomes in their portfolio. Given some cost of supporting a struggling investment, and one would predict a rational VC will writeoff investments when they believe their equity value is zero. The nature of disclosure between VC and LPs means that the former is only one who can observe delay of writeoffs.

The benefits of delaying information regarding an eventual firm writeoff can be large. In a fund portfolio of ten investments, keeping just one investment at book instead of zero has seven times the impact on reported IRR than inflating that same investment two times.[9] Delay mimics the

[7]After the passage of FAS157, it is difficult for venture capitalists to write up parts of their portfolio without some "market" pricing event.

[8]The sample of returns has positive selection bias for non-zero returns and perfect coverage of zero outcomes. Thus, the returns distribution does not map directly to the firm outcome distribution.

[9]The mean IRR of firms in an average VC fund in our sample is 14.1%. Delaying negative information about a writeoff (i.e., -100% return) improves reported returns seven times more than a doubling of an investment's book value to an IRR of 28% (for the hypothetical ten investment fund).

"conservative approach" taken by many VCs during fundraising: maintain the portfolio at book value, leading to the following hypothesis:

H2: *Writeoffs of investments increase after the next fund closes.*

An increase in writeoffs after fundraising could stem from our proposed agency frictions or other non-agency explanations. The next two hypotheses consider these options. Under the agency frictions hypothesis, writeoffs are delayed past the optimal time. VC investors keep some investment on their books until after the next fund closes:

H2a: *An increase in writeoffs after fundraising is driven by active delay in the realization of failure.*

The alternative to (H2a) is that the increase in writeoffs stems not from delay, but rather bundling or VC capacity constraints. VCs invest human and organizational resources to manage firms in their funds, and are thus constrained in terms of their human capital. Upon raising the next fund, the VC must choose where to exert effort. If the average quality of new investments exceeds that of a subset in the current portfolio (A2), then they will write off the latter. Alternatively, an increase in writeoffs could stem from a desire to realize bad news after the positive news shock of a new fund. For example, Rajan (1994) shows that banks realize bad loans in adverse states of the economy when reputation is less important. Grenadier, Malenko, and Strebulaev (2014) provide a real options model where agents time abandonment decisions to match shocks that are publicly known, in an effort to protect their reputation. Kothari, Shu, and Wysocki (2009) show that firm management, on average, delays the release of bad news to investors.[10] The next hypothesis predicts the increase in writeoffs follows from bundling or time constraints:

H2b: *A new fund leads to effort capacity constraints for the VC or an opportunity to bundle bad news with good. This leads to an increase in previous fund writeoffs.*

Separating (H2a) and (H2b) requires documenting the characteristics of the investments written off around the next fund closing. Under (H2a), writeoffs are delayed after fund closing and will thus be older and more capitalized because the VC had to support the investment longer. Under (H2b) the increase in writeoffs after fund closing are not delayed, but rather sped up in response

[10] On the other hand, Acharya, DeMarzo, and Kremer (2011) show theoretically that bad market news can trigger immediate disclosure by firms.

to bundling benefits or effort provision. Thus, we would predict failures in this period to occur for younger investments with lower capitalizations. Whatever the conclusion, both hypotheses suggest agency problems in fundraising.

1.3 Selective reinvestment

The final hypothesis regarding investment strategy concerns the reinvestment in a subset of the VC fund's portfolio, which reveals a market price and impacts the reported NAV. In presence of heterogeneity in quality of investments in a portfolio (A2), there is value in delaying the marking-to-market of sub-par investments. We predicted in (H1) that the average VC will not actively inflate valuations. However, avoiding the pricing of relatively worse investments can indirectly improve NAV. Hence, a VC may aim to "control the message" during the fundraising period by reinvesting in the best companies (as in Gompers (1996), exiting the best investments) and delaying the reinvestment in the subset of underperforming investments.

H3: *VCs delay reinvestment in worse firms until after fundraising to delay bad news about their talent level.*

To test (H3), we will use the investment outcome – final exit valuation and exit status – as a proxy for its quality.

1.4 Reputation and investor quality

Notwithstanding our argument that the strategies of delaying bad news are unobservable to the LP and beneficial to fundraising VCs, other forces may also limit some VCs from taking such actions. First, high quality VCs may have sufficient experience and track record to be able to safely reveal failures and price all investment at the required time. Second, delaying a writeoff past the next fund closing will likely cost both time and capital. High quality investors have better outside options in their portfolio, so may delay relatively less. The next hypothesis predicts that the implications of (H2) and (H3) will be confined to VCs that failed to raise a subsequent fund or to younger VC firms.

H4: *Any delayed writeoff or reinvestment is confined to low reputation or low quality investors.*

1.5 Long-run learning

The information regarding poor performance is eventually revealed, even though delayed. LPs should use this information to update their talent assessments. The final hypothesis considers the long-term assessment of VCs by investors.

H5: *The current fund performance metrics including delayed writeoffs and refinancings predicts fundraising success in the subsequent fund.*

Confirmation of this hypothesis would complement the findings of Chung, Sensoy, Stern, and Weisbach (2012) and Hochberg, Ljungqvist, and Vissing-Jörgensen (2014) who show performance matters for fundraising success. Furthermore, (H5) would confirm that any evidence in favor of agency conflicts does not imply that LPs are unsophisticated or misled in equilibrium, reconciling our findings with those of Brown, Gredil, and Kaplan (2015).

In sum, this set of hypotheses posits that given difficult-to-observe actions that can improve performance signals, VCs will delay writeoffs and reinvestments in underperforming firms. However, any short-term ability to alter performance signals is eventually revealed to LPs and reflected in later fundraising success.

2 Data

We use the venture capital financing database VentureSource provided by Dow Jones and supplemented by the quantitative VC fund Correlation Ventures. VentureSource has been supplemented with additional hand-collected data from individual VCs and LPs.[11] The combined dataset is merged with valuation data in Thompson's VentureXpert. The financing data cover equity, debt and exit events for US-based VC-backed entrepreneurial firms from 1992 through 2013. The sample includes the subset of financing events where we can observe the VC fund that provided the capital (as opposed to simply knowing the VC firm but not the specific fund). Further, we require that the VC fund makes at least one investment before and after a fund closing. The sample also excludes funds managed by private equity firms, angel groups, non-US investors, buyout funds, and corpora-

[11] For example, Correlation Ventures provides portfolio analysis for other VCs and receives portfolio data in exchange.

tions. The main sample of financings with a known US-based VC fund includes 7860 entrepreneurial firms in 15,688 financing or exit events. This sample represents 39% of all entrepreneurial firms and 31% of all financing events. These financings are merged to VC fund characteristics, for which we know the sequence of closings and the total amount of committed capital. There are 1473 unique funds associated with 776 VCs. These fund counts are quite comparable to other major studies using VC funds: there 450 VC funds in Barber and Yasuda (2014), 627 PE and VC funds in Jenkinson, Sousa, and Stucke (2013), and for a longer time series than used here, Brown, Gredil, and Kaplan (2015) have 1,047 VC funds from 1984 and onwards.

Compared to the full sample, the sample with VC fundraising data includes older entrepreneurial firms that have raised more capital in more financing rounds. The VCs in the sample have four times the investing experience (in terms of deals) as the investors without fundraising data. However, any sample selection bias goes in the opposite direction of the predictions in Section 1. There we predicted that agency frictions and information asymmetry lead VCs to strategically delay the revelation of bad news. Any selection in our sample of funds and investments will attenuate these predictions insofar as reputation and investor experience counteract the incentives and necessities to delay bad news.[12]

2.1 VCs that fail to raise a fund

The average VC in the sample has over three funds. However, many venture capitalists are unsuccessful in raising capital for a new fund when their past fund under-performs. Following Brown, Gredil, and Kaplan (2015), we include such VCs in our analysis under the assumption that they tried but failed to raise a new fund. Our predictions in Section 1 simply require that a VC intends to raise a new fund, so the inclusion of those that are unsuccessful is reasonable. A VC fund's life is often split into two periods: the investment period (years 1 to 5) and the follow-on period (years 6 to 12). The investment period involves finding new entrepreneurial firms and is thus where we expect most of the investment of fund capital. This structure informs the fund closing imputation.

One can track the capital invested by a VC fund over time to measure the capital available

[12]Similar selection issues exist in fund-level data that is sourced by public filings (e.g. Preqin). Pension funds and endowments have improved access to the largest, most successful private equity funds.

for new investments or "dry powder," which is the difference between this sum and the total committed capital. Figure 1 reports the pattern of capital available for new investments across the final sample of funds. The path of dashed line is consistent with more investment early in a fund and less investment over time as the fund matures.[13] The median (mean) dry powder of funds that successfully raised a fund in the year window around closing is 71% (68%). The number of new investments made by the fund peaks around this value of dry powder as well, which is often the time a VC begins to seek a new fund. For those funds that failed to raise a next fund, we impose the assumption that the next fund close date is the time when their current fund has invested 65% of the fund.[14]

2.2 Summary statistics

Table 2 describes the sample of entrepreneurial firms, financings, investors and funds used throughout the analysis. An entrepreneurial firm and its financings are in the sample if we can match an investor and fund to the event. The average entrepreneurial firm was founded in 1998 and raised nearly $6m in its first financing event. A quarter of the firms have failed by the end of the sample, while over 23% have still not exited. These characteristics are similar to those in the full sample of entrepreneurial firms founded in the same time period. The next panel describes the 15,688 financing events associated with these firms. The average financing happens in the year 2001 and has raised $3.1m. The typical investor is over eight years old at the time of the financing and invests out of their third fund. These characteristics show that our sample of financings leans towards older and larger VC firms.

The last two panels of Table 2 detail the set of VC firms and funds in the sample (one observation per firm and fund respectively). The typical investor first entered the market in 1996 and has made over 113 investments by the end of 2013. Finally, the funds associated with these investors were on average closed in 1999 and were followed by a subsequent fund 69% of the time.

[13]The figure does not show the full time window of 10–12 years, hence the fraction does not fall to zero. Moreover, VCs will invest in a first financing of an entrepreneurial firm and then reserve 1 - 2 times that amount for future needs. The graph only shows the investments.

[14]The results are insensitive to using a value in the range $[60, 75]$. The resulting imputation accounts for 13% of the final sample of funds. However, the exclusion of unsuccessful VCs does not materially affect our results.

2.3 Main variables

There are several variables of interest tied to the hypotheses detailed in Section 1. The main independent variable is the time around a VC fund's next fund closing. That is, for every investment made by a VC firm out of fund N, we compare its date to the date of the first close of the firm's fund $N+1$. For example, Fund N of the VC invests from 1998 to 2005. The firm's fund $N+1$ has a first close in 2001. The variable "Time to next close" is in the range $[-3, 0]$ for all investments made out of fund N between 1998 and 2001. Similarly, the post-2001 financings have a range $(0, 3]$. Figure 2 provides a visual representation of how funds overlap and investment dates are referenced. From this continuous variable, we consider the indicator "One year after fund close" which is one if the investment or other action occurred in the $[0, 1)$ period after the next fund closed. The next set of variables considers the characteristics of investments made by VCs.

An equity investment made by a venture capitalist in an entrepreneurial firm reveals a valuation. That valuation – called "post-money" – captures the total equity value of the firm. After a first investment in an entrepreneurial firm, we track the slope of changes in firm valuation with the variable "Up round." This is an indicator equal to one if the valuation of the current investment exceeds the last valuation in the previous equity financing. Any write-ups in valuation would directly improve the NAV value reported to limited partners. It is important to note that the sample of financings for which we have valuation is positively selected towards successful investments (see Korteweg and Sorensen (2010)), which we address in regressions below.

A common outcome for a VC-backed entrepreneurial firm is failure or shutdown. Some 32% of entrepreneurial firms exit in this manner, returning little, if any, capital invested to investors.[15] The variable "Writeoff" is an indicator for these failure events. The date of failure is obtained from VentureSource (the date a firm ceased operations or the last date when the firm's profile was updated) and failure dates from article of incorporation filings.[16] Reassuringly, these writeoffs occur on average 4.15 years after a firms first VC financing, which is similar to the full sample results in Puri and Zarutskie (2012) who use Census data. The Appendix provides more detail of

[15]This percentage is almost surely a conservative estimate because many acquisitions are hidden failures (see Puri and Zarutskie (2012)).

[16]We found incorporation information for over 60% of the entrepreneurial firm on their local state's business registry. These profiles often include the last date taxes or business fees were paid along with the current status of the firm.

the failure date assignment and a discussion of impacts of any measurement error issues.

The next portfolio strategy available to a VC investor is the timing of the re-investment in the entrepreneurial firm. A reinvestment in an entrepreneurial firm results in an update to the VC fund's NAV and provides a signal of the portfolio's performance. We measure delay with the variable "Years since last financing" that measures the time between a follow-on financing and the previous investment made by the VC investor. This variables forms the basis of the hazard model specification. Under (H3), we should observe an increased hazard of reinvestment in the subset of lower quality investments after the next fund closes. Of course, this reinvestment event is only defined conditional on the firm having a new financing event. The writeoff variable above covers the remaining non-financed firms.

The last set of variables concern the ultimate investment outcome of the entrepreneurial firm in the VC portfolio outside of failure. We employ three measures of firm prospects. A popular measure of success for entrepreneurial firms is whether such firms have an initial public offering (IPO) or are acquired—the latter defined as cases in which reported exit values exceed twice the capital raised by the firm. The first measure is an indicator variable that takes a value of one in case of either of these outcomes.[17] The next measure is the total value created at exit after controlling for capital raised, which proxies for return to investors (we use a conservative estimate of 10% of total capital invested in the case of failure, although our results are robust to other estimates). The final measure of firm success is the return earned in a specific financing event. "Log multiple" captures the cash-on-cash return of an equity investment accounting for any dilutive effects of follow-on financings.

3 Do these delay strategies matter?

Two underlying assumptions of our analysis concern (i) the observability of certain actions and (ii) the benefits of inaction given heterogeneity in investment quality. For (ii), it is necessary that delayed writeoffs or higher rates of write-ups (i.e. "Up round") improve a VC's chances or raising

[17]The results are robust to using simply acquisition; however, many acquisitions that lack exit valuations may be disguised failures. That is why we only include acquisitions where the exit value is larger than twice the capital raised.

a new (and larger) fund. We are interested in the specific features of fund performance available with investment-level data, which allow us to measure the specifics of the portfolio outcomes that were available to the LP at the time of the next fund closing: writeoffs, quality exits and valuation writeups.

Table 3 asks whether these three measures predict fundraising success. If we find that observable writeoffs and writeups weaken and improve the fundraising success respectively, then we have evidence suggesting that VCs have incentives to alter the timing of the outcomes. The first three columns consider the probability that a current fund raises a subsequent fund. The independent variables include the logarithm of number of writeoffs (i.e., failure), "good exits" which is the number of IPOs or high-value acquisitions and the number of "up rounds".[18] Each variable mirrors what was available to the LP at fund closing.

All coefficients in Columns (1)–(3) are consistent with predictions for delay strategies in Section 1. Column (1) shows that the higher the level of writeoffs in the pre-fundraising period, the lower the probability of fundraising. The implied marginal effects of a one standard deviation increase in the pre-close failure rate results in a 10% lower probability of a successful fund closing. Column (2) considers observable good news and reports a similar, but opposite relationship to fundraising as writeoffs. Column (3) shows a strong positive relationship between valuation writeups and fundraising success. Columns (4)–(6) ask whether the intensive margin of fundraising correlates with pre-fundraising disclosures. The conclusions are substantively the same. Column (4) shows that the size of the next fund decreases by 0.26% for each percent increase in the number of writeoffs rounds. Overall, the evidence supports our assumption that there is value in controlling the timing of writeoffs, quality exits and changes in valuation. The value of delay to general partners at VC funds is only positive if the actions are unobservable and do not lead to punishment by LPs.

[18]The quality of exit variable uses all successful exit events in a manner similar to the IPO variable in Gompers (1996).

4 Empirical strategies

The two empirical specifications are a Cox proportional hazard model and a VC firm fixed effects model. Both models exploit variation in an entrepreneurial firm's exposure to their investors' fundraising activities. To test the hypothesis that VC's time the writeoff or reinvestment of their portfolio companies, we consider first the hazard or duration model. An event is considered a failure in the hazard model setting if the entrepreneurial firm raises a new round of financing or is written off. An exit via an acquisition or public offering is treated as a censored observation. The hazard rate specification of a financing/write-off event for entrepreneurial firm i with investor j at time t is:

$$h(\tau|X_{it}, Z_{jt}) = h_0(\tau)\exp(\beta_1 \text{After fund close}_{jt} + \beta_2 X_{it} + \beta_3 Z_{jt} + \gamma_t) \quad (1)$$

The variable τ is the time since the entrepreneurial firm i has raised its last round of financing. This expression gives the instantaneous hazard of a new event occurring at time τ conditional on survival to that point. Entrepreneurial controls in X_{it} include entrepreneurial firm age and stage, and VC firm time-varying controls Z_{jt} include fund age and fund sequence controls.[19] The Cox proportional hazard model requires that the covariates multiplicatively shift the baseline hazard $h_0(\tau)$, without imposing a parametric form for the baseline. This baseline hazard is common to entrepreneurial firms across all those with investors near their fundraising events. The final specification stratifies the estimator by VC firm, which allows the baseline hazard to be unique to each investor:[20]

$$h(\tau|X_{it}, Z_{jt}) = h_{j0}(\tau)\exp(\beta_1 \text{After fund close}_{jt} + \beta_2 X_{it} + \beta_3 Z_{jt} + \gamma_t) \quad (2)$$

An important component of the controls X_{ijt} and Z_{jt} in equation (2) concern trends in VC fund investing. Studies such as Barrot (2014) find that VC portfolio characteristics adapt to fund age. Figure 3 presents two strong fund investment patterns around the fundraising cycles. First, the

[19]The main results are robust to include of fund age (year) dummies in place of age as discussed in Section 7 and shown in Tables B.1 and B.2 in the Appendix.

[20]This approach allows us to adjust for VC firm fixed effects without directly estimating them. Alternatively, one could incorporate dummy variables into the model for VC firms, however, this introduces the incidental parameters problem common in non-linear estimators.

number of new investments made by the current fund peaks at or near the closing of the VC's next fund. Similarly, the number of new follow-on investments — reinvestments in existing portfolio companies — dramatically increases after fundraising. These two patterns also produce a pattern for the age of entrepreneurial firms in the fund over time: funds have younger firms in the early years of a fund's lifecycle, and firm age increases over the fund's life. Such trends correlate with our predictions about writeoff and reinvestment rates, hence all specifications include fund age and firm age controls. Note that the hazard specification also addresses the baseline rate of each event's occurrence.

Not all portfolio strategies considered in Section 1 fit into the hazard specification. For a dependent variable Y_{ijkt}, where i is the entrepreneurial firm, j is VC firm, k is the VC fund and t represents time, we estimate the following fixed effects equations:

$$\begin{aligned} Y_{ijkt} &= \beta_0 + \beta_1 F_{kt} + \beta_2 X_{it} + \beta_3 Z_{kt} + \gamma_t + \alpha_i + \sum_{s=-4, s\neq -1}^{4} \rho_s \tau_s + \epsilon_{ijkt}. \\ Y_{ijkt} &= \beta_0 + \beta_1 F_{kt} + \beta_2 X_{it} + \beta_3 Z_{kt} + \gamma_t + \alpha_i + \rho \text{After fund close}_{jt} + \epsilon_{ijkt}. \end{aligned} \quad (3)$$

Here, Y_{ijkt} is an indicator variable for an up round or a writeoff event. The variable F_{kt} is the fund age in years, a control for trends in the fund life-cycle. The main coefficients of interest are ρ_s with time index s, which characterize the relationship between the time to the next fund close and Y_{ijkt}. This specification allows us to capture any changes in VC behavior period by period. In the second specification, we estimate one coefficient ρ to capture the difference in dependent variable Y_{ijkt} just after fundraising from the average value of the dependent variable in the remaining periods. The other controls include VC firm time-varying variables X_{it}, entrepreneurial firm characteristics Z_{kt}, time fixed effects γ_t measured at the financing events and VC firm fixed effects α_j. The inclusion of this last fixed effect is crucial for the interpretation of the estimates. These controls (detailed in Table 1) ensure that we compare the investing activity — Y_{ijkt} — across a VC's multiple funds. If any of the outcome variables do not respond to fundraising – all else equal – then the estimated coefficients $\hat{\rho}_s$ should be zero.

Identification

Here we briefly discuss the variation that identifies the coefficients of interest in Eqs. (2) and (3). The ideal experiment in our setting would be to randomly force some investors to attempt to raise a fund, while other investors are forced to wait to raise funding until some later date. We would then compare the portfolio investments of these two sets of investors over time.

In our specification, we compare entrepreneurial firm financings that have different exposure to the fundraising event of their investors. The hazard models stratify the estimation by VC firm, thus allows unobserved heterogeneity to be reflected in individual baseline hazards. The variation that identifies the "After close" coefficient requires that some set of entrepreneurial firms – otherwise observationally the same – raised capital in the years prior to the next fundraising event. This approach is a cross-sectional regression that compares entrepreneurial firms that had events – writeoffs, writeups or reinvestments – immediately after their investors closed their next fund to observationally similar firms who raised outside of this window. We do not make causal claims as we discuss the results, however, inference requires that investors cannot anticipate the time to failure ex-ante to correspond to fund closing. This is a safe assumption as the literature on VC returns shows that failure is unavoidable and difficult to forecast (e.g. Sahlman (2010) and Kerr, Nanda, and Rhodes-Kropf (2014)).

5 Portfolio strategies around fundraising

This section considers the three major investment strategies that can respond to fundraising: valuation inflation/writeups, writeoffs and reinvestment decisions.

5.1 Valuation inflation

Observed changes in NAV for unrealized investments thus far studied in the literature requires change in valuation of individual portfolio investments. Limited partners in venture capital typically require markups in valuation occur at new financing events, preferably with new outside investors. Our investment-level data allows us to test whether individual investments within a fund's portfolio exhibit changes in the probability of such writeups around fundraising. These actions are perfectly observable by their limited partners, however, some VC firms with low reputation may still gain from manipulation. We consider the variable "Up round" for each entrepreneurial financing event where data is available in the sample. Given that LPs can observe such actions and controlling for any trends over the life-cycle, we predict that there should be no relationship between fundraising and up-rounds on average but confined to low-reputation investors, i.e. (H1). However, it is possible that the rate of these financing outcomes peaks at the time of fund closing because VCs time their fundraising at peak performance (e.g. Barber and Yasuda (2014)). For example, VCs could perform a form of grandstanding (i.e. Gompers (1996)) where they rapidly reinvest in their best portfolio companies to increase overall NAV. We estimate Eq. (3) for the up round dependent variable. Figure 4 presents a basic univariate analysis of rate of up round events around fundraising averaged across all investors and Table 4 provides regression estimates.

A unit of observation is an entrepreneurial firm financing event matched to a VC fund of an investor. Controls include VC fund age and its square to control for the basic trends in the probability of these events over the fund life-cycle. The specification also includes entrepreneurial firm characteristics such as total capital stock, firm age and fixed effects for industry, financing year and the stage of the company (e.g. early vs. late development). The sample of valuations is positively selected, so we follow Korteweg and Sorensen (2010) and weight the observations by the realized exit rates.[21] Column (1) presents the basic specification with the major controls. Fund age and its square are important predictors of valuation writeups, as is the cross-sectional variation in fund size. Column (2) introduces the variable of interest "After fund close" in a probit specification. As predicted in (H1), there is no relationship between the fund closing and writeups on average. Column (3) narrows the window of analysis to the two years around fund closing with no change of results.

The last two columns of Table 4 ask whether the behavior of successful fund-raisers or younger VCs with little reputation differs from other VCs. In column (4) the indicator variable "Had next fund?" is one if the current VC fund was not followed by a new VC fund (recall that we impute

[21] In effect, the estimation puts more weight on those reported valuations from eventually failed or acquired firms relative to the over-sampled IPO'd firms.

dates of fundraising if no next fund is closed). The analysis of NAV inflation or management conducted in Brown, Gredil, and Kaplan (2015) and Barber and Yasuda (2014) show that most manipulation resides in the low reputation and unsuccessful fund-raisers. These differences in fundraising outcomes show that LPs see through these strategies and punish VCs.

The results in column (4) show that those investors who successfully raised a next fund have relatively *less* writeups prior to fund closing compared to unsuccessful VCs. This result is consistent with LPs seeing through any active inflation of NAV, punishing those who inflate their portfolio. The final column (5) consider the variable "VC's first fund" which is a dummy variable for the first fund raised by the VC firm. If low reputation VCs are more likely to inflate, then the interaction of this indicator and "After fund close" should be negative. Here, the interaction is weak but the coefficient sign is as predicted. Our regression results are consistent with those of Brown, Gredil, and Kaplan (2015) and Barber and Yasuda (2014) who show that active inflation is not found in successful fund-raisers and thus weakly consistent with (H1). This analysis provides support for the view that LPs' ability to observe direct inflation limits its use by VCs.

5.2 Writeoffs around fundraising

We next ask whether the timing of entrepreneurial firm's failure coincides with the fundraising outcomes of their investors. We posit that venture capital investors in the process of raising their next fund benefit from delaying their writeoffs (H2). Given that the average investment constitutes 10 - 15% of a VC fund, delaying a write-down to zero (typically from book value) can significantly improve reported NAV.

To begin, Figure 5 plots the rate of writeoffs around fundraising across all the funds in our sample. Each time unit on the x-axis represents a half-year interval around the next fund closing event, with the fraction of financing or exits that are writeoffs being on the y-axis. In the years prior to fund closing, the average rate of writeoffs is approximately five percent. In the year of the fund closing this rate more than doubles, followed by a significant upward trend. This univariate analysis could be explained by a host of observable features. For example, writeoffs may trend with the current fund's age that in turn relates to the date of the next fund closing.

Next, Figure 6 presents estimates from the following linear probability model where the dependent variable is an indicator for a writeoff event of entrepreneurial firm j in fund i at time t:

$$\text{Writeoff}_{ijt} = \beta_0 + \beta_1 \text{Fund Age}_{it} + \beta_2 \text{After close}_{it}(\text{Fund age}_{it} - A_i) + \hat{\beta}_3 X_{ijt} + \epsilon_{it} \tag{4}$$

where A_i is the age of fund i when the next fund closed. The vector X_{ijt} includes time-varying controls of the entrepreneurial firm. The interaction term "After $\text{close}_{it} * (\text{Fund age}_{it} - A_i)$" allows for a continuous break in the trend of writeoffs with fund age. Given a fixed fund life of a fund, VCs must liquidate investments near the end of fund. We would thus expect a positive trend of writeoff (and exit) rates with fund age. Figure 6 exhibits just such a positive trend and also has a statistically significant increase in the slope in the year of the next fund closing (i.e. $\hat{\beta}_2 > 0$). The solid line represents the predicted rate of writeoffs as a function of fund age for the estimate of Eq. (4). The dots report the residual predicted writeoff rate after controlling for the predicted impacts of both the trend and observable $\hat{\beta}_3 X_{ijt}$. As in Figure 5, we see a response of writeoff probability to the next fundraising event. Next, we address whether writeoffs respond to fundraising in a hazard specification.

We estimate the hazard model in Eq. (2) where the time variable is the years from last capital raised to either exit or another financing event measured each month. We test if the covariate of interest – "After fund close" – shifts the baseline hazard of a writeoff event. The data is structured to allow for time-varying covariates. This means that for each month between the last financing of the entrepreneurial firm and either another financing or exit, we have an observation where covariates such as firm age, fund age and time since last fund close vary. The sequence of observations stops at the failure event or end of sample. We predict that the coefficient β_1 on the post-closing variable will be positive. That is, the rate of writeoffs changes after the fund closes and the LPs can no longer incorporate fund performance into their decisions. Table 5 presents the results.

All specifications include controls for fund age trends and its square, which the estimates indicate are important. Column (1) indicates a strong trend in the rate of writeoffs as a function of fund age, attenuating slightly as the fund matures. Column (2) introduces the control "After fund close" that varies within a financing spell. The coefficient implies a 30% increase in the hazard of a writeoff relative to the baseline hazard after an investor's next fund closes. Column (3) breaks out the dynamics of the writeoff changes uses indicator variables for each of the years around fund-closing. The economically and statistically significant coefficient on "1 year after after close" indicates that writeoffs respond quickly to the funding event. The last two columns of Table 5 ask whether the results are driven by either those VCs that failed to raise their next fund or low reputation investors.

Column (4) breaks down the sample of VC funds into those that successfully closed their next fund versus those where we imputed the event. If the average LP can observe any strategic timing of writeoffs in a VC fund's portfolio, then they will punish those that pursue such a strategy, and such VCs will not raise a new fund. Thus, the coefficient on the interaction "Had next fund X After close" should be negative. We find the opposite result, suggesting that the failed fund-raisers do not drive our results. Finally, Column (5) asks whether reputation of a VC as proxied by age drives the results. Younger VCs with short investment histories should find any strategic writeoffs more beneficial than those VCs with multiple past funds. The indicator "VC's first fund" is one if the fund is the first in the VC firm's history. The interaction term with the post-close dummy variable – "First fund X After close" – is negative, suggesting that VC's in their first fund delay relatively less. This coefficient again goes in the opposite direction predicted by low reputation investors driving the main results. We conclude that the main results cannot be explained by a subset of failed or low-reputation VC funds. Overall, these hazard estimates indicate that the likelihood that an investor writes-off an investment increases significantly after fund closing.

5.3 Delayed reinvestment around fundraising

We next test whether the hypothesized strategic delay also holds for any reinvestment financings in the VC fund. Hypothesis (H3) predicts selective reinvestment by VC firms in the process of fundraising which helps avoid repricing the relatively worse parts of the portfolio. Here, VCs may delay reinvesting in those investments without large up-ticks in valuation or avoid those with downward shifts in pricing. We again use the hazard model of Eq. (2) to test this prediction, where now the "failure" event is a refinancing event of an active portfolio firm in the VC fund. We focus on those entrepreneurial firms that do not subsequently fail to better isolate the delay here from writeoff strategies.[22] The hazard specification allows us to estimate the impact of fundraising on the baseline hazard of a new financing event. Such a strategy mimics that of Townsend (2015) who studied the reinvestment of VC funds after the crash of the technology boom. There are few observables available for entrepreneurial firms that signal their quality prior to any exit event such as an IPO. We therefore use the ex-post outcomes of exit valuations to total capital invested to separate the high and low quality investments. This forward-looking approach simply requires that the VC's know the relative quality of their investments at the time of refinancing (A2). If they lack such predictive power, then we have measurement error attenuating against our predictions.

Table 6 presents the results. Column (1) uses the basic specification of the reinvestment event with controls for fund age, capital and firm age. As before, a spell in the hazard model begins at the entrepreneurial firm's last financing event and ends either at the end of the sample or when new capital is raised. The positive coefficient on fund age shows there is a basic trend in the likelihood of a new financing as the fund ages. The coefficient on fund age squared shows that other events – exit or no financing – are more likely as we reach the later years of the fund's life. Hypothesis (H3) predicts that VCs will delay reinvestment in their lower quality investments. Column (2) introduces dummy variables and indicators for these investments. "Low quality" is one if the entrepreneurial firm eventually exited for a price less than capital invested or did not exit within seven years of the first VC financing. "High quality" is one if the financing returned more than twice capital invested or had an IPO. These variables represent 25% and 21% of the financings respectively. Across all specifications, the coefficient on "High quality" is positive, consistent with a story that better outcomes occur more quickly. The interaction "Low quality X After close" has a positive and statistically significant coefficient. That is, the hazard of a reinvestment increases after fund closing only for those firms in the portfolio that eventually lose capital. As in Gompers, we find no evidence that the average VC investor has more rapid positive exits pre-fundraising, but the low-reputation investors may still behave in this way.

The last three columns of Table 6 ask whether reputation or experience of VCs attenuate the results in the previous columns. Hypothesis (H4) predicts that low quality VCs or younger VCs

[22] The results are quantitatively similar if we include failed firms in the analysis.

will be more likely to use these delay strategies. To test this, we consider the sub-samples of (i) successful fund-raisers and (ii) non-first-time funds. If the results are driven by low quality and low reputation investors, then the estimates for these samples will show no evidence for delay. Column (3) considers successful fund-raisers, which should have none of the patterns exhibited in column (2). The results are not confined to the those that fail to raise a fund, so it does not appear to be behavior confined to low quality investors. The final two columns – (4) and (5) – break the sample into non-first-time funds and first-time funds. The coefficient in the last column for the sub-sample of first time funds is weakly positive and larger than that of later funds. Thus there is some evidence that the delayed reinvestment in lower quality firms holds more strongly for the low-reputation VCs.

Overall, the evidence in Table 6 is consistent with hypothesis (H3) and shows that VCs delay bad news about the VC fund's performance until after the LPs have committed capital to the fund. The selective reinvestment into lower quality investments should improve the reported NAV before fundraising. Importantly, such reinvestment delay is difficult to observe for an LP, as it effectively requires an estimate of the baseline hazard and knowledge of the relatively worse quality investments in the portfolio.

6 Cost of delay strategies and equilibrium implications

This section investigates the consequences of strategic delay around VC fundraising events.

6.1 Investment quality differences around fundraising

The fundraising process introduces shifts in the timing of writeoffs and the reinvestment in underperforming portfolio companies. We next ask whether these responses manifest themselves in the outcomes that impact returns earned by limited partners.

Table 7 compares a set of financings in the two years prior to the two years after the fund closes. The sample only includes the first investment made by the fund in an entrepreneurial firm, so we compare similar first-time investments of similar age and stage. The first is the indicator for whether the entrepreneurial firm eventually had an IPO. Next, we measure the log of the total exit valuation (e.g. sale price or IPO valuation) for all firms and those that did not fail. Finally, for a subsample of investments we can calculate the equity return earned by an investor in the round ("Log return"). This return incorporates the price paid at the financing, future equity dilution and the eventual sale price. We predict that investments done immediately after fund closing under-perform across each outcome metric.

Column (1) of Table 7 shows that new financings made immediately after the next fund closes (or is imputed to close) IPO at a lower rate. The implied marginal effects are approximately 7%. Columns (2) and (3) show that the realized valuations of any exits are 16% lower for investments done in the two years after fund closing. The lower exits valuations are not driven by failed exits, as the coefficient in Column (3) is almost the same as that in Column (2). Finally, the differences in exit types and valuations manifest themselves in lower returns earned as shown in Column (4). Investments made in the years prior to the fund closing have 15% higher returns than those immediately after. These differences are likely not due to lower risk taken post-fundraising, which could provide an alternative theory for lower returns. On the one hand, we compare investments in the same VC fund in first time investments. VCs rarely make huge shifts in their risk profile within a fund over a short time period. On the other hand, the investment occur within an average of two years of each other and the regressions include controls for industry, firm age and financing year.[23] Overall, the results in Table 7 show that investment quality differs around fundraising and reinforce the conclusions above concerning delayed bad news.

6.2 Cost of delayed writeoffs

In Section 1, we posed two alternative explanations (H2a and H2b) for the delayed writeoffs and delayed reinvestments in lower quality firms: strategic delay versus bundling or effort constraints. To isolate which mechanism dominates, we study the features of failed investments around fund closings. Under the strategic delay (H2a), companies written off after fundraising will have been given a longer than expected life and thus be older and more capitalized than the average writeoff. Investors had to support the delay on the margin with more financings and investments in the

[23] Assuming a Sharpe ratio of 0.5 (for U.S. stock market), the VC funds would have to reduce risk from say 48% to 16% (the S&P 500 standard deviation) post-fundraising to justify the 15% reduction in returns.

entrepreneurial firms. If the VCs instead writeoff investments to limit portfolio size due to effort constraints or to bundle bad news with good, then we would predict quicker failures after fundraising (H2b).

We consider several observable features of written-off companies to test these separate hypotheses. There are real costs to keeping entrepreneurial firms alive to avoid failure and thus a notion of an optimal stopping time. First, keeping a firm in operation requires capital investment. Hence, a firm that is kept in operation longer to avoid writeoffs (i.e., to avoid bad news reaching LPs) needs more capital. This capital will be ultimately lost when the entrepreneurial firm is shutdown. The next class of costs are the VCs' time and human resources. Entrepreneurial firms kept in operation longer than optimal may require additional board meetings, monitoring, or advising.[24] We measure these with age of the entrepreneurial firm and the number of financing events.

Table 8 analyzes the set of written-off firms and asks whether delay strategies result in more capital being invested, more financing rounds, and longer time to failure. We compare all written-off investments within the four year window around fund closing, where a unit of observation is the entrepreneurial firm. The main controls are dummies for each six-month window around fund closing. Column (1) first asks whether the time since the last capital infusion before writeoff differs by when the writeoff occurs. If VCs delay as we predict, then this variable should be relatively larger after fund closing. The coefficient on "6 months after close" indicates just this. Economically, firms that fail in the one year after fund closing occur have six more months since the previous capital infusion relative to those that shut down in the year prior. This difference represents a 32% longer period of time between events than the average time between financing and failure. Column (2) asks whether those firms that fail after fund-closing had more financing events as well. The estimates from a poisson regression (the dependent variable is a count) suggest that those who shut down immediately after fund raising have more past financing rounds. Relative to the writeoffs outside of the six-month post-closing period, those failures immediately after had approximately one-half more rounds on average. Each of these patterns is consistent with delay and also suggestive of the costs of such strategy.

[24] Costs of delay also include any inefficient allocation of capital due to altered signals of performance; however we do not study them in this section, since we cannot estimate optimal allocation of capital for investors.

The final two columns of Table 8 attempt to quantify the costs to limited partners in the current fund of this delay. Column (3) shows that in the one year period after fund closing, written off firms have raised 21% more capital. This estimate translates to approximately $2m compared to the average capitalization of written-off firms. As a fraction of the median fund size of $100m in the sample, $2m for a single delayed writeoff accounts for 2% of the total fund. This 2% is relatively large when compared to the typical 10-20% of a fund devoted to one entrepreneurial firm. Finally, column (4) asks whether the VC firm held the investment in the written-off firm for a longer time conditional on raising a fund. We predict that the delay strategy requires the VC to hold the investment and thus exert additional sub-optimal effort to keep the investment active. The estimates in column (4) show that firms shutdown in the year immediately after fund closing have been VC-backed longer. Economically, the coefficient translate to about six months longer survival for these investments, which is 13% more time than the average time from investment to writeoff. Overall, the collection of evidence in Table 8 show that the increased writeoffs after fundraising is primarily a delay strategy (H2a) as those firms received more financings, time and capital. These differences in capital and time are costly to both the VC firm and the fund's limited partners.

6.3 Learning about VC quality over time

Managerial quality must eventually reveal itself since delay strategies cannot hide information indefinitely. For example, a writeoff's impact on the total fund return does not depend on the timing of the exit (unless more capital is spent keeping it alive, which only exacerbates the cost of delay). We next study whether the eventual release of a delayed negative signal leads to response from LPs (i.e. hypothesis (H5)). An LP's eventual response to the revelation of the delay strategies implies a separating equilibrium of VCs by talent (slowed by the delay). We consider the information about performance from two time periods of the current fund: pre- and post-close. The latter characterizes the events that took place in fund N after the fund $N+1$ was raised. "Pre-close" events are those outcomes that were observable to the LP before fund $N+1$ was raised.

Table 9 considers the probability a $N+2$ fund is raised and its size if so. Column (1) asks whether the number of writeoffs in fund N predict fundraising success in Fund $N+2$. Both the preand post-close writeoffs correlate strongly with the ability to raise a subsequent fund, suggesting both benefits to avoiding and delaying writeoffs. Interestingly, Columns (2) and (3) indicate that good exits and increased valuation prior to closing have little predictive power for fundraising for fund $N+2$. This lack of relationship could stem from LPs using more recent history.

The last three columns of the table condition on successful fund raising of fund $N+2$. The results for writeoffs diminish significantly, showing that writeoffs matter more on the extensive margin. We do find that good exits and increases in valuation during Fund N have some predictive power on the intensive margin, i.e. for the size of Fund $N+2$. The collection of evidence demonstrates that although delayed bad news in Fund N may improve the chances of raising Fund $N+1$, any signals that their eventual release reveal about quality is incorporated by LPs in later fundraising rounds.

7 Robustness

This section conducts some additional tests to provide further confidence in our results.

7.1 Hot markets

A possible concern is that fundraising success and its timing is correlated with returns of public equity markets. If VCs find it easier to raise a fund during hot equity markets and such markets eventually mean revert, then some of the results may depend on market cycles. The next robustness check separates VC funds by the characteristics of equity markets at the time of fundraising. We divide time based on quarterly S&P 500 returns, by labeling quarters above the historical 90th percentile as "hot." This dummy variable strongly correlates with the timing of fundraising, as the probability of such markets is highest in the year prior to observed (imputed) fund closing. We ask whether this correlation can explain the delay results above.

Table 10 presents the results for the two delay strategies of writeoffs and reinvestments. Panel A splits the writeoff hazard sample into funds raised in and out of hot markets. Panel B repeats the sample split for the reinvestment hazard. The estimates in Column (1) of each panel are economically similar than in the full sample regressions. The estimates are in fact confined to the non-hot markets, which is opposite of what is predicted by a mean reversion argument. Thus, hot market fundraising and any subsequent mean-reversion does not explain our main results. In unreported regressions we find that the results are also not driven by investments made during the dot com bubble era of 1998–1999, as excluding funds raised in this period has no impact on the estimates.

7.2 Past success

Although we ruled out two forms of non-strategic delay (H2b), another form effort capacity could be at play. VCs may raise funds immediately after they have a successful exit in their current fund (e.g. Barber and Yasuda (2014) show that VCs time funds at peak performance). The VC may divert effort and resources towards this goal. This diversion could lead to delayed reinvestment and writeoffs until after the investment exits (and in turn, the next fund closes). In unreported regressions, we rule out this explanation by comparing two sub-samples. The first sample looks at funds that are raised within a year of a large exit (an IPO or acquisition that returns at least two times capital invested). The second sample includes all other funds. The estimates are economically similar across these sub-samples, which shows that this form of distraction likely does not explain the original results.

7.3 Additional robustness

The main specifications for writeoff events and reinvestment timing included controls for fund age and its square to control for any mechanical trend in these events over the fund life-cycle. First, in Tables B.1 and B.2 in the Appendix we instead use fund age dummies controls to address trends. The patterns for the coefficients show an decreasing (increasing) probability of writeups (writeoffs) over the fund lifecycle. The main results are unchanged. In unreported regressions, we also implement the test for a continuous trend break as a function of fund age as shown in Figure 6. The hazard model estimates are qualitatively similar for both writeoffs and reinvestment. We conclude that both the hazard specification itself and direct controls for fund age address any concerns about underlying trends driving the estimates. Finally, we randomly move the fund closing date forward or back up to two years to construct a placebo test. A mechanical relationship between writeoffs and fund closing that is not driven by our agency explanations will produce similar coefficient patterns as in Tables 5 and 6. After randomizing the fund closing, the results for both disappear as expected.

8 Conclusion

It is often said that a venture capitalist has two jobs: investing in entrepreneurial firms and raising their next fund. That next fund provides a new, valuable, and steady stream of performance insensitive management fees for at least ten years. Performance evaluation by the capital providers to VCs is thus an area ripe for manipulation with high stakes. This paper asks whether the information asymmetry between LPs and money managers incentivizes changes in investment strategy through actions plausibly unobservable during fundraising. Our approach allows us to disentangle a window-dressing explanation (i.e. active inflation) from strategic delay while assuming the investors in this asset class are sophisticated enough to observe manipulation.

VCs significantly delay the revelation of bad news until after their next fund closes, and this behavior improves VCs' fundraising prospects. The evidence shows even under the assumption that LPs can limit observable portfolio manipulation, information asymmetry remains that allows the average VC to strategically delay actions in their portfolio to improve the signal of their performance. Our results help reconcile the findings that VCs attempt to alter signals to help raise higher funds in the next funding cycle with results that sophisticated VCs are able to separate good VCs from less-talented VCs. Noisy performance signals and hidden actions appear to result in strategic portfolio changes by VCs, the markets in the long-run appear to learn managerial talent levels and produce a separating equilibrium.

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Figures and Tables

Figure 1: Dry powder and reinvestments around fundraising

Notes: The figure reports the estimated fraction of capital remaining in the current fund around the closing of the next VC fund. The solid lines reports the average number of reinvestments made in already existing portfolio companies. The sample includes all funds that were followed by another fund closing.

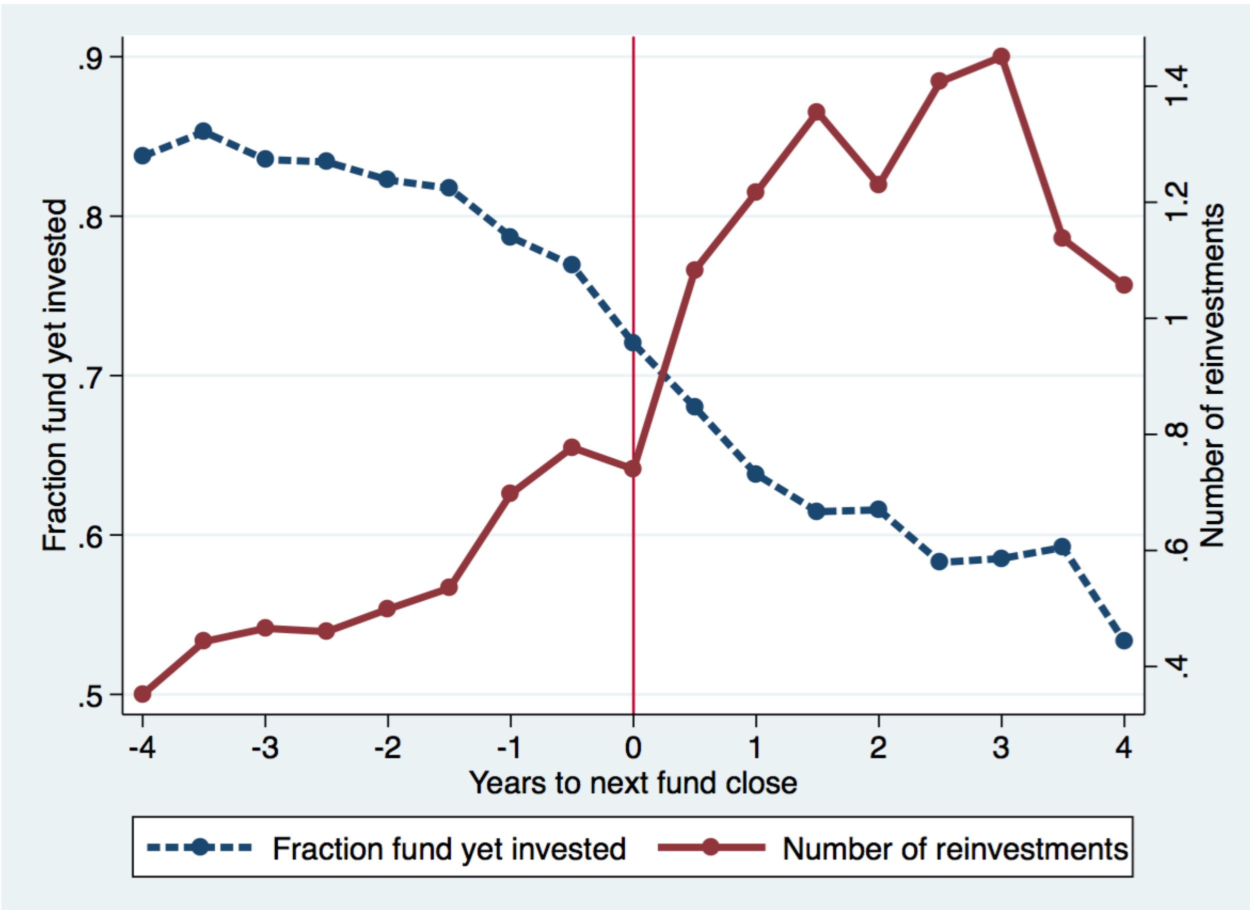

Figure 2: Overlapping nature of fundraising

Notes: The figure shows the usual time line of fundraising for VCs. The next fund is raised on average 3 to 4 years after the previous fund is raised. The overlap between fundraising for the next fund and investment activity represent the identifying variation throughout the paper.

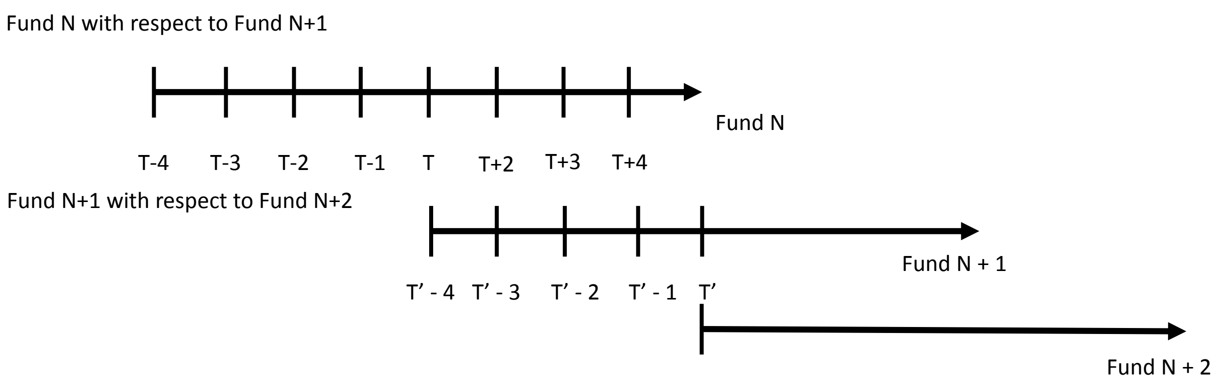

Figure 3: New and follow-on investments within funds

Notes: The figure reports the average number of two types of investments made by a fund. "New investments" are the first investment in an entrepreneurial firm made by a fund and "Follow-on investments" are all subsequent investments in the entrepreneurial firm made by the fund.

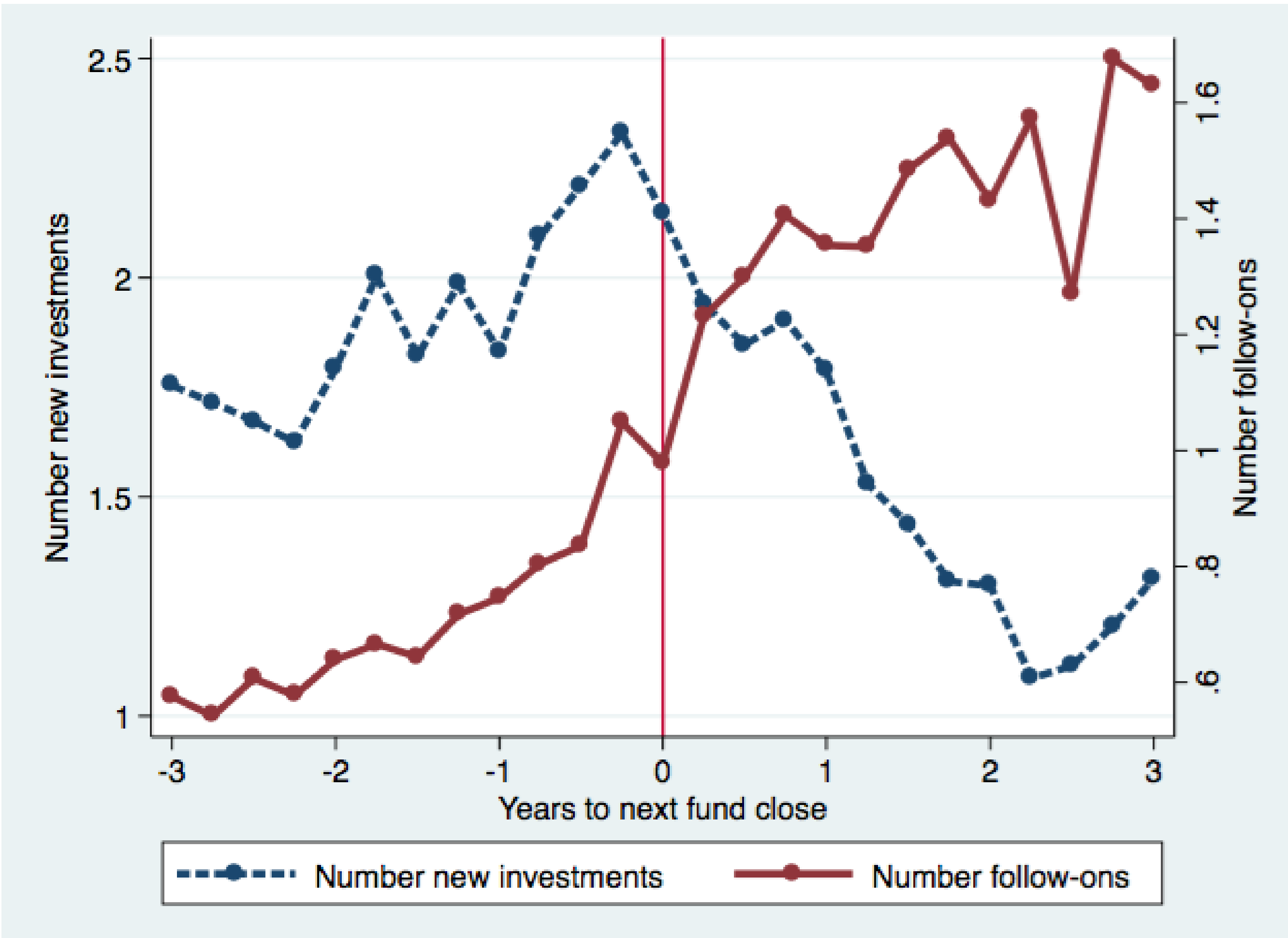

Figure 4: Financing writeups around the fund lifecycle

Notes: The figure reports the fraction of financings in a VC fund's portfolio that have a writeup in valuation for each 6 month period around the next fund closing. The average is computed across all VC funds in the sample that have at least one writeoff over the sample period.

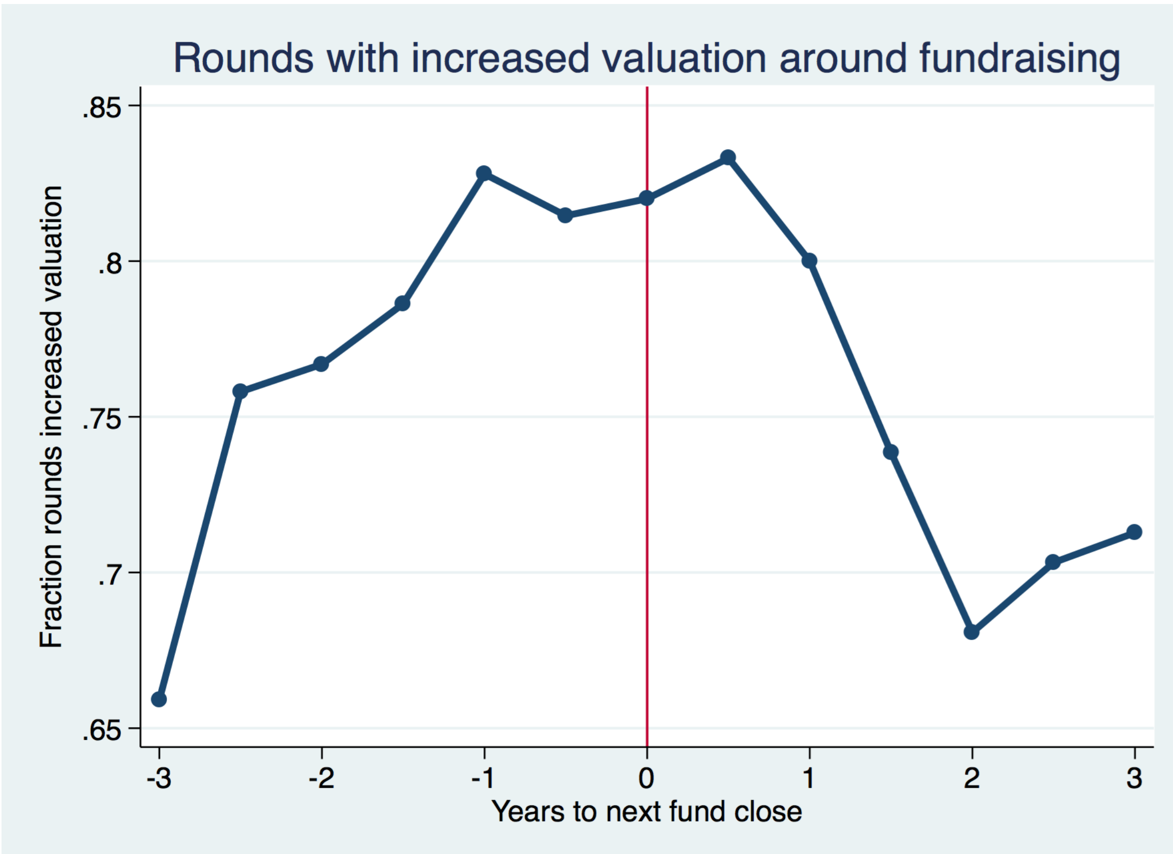

Figure 5: Writeoffs around fundraising

Notes: The figure reports the average fraction of write offs in a VC fund's portfolio around fundraising in a given six month period. A writeoff is an instance where an entrepreneurial firm in the portfolio is listed as failed or had its assets acquired. The x-axis is centered around the closing date for the next fund, relative to the current fund making the investment.

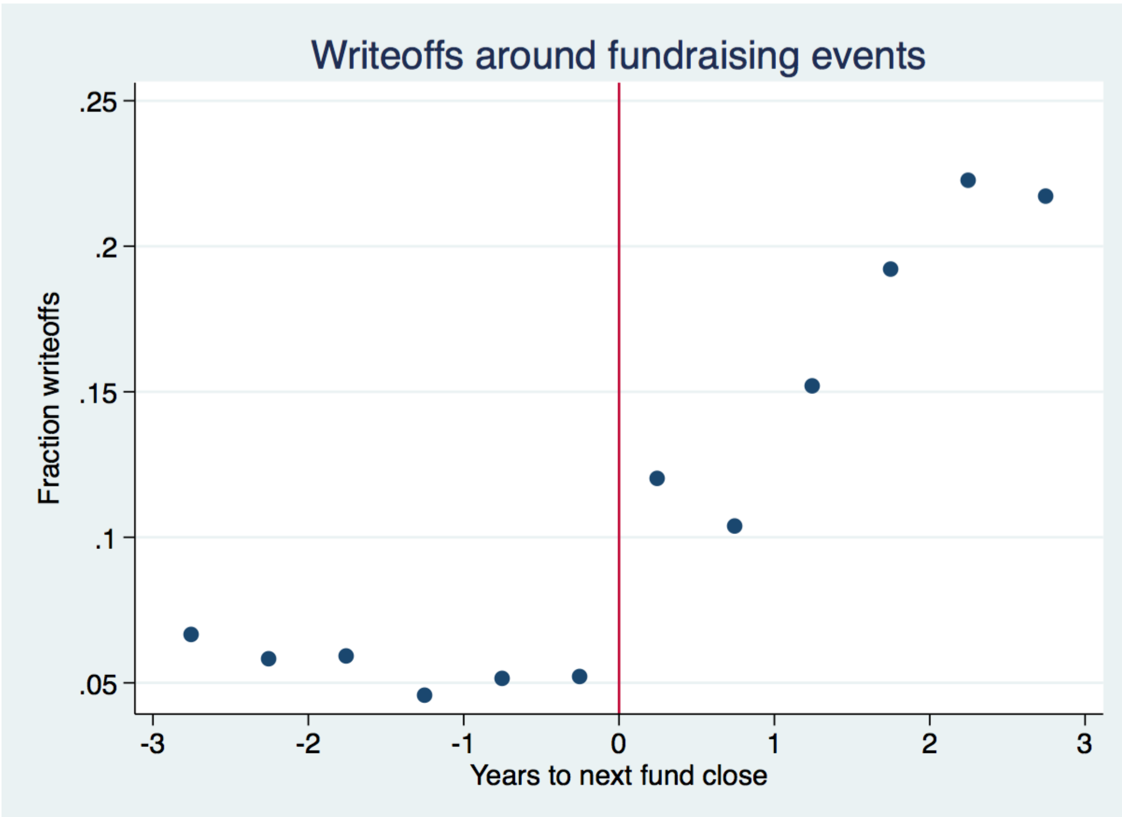

Figure 6: Writeoffs over the fund life-cycle

Notes: The figure reports the predicted rate of writeoffs as a function of fund age from the follow linear probability regression:

$$\text{Writeoff}_{ijt} = \beta_0 + \beta_1 \text{Fund Age}_{it} + \beta_2 \text{After close}_{it}(\text{Fund age}_{it} - A_i) + \hat{\beta}_3 X_{ijt} + \epsilon_{it}$$

where A_i is the age of fund i when the next fund closed. The solid lines report the predictions of the trend from the above regression (i.e. $\hat{\beta}_0 + \hat{\beta}_1 \text{Fund Age}_{it} + \hat{\beta}_2 \text{After close}_{it}(\text{Fund age}_{it} - A_i)$) while the dots represent the residual predicted writeoff rate after demeaning by the predicted $\hat{\beta}_3 X_{ijt}$. The solid vertical line is the mean fund age at the time of next fund closing.

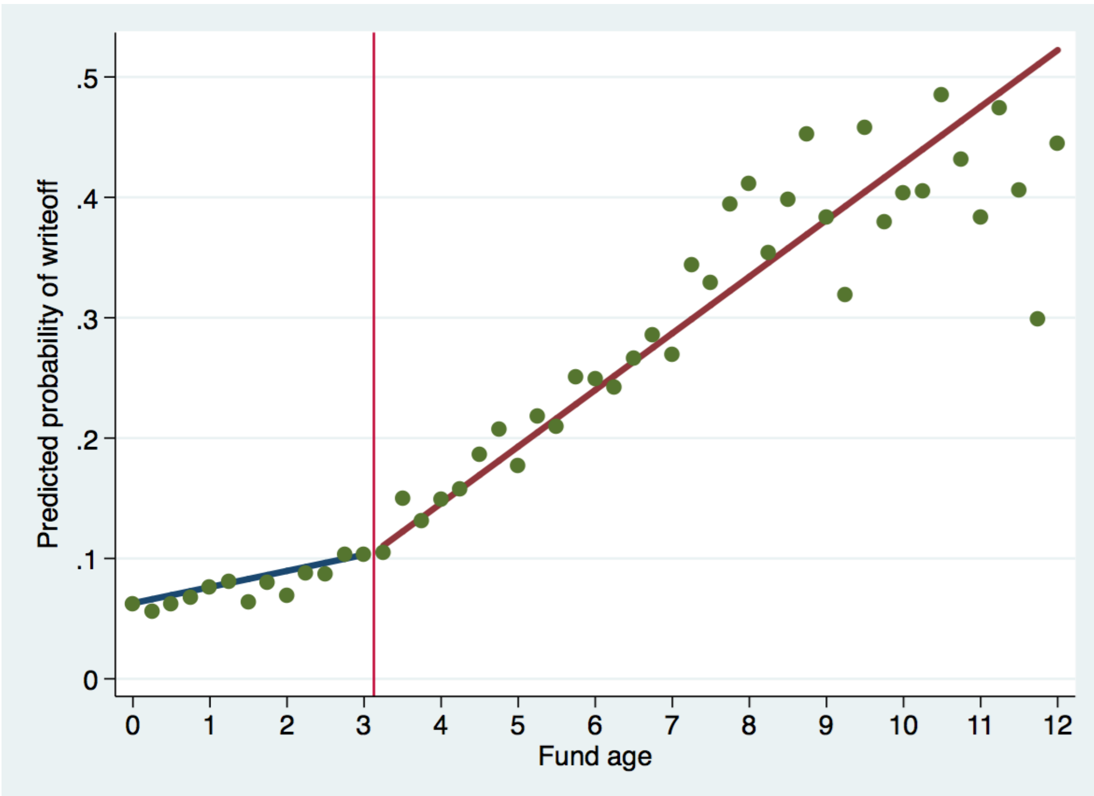

Table 1: Variable description

Notes: Definitions of the main variables used throughout the text.

Variable	Description
N years to closing	A dummy for a VC fund's investment that occurred N (0 to 3) years (rounded to the quarter) to the next realized or predicted fund closing.
N years after after closing	A dummy for a VC fund's investment that occurred N years (rounded to the quarter) after the first fund to close after the current fund.
"After close"	A dummy equal to one if the VC fund's investment occurred in the year of or years after the next fund closing. The excluded group are the financings in the two years prior (samples with this control have a three-year window around each fund closing).
Log VC age (years)	The log of the number of years since the VC firm first invested.
Fund age (years)	The age of the VC fund at the time of the financing or exit event.
Log total capital raised	The log of the sum of capital raised (in millions), as of each entrepreneurial firm's financings.
Up round	A dummy equal to one if the valuation of the financing for the entrepreneurial firm is at least as large as the previous equity valuation.
Has revenues	A dummy equal to one if, at the time of the entrepreneurial firm's financing, the firm reported revenue.
Profitable	A dummy equal to one if, at the time of the entrepreneurial firm's financing, the firm reported profits.
Log firm age (yrs.)	The log of the age of the entrepreneurial firm as of each financing event.
Log fund size (m)	The log of the total capital raised in the current fund (in millions).
Industry FE	Categorical dummies for one of four major industry categories: Business/Consumer/Retail, Healthcare, Information Technology and Other.
Fin. year FE	Dummies for the year of the entrepreneurial firm financing event.
Stage FE	Fixed effects for the development stage of the entrepreneurial firm: early, middle, and late.
Log pre-money	The log of the financing pre-money valuation, which is the equity valuation of the entrepreneurial firm prior to the VC's capital infusion.
Had next fund?	Indicator equal to one if the current VC fund was followed (by 2013) by a new fund closing.
Fraction fund K remaining	The fraction of the fund's initial capital that remains by the financing event (i.e. "dry powder").
VC's first fund	Indicator equal to one for the first fund raised by a VC firm (for the sample of VCs with at least two funds).
IPO	An indicator for whether the entrepreneurial firm had an IPO or a successful acquisition (greater than $100m valuation) as of the end of 2013.
Log return	The log of the gross multiple for the return to investing in a financing event. The multiple captures the cash-on-cash return accounting for any dilution and assumes common equity. Many returns are missing due to missing valuations.
Log valuation	The log of the value of the entrepreneurial firm at exit, set to 10% of total capital raised if a failure. Some exit valuations are missing because the sale price is not reported.
High quality	The entrepreneurial firm had an exit that was at least two times capital invested.
Low quality	The entrepreneurial firm had an exit that was less than capital invested.

Table 2: Summary statistics

Notes: The table provides summary statistics for the main control variables used throughout the paper (defined in Table 1). The sample of financings and investors includes the full set that encompasses all the tables below.

	Entrepreneurial firm variables						
	mean	sd	min	p25	p50	p75	max
Year founded	1998.1	5.51	1910	1996	1999	2001	2013
First capital raised	6.32	22.6	0.0100	1.47	3.22	7	1500
Had IPO	0.11	0.31	0	0	0	0	1
Still private	0.23	0.42	0	0	0	0	1
Acquired	0.38	0.49	0	0	0	1	1
Failed	0.25	0.43	0	0	0	0	1
Information Tech.	0.51	0.50	0	0	1	1	1
Biotech	0.25	0.43	0	0	0	1	1
California	0.40	0.49	0	0	0	1	1
Texas	0.056	0.23	0	0	0	0	1
New York	0.045	0.21	0	0	0	0	1
Observations	7860						

	Financing variables						
	mean	sd	min	p25	p50	p75	max
Financing year	2001.8	4.03	1992	1999	2001	2005	2013
Capital raised ($)	3.15	4.59	0.0050	0.90	2	3.90	175.0
Mid-stage	0.32	0.47	0	0	0	1	1
Avg. VC age	7.84	5.10	0.100	3.84	7.07	10.9	43.9
Late stage	0.18	0.38	0	0	0	0	1
Years since last financing event	0.90	0.89	0	0	0.80	1.37	17.5
Total capital raised	27.1	38.9	0.050	6.20	15.5	34	1693.9
Round #	2.92	1.86	1	1	2	4	10
Debt (+ Bridge)	0.096	0.29	0	0	0	0	1
Has revenues	0.56	0.50	0	0	1	1	1
Profitable	0.044	0.21	0	0	0	0	1
Firm age (years)	3.99	3.98	0	1.45	3.07	5.33	83.7
Syndicate size (funds)	3.18	2.04	1	2	3	4	16
Avg. fund sequence	3.58	2.97	1	1.50	3	5	26
Avg. fund size	240.5	336.2	0	60	125	289	6500
Observations	15688						

	VC firm variables						
	mean	sd	min	p25	p50	p75	max
Year first investment	1996.2	6.37	1980	1994.5	1998	2000	2008
Number investments	113.1	178.2	1	23	54	123.5	2107
Total funds	2.80	2.63	1	1	2	3	26
Observations	776						

	VC fund variables						
	mean	sd	min	p25	p50	p75	max
Vintage year	1999.1	4.22	1969	1997	1999	2001	2006
Total fund size	167.8	310.8	0	30.2	75.3	189	6500
Fund number	3.05	2.74	1	1	2	4	26
Raised next fund?	0.69	0.46	0	0	1	1	1
Number separate closings	1.17	0.48	1	1	1	1	8
Observations	1473						

Table 3: Learning from interim performance: probability of raising fund and fund size

Notes: The table reports probit and Ordinary Least Squares (OLS) regressions of fundraising success and the log of a VC fund size on a set of controls for the set of non-first-time VC funds. The analysis includes all firms with first vintage year post-1995. The main control variables measure the number of exit and financing types that occurred in the previous fund immediately prior to the current fund's closing. "Log # failure pre-close" counts the number of writeoffs in the previous fund up to the first closing of the current fund. "Log # up rounds pre-close" counts the number of financings with an increased valuation in the previous fund and "Log # good exits pre-close" counts the number of IPOs or high-value acquisitions prior to the current fund close. "Log Fund N size" is the log of the previous fund size. "Log # pre-fund close invs." is the log of the total number of unique investments made out of the previous fund as of the next fund's first close. "Vintage year FE?" are fixed effects for the previous fund vintage year, while "Fund N +1 vintage year FE?" are fixed effects for the current fund's vintage year. Robust standard errors are reported in parentheses. * , **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

	(1) Raised fund?	(2) Raised fund?	(3) Raised fund?	(4) Log Fund $N+1$ size	(5) Log Fund $N+1$ size	(6) Log Fund $N+1$ size
Log # failure pre-close	-0.386***			-0.259**		
	(0.106)			(0.107)		
Log # good exits pre-close		0.299**			0.355***	
		(0.134)			(0.0963)	
Log # up rounds pre-close			0.282***			0.245***
			(0.0838)			(0.0751)
Log Fund N size	0.237***	0.231***	0.222***	0.658***	0.653***	0.648***
	(0.0323)	(0.0324)	(0.0324)	(0.0374)	(0.0373)	(0.0381)
Log # pre-fund close invs.	0.150***	0.0536	-0.0283	0.0716*	-0.0129	-0.0734
	(0.0426)	(0.0413)	(0.0510)	(0.0419)	(0.0425)	(0.0525)
Constant	0.0840	0.238	0.214	1.380***	1.516***	1.465***
	(0.263)	(0.265)	(0.267)	(0.258)	(0.264)	(0.260)
Observations	1230	1230	1230	766	766	766
Pseudo-R^2	0.226	0.221	0.224			
R^2				0.422	0.426	0.426
Num. VCs	738	738	738	438	438	438
Num funds	1230	1230	1230	766	766	766
Model	Probit	Probit	Probit	OLS	OLS	OLS
Vintage year FE?	Y	Y	Y	Y	Y	Y
Fund $N+1$ vintage year FE?	Y	Y	Y	Y	Y	Y

Table 4: Financing valuations around fundraising

Notes: The table reports the estimates of probit estimates for a regression of the change in the entrepreneurial firm valuation for VC fund investments on a set of observables. The dependent variable is one if the firm's financing valuation (i.e. post-money) was higher than the last known valuation. The unit of observation is the entrepreneurial firm financing event paired with a VC fund (thus, the financing may be repeated if there are multiple funds investing). To account for the non-random, positive selection of financing valuations, the observations are weighted using exit probability similar to that used in Korteweg and Sorensen (2010). The sample includes all entrepreneurial firm financings between 1992 and 2013 for which a VC investor had a fund close before 2007. The control "Fund age" is the age of the current fund in years. "After fund close" is a dummy variable equal to one if the financing event occurred after the next fund closing for the VC firm. Columns (1) and (2) compares the three years prior to three years after closing. Column (2) considers the two years around fund closing and column (3) looks at the two year window around fund closing. Columns (4) introduces the dummy "Had next fund" which is equal to one if the VC raised a next fund (imputed if not). Columns (5) introduces the dummy "VC first fund" for the VC firm's first fund as a test for reputation differences. Other control variables are defined in Table 1. Standard errors in parentheses, clustered at the VC firm level. * , **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

	Increase in valuation?				
	(1)	(2)	(3)	(4)	(5)
	Full	Full	$[-2, 2]$	Full	Full
Fund age (yrs)	-0.0491	0.0118	-0.0461	-0.0449	-0.0329
	(0.0419)	(0.0180)	(0.0599)	(0.0465)	(0.0481)
Fund age sq. (yrs)	0.00588		0.00447	0.00583	0.00482
	(0.00394)		(0.00569)	(0.00447)	(0.00445)
After fund close		-0.0662	-0.0634	-0.300*	-0.0487
		(0.0629)	(0.0747)	(0.172)	(0.0765)
Had next fund?				0.00580	
				(0.122)	
Had next fund? X After close				0.301	
				(0.185)	
First fund					-0.0457
					(0.130)
First fund X After Close					0.00589
					(0.124)
Log VC age (years)	-0.107**	-0.112***	-0.0260	-0.115***	-0.125*
	(0.0424)	(0.0402)	(0.0467)	(0.0408)	(0.0664)
Log total capital raised	-0.0498	-0.0470	-0.0330	-0.0494	-0.0480
	(0.0492)	(0.0403)	(0.0486)	(0.0405)	(0.0404)
Firm age (years)	-0.0238*	-0.0238***	-0.0221**	-0.0243***	-0.0238***
	(0.0122)	(0.00834)	(0.00923)	(0.00834)	(0.00831)
Log fund size (m)	0.0793***	0.0805***	0.0634**	0.0681**	0.0784***
	(0.0293)	(0.0272)	(0.0322)	(0.0279)	(0.0271)
Fraction fund K remaining	-0.0283	-0.0277*	0.0182	-0.0266*	-0.0297*
	(0.0228)	(0.0155)	(0.0513)	(0.0161)	(0.0155)
Constant	1.141**	1.022**	1.593**	1.155**	1.139**
	(0.471)	(0.442)	(0.627)	(0.455)	(0.444)
Observations	5427	5427	3881	5427	5427
Pseudo R^2	0.168	0.168	0.167	0.171	0.169
Num. VCs	405	405	241	405	405
Num funds	829	829	598	829	829
Num. firms	2476	2476	1991	2476	2476
Industry FE?	Y	Y	Y	Y	Y
Fin. year FE?	Y	Y	Y	Y	Y
Stage FE?	Y	Y	Y	Y	Y

Table 5: Writeoff probabilities around fund-raising: hazard models

Notes: Table presents the Cox proportional hazard regression of writeoff events around VC fundraising. A unit of observation (i.e. spell) is an entrepreneurial firm financing event. A financing may be associated with multiple funds, but each fund can have its own fundraising schedule. A failure in the model is an equity financing that is followed by a writeoff. Alternatively, the financing can be followed by a new equity round, an exit or no event at all (these are non-failures). The variable "After fund close" varies over time within each spell and is one for periods after an investor's next fund closes. A positive coefficient demonstrates a higher hazard of the event – here a writeoff. The control "Fund age" is the age of the current fund in years. "N years to (after) closing" are dummy variables for specific periods around fund closing. "Firm age (years)" is the age of the entrepreneurial firm at the time of the financing. "Had next fund" is a dummy variable if the VC raised a new fund, where we infer the closing date if unknown using observed "dry powder." "VC's first fund" is a dummy variable equal to one if the current fund is the VC firm's first fund. "Year FE" are fixed effects for financing year and "Industry FE" are fixed effects for the entrepreneurial firm's industry. The baseline hazards in all models are stratified at the VC firm-level. Standard errors reported in parentheses with clustering at the entrepreneurial firm. * , **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Fund age (yrs.)	0.271***	0.219***	0.229***	0.212***	0.222***
	(0.0776)	(0.0794)	(0.0802)	(0.0791)	(0.0793)
Fund age squared	-0.0185**	-0.0147*	-0.0154**	-0.0140*	-0.0149*
	(0.00766)	(0.00769)	(0.00773)	(0.00765)	(0.00769)
After close		0.264***		0.00276	0.370***
		(0.0926)		(0.181)	(0.109)
3 years to closing			-0.235		
			(0.165)		
2 years to closing			0.121		
			(0.124)		
1 year after closing			0.258**		
			(0.118)		
2 years after closing			0.264		
			(0.170)		
3 years after closing			0.232		
			(0.184)		
Had next fund?				-0.0809	
				(0.121)	
Had next fund? X After close				0.348*	
				(0.205)	
VC's first fund					0.0665
					(0.120)
First fund X After Close					-0.325*
					(0.188)
Fraction fund K remaining	0.00100	0.00517	0.00774	0.00456	0.00370
	(0.0252)	(0.0272)	(0.0274)	(0.0269)	(0.0257)
Firm age (years)	-0.0144	-0.0161	-0.0171	-0.0166	-0.0164
	(0.0123)	(0.0123)	(0.0125)	(0.0123)	(0.0125)
Log total capital raised	-0.362***	-0.375***	-0.375***	-0.379***	-0.384***
	(0.0478)	(0.0478)	(0.0482)	(0.0482)	(0.0481)
Spells	7908	7908	7908	7908	7908
Pseudo-R^2	0.0557	0.0565	0.0570	0.0569	0.0569
Number firms	3978	3978	3978	3978	3978
Number VCs	615	615	615	615	615
Number funds	1131	1131	1131	1131	1131
Year and Industry FE?	Y	Y	Y	Y	Y

Table 6: Reinvestment decisions around fund-raising: hazard models

Notes: Table presents the Cox proportional hazard regression of new equity or debt financing events for an entrepreneurial firm around VC fundraising for the sample of firms that did not fail. A spell is the time between the last financing and a next refinancing event (or censoring). The unit of observation is an entrepreneurial firm financing event matched to a VC fund. Variables are as defined in Table 5. The variable "After close" varies over time within a financing's spell and is equal to one after the investor's next fund closes. A positive coefficient on a variable implies a higher hazard of a new equity or debt financing event for the entrepreneurial firm. Column (4) introduces an interaction of the "After close" dummy variable and an indicator for whether the entrepreneurial had a high or low quality exit (ex-post). A high quality exit is an IPO or an exit that resulted in at least two times capital returned to investors. A low quality exit is an exit that resulted in some loss of capital (excluding failures). The interaction "Low quality X After close" asks whether the hazard of a new financing event differs for firms that eventually have poor exit outcomes. The excluded category are the outcomes outside of the left and right tail. The baseline hazards in all models are stratified at the VC firm-level. Column 3 considers only those VC funds that are followed by a sucessful fundraising, while columns 4 and 5 break the sample into first time and non-first time funds. Standard errors reported in parentheses with clustering at the entrepreneurial firm. * , **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

	(1) All	(2) All	(3) Had Next	(4) Fund > 1	(5) First fund
Fund age (yrs.)	0.136***	0.0842***	0.145***	0.942***	0.0949**
	(0.0264)	(0.0216)	(0.0306)	(0.0934)	(0.0391)
Fund age sq.	-0.00946***	-0.00605***	-0.0104***	-0.00387	-0.00735**
	(0.00235)	(0.00192)	(0.00270)	(0.00738)	(0.00340)
After fund close		-0.0427	0.0210	-0.400***	-0.0891
		(0.0369)	(0.0475)	(0.114)	(0.0642)
Low quality X After close		0.129***	0.119**	0.0903	0.147*
		(0.0431)	(0.0525)	(0.100)	(0.0783)
High quality X After close		0.00686	-0.0555	0.137	0.0233
		(0.0529)	(0.0620)	(0.154)	(0.0974)
Low quality		-0.264***	-0.254***	-0.248***	-0.254***
		(0.0363)	(0.0439)	(0.0699)	(0.0648)
High quality		0.226***	0.289***	-0.00653	0.140*
		(0.0433)	(0.0524)	(0.108)	(0.0764)
Fraction fund K remaining	-0.0182	-0.0220	-0.0326	0.119	-0.00721
	(0.0214)	(0.0162)	(0.0250)	(0.144)	(0.0303)
Firm age (yrs.)	-0.0143***	-0.0155***	-0.00325	0.000488	-0.00803
	(0.00386)	(0.00383)	(0.00397)	(0.00817)	(0.00642)
Log total capital raised	-0.117***	-0.0902***	-0.0757***	-0.176***	-0.0807***
	(0.0151)	(0.0128)	(0.0142)	(0.0372)	(0.0229)
Spells	6772	6772	5262	1510	1907
Pseudo-R^2	0.00943	0.00508	0.0113	0.0509	0.00615
Number firms	3352	3352	2752	985	1215
Number VCs	574	574	404	298	370
Number funds	1082	1082	784	298	370
Year FE?	Y	Y	Y	Y	Y
Industry FE?	Y	Y	Y	Y	Y

Table 7: Entrepreneurial firm outcomes around fundraising

Notes: The table reports the VC firm fixed effect estimates of several entrepreneurial firm outcome measures on a set of observables. In Column (1), the dependent variable is equal to one if the entrepreneurial firm went public by the end of the sample. Column (2) uses the log of the exit valuations (log(.01) if failed) for the firms that have a known value, while Column (3) uses the log of the gross multiple return of an investment accounting for dilution. The unit of observation is the entrepreneurial firm financing event paired with a VC fund (thus, the financing may be repeated if there are multiple funds investing). The sample includes all entrepreneurial firm financings between 1992 and 2013 for which a VC investor had a fund close before 2007. We consider the first investment made by a fund in the entrepreneurial firm in the four-year window around fundraising. The variable "0–2 years after close" is a dummy for the post-closing investments. Other control variables are defined in Table 1. Column (1) is a conditional logit with a VC firm FE, while Columns (2) and (3) use standard VC firm fixed effects. Standard errors in parentheses, clustered at the VC firm level. * , **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

	Financing outcomes			
	IPO	Log Valuation	Log Valuation	Log Return
	All	All	Non-failed	All
	(1)	(2)	(3)	(4)
0-2 years after close	-0.140*	-0.166**	-0.165***	-0.149**
	(0.0716)	(0.0798)	(0.0504)	(0.0698)
Fund age (yrs)	-0.000567	-0.00533	0.0187	0.0193
	(0.0275)	(0.0310)	(0.0157)	(0.0279)
Log VC age (years)	-0.127*	-0.165*	-0.0503	-0.0746
	(0.0719)	(0.0894)	(0.0686)	(0.0863)
Mid-stage	0.140**	0.0811	-0.0876	0.106
	(0.0716)	(0.0863)	(0.0610)	(0.0848)
Late stage	0.246**	0.0959	-0.0958	0.178
	(0.104)	(0.109)	(0.0909)	(0.109)
Log total capital raised	0.540***	0.802***	0.352***	0.149***
	(0.0357)	(0.0403)	(0.0364)	(0.0328)
Has revenues	-0.0349	0.137*	0.0263	0.374***
	(0.0709)	(0.0734)	(0.0659)	(0.0704)
Profitable	0.715***	1.182***	0.460***	1.465***
	(0.149)	(0.155)	(0.121)	(0.156)
Firm age (years)	-0.00450	-0.0127	-0.0274***	-0.00244
	(0.0115)	(0.00957)	(0.00997)	(0.00836)
Log fund size (m)	-0.204***	-0.264***	-0.0924**	-0.206***
	(0.0461)	(0.0622)	(0.0366)	(0.0636)
Years to exit				0.00550
				(0.0150)
Constant		2.137***	4.451***	-0.182
		(0.401)	(0.271)	(0.331)
Observations	8702	5882	4704	4219
Pseudo R^2	0.0971			
R^2		0.184	0.0796	0.134
Num. VCs	357	425	391	411
Num funds	832	893	818	836
Num. firms	5834	3855	1999	2823
Specification	C. Logit	FE	FE	FE
VC FE?	Y	Y	Y	Y
Industry FE?	Y	Y	Y	Y
Fin. year FE?	Y	Y	Y	Y

Table 8: Cost of delayed writeoffs

Notes: The table reports entrepreneurial firm investment characteristics for the set of entrepreneurial firms that failed (i.e., were written off) by the end of 2013. All models except column 2 are OLS where the unit of observation is a writeoff event with one observation per entrepreneurial firm. Column 2 uses a poisson model for the count dependent variable. The sample considers all writeoff events that occurred in the 4 year window around a next fund closing. "Years since last K" is the number years from the last capital infusion to the writeoff event. "# rounds" is the total number of financing events before exit and "Log capital invested" sums the total capital invested by VCs into the entrepreneurial firm by its exit. "Years VC-backed" is the total amount of years from first VC financing to writeoff event. The main controls are dummies variables for six-month intervals around fund closing. For example, "6 months after close" is one if the writeoff occurred at or six months after the next fund closing. "Log round #" is the log of total financings to writeoff and "Fund age" is the log of fund age at the time of the writeoff. "Start year FE" are fixed effects for the year of the firm founding, "Industry FE" are fixed effects for the four major industry classification. Standard errors are clustered at the entrepreneurial firm founding year level. * , **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

	Years since last K (1)	# rounds (2)	Log capital invested (3)	Years VC-backed (4)
2 years to close	-0.0150	0.0616	0.238	-0.993***
	(0.181)	(0.0639)	(0.148)	(0.301)
1.5 years to close	0.0866	0.148*	0.0848	-0.287
	(0.180)	(0.0758)	(0.113)	(0.261)
1 year to close	-0.0331	0.0114	-0.158	-0.0284
	(0.193)	(0.0644)	(0.124)	(0.257)
6 months after close	0.497***	0.0529**	-0.0462	0.285*
	(0.127)	(0.0225)	(0.0741)	(0.156)
1 year after close	-0.339***	-0.0832**	0.156**	0.0244
	(0.110)	(0.0381)	(0.0760)	(0.139)
1.5 years after close	-0.416***	-0.0486**	0.115	-0.0195
	(0.112)	(0.0248)	(0.0762)	(0.143)
2 years after close	-0.435***	-0.00567	0.0321	0.139
	(0.131)	(0.0560)	(0.0845)	(0.164)
Fund age	1.114***	0.425***	-0.0466	0.894***
	(0.110)	(0.0884)	(0.0505)	(0.0987)
Log round #	-0.150**		1.033***	1.402***
	(0.0712)		(0.0420)	(0.0839)
Constant	10.85***	-0.445***	1.005***	-1.110***
	(0.175)	(0.0881)	(0.0772)	(0.184)
Observations	1516	1516	1516	1516
R^2/Pseudo-R^2	0.254	0.0646	0.417	0.362
Specification	OLS	Poisson	OLS	OLS
Start year FE?	Y	Y	Y	Y
Industry FE?	Y	Y	Y	Y

Table 9: Fund N performance and fund $N+2$ outcomes

Notes: The table reports regressions of fund characteristics on the outcomes of the fund closed in the past. The dependent variable in Columns (4)–(6) are dummy variables for whether this fund closed, while Columns (1)–(3) are the logarithm of the fund size of fund $N+2$. The control variables are all measured for the fund sequence N in the past. Thus, the table asks whether proxies for Fund N performance correlate with the characteristics of future funds. "Log # writeoffs" is the log of the total number of failures in Fund N. "Log total # IPOs" and "Log # quality exits" are the number of IPOs and successful exits in Fund N. "Log Fund $N+1$" is the log of the intervening fund and "Log # fund N investments" sums the total investments done in Fund N. Robust standard errors in parentheses. *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

	Raised Fund $N+2$?			Log Fund $N+2$ size		
	(1)	(2)	(3)	(4)	(5)	(6)
Log # failure pre-close	-0.448***			-0.116		
	(0.155)			(0.187)		
Log # failures post-close Fund N	-0.232**			0.0300		
	(0.0974)			(0.123)		
Log # good exits pre-close		-0.0743			0.333**	
		(0.135)			(0.141)	
Log # good exits post-close Fund N		0.383***			0.449***	
		(0.0995)			(0.120)	
Log # up rounds pre-close			0.0380			0.297***
			(0.0844)			(0.0874)
Log # up rounds post-close Fund N			0.363***			0.0532
			(0.0809)			(0.106)
Log Fund N size	0.193***	0.153***	0.161***	0.596***	0.537***	0.591***
	(0.0409)	(0.0420)	(0.0411)	(0.0628)	(0.0623)	(0.0622)
Log # fund N investments	0.381***	0.0360	0.0314	-0.0945	-0.390***	-0.243**
	(0.0750)	(0.0739)	(0.0737)	(0.0963)	(0.105)	(0.0958)
Constant	-0.788***	-0.497*	-0.491*	2.655***	3.048***	2.856***
	(0.276)	(0.277)	(0.280)	(0.377)	(0.375)	(0.376)
Observations	758	758	758	372	372	372
R^2				0.329	0.358	0.346
Pseudo R^2	0.167	0.168	0.171			
Num. VCs	414	414	414	201	201	201
Num funds	758	758	758	372	372	372
Model	Probit	Probit	Probit	OLS	OLS	OLS
Fund N vintage FE	Y	Y	Y	Y	Y	Y
Fund $N+1$ vintage FE	Y	Y	Y	Y	Y	Y

Table 10: Fundraising in hot markets

Notes: The table repeats the main regressions in Tables 5 and 6 for subsamples based on the state of the public equity markets. A fund is in the sample "Hot market" if the year before it was raised, the S&P 500 quarterly return was above the historical 90th percentile. Panel A repeats the hazard model for writeoff events in Table 5 and Panel B repeats the reinvestment hazard in Table 6. All regressions include the controls and fixed effects, as found in those tables ("Controls and FE?"). Standard errors in parentheses, clustered at the VC firm level. * , **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

	Panel A	
	Writeoff hazard model	
	(1)	(2)
	Non-hot market	Hot market
After close	0.285***	0.518
	(0.0979)	(0.412)
Fund age (yrs.)	0.201**	0.474**
	(0.0853)	(0.240)
Fund age squared	-0.0125	-0.0351
	(0.00836)	(0.0217)
Spells	6960	949
Pseudo-R^2	0.0590	0.116
Controls and FE?	Y	Y

	Panel B	
	Reinvestment timing	
	(1)	(2)
	Non-hot market	Hot market
Low quality	-0.296***	-0.135*
	(0.0441)	(0.0716)
High quality	0.273***	0.0363
	(0.0564)	(0.0817)
Low quality X After close	0.126**	0.0198
	(0.0530)	(0.0958)
High quality X After close	-0.0447	-0.00275
	(0.0672)	(0.114)
Spells	5347	1427
Pseudo-R^2	0.0123	0.0108
Controls and FE?	Y	Y

Appendix

A Identifying failure dates

Most databases of venture capital financings do not include explicit dates for failed investments. Failure here involves the official dissolution of the firm where employees are all let go and any assets are sold off. We exploit three types of information to identify approximate dates of these events. The first is a status from VentureSource where they identify when the firm "ceased operations." If this is unavailable, then we use a field that reveals the last time that they spoke to either an investor in the firm or a contact at the entrepreneurial firm itself. VentureSource aims to have at least one of these contacts each year. Finally, for a large fraction of the failed companies we gathered their incorporation infomation from Delaware and California, two of the most popular states of incorporation. Both states require an annual fee to maintain status, so the last paid fee revealed on the website is a close approximation of the date the firm shut down. Any last incorporation filing that occurred prior to the previous two VentureSource dates is the primary failure date used.

How, if at all, could measurement error in this date impact the results? It is clear that each of these dates are all likely upper bounds on the true failure date. Any systematic delay in assigning failure would simply shift the estimated jump in writeoff events back in time. Importantly, given the semi-annual surveys conducted by VentureSource and the annual taxes due in CA and DE, these failure dates are off by an average of six month and a maximum of one year. In unreported regressions, the results are unchanged if we adjust all failure dates that were found with the noisier incorporation information back by six months.

B Tables

Table B.1: Valuation around fundraising: fund age dummies

Notes: The table reports the estimates of both probit estimates for a regression of the change in the entrepreneurial firm valuation for VC fund investments on a set of observables. It is the same specification as Table 4 where we instead introduce dummies for the age of the fund. The excluded category is the first year of the fund. Regressions include all the same controls as in Table 4, excluded here for space. Other control variables are defined in Table 1. Standard errors in parentheses, clustered at the VC firm level. * , **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

	Increase in valuation?				
	(1)	(2)	(3)	(4)	(5)
	Full	Full	$[-2, 2]$	Full	Full
Fund 2 yrs. old	0.0403	0.0532	0.129	0.0533	0.0509
	(0.107)	(0.112)	(0.127)	(0.111)	(0.114)
Fund 3 yrs. old	-0.120	-0.112	-0.0864	-0.101	-0.0996
	(0.111)	(0.118)	(0.138)	(0.115)	(0.120)
Fund 4 yrs. old	-0.0306	-0.0324	0.0776	-0.0186	-0.00277
	(0.114)	(0.128)	(0.145)	(0.116)	(0.122)
Fund 5 yrs. old	-0.0663	-0.0806	-0.000636	-0.0566	-0.0338
	(0.123)	(0.145)	(0.152)	(0.123)	(0.128)
Fund 6 yrs. old	-0.106	-0.135	-0.0710	-0.0994	-0.0723
	(0.143)	(0.195)	(0.206)	(0.165)	(0.173)
Fund 7 yrs. old	0.0251	-0.0164	0.0180	0.0625	0.0619
	(0.164)	(0.221)	(0.223)	(0.176)	(0.181)
Fund 8 yrs. old	-0.0226	-0.0871	-0.122	-0.0107	0.0107
	(0.239)	(0.286)	(0.281)	(0.233)	(0.241)
Fund 9 yrs. old	0.0685	-0.0251	-0.237	0.111	0.0961
	(0.248)	(0.303)	(0.289)	(0.248)	(0.262)
Fund 10 yrs. old	0.254	0.162	0.943***	0.399	0.291
	(0.294)	(0.428)	(0.359)	(0.350)	(0.365)
After fund close		-0.0478	-0.0735	-0.307*	-0.0454
		(0.0670)	(0.0766)	(0.171)	(0.0779)
Had next fund?				0.0126	
				(0.121)	
Had next fund? X After close				0.315*	
				(0.184)	
First fund					-0.0330
					(0.127)
First fund X After Close					0.0118
					(0.125)
Observations	5427	5427	3881	5427	5427
Pseudo R^2	0.169	0.170	0.171	0.172	0.169
Num. VCs	405	405	241	405	405
Num funds	829	829	598	829	829
Num. firms	2476	2476	1991	2476	2476
Specification	Probit	Probit	Probit	Probit	Probit
Industry FE?	Y	Y	Y	Y	Y
Fin. year FE?	Y	Y	Y	Y	Y
Stage FE?	Y	Y	Y	Y	Y

Table B.2: Writeoff probabilities around fund-raising: hazard models with fund age dummies

Notes: Table presents the Cox proportional hazard regression of writeoff events around VC fundraising. A unit of observation (i.e. spell) is an entrepreneurial firm financing event. It is the same specification as Table 5 where the fund age and its square are replaced by a set of dummies for each year of fund age (the first year as the excluded group). All other controls from Table 5 are included but not reported here. The baseline hazards in all models are stratified at the VC firm-level. Standard errors reported in parentheses with clustering at the entrepreneurial firm. * , **, *** represent significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Fund 2 yrs.	0.0332	0.104	0.107	0.110
	(0.572)	(0.573)	(0.574)	(0.577)
Fund 3 yrs.	0.275	0.289	0.298	0.300
	(0.571)	(0.572)	(0.573)	(0.576)
Fund 4 yrs.	0.447	0.428	0.421	0.440
	(0.572)	(0.573)	(0.574)	(0.577)
Fund 5 yrs.	0.349	0.320	0.322	0.339
	(0.582)	(0.582)	(0.583)	(0.587)
Fund 6 yrs.	0.587	0.560	0.551	0.562
	(0.587)	(0.587)	(0.588)	(0.591)
Fund 7 yrs.	0.862	0.845	0.839	0.850
	(0.592)	(0.592)	(0.593)	(0.596)
Fund 8 yrs.	0.864	0.828	0.822	0.841
	(0.627)	(0.628)	(0.630)	(0.632)
Fund 9 yrs.	1.085*	1.006	1.061*	1.033
	(0.638)	(0.639)	(0.639)	(0.645)
Fund 10 yrs.	0.0535	0.0149	0.0356	0.0497
	(0.783)	(0.790)	(0.791)	(0.793)
After close		0.262***	-0.00834	0.364***
		(0.0936)	(0.183)	(0.110)
Had next fund?			-0.0782	
			(0.121)	
Had next fund? X After close			0.358*	
			(0.207)	
VC's first fund				0.0623
				(0.120)
First fund X After Close				-0.313*
				(0.188)
Spells	7909	7909	7909	7909
Pseudo-R^2	0.0567	0.0575	0.0579	0.0579
Number firms	3978	3978	3978	3978
Number VCs	616	616	616	616
Number funds	1132	1132	1132	1132
Year FE?	Y	Y	Y	Y
Industry FE?	Y	Y	Y	Y