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ABSTRACT

Private equity funds hold assets that are hard to value. Managers may have an incentive to distort reported valuations if these are used by investors to decide on commitments to subsequent funds managed by the same firm. Using a large dataset of buyout and venture funds, we test for the presence of reported return manipulation. We find evidence that some under-performing managers boost reported returns during times when fundraising takes place. However, those managers are unlikely to raise a next fund, suggesting that investors see through much of the manipulation. In contrast, we find that top-performing funds likely understate their valuations.

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I. Introduction

Recent SEC inquiries have examined the possibility of private equity partners overstating portfolio net asset values (NAVs) in an attempt to attract investors to future funds.[1] Because there is no liquid market for most assets held by private equity funds, investors rely on estimates of NAVs in quarterly reports provided by private equity general partners (GPs). Increasingly, NAVs are determined by outside valuation consultants and auditors, but the process is nonetheless subjective and is based on data produced by the portfolio companies that are directly owned by the funds.

In this paper, we examine the empirical evidence on potential NAV manipulation using a large dataset of buyout and venture capital funds. Our findings suggest that little manipulation of NAVs goes unnoticed by institutional investors. Some GPs of poorly performing funds appear to overstate NAVs around the time they would be attempting to raise a follow-on fund. However, these embellishments appear unsuccessful at influencing investment decisions in so far as those firms are significantly less likely to raise a follow-on fund, on average. We also find evidence of conservatism in valuations among the best performing funds. This is consistent with a concern on the part of GPs about being wrongly labeled as a firm that exaggerates NAVs. This also suggests that the equilibrium behavior of GPs in reporting NAVs is influenced by the potential for gaming reported values. Of course, the odds of GPs obtaining benefits from manipulating NAVs one way or the other depend on a variety of assumptions including the reliance of investors on past NAVs to make investment decisions as well as the inability of investors to detect or punish manipulators.

We utilize data provided by Burgiss which includes quarterly cash flows and NAV reports from a sample of 2,071 funds. These data are sourced from over 200 institutional investors that represent approximately $0.75 trillion in committed capital to private equity. We supplement these data with an independent database of private equity firms provided by StepStone. The StepStone database contains a nearly exhaustive record of institutional private equity fundraising between 1971 and

[1] For example, see "Private Equity Industry Attracts S.E.C. Scrutiny" by Peter Lattman, New York Times, February 12, 2012.

2016. This combination of data sources allows us to examine the relation between private equity performance reporting and fundraising success with a high degree of confidence in the data.

In our primary analysis, we conduct several tests to see if fundraising for a subsequent fund is related to abnormal returns. First, we consider returns around the first capital call for a firm's next fund. If there is no next fund, we assume fundraising attempts occur near the end of the fund's life (i.e., this is when a firm would have to be making a final push to raise a new fund). The data reveal a decline in performance around these events for both the average buyout and venture fund. We examine the source of the change in performance by separating funds into three groups that raise a next fund quickly, slowly, or not at all. For buyout funds, the decline in performance is entirely due to funds that are unable to raise a follow-on fund. For venture funds, those with no next fund also exhibit a decline in returns late in life.[2] We undertake similar event studies across additional subsamples to demonstrate that fundraising does not appear to be driven by naïve investors.

Next, we estimate a probability model of fundraising success as a function of excess returns and distributions to investors while controlling for the variation in fundraising environment and fund characteristics. We find evidence that exaggerated NAVs are associated with lower probability of raising a follow-on fund. Furthermore, we show that conservative reporting and credible signaling (via distributing capital back to investors) have stronger effects than market-adjusted performance. The results are similar for both buyout and venture funds.

We also examine how NAV changes depend on the performance of peer funds (i.e., those of similar vintage and strategy) and identify the determinants of the reporting bias over a fund life. We find evidence consistent with "peer-chasing" where top-performing funds report lower interim returns subsequently and bottom performing funds report higher returns. We show that this behavior is especially pronounced when fundraising incentives are strong.

Finally, we examine whether the adoption of new mark-to-market accounting standards in 2006-08 (FAS 157) has affected the quality of NAV reporting by private equity funds. We find

[2] Venture funds that raise a next fund late experience a leveling off of returns after fundraising. However, their returns before fundraising are better than for the average fund, so lifetime returns match those of funds that raise a next fund early in their life. On average, these funds do not experience a decline in returns after fundraising.

some evidence that regulation has improved accuracy of reported NAVs, however the analysis is confounded by the 2008-09 financial crisis. In general, our results are robust to the change in reporting standards around FAS 157 adoption.

Our conclusions add to the private equity literature and are distinct from several contemporaneous studies of private equity interim reporting and subsequent fundraising. Similar to Jenkinson, Souse and Stucke (2013) and Barber and Yasuda (2015), we find abnormal returns for a typical fund are smaller after the time that fundraisings occur. However, unlike the other papers, we show that the abnormal returns remain positive, on average, for successful fundraisers. Our results differ because the tests of NAV manipulation in the other papers are inherently misspecified. Because they use only fund-level data, measurement error is correlated with the history of cash flows and market returns. This makes such tests prone to spurious results as many explanatory variables of interest correlate with the fund cash flows and market returns. We exert a high degree of caution in constructing our variables and verify the validity of the null hypothesis via falsification tests.[3]

While confirming that performance rank versus peers tends to peak during fundraising (as do Barber and Yasuda, 2015), we go one step further in examining the market (i.e. investors') response. Our estimates suggest that 'signal-jamming', as proposed in Chakraborty and Ewens (2014) and Barber and Yasuda (2015), is not a complete characterization of the fundraising equilibrium. Rather, this equilibrium likely features elements of costly signaling (of which the investors are aware) as well as conflicts of interests between the current fund's investors and the next fund's investors (with respect to resources for monitoring and nurturing of the investments portfolios). The importance of these tensions have been long recognized as evidenced by the nature of covenants in fund term sheets (e.g. see Gompers and Lerner, 1996). These features provide an alternative explanation (which our results strongly support) for the elevated write-off rates that both studies interpret as evidence of previously overstated NAVs.

We also show that (1) performance rank during fundraising predicts final performance rank,

[3] We conduct simulations where we create placebo samples of funds using portfolios of public equities with similar properties and show that our tests are robust to funds' systematic risk misspecifications as well as correlations with the funds' cash flow patterns.

and (2) rookie managers do not report more aggressive NAV marks. These findings are different from the evidence in Jenkinson et al (2013) and Cumming and Walz (2010), respectively. The differences arise because we condition on the peer fund average final returns (unknown as of fundraising), and because we more clearly separate current performance from experience.

Overall, our results indicate that overstating interim returns has not been a winning strategy for GPs on average. While current fund performance impacts the odds of a successful fundraising, aggressive NAV marks are associated with a lower probability of raising a next fund. Consequently, GPs who are not underperforming should have an incentive to be truthful, or even conservative, with their unrealized investment valuations. Our evidence supports this. These results are notable (and distinct from the findings of related papers) because they show that while top-performing funds are more likely to raise a follow-on fund, inflating NAVs seems to reduce the odds of success.

The paper proceeds as follows: Section II provides a more detailed discussion of the economic game managers and investors might play. Section III describes the data used in the analysis. Section IV provides our main result. Sections V and VI report additional tests and more carefully address the endogenous relationship between fundraising and performance. Section VII concludes.

II. Reporting NAVs with incomplete and asymmetric information

The relationship between general partners (GPs) in a private investment firm and the outside investors (LPs) who invest in the GPs' funds is complicated by a lack of hard and timely information on performance. At the time of committing capital to a new fund, LPs do not know what specific investments the GPs will undertake. Consequently, in making fund investment decisions, LPs are forced to rely on (often interim) reported values of GPs' previous funds (if any) and soft information about the value-relevant qualities of GPs (e.g., access to deal flow, reputation in the industry, etc.).

LPs rely on past performance because of their expectation that the performance of a GP's previous funds predicts the performance of its subsequent funds. Academic evidence suggests that this expectation is reasonable. For example, Kaplan and Schoar (2005) document that absolute and relative performance of earlier funds predicts that of subsequent funds managed by the same private equity firm – both in venture and buyout. In a recent study, Harris, Jenkinson, Kaplan and Stucke (2013) find additional evidence of persistence for venture funds established after 2000 (about when sample coverage of many prior empirical studies stops). They document a decline in (but not disappearance of) persistence for buyout funds with inception dates after 2000. Kaplan and Schoar (2005) and Harris et al. (2013) also find that positive performance predictability decays in fund sequence – that is, the second previous fund is less informative about the current fund performance. While LP's expectation of persistence is reasonable in this context, there is abundant evidence that investors in mutual funds also condition investment decisions on past performance even though that past performance does not predict future performance.

In a survey of over 200 LPs, DaRin and Phalippou (2014) find that LPs indeed focus on past performance. They spend an average of 16 to 26 days (depending on the fund type) on due diligence for each fund they invest in. More than 90% of the LPs calculate their own measure of GP past performance and benchmark that past performance against other GPs.

The typical private equity fund has an investment period of five or six years and a fund life of at least ten years. After the investment period, the typical PE firm will seek to raise a new fund so that it can continue to invest while its previous investments mature. As a result, when LPs evaluate the performance of a GP's most recent fund, they must rely on net asset values (NAVs) reported by the fundraising GPs. This is particularly relevant for buyout funds since the performance of already resolved funds (e.g., third and fourth back in a sequence) appears to contain little predictive power on average.

GPs make investments in companies that are privately held, and thus market prices are not observable for most of the fund's unrealized assets. GPs have the potentially difficult problem of obtaining a valuation for each portfolio company at the end of each reporting period (normally quarterly). The GPs observe contemporaneous and lagged company characteristics for their portfolio companies (e.g., sales, profits, etc.) as well as public market characteristics for other, sometimes quite similar, companies, industries, and markets. In addition, GPs may observe, but only with a lag, the performance of their competition – that is, the performance of other funds of similar vintage and investment strategy.[4]

GPs have an incentive to assign valuations in a way that maximizes the value of their fund management firm. This problem includes maximizing not only the return from the current fund, but also possible future funds. Metrick and Yasuda (2010) and Chung, Sensoy, Stern, and Weisbach (2011) show that the expected income from subsequent funds comprises a similar fraction of a GP's lifetime income as the income from the GP's current fund. Chung et al. (2011) propose and find empirical support for a rational learning model where follow-on funds provide an indirect payoff for performance to GPs. GPs, therefore, have an incentive to overstate recent fund performance if such an overstatement increases the likelihood they raise their next fund.

At the same time, overstatements have potential costs to the GPs if LPs can detect overstatements and punish GPs by not investing when they discover an overstatement. DaRin and Phalippou (2014) report that 30% of the LPs in their survey say that they use their own fair value assessments of unrealized values (or NAVs). This strongly suggests that LPs are aware of the potential for GPs to overstate performance and that many LPs exert effort to detect those overstatements.

In this institutional context, therefore, GPs likely face a set of trade-offs in deciding whether or not to overstate reported NAVs. There are at least three potential equilibria in this environment.

First, it is possible that LPs can always detect overstatements and penalize the GPs who do so by not investing in their fund. In this case, the costs of overstatement are high and GPs will not overstate. Given the result in DaRin and Phalippou (2014), this seems an unlikely equilibrium.

Second, it is possible that LPs cannot explicitly detect or see overstatements and that the costs of overstating are not high. In this case, all GPs will overstate even though LPs may understand that overstating is taking place. This is analogous to the signal-jamming equilibrium in Stein (1989).

Finally, overstatement may have different costs and benefits to different GPs if LPs can observe fund value but only imprecisely. For example, for a GP with a very poorly performing fund, there is not much value in reputation if the firm ceases to exist after an unsuccessful attempt at raising

[4] Discussions in Phalippou (2009) and Harris, Jenkinson and Stucke (2012) as well as the proliferation of private equity benchmarking data vendors and consultants (e.g. in Brown et al. 2015) suggest that most GPs are aware where they stand versus peers.

a new fund. So, the cost to overstating is small. For a strong-performing GPs, with a fund that is performing well, there is no benefit to overstating. In fact, given the potential for a negative shock in the future, a strong GP might have an incentive to be conservative. Doing so will not reduce the likelihood of raising a fund, but may reduce the odds of being mistakenly classified as a manipulator if the negative shock were to occur.

More formally, in this equilibrium, LPs use imprecisely measured fund NAVs as an input to the decision on whether to invest in follow-on funds. Low ability managers try to mimic high ability managers by overstating returns, and usually, but not always, fail. Given the information asymmetry, good managers have an incentive to be conservative so as to not get confused with the bad managers (in the case of idiosyncratic bad outcomes unrelated to their ability). This equilibrium relies on only three assumptions: (i) PE managers have heterogeneous ability; (ii) past performance by PE managers provides a useful, but imperfect assessment of their ability; and (iii) portfolio company values cannot be determined precisely, but costly research by LPs improves accuracy.

Our analyses attempt to answer which, if any, of these three equilibria are present in the data.

III. Data

We obtain data on private equity funds for this study from Burgiss and StepStone. The Burgiss dataset is sourced exclusively from LPs and includes the complete transactional and valuation history for fund investments. The Burgiss data we utilize are provided by over 200 institutional investment programs and represent over $0.75 trillion in committed capital. The Burgiss LP customer base consists of approximately 60% pension funds (a mix of public and corporate), 20% endowments and foundations, and 20% other institutional investors such as funds-of-funds and sovereign wealth funds. Data from individual LPs are scaled by Burgiss to be representative of the full fund and supplemented with fund-specific characteristics (e.g., investment strategy). [5]

We supplement the Burgiss data with information obtained from the StepStone SPI database

[5] Additional details on the Burgiss data are available in Brown et al. (2015)

to provide an independent source of information about fund sequences and start dates. The SPI database tracks 12,545 U.S. dollar-denominated funds by 5,128 PE firms between 1969 and 2016. The SPI database is among the most comprehensive we are aware of in terms of coverage of buyout and venture funds. For each of the funds in the Burgiss sample, we identify the same fund and parent firm in the SPI database to verify the dates of new fund formation and the sequence of funds operated by a particular GP. Independent verification of fund sequence is especially important for our analysis of unsuccessful fundraising as described in more detail below.

The Burgiss dataset has been utilized in other academic studies. Harris, Jenkinson, and Kaplan (2014) compare several private equity datasets and conclude that the Burgiss dataset is representative of the buyout and venture funds investable universe. A major advantage of the Burgiss dataset is a complete and audited set of fund cash flows derived from direct recording of the fund accounting information disseminated to LPs. This feature is important for our research question because it insures against breaks in voluntary reporting by GPs and certain selection biases in other datasets (e.g., those relying on disclosures from public records and Freedom of Information Act requests to certain LPs). We limit our sample to U.S.-dollar denominated buyout (venture) funds with more than $25 ($10) million in capital commitments. Our total sample includes 997 buyout funds and 1,074 venture funds. Of these, 641 buyout and 910 venture funds focus on North America. In our sample, 488 of the buyout and 323 of the venture funds remain active (i.e., are unresolved) as of March 2012.[6] We are able to categorize each fund by: (1) industry sector according to Global Industry Classification Standard; (2) amount of capital committed; (3) strategy description; (4) firm affiliation; (5) dated (to the day) cash in-flows and out-flows as well as quarterly reported Net-Asset Values (NAVs).

Table 1 reports summary statistics for the funds in our sample separately for buyout and venture funds. We define a fund as no longer active or "resolved" once it has an NAV less than 2% of the fund's initial commitment amount. Results in Panel A indicate the well-known heterogeneity and

[6] In unreported results, we verify that the main findings hold in just the funds focusing on North America. Because of the smaller sample size, the power of tests using samples of funds focusing outside North America are necessarily weaker, but we do not find any results contrary to those reported for the full sample.

positive skew in performance among both resolved and active funds as well as the generally larger commitment amounts for buyout funds. The median buyout (venture) fund makes a distribution or capital call in 32% (25%) of active quarters.

Our data allow us to track each fund's affiliation with a private equity fund-management firm (henceforth, PE firm) so that we are able to generate fund sequences. Panel A of Table 1 also shows that for firms with at least two funds, the (interquartile) time between a particular fund's inception and a follow-on fund's first capital call varies from two to five years. Panel B of Table 1 presents further detail on successive fundraising patterns by breaking out each fund type into groups based on the number of years between a fund's inception and the next fund offering by the same firm (as measured by the date of the follow-on fund's first capital call). In addition, we tabulate the number of funds (i) by firm experience as measured by the number of previous funds raised and (ii) fundraising conditions as measured by public equity market performance through the third year of fund operations. If public market total returns in the three years around a fund's inception were in the bottom (top) tercile in comparison to other funds of the same type, we classify the fund as starting operations in a low (high) market environment.

Combining the Burgiss data on cash flows and NAVs with the SPI data on fund starts enables an analysis of the relationship between fund interim performance and fundraising success. For all tests in this paper, we define a follow-on fund as the first fund by the same GPs raised after 3 years from the current fund's first capital call. We define "same GP" for follow-on funds as those: (i) operated by the same PE firm; (ii) with the same geographic focus (if any) and currency denomination; (iii) with a similar investment strategy (e.g. buyout or venture). According to the above criteria, the follow-on success rate for buyout (venture) funds is 86.5% (83.2%). These values are about 10% higher than the follow-on rates inferred from the Burgiss data alone which are 77.2% (72.7%).

IV. Primary Results

We start our analysis by examining the patterns in fund returns since inception and around fundraising events. Specifically, we seek to detect the presence of any bias in reported NAVs. A bias could enter NAVs in several ways. First, valuing companies using comparable firms requires judgment as to which set of firms constitutes the appropriate comparison set and which metrics are the most suitable for determining value. Second, valuing companies using cash flow models requires a set of subjective modeling assumptions about growth rates, discount rates, etc. Finally, a bias in NAVs can derive from the timing of changing to fair value versus historical cost (or timing of write-downs of failed investments), particularly for venture funds. Historically, fund managers have had some flexibility on when to switch valuation methods. While funds use external valuation firms today, the valuation process remains at least partially subjective.[7]

A. Do Funds Overstate Returns?

If private equity firms inflate existing fund NAVs to boost to-date performance during new fundraisings, fund performance should subsequently deteriorate. The unwinding of such biases need not be immediate, but would necessarily occur when portfolio companies are sold or written off. We start our analysis by averaging quarterly performance as a function of time since inception across many funds. Because internal rate of return (IRR) is a money-weighted mean, quarterly changes in the IRR are poor measures of interim performance.[8] The commonly-used money-multiple (MM or TVPI) is the ratio of all fund distributions and remaining NAV (i.e. "Total Value") to total capital calls ("Paid-in Capital"). In Appendix A, we show that a change in MM is a special case of a change in the to-date PME, when gross benchmark returns, $R_{m,t}$, are set equal to 1 for all periods. Consequently, our analysis relies on a measure of the change in PME defined as

$$\Delta PME_t = (R_t^{NAV} - R_t^{mkt})\frac{NAV_{t-1}}{fv_t(Calls)} \quad , \tag{1}$$

[7] Before 2009, GPs had a large amount of discretion in valuing their portfolios. Since 2009, Financial Accounting Standards Board (FASB) Accounting Standard Codification Topic 820 (also known as FAS 159) requires private equity firms to value their assets at fair value every quarter, rather than permitting them to value the assets at cost until an explicit valuation change. This has likely had the practical effect of making estimated unrealized values closer to true market values than in the past. We examine this question later.

[8] In Appendix A we provide a simple example where the interpretation of IRR-to-date leads to a misleading assessment of actual fund to-date performance.

where R^{mkt} and R^{NAV} are, respectively, the public equity index gross return and the fund gross return.[9] The latter is computed using NAV changes adjusted for cash flows. We define $fv_t\,(Calls) = \sum_{i=0}^{t}\{Calls_i(\prod_{\tau=i}^{t} R_{\tau+1}^{mkt})\}$ as the time t value of cumulative capital calls adjusted by cumulative market returns. $(R_t^{\text{NAV}} - R_t^{\text{mkt}})$ is the excess return of a fund's invested assets over period t. Equation (1) captures the importance of NAV changes in the performance numbers that investors get to observe. To compute abnormal performance based on NAVs over a time interval (a,b) for a cross-section S of funds, we define the Weighted-PME (WPME) as

$$WPME_a^b = 1 + \sum_{t=a}^{t=b}\left[\sum_{i\in S}\Delta PME_{i,t} \Big/ \sum_{i\in S}\frac{NAV_{it-1}}{fv_{it}(Calls)}\right] \quad . \tag{2}$$

In a Monte-Carlo experiment described in Appendix A, we find that excess returns and, thus WPME changes, yield sharper estimates of time trends in mean excess returns than do raw returns or money-multiples.[10]

Figure 1 presents the WPMEs across all buyout and venture funds in our sample since fund inception (Panel A) and +/-12 quarters around the next fundraising event (Panel B). We define the date of the next fundraising event as the quarter of the first capital call by the next fund by the same firm (given at least 11 quarters since the current fund inception). In case there is no such follow-on fund according to our data, the event quarter is the 13th quarter preceding the last NAV report if the fund is resolved or at least 10 years old.

Panel A of Figure 1 shows that average abnormal performance since inception for both buyout and venture funds increases fairly steadily for the first few years of fund life. Around quarters 15-20 average fund returns start to grow more slowly, though excess returns remain mostly positive. The slowing in return growth is slightly more pronounced for venture funds.

[9] We use the CRSP Value-Weighted market return as a proxy for public market returns. However, the choice of benchmark is not an obvious one (see Phalippou, 2013) so we have also examined alternatives and our results are robust to the choice of benchmark. In addition, our subsequent analysis with placebo fund returns uses style- and size-matched public equity portfolio returns based on Fama-French research portfolios. Note that Kaplan-Schoar PME, as an estimator of the expectation of a product of cash flows and the discount factor, is inherently robust to risk-exposure misspecification. See Korteweg and Nagel (2016), Sørensen and Jagannathan (2015) for a theoretical exposition as well as Robinson and Sensoy (2011) for an empirical assessment of the sensitivity of cross-sectional mean *PME* to different beta/benchmark assumptions.

[10] We also show that inference about the path of cross-sectional mean returns does not depend much on our assumption about a typical fund's level of systematic risk (i.e., market beta).

Since funds launch a follow-on fund at different times in the existing fund's life, we next examine returns around the subsequent fundraising event. In particular, the 3-year window before a fund's first capital call is the time that a firm is most likely to be active in trying to secure commitments to a new fund. Panel B of Figure 1 plots cumulative abnormal performance starting 3 years before the next fundraising event. The plots show the same pattern suggested by Panel A. The cumulative average excess return for both buyout and venture funds in the 3 years following the fundraising event is less than in 3 years preceding the event. However, it is important to note that after fundraising (t$>$ 0 in Panel B) excess returns remain positive.

Contrary to the literature discussed in the introduction, we do not consider the assumption of constant excess returns over a fund's life an appropriate null hypothesis. There are alternative explanations that are consistent with the flattening of excess returns post-fundraising which do not involve a bias in reported valuations. For example, if part of the value-added by a GP involves finding underpriced assets then excess returns will decline as investments are made and then properly valued. GPs may then need time to facilitate an exit from the investment or simply add additional value, but at a lower rate, through "nurturing" portfolio companies.

In addition, the elevated write-off rates after fundraising may occur as a result of GPs learning about the ultimate prospects of specific investments. Intuitively, GPs will be more likely to "throw in the towel" for any given investment later in a fund's life while factoring-in the probability of the write-down is not consistent with GAAP.[11] A fund's performance may also deteriorate after a next fund is raised if GPs dedicate most of their efforts (and possibly better deals) to the new fund or simply face better investment opportunity earlier in a fund's life with the marginal return to investment declining with the investment period approaching its expiration. While this potentially represents an agency cost born by LPs in the old fund, this would not constitute a NAV manipulation.

Figure 1 is also consistent with standard industry practice in how many LPs evaluate perfor-

[11] According to SFAS 157 (ASC 820), the Level III assets must be assigned a value corresponding to '*Highest and Best Use* ' as being '*consequently operated with the other assets in its group'*. So changes to the fund portfolio may naturally trigger changes to 'Highest and Best Use'-valuations of the remaining assets.

mance of GPs. LPs often require a certain level of successful divestments from the current fund before committing new capital, so GPs may have to exit some of their best investments early to credibly convey their ability. Such actions can be viewed as a cost of asymmetric information and uncertainty about NAVs that LPs are nonetheless willing to endure to better learn about a GP's skill (in spirit of Leland and Pyle, 1997). However, this sort of behavior is also distinct from reporting biased valuations. In addition, some investors could simply overreact to particularly strong (yet truthfully reported) returns over the last few quarters. Thus, a reversion to lower levels (that would occur irrespective of the new fund launch) may induce the aforementioned pattern. Finally, it is possible that broad market conditions relevant to buyout and venture fund returns (e.g., access to exits or new capital) determine the timing of fundraising. Much of our subsequent analysis seeks to differentiate among these explanations.

A.1. Successful versus unsuccessful fundraisers

As a next step, we investigate WPMEs for subsets of buyout and venture funds. First, we categorize funds into groups based on the time it takes to raise a next fund. We create three groups: The "Early (Late) Next Fund" group is defined as those funds that take less (more) than the median time to raise a new fund. The "No Next Fund" group is defined as those funds for which we do not observe a follow-on fund (as discussed in section III). We also split the sample based on median 5-year rolling public markets returns as of the 13$^{\text{th}}$ quarter of the fund's life and call these "High Market Return" and "Low Market Return" funds.

Panel A of Figure 2 show the cumulative changes in excess returns for buyout and venture funds conditional on the time it takes to raise a follow-on fund. Unsurprisingly, funds with no next fund have much weaker performance than funds which are successful at fundraising. Otherwise, moderation in performance is only apparent for venture funds with a late next fund. Excess returns in early years are typically as good or better for those funds that take longer than average to raise a next fund though we show subsequently that this is partly related to market conditions.

Recall that we define a hypothetical fundraising event for the No Next Fund group as the 13$^{\text{th}}$ quarter before the last NAV report for funds that are resolved or lived for at least 10 years. This approach takes into account the salient features of the contractual and operating environment documented for private equity funds (e.g. see Metrick and Yasuda, 2010). Specifically, GPs are generally free to choose when to exit fund investments subject to constraints on how long they can charge management fees for, and rarely enter (or exit) several "deals" simultaneously. In such settings, one would expect that any existing valuation bias to reveal itself gradually as the fund unwinds its portfolio (rather than a one-time write-off or liquidation).[12]

Panel B of Figure 2 reveals the most interesting results. For both buyout and venture funds, the excess returns of funds that are unsuccessful at raising a next fund (dotted lines) show patterns consistent with funds gaming returns. In both cases, excess returns increase in the period during which a firm is likely to be making a final effort to raise a next fund only to reverse returns in the final years of the fund (as cash flows are realized).[13] We note that these represent not just lower excess returns, but in fact, negative excess returns. Thus, this evidence is suggestive of attempts at manipulation that are not successful since investors are not willing to commit to a next fund. In other words, the market for buyout and venture funds may look through attempts at gaming NAVs and determine the actual performance of a fund. These results are consistent with the third equilibrium described above.[14]

In Figure 3, we further refine the analysis by considering the performance of different fund groups during periods of strong and weak market returns. Both buyout and venture funds have higher excess returns prior to fundraising when market returns are low (regardless of when the fund was raised) suggesting a higher bar for raising funds during a weak market. The evidence for No Next Funds shows that the degree of potential gaming also appears to be more pronounced

[12] See the example in the opening of section V for more intuition.

[13] Figure B.3 shows that this result is not driven by outliers and assumptions about the timing of a last-ditch effort to raise a follow-on fund. The top charts in Panel A show that when 2008:Q2-2009:Q2 are excluded, the hump-shaped pattern of WPME in buyout and venture subsamples remains largely unchanged for the No Next Fund groups (while not being evident among the successful fundraisers). In Panel B, we define the event time as 3 years after the median peer fund raised a successor fund. The subsequent underperformance relative to successful fundraisers remains obvious in both subsamples. The bottom charts in both panels demonstrate the advantage of using our preferred metric based on Kaplan-Schoar PMEs. Nonetheless, the increase in the performance gap from the successful fundraisers is evident with TVPI as well.

[14] An alternative explanation would be that these GPs delayed fundraising and then were unlucky with their investments. Such delays are likely to be costly given the GPs' value maximization objectives discussed in Metrick and Yasuda (2010) and Chung et al. (2011).

during weak markets for buyout funds. There is no evidence that the mean excess returns become negative after successful fundraising in either of the subsamples.

A.2. Heterogeneity among successful fundraisers

To more closely examine the issue of performance reporting around fundraising, we consider future performance conditional on past performance using tercile transition probabilities (similar to Kaplan and Schoar (2005) and Phalippou (2010) but over a given fund's life rather than across funds). Table 2 reports transition probabilities between performance terciles based on IRR-to-date within each fund peer group. Panel A shows results for buyout funds and Panel B shows results for venture funds. In both cases we examine only funds that have a follow-on fund. For example, the first row of each panel reports the probability of being in each final performance tercile conditional on being in the bottom tercile at the conclusion of fundraising. The last row of each panel reports the unconditional distribution of funds across final performance terciles, and the last column reports how many funds successfully raised a next fund in each tercile.

First, the far right columns in each Panel show that a firm is about twice as likely to raise a follow-on fund when the current fund performance is in the top tercile versus in the bottom tercile: 44.7% [42%] versus 18.8% [22.9%] for buyout [venture]. This finding is consistent with funds gaming NAVs as well as with investors requiring credible evidence of investment success through exits before committing to a follow-on fund. However, for both buyout and venture funds, top and bottom performers during the fundraising period are most likely to remain in the same performance tercile. Thus, the interim performance rank is typically informative about the final performance rank for the current fund. In the appendix, we demonstrate that this result holds if PME is used in place of IRR (Table B.2) and appears to be even stronger with quartiles (Table B.3).

Nonetheless, there are some funds that transition between top and bottom terciles. For example, about 10% of top buyout and venture funds at life-end were in the bottom tercile during fundraising. This suggests that investors put weight on other indicators of GP quality besides interim returns. For both buyout and venture funds, there were slightly more transitions from top to bottom terciles than from bottom to top. Likewise, for both buyout and venture funds more middle-tercile funds at fundraising transition to the bottom tercile than to the top tercile. These results also suggest heterogeneity in NAV reporting biases among successful fundraisers. However, it is not clear if it pays to overstate NAVs. In the next sections, we investigate if overstated NAVs actually increase the odds of a successful fundraising.

A.3. A signaling model of fundraising

While the evidence presented previously is suggestive, we have yet to provide statistical tests of our hypotheses. We start our statistical analysis by estimating a linear probability model where the dependent variable equals one if we observe a follow-on fund and zero otherwise. For now, we limit our sample to the funds that were resolved or operated for at least 10 years. As before, the event time is defined by the quarter in which the follow-on fund made its initial investment or the 13^{th} quarter before the last NAV report (if the fund is resolved or operated for at least 10 years).[15] We consider the following covariates; all are defined as categorical variables to simplify the interpretations:

- *PME drop (after)* – equals 1 if the fund's PME at resolution is lower than at the event time and zero otherwise;
- *PME run-up (before)* – equals 1 if the fund's PME 1 year before the event time is lower than at the event time and zero otherwise;
- *Large Distribution (before)* – equals 1 if the sum of distributions over the year preceding the event time exceeds 20% of NAV and zero otherwise;
- *Top tercile-to-date* – equals 1 if the fund is in the top (best) IRR-tercile across vintage and strategy peers at the event time and zero otherwise, and
- *Bottom tercile-to-date* – equals 1 if the fund is in the bottom (worst) IRR-tercile at the event time and zero otherwise.

[15] In sections III and A.1 we provide additional discussion and robustness tests.

Table 3 reports the results of this estimation, separately for buyout (Panel A) and venture (Panel B) subsamples. All specifications include the interaction of the fund vintage year and industry fixed effects to absorb the variation in investor demand for certain types of funds over time. The standard errors are clustered by the event year to account for any correlated shocks affecting the fund returns. In specifications (3) and (4), we also include the level of PME at the event date as well an indicator whether the market return was positive in the year prior to the event.

From specifications (1) through (3), we see that negative post-event abnormal returns as well as lower returns just before the event correspond to a lower probability of successful fundraising. The magnitudes of the effects similar to those of being in the top performance tercile (a difference in probability of a successful fundraising of 8-12 percentage points). As discussed above, *PME drop (after)* is an indication of overly optimistic NAVs at the event time. It therefore appears that investors scrutinize fund portfolios and consider aggressive valuations in the current fund as a bad signal about a GP's ability. The negative coefficient on *PME run-up (before)* suggests that investors also react negatively to above market return reports over the few quarters before the event.

Specification (4) examines another possible explanation. The significant positive coefficients on *Large Distribution (before)* interacted with *PME run-up (before)* suggests that investors appreciate positive excess returns when accompanied by large distributions from the fund. This may drive much of the performance rank affect around the fundraising quarters documented by Barber and Yasuda (2015). Overall, these results are consistent with NAV overstatements reducing the odds of fundraising success.

These results suggest that it is unlikely that overstating interim returns has been a winning strategy for GPs on average. Although the current fund performance clearly has bearing on the odds of a successful fundraising, overly optimistic NAVs (nefarious or not) are generally associated with a lower probability of raising a follow-on fund. Therefore, GPs would have an incentive to be truthful, or even conservative, with their unrealized investment valuations. These results are interesting (and distinct from the findings of related papers) because they show that while top-performing funds are more likely to raise a follow-on fund, inflating NAVs seems to reduce the odds of success. Overall, the findings are consistent with the third equilibrium we describe above.

Next, we more carefully examine the sources of cross-sectional variation in NAV biases.

B. Peer-Chasing

The extent and nature of any strategic behavior regarding NAV reporting is likely to depend on to-date performance of a fund as compared to its peer funds. This is reflected in the standard industry practice of comparing performance across funds of similar vintage-year. It is therefore natural to assume that GPs track their fund's performance as compared to that of the peers. Likewise, GPs likely have an incentive to incorporate this knowledge in the valuation process. Discussions in Phalippou (2009), Stucke (2011) and Harris and Stucke (2012) suggest that some GPs "manage" their peer set.

If the resulting behavior results in mimicking peer fund performance, or what we call "peer-chasing", this could cause NAV manipulation to spread across firms as a strategic response to the informational asymmetry between GPs and LPs. For example, underperforming funds have an incentive to report upward-biased NAVs and may have limited tools to credibly convey that their NAVs are more conservative than those of their peers. At the same time, top performing funds may want to insure against bad luck that could tarnish their reputation in the long-term.

Empirically, peer-chasing could appear as mean-reversion in reported performance. To identify peer-chasing, we compare future reported returns conditional on cumulative to-date performance. Specifically, for each fund-quarter we compute the 4-quarter ahead change in PME-to-date. We then rank these changes by funds of similar vintage year (+/- one year) and plot the distribution of the ranks by cumulative performance tercile (as measured by IRR-to-date) for different fund-life periods. Specifically, we look at: 8-17 quarters since inception (denoted as ˜ 3yrs); 18-27 quarters since inception (denoted as ˜ 5yrs); and 28 or more quarters since inception (denoted as $>$ 7yrs).

Given the probable relation between fund returns on public market returns, we need to be careful about the null hypothesis for peer-chasing tests. It could be that mean-reversion is naturally present in the unobservable true return-generating process (weighted by fund-quarter population). To address this concern, we also construct placebo return series for each fund in our dataset as a sum of style-matched public equity portfolio returns. [16]

Results for these tests are reported in Figure 4 for buyout funds (Panel A) and venture funds (Panel B). In each panel, top to-date performers are shown in the top graph and bottom to-date performers are shown in the bottom graph. The results suggest strong peer-chasing patterns for both buyout and venture funds. For example, in Panel A of Figure 4, a buyout fund that is in the top to-date tercile after 3 years is much more likely to report relatively low returns over the next year (as the darkest bar is much higher than the other two). This effect persists but is notably weaker for ˜ 5yrs since inception. By the ˜ 7yrs since inception the mean-reversion flips as the top-to-date funds are more likely to report relatively high changes (the darkest bar is the lowest). This is consistent with the necessary undoing of conservatism as portfolio companies are exited. In contrast, before the ˜ 5yrs since inception, buyout and venture funds in the bottom tercile are more likely to report high excess returns over the next 12 months. While after ˜ 7yrs since inception, when performance numbers again become increasingly driven by actual cash flows, the 12-month excess returns become notably worse than those of top tercile peers. In addition, there is some apparent asymmetry in these results in the early years with bottom tercile funds overstating performance more than top performing funds are understating performance. The placebo returns generated from public portfolios (reported in the appendix in B.4) indicate that comparable public market returns exhibit very weak, if any, return-reversal patterns.

Overall, the evidence in this section reveals interesting, and economically significant, patterns in reported NAVs. These patterns appear related to some poor performing funds inflating returns during fundraising as well as evidence of conservatism by top-performing funds. However, the

[16] The style-matched public portfolio for each fund is a weighted subset of Fama-French research portfolios that represent U.S. equity sorts into deciles based on mid-year book-to-market ratios and market capitalization. We use only the below-median size portfolios. For buyout funds we use the 25 highest book-to-market portfolios and lever their returns by a factor of two to account for leverage in buyout transactions (for example, Axelson, Jenkinson, Strømberg, and Weisbach (2013) report the Debt-to-Enterprise Value ratio of 0.6 for their sample of LBOs against just 0.3 for the public firm matches). For venture funds we take actual returns of the 25 lowest Book-to-Market portfolios. Once the weights are selected, they remain fixed over the fund life-time while the placebo returns correspond to the actual fund operation periods. This placebo comparison can be thought of as deriving from a simulation where we draw factor-returns from a sample of actual paths rather than taking a stand on return-generating process explicitly. An advantage of this approach is that it retains the cross-sectional heterogeneity in the actual time-series of equity returns (including any anomalies).

findings are not consistent with the fundraising success being positively related to NAV overstatements. On the contrary, we show evidence that investors punish overoptimistic NAVs by not providing capital to new funds. In addition, LPs appear to prefer positive interim performance signals in the form of cash distributions following successful divestments by funds. The data are also consistent with the realized performance bar being higher (and attempts to manipulate NAVs being stronger) in a tough fundraising environment. Luck experienced by funds in their early years appears to have less of an effect on fundraising. If luck were important, we would observe lower excess returns after early fundraisings. Instead the post-fundraising excess returns for funds that are early to raise the next fund are on average positive and no different from those after late fundraisings.

V. Comprehensive Analysis

In the reminder of the paper we seek to characterize the bias in performance reporting that is robust to measurement errors and certain alternative explanations. Given the variety of factors that may affect NAV, focusing on just cross-sectional mean changes for excess returns is limiting. In this section we take a careful look at how fund timing and peer-chasing may jointly determine NAVs. We define the NAV-bias and make clear what may obscure inference.

We define the NAV bias as a ratio ($\equiv \Gamma_t$) of reported NAV to an unbiased assessment of the market price of the fund in an arms-length transaction.[17] By construction, this ratio will have a value that is always greater than zero and equal to one when the bias is zero (e.g., when NAVs turn into cash). We model this bias as a continuously compounded change from the level in the previous period. Such a change in bias over a period can be written as:[18]

$$\Delta bias_t = \log\left(NAV_t\right) - \log\left(NAV_{t-1} \times R_t^m - K_{t-1} \times CF_t\right) - \log(R_t^{\varepsilon}), \tag{3}$$

where R_t^{ε} and R_t^m are the fund idiosyncratic gross returns and systematic gross returns, re-

[17] An unbiased assessment satisfies the GAAP fair value definition as the value “at which that asset could be bought or sold in a current transaction between willing parties, other than in a liquidation.” We do not distinguish between cases when GPs (i) pretend that reported NAVs are fair values in the GAAP sense and (ii) report NAVs that are conditional on a successful realization of the business plan (which is a very uncommon practice according to our conversations with LPs).

[18] See Appendix A for derivation.

spectively; CF_t represents net distributions to fund investors over period t; K_{t-1} is a ratio of the valuation bias multiple (Γ) at time $t-1$ to time t idiosyncratic gross return.

The intuition behind $\Delta bias_t$ is straightforward. It is a change in log(NAV) that cannot be explained by the market returns or fund cash flows. Conditioning on the previous level of the bias (through multiplication by K_{t-1}) in periods with cash flows is necessary because the cash flows implicitly change the level of the remaining bias. For example, suppose the fund's "true value" of assets did not change from \$10m but had been overstated by 10% last period so that $NAV_{t-1} = 10 \cdot \exp\{0.10\} = 11.05$. Consider what happens when the underlying assets do not change in value, but the fund distributes a quarter of its assets at t (i.e., $CF_t = 1/4 \cdot 10 = 2.5$). The valuation bias ($\Gamma$) on the remaining assets will have to step-up for the reported returns to be zero. Specifically, $0 = NAV_t + CF_t - NAV_{t-1} = \Gamma_t \cdot 7.5 + 2.5 - 1.105 \cdot 10$ implies that the new bias will be $\Gamma_t = 1.14$. So multiplication by K_{t-1} allowes to capture the innovations in the bias in t (rather than the interaction of the past levels with the cash flows).[19] However, neither returns nor past levels of the valuation bias are observable, so we must replace them with proxies. Next, we discuss the rationale behind our choices of proxies.

A. Dependent variables

For our main dependent variable, we utilize equation (3) assuming K_{it} and R^{ε}_{it} are equal to 1 while R^m_t is the value-weighted CRSP index return (or CRSP index returns levered by market beta estimates from the literature). So for each fund-quarter it, $\widetilde{\text{bias}_{it}}$ is defined as:

$$\widetilde{\Delta bias_{it}} = \log\left(NAV_{it}\right) - \log\left(NAV_{i,t-1} \times R^{CRSP}_t - CF_{it}\right). \tag{4}$$

Thus, $\widetilde{\text{bias}_{it}}$ is just the market and cash flow adjusted NAV growth between $t-1$ and t. As outlined above, the measurement error on this feasible proxy for $\Delta bias_t$ will be a function of:[20]

[19] Jenkinson et al. (2013) consider a change in NAVs from the past period as their main dependent variable while Barber and Yasuda (2013) define a "markdown" variable as $min\{NAV_t - (NAV_{t-1} - CF_t), 0\}$. To see how this may result in a spurious correlation with cash flows consider a situation when a fund decides to value the remaining holdings more conservatively having made some distributions recently. The inference using their method would be that NAVs were overvalued prior to when those distributions took place even if in reality they were undervalued (i.e. $\Gamma_t < \Gamma_{t-1}$ is considered evidence of $\Gamma_{t-1} > 1$). See Appendix A for details.

[20] To the extent (i) true exposure to the market deviates from the assumed one, and (ii) the ratio of the previous period valuation bias to the current period idiosyncratic return (gross) deviates from one. See Appendix A for details.

- fund i idiosyncratic returns for period t,
- the market return for period t, $R_t{}^{CRSP}$, and
- the fund i cash flow for period t, CF_{it}.

Thus, any multivariate analysis with this dependent variable would be susceptible to biased coefficient estimates whenever the regressors (X) correlate with these items. To confirm that our results are not driven by such spurious relations, we also construct a placebo dependent variable that is a function of misspecified systematic risk and the actual fund cash-flows. Substituting $(NAV_t + CF_t)/R_t^{placebo}$ for NAV_{t-1} in equation (3) while keeping K_{t-1}=1, yields the following placebo counterpart:

$$\widetilde{\Delta bias}_t^{placebo} = \log(R_t^{placebo}) - \log\left(R_t^m + (R_t^m - R_t^{placebo})\frac{CF_t}{NAV_t}\right). \quad (5)$$

If controlling for cash flows results in spurious correlations of residuals of $\widetilde{\Delta bias}_t$ and X then we should observe similar spurious correlations with $\widetilde{\Delta bias}_t^{placebo}$ and X. Similarly, if R^{CRSP} or idiosyncratic returns are correlated with X, this will also be the case for $\widetilde{\Delta bias}_t^{placebo}$. In other words, regressions using $\widetilde{\Delta bias}_t^{placebo}$ will indicate the direction and magnitude of the econometric bias in the estimates arising from the measurement error's correlation with X.

B. Explanatory variables

Our two primary explanatory variables of interest are called FundTiming and PeerChasing. FundTiming is defined as the natural log of the number of years (1 plus years after the second) spent without a follow-on fund. It is a proxy for a growing incentive to boost NAV as the GP goes longer without raising a follow-on fund. By construction, the change in FundTiming will be smaller for each subsequent quarter without a fund.[21]

[21] We note that the term *FundTiming* is somewhat misleading insofar we intend to test for the active manipulation of NAV reports rather than the choice of time to launch a fund. We also note that it is possible that a reverse causality drives the relationship between upward-biased NAVs and follow-on fund launches and that using FundTiming should help mitigate concerns about us identifying this as nefarious manipulation. Suppose that, innocuously, GPs become overly optimistic about the investment opportunity set or their skill. These are precisely the times when they would seek to start another fund for a good reason. In other words, GPs may make honest mistakes that induce correlation between reported returns and new fund launches. Unlike dummy variables indicating lead/lags from the fundraising quarter, the variation in FundTiming can be considered relatively exogenous with respect to such "honest optimism" waves in so far as the optimism is unlikely to increase monotonically in the time spent without a fund.

PeerChasing is the difference between a funds reported IRR-to-date and the median across the fund's peers. We construct fund peer groups as we did for Figures 4. Specifically, peer groups consist of other funds of the same strategy and adjacent vintage years (including already resolved funds) as of the previous quarter. For placebo tests, we also construct a PeerChasing series from placebo returns. Under the null of unbiased (independently distributed) NAV changes, risk-adjusted returns should not correlate with their own lags. Additional details on the construction of both variables are presented in Appendix A.

An alternative explanation for a relation between NAV growth and FundTiming or PeerChasing is that some funds have stale NAVs. That is, some GPs simply lag behind their peers in updating their portfolio valuations. For example, GPs may wait to revalue until a next funding round or follow a convention of holding assets at cost. Such firms may nonetheless have to bring stale NAVs more up to-date when it is time to start marketing a new fund. Thus, managerial style may result in mean-reversion of returns that is stronger when it has been awhile since the previous fund's inception. We address this concern via our cross-sectional tests in this section as well as in separate tests in the robustness section.

Because we want to focus on NAV reports that can be plausibly manipulated and also affect the fund performance assessment by investors, we only consider reports between the 6^{th} and 28^{th} quarter of fund life for this analysis. To reduce the impact of outliers and remain realistic about the extent to which a common slope may hold across funds with dramatically different performance, we include only fund-quarter observations where IRR-to-date is within 30 percentage points from the peer-group median. To motivate this censoring, we estimate local polynomial regressions of $\widetilde{bias}_{\text{it}}$ on $\text{PeerChasing}_{it-1}$ and $\text{PeerChasing}_{it-2}$ (Figure B.6 contrasts them against $\widetilde{\text{bias}}_{\text{it}}^{\text{placebo}}$). We find a negative association with reported returns when *PeerChasing* is close to zero. However, when it is more than 30 percentage away from zero, the relationship dissipates. These results suggest that *PeerChasing* effect is present only where it might be credible (or relevant). Table B.4 reports summary statics for the dependent and explanatory variables used in subsequent tests.

C. Main effects

Table 4 reports estimates for the following two models (for both buyout and venture funds) over the sample period covering 1984 through 2011:

(i) $\widetilde{\Delta bias_{it}} = [FundTiming_{it} \quad PeerChasing_{it}]\beta + Controls_{it} + v_{it}$

(ii) $\widetilde{\Delta bias_{it}} = [FundTiming_{it} \quad PeerChasing_{it} \quad FundTiming_{it} \times PeerChasing_{it}]\gamma + Controls_{it} + u_{it}$

Results from model (i) are reported in specifications (1) and (2) while results from model (ii) are reported in specifications (2) and (4). $\text{Controls}_{\text{it}}$ include fund fixed effects, year-quarter fixed effects, as well as fund distributions and capital calls over the current quarter scaled by the end-of-quarter NAVs. Specifications (1) and (2) have adjusted NAV growth computed assuming a beta of one relative to the value-weighted CRSP stock index. In specifications (3) and (4), we use a beta of 1.7 for buyout funds and of 2.4 for venture funds which are provided in Driessen, Lin and Phalippou (2012).[22]

For buyout funds (Panel A), estimation results in specification (1) indicate a positive and significant coefficient on FundTiming and a negative and significant coefficient on PeerChasing across all specifications. The corresponding results for the venture sample (Panel B of Table 4) show similar relations with somewhat smaller magnitudes for FundTiming. These coefficients constitute a prediction of next period fund reported returns up to a fund-specific trend. Results in specification (3) indicate that the findings are not very sensitive to the alternative market beta.[23]

To gauge the economic significance, we can calculate that for a buyout fund, the fourth year spent without a follow-on fund elevates the reported excess returns an average of about 6.5% next quarter (0.08*log(3)). The coefficient on PeerChasing indicates how much the average fund excess return increases next quarter if it is above the peer group median IRR-to-date by 1 percentage point. For example, the estimate in the first column of Table 4 Panel A of -0.205 for buyout funds suggests a reversion of about 20 basis points. Given the standard deviation of 0.13 for *PeerChasing*

[22] These are the highest values of beta among the papers we reviewed: Brav and Gompers (1997), Cao and Lerner (2007), Kortoweg and Sorensen (2009), Franzoni, Nowak and Phalippou (2012), Driessen, Lin and Phalippou (2012), Ewens, Jones and Rhodes-Kropf (2013).

[23] This suggests that the measurement error discussed in the previous section is not driving the results. Table B.5 reports additional specifications for model (i) and (ii) that demostrate the estimates robustness to different set of fixed effects and cash flow controls which provides additional assurance against the spurious correlation risk discussed in Appendix A.

this suggests a typical reporting distortion is around 2.6 percentage points of quarterly returns.

In model (ii), we examine the interaction between fund timing and peer chasing. The coefficients on *FundTiming* remain positive and significant for both buyout and venture funds suggesting that timing effects are robust to accounting for the interaction effects. The coefficient on PeerChasing becomes positive and significant in some specifications, suggesting that when the $FundTiming$ variable is zero there is no reversion in returns but rather a persistence (whereas in model (i) the effects are implicitly evaluated at a mean level of other variables).[24] To better assess the economic significance, consider the case where a buyout fund has performance two standard deviation below its peers and five years have elapsed without raising a new fund. In this case, the model suggests that the change in reported performance from previous quarter will have a positive bias of nearly 5 percentage points.[25] Now consider a similar fund that has gone five years without raising a new fund but has performance two standard deviation *above* its peers. In this case the bias will be just about 1 percentage point. These magnitudes are similar to the venture sample.

In short, the negative and significant coefficient on the interaction term reinforces the conclusion that peer-chasing is stronger when the incentive to do so is high (as measured by FundTiming). In other words, the longer it takes to raise a next fund, the more strongly the funds reported returns revert to those of its peers. Because the effect is stronger when incentives are large, this finding is consistent with NAV manipulation rather than alternative explanations discussed in the previous section. To the extent that more time spent without a fund is associated with lower performance, these results are consistent with underperforming funds tending to overstate NAVs.[26]

D. Cross-sectional differences

In this section we investigate how cross-sectional differences affect fund timing and peer-chasing. We extend model (i) by including the interactions of FundTiming and PeerChasing with the following variables:

[24] Albeit the models' R-squared hardly moves after adding the interaction term, the reduction in Bayesian Information Criterion (untabulated) is greater than 20 for both, buyout and venture funds, regardless of the additional control variables.

[25] 0.053*log(4) +0.117*[2*-0.13] -0.304*[log(4)* 2*-0.13]

[26] Year-quarter fixed effects, very close point estimates across different beta assumptions leave hardly any room for a risk-based explanation of our results.

- Rookiee_i, equals 1 if the firm has had two or less previous funds in the sample and zero otherwise;

- TopTercile_{it}, equals 1 if fund i to-date-IRR at time t is in the top tercile of peer funds in the same strategy in adjacent vintage-years and zero otherwise;

- BtmTercile_{it}, equals 1 if fund i to-date-IRR at time t is in the bottom tercile of peer funds in the same strategy in adjacent vintage-years and zero otherwise.

Table 5 reports four specifications separately for buyout and venture funds. All are estimated with fund fixed effects, year-quarter fixed effects, and fund distributions and capital calls over the current quarter scaled by the end-of-quarter NAVs. Since TopTercile_{it} and BtmTercile_{it} are time-varying characteristics over a fund's life, we can identify the effect on reporting bias in the quarters right after transitions to and from the respective tercile. In contrast, Rookiee_i is a fixed characteristic for a given fund so only its interaction terms are present in the model.

Specification (1) examines the Rookie effect, (2) examines the TopTercile effect, (3) includes all effects (thus, the base case is middle tercile funds with two or more previous funds from the same firm), and (4) investigates whether our inference is sensitive to the level of market beta we assume. It is important to note that the control group for top tercile funds in specification (2) is both middle and bottom tercile funds, whereas the control group in specifications (3) and (4) is only middle tercile funds.[27]

We first consider the results from specification (1) for buyout and venture funds which examines the rookie-effect. The coefficient on the interaction with FundTiming_{it} is negative but insignificant and small. We note that rookie venture funds do not exhibit significantly different fund timing or peer-chasing behavior. However, peer-chasing is more pronounced among rookie buyout funds.

In specification (2), we consider how the effects differ for top-performing funds. The positive and significant coefficient on TopTercile indicates that top performing funds to-date continue to report abnormally high NAV-growth in both subsamples, buyout and venture. This is consistent

[27] By construction, performance-tercile dummies are strongly correlated with PeerChasing variable. Thus, the effects of (1 TopTercile $BtmTercile) \times FundTiming$ effectively proxy for FundTiming $\times$ $Peerchasing \times PerformanceRank$.

with these funds carrying conservative valuations or having superior ability. The coefficient on the interaction with FundTiming is negative and significant suggesting that top-tercile buyout and venture funds time less than their underperforming peers. The insignificant coefficient on the interaction between TopTercile and PeerChasing indicates that the top performing funds appear to peer-chase about the same as other funds. Taking baseline and interaction effects of *FundTiming* and *PeeChasing* together, the point estimates suggest that top-tercile buyout and venture funds tend to report downward-biased returns for the next quarter when current IRR is one or more standard deviation above their peers.[28] This is consistent with our third equilibrium described above where top-performing funds report conservative NAVs (e.g., to build a cushion against negative idiosyncratic returns in the future).

In specification (3), we examine all effects simultaneously and find similar results for fund-timing overall. Meanwhile, specification (4) suggests that our inference about the cross-sectional effects is unlikely to be affected by heterogeneity in the risk exposure across funds. The estimates with high betas are very similar to those with unit betas. We find evidence that *FundTiming* amongst buyout and venture funds is significantly stronger in the bottom tercile (as indicated by the large positive coefficient on the BtmTercile interactions with FundTiming). As for *PeerChasing*, the effect appears stronger for bottom tercile buyout funds while not being significant for the funds in the middle performance tercile. This is somewhat different from the venture sample where the relationship between the next quarter returns and the current distance from peers' IRR does not appear to be statistically different across performance terciles.

The evidence presented in Table 5 is not consistent with less experience leading to more aggressive NAV marks. In fact, the rookies appear somewhat more conservative regardless of their performance to-date which is consistent with incentives to build a long-term reputation as per Chung et al. (2011). Instead, it follows that it is the current performance what largely determines the direction of the reporting bias.

[28] Even for IRRs very close to a median peer (i.e. *PeeChasing* near zero), overstating NAVs by top-tercile funds is statistically zero as conveyed by the tabulated F-tests for sum of coefficients on *FundTiming* +*Top* $\times$ *FundTiming*.

We note that the cross-sectional results are inconsistent with stale NAVs for some funds driving the main results. If stale NAVs were a significant driver in Table 4, we would expect that funds with the highest true returns had the largest gap to cover which predicts positive coefficients on $Top \times FundTiming$ and a positive total peer-chasing effect for that group (in contrast to what we find in specification (2)).

E. Placebo tests

As noted above, to better calibrate the null hypothesis for our tests, we examine a set of specifications similar to those in Table 4 and 5 but use placebo equivalents to determine if our estimation method is capturing something inherent in market conditions. Essentially, we estimate how style-matched public equity returns, conditional on actual fund cash flows, associate with lagged public equity returns since the respective fund inception (via PeerChasing). Also, we can identify actual calendar time patterns in subsequent funds starts (via FundTiming). The interactions with Rookie, TopTercile and BtmTercile dummies allow us to check whether these relations (1) are different in time periods when funds with less than two predecessors were operating, and (2) vary across performance ranks.[29] The results are tabulated in the appendix (Table B.6) but reveal no consistent relationships for either fund-timing or peer-chasing. Although a few coefficients are statistically different from zero, they tend to have opposite signs from what we find in Tables 4 and 5. This reassures that the effects we report in Table 5 are unlikely to be spurious.

VI. Robustness and other tests

A. Alternative estimators

In this section we scrutinize the assumptions about the fund return-generating process in the panel regressions of Section V. Namely, (1) the strict exogeneity of fund fixed effects with regards to other regressors included in the model, (2) the constant trend in fund excess returns between

[29] In matching placebo portfolios, we further condition on placebo to-date returns being in the same tercile as the actual fund IRR as of 28th quarter since inception or the last quarter in the sample for younger funds.

the 6th and 28th quarters of fund life, and (3) the stale NAV explanation for the fund-timing and peer-chasing effects in Table 4.

Assumption (1) is a concern since both key explanatory variables, FundTiming and PeerChasing values depend on past idiosyncratic returns of the fund which are also components of the measurement error on the dependent variable, $\widetilde{\Delta bias}$. In other words, the underlying model has strong features of a dynamic panel (i.e. $y_{i,t} = \gamma y_{i,t-1} + \alpha_i + \varepsilon_{i,t}$) where fixed effects estimators may yield biased estimates of γ because $E[y_{i,t-1}(\varepsilon_{i,t} - \bar{\varepsilon_i})] \neq 0$.[30]

Assumption (2) appears vulnerable in light of the discussion in section IV. Absent any valuation biases, the abnormal performance trend may nonetheless deteriorate after a follow-on fund launches because of changes in asset composition, lack of manager attention, etc. Fixed effects models will disregard such changes during a fund's life and may falsely relate them to the variation in the explanatory variables.

A possible fix for these econometric difficulties is to use a first-difference (FD) estimator to remove fund-level unobserved heterogeneity. Further, if we make an assumption that real changes to a fund's return generating process (i.e. due to incentives) do not happen in a short interval (e.g., over few quarters) whereas manipulated changes to NAV do, a FD estimator should yield more power against the "gaming" alternative.

Not demeaning the dependent and explanatory variables at the fund level also allows for including explanatory variables that are functions of future idiosyncratic returns. This helps with controlling for the possible effects of stale NAVs. Note that stale NAVs can be formulated as self-correcting valuation errors which should be greater the further the reported performance level is from the final value (i.e. by the time all holdings are converted to cash flows). So if some GPs are simply slow to update values, the difference between the final PME from its level in the next period should absorb all of the suspicious variation in $\widetilde{\Delta bias}$.

With first-differencing, there is still a concern regarding endogenous variables so long as parts

[30] The bias of the fixed-effect estimates would be finite and decreasing in panel length, but still can be sizeable in the case of highly persistent regressors. See, for example, Wooldridge (2002).

of $FundTiming$ and *PeerChasing* (henceforth, X_{it}) depend on returns at $t-1$. Therefore, we instrument ΔX_{it} with two lagged levels, X_{it-1} and X_{it-2}. Provided that the process for X is persistent and carries information about unobserved heterogeneity among funds, lagged levels are valid instruments for the difference (see Wooldridge, 2002).

Table 6 reports estimates of models (i) and (ii) in first-differences over fund-quarters via a two-step GMM with an optimal weighting matrix, robust to heteroscedasticity and autocorrelation. Results are reported separately for buyout (Panel A) and venture (Panel B) subsamples. All specifications except (3) use the instruments discussed above, namely: $(X_{it-1}\ X_{it-2}\ Controls_{\text{it}})$. We seek to further clarify the explanation for the effects we document in specification (3) by using *ExcessFundTiming* and *ResidualPeerChasing* as instruments for X. The tabulated partial F-statistics for the first stages suggest that we do not have a weak-instruments problem.

We define *ExcessFundTiming* as a ratio of the time spent without a follow-on fund to the median time it took to raise a follow-on fund by vintage and strategy peers. In essence, we adjust the temptation to fund-time by the average peer-pressure so that the potentially higher performance bar (see section IV.A) is unlikely to interfere with the biased NAVs explanation. We define *ResidualPeerChasing* as the residuals from a regression on four lags of median-IRR by peer group, allowing for fund-varying slopes. Hence, this instrument should disregard the variation due to lack of timely updating by some funds.

Specifications (1) and (2) of Table 6 are very consistent with those in Table 4 although the effects are larger in magnitude and stronger statistically (particularly, for venture fund-timing). A comparison of (3) with (1) suggests that some of the peer-chasing effect might be explained with a lag of peers' returns but the residual effect is still significant.

We only consider funds that are nearly resolved in specification (4) so that the final PME value is known. Although the sample of fund-quarters drops by half, the coefficient estimates on FundTiming and PeerChasing are close to those in specification (1) suggesting the model is structuraly stable. The coefficient on the proxy of the self-correcting valuation error (the difference from the final PME) is insignificant.

B. NAV reporting and SFAS 157

In September of 2006, the U.S. Financial Accounting Standards Board adopted Statement of Financial Accounting Standards 157 (SFAS 157) which effectively changed the NAV reporting standard for PE funds. A part of SFAS 157 referred to as ASC 820 requires fair-value reporting of balance sheet assets. Thus, the implementation of FAS 157 occurred during our sample period. The earliest adopters began complying in the fourth quarter of 2006 with all U.S. funds complying by the end of 2008. As a consequence, our sample may allow us to determine if FAS 157 had a notable effect on reported NAVs.

Unfortunately, the timing of the adoption coincides with the financial crisis of 2007-2008 which confounds the analysis. We undertake several tests and find only weak evidence that the regulation affected systematically affected reporting for venture funds and no evidence for buyout funds. For brevity, we discuss these results in the appendix.

VII. Conclusion

We investigate whether private equity firms manipulate their NAV reports to investors. We find that the data are consistent with an equilibrium where overstatement has different costs and benefits to different GPs. In this equilibrium, LPs do not assume the interim performance reports are unbiased; they punish GPs for the appearance of overstated performance by not providing capital to subsequent funds. Correspondingly, top performing GPs may try to safeguard their long-term reputation from bad luck by reporting conservative NAVs. They are more likely to do this when it does not jeopardize their high relative performance rank. For underperforming GPs, these long-term reputational concerns appear to be dominated by a short-term concern related to firm survival (and possibly a lack of credible ways to signal that valuations are conservative). Therefore, certain poorly performing funds appear incentivized to boost interim NAVs.

An assessment of the welfare effects of such a performance-gaming equilibrium hinges on the degree to which relatively unskilled LPs misallocate capital. In light of our results, sophisticated LPs are, on average, unlikely to misallocate capital and may therefore prefer the current stance to one with more regulation and (possibly) less gaming.

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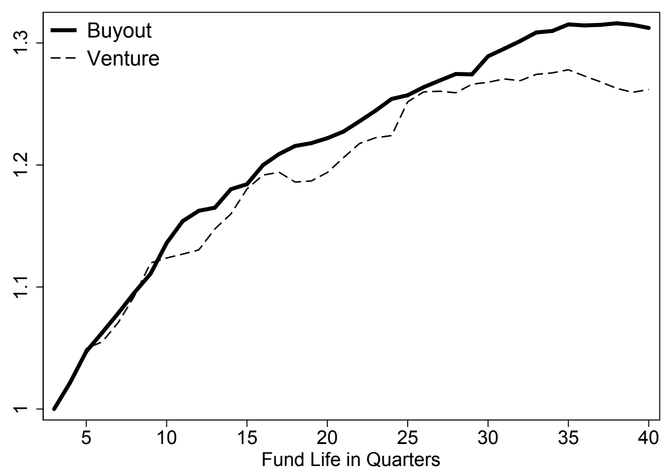
Figure 1: Average Fund Performance

This figure reports cumulative NAV-weighted excess returns of private equity funds over the public market index. Panel A plots values since inception and Panel B plots values twelve quarters before and after the follow-on fund's first capital call. In cases where no follow-on fund exists, the event quarter is the 13th quarter preceding the last NAV report for resolved funds or the 10-year mark for unresolved funds. As described in equations (1) and (2), the change in a given quarter is a mean PME-to-date change from the previous period across a subset of funds multiplied by the average ratio of NAV to market-adjusted paid-in capital (to date). Appendix A shows that this is equal to a weighted-average excess return and that the inference about the path is robust to misspecification of fund-level systematic risk.

Panel A: Since Inception



Panel B: Around Fundraising

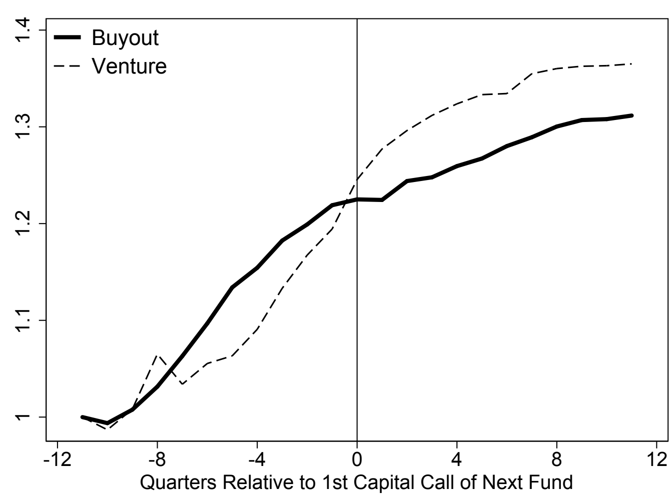
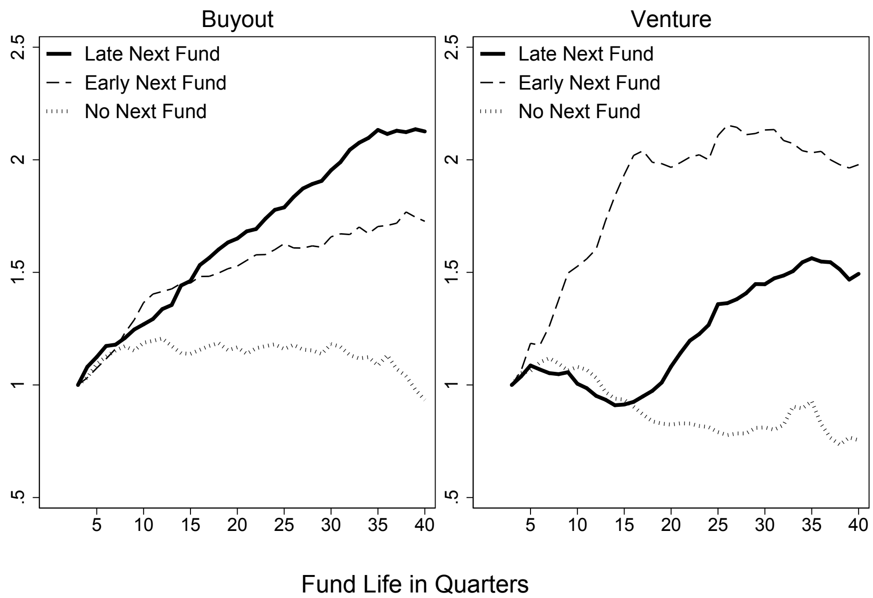


Figure 2: Average Performance Paths by Time Until Next Fund

This figure reports cumulative NAV-weighted excess returns of private equity funds over the public market index. Panel A plots values since inception and Panel B plots values twelve quarters before and after the follow-on funds first capital call. As described in equations (1) and (2), the change in a given quarter is a mean PME-to-date change from the previous period across a subset of funds multiplied by the average ratio of NAV to market-adjusted paid-in capital (to date). Appendix A shows that this is equal to a weighted-average excess return and that the inference about the path is robust to funds risk misspecification. We define subsets of funds in the legends of respective subfigures. In cases where no follow-on fund exists (No Next Fund), the event quarter is the 13^{th} quarter preceding the last NAV report for resolved funds or the 10-year mark for unresolved funds. *Late(Early)* denotes whether the follow-on fund was later(earlier) than the sample median across all buyout and venture funds respectively.

Panel A: Since Inception



Panel B: Around Fundraising

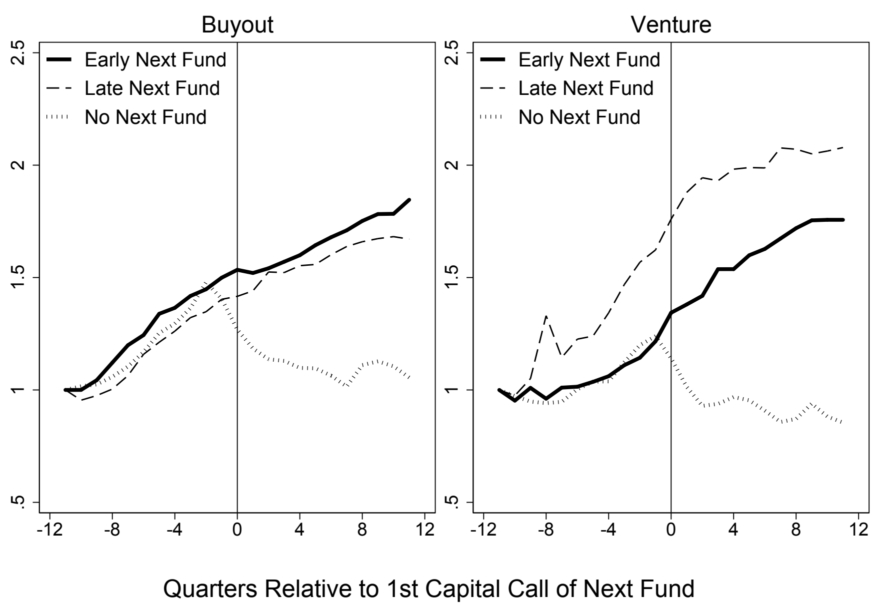
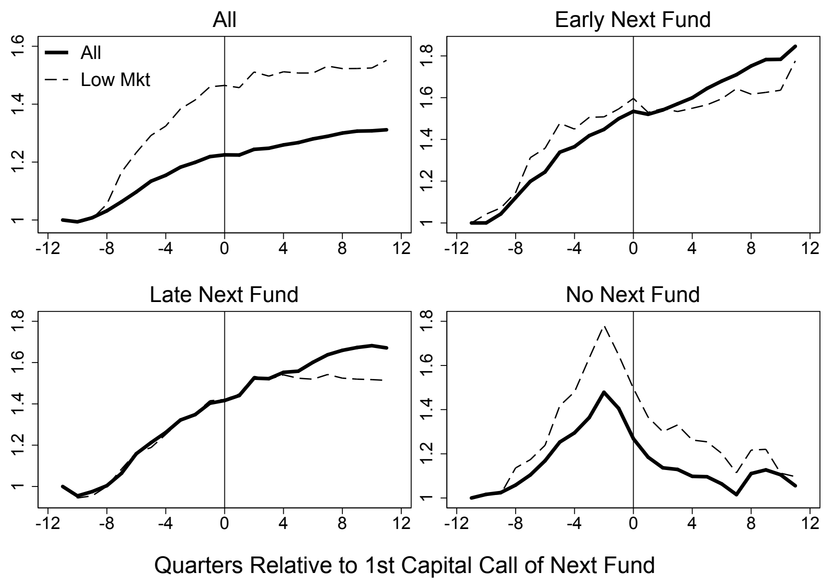


Figure 3: Average Fund Performance Path Around Fundraising

This figure reports cumulative NAV-weighted excess returns of private equity funds over the public market index. Panel A plots values since inception and Panel B plots values values twelve quarters before and after the follow-on funds first capital call. As described in equations (1) and (2), the change in a given quarter is a mean PME-to-date change from the previous period across a subset of funds multiplied by the average ratio of NAV to market-adjusted paid-in capital (to date). Appendix A shows that this is equal to a weighted-average excess return and that the inference about the path is robust to funds risk misspecification. We define subsets of funds in the legends of respective subfigures. In cases where no follow-on fund exists (*No Next Fund*), the event quarter is the 13^{th} quarter preceding the last NAV report for resolved funds or the 10-year mark for unresolved funds. *Late(Early) Next* denotes whether the follow-on fund was later(earlier) than the sample median across all buyout and venture funds respectively. *Low Mkt* plots excess returns for funds where the public markets 5-year rolling return was below the sample median as of the 13^{th} quarter of fund life.

Panel A: Buyout



Panel B: Venture

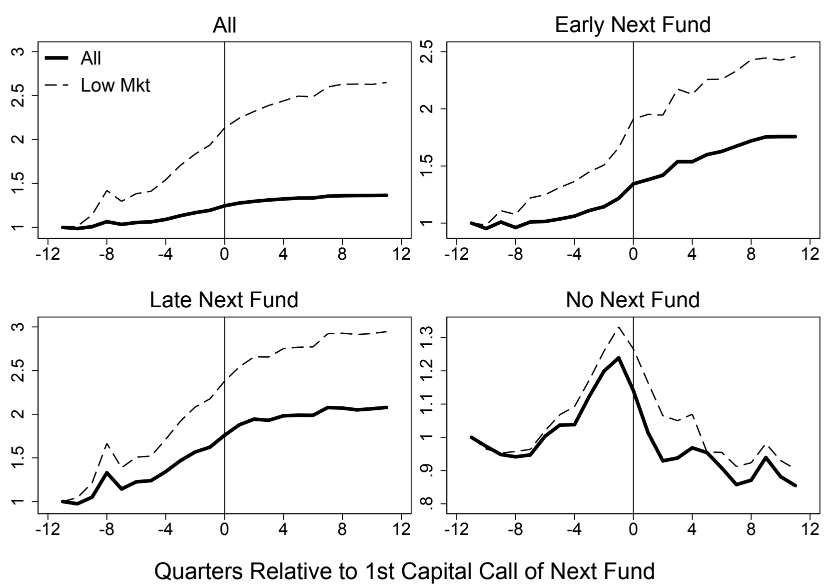
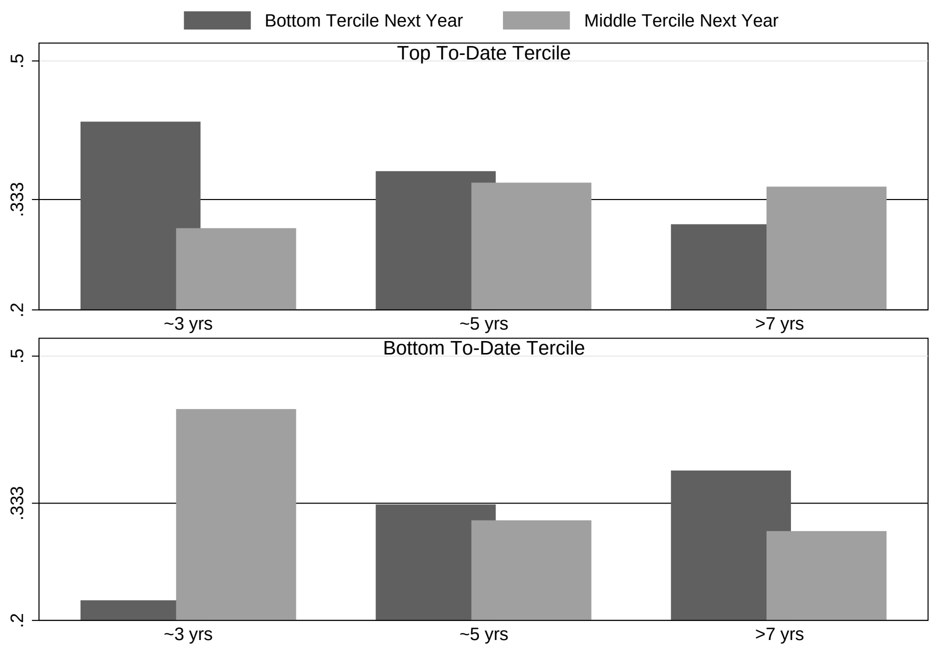


Figure 4: Next Year PME Growth Conditional on To-Date Performance

This figure reports the probabilities of a fund's excess returns over the next 4 quarters being in the top(bottom) tercile conditional on the fund's to-date performance tercile. We plot results separately for Buyout (Panel A) and Venture funds (Panel B). We define the fund peer group for to-date and next year terciles as all funds of the same strategy incepted within one year from the fund vintage year. The top chart of each panel reports results for top to-date tercile funds as of 8 to 17 quarters since inception ($\sim$3yrs), 18 to 27 quarters since inception ($\sim$5yrs), and more than 27 quarters ($>$7yrs). The bottom chart of each panel reports values for the bottom tercile to-date funds.

Panel A: Buyout funds



Panel B: Venture funds

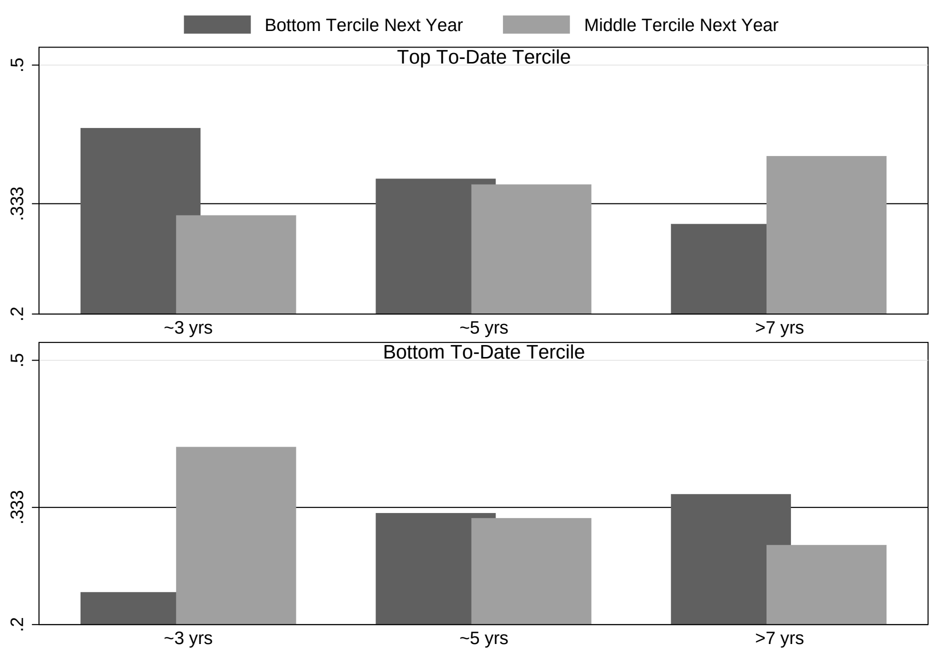


Table 1: Summary Statistics

This table reports summary statistics for the 997 buyout and 1,074 venture funds in our sample. Panel A provides basic statistics for buyout and venture funds separately. We also report common performance statistics conditional on whether or not the fund is resolved (or older than 8 years). Panel B provides detailed statistics on the timing of subsequent funds for buyout and venture funds separately. We provide statistics for subgroups based on number of prior funds and market return terciles (low, mid, high) in the 3 years prior to the fundraising period.

Panel A: Basic Statistics

		Buyout							Venture						
		Mean	StDev	5	25	50	75	95	Mean	StDev	5	25	50	75	95
All	Funds Per Firm	2.0	2.0	1.0	1.0	2.0	3.0	5.0	3.0	2.0	1.0	1.0	2.0	4.0	8.0
	Fund Size ($ mln)	1,324	5,755	80	220	450	1,070	4,210	390	2,288	26	74	170	330	740
	Vintage Year	2002	6	1989	1998	2004	2006	2008	1999	7	1984	1995	2000	2005	2008
if >1 Fund	Funds Per Firm	3.0	2.0	2.0	2.0	3.0	4.0	6.0	4.0	2.0	2.0	2.0	3.0	5.0	8.0
	Median interval per Firm	3.5	3.1	1.5	2.8	3.8	4.8	5.8	3.5	2.5	1.0	2.3	2.8	4.3	10.3
If Already Resolved	Life (years)	12.1	3.0	7.8	10.0	12.0	13.8	17.3	13.1	3.2	8.3	11.3	12.5	14.8	19.3
	IRR (%)	13.63	18.62	−10.48	4.22	11.29	22.27	38.83	14.48	48.53	−18.76	−6.12	3.46	16.00	86.31
	TVPI	1.72	1.00	0.60	1.18	1.56	2.03	3.38	2.00	3.25	0.31	0.72	1.19	1.98	5.87
	PME	1.27	0.58	0.48	0.89	1.22	1.53	2.16	1.26	1.95	0.21	0.52	0.80	1.22	3.61
If Still Alive	Life (years)	5.3	1.1	3.5	4.3	5.3	6.3	7.3	5.3	1.1	3.5	4.5	5.3	6.3	7.3
	IRR (%)	6.37	12.17	−12.93	0.03	6.87	12.69	23.69	4.44	14.63	−14.83	−4.72	3.82	11.77	30.57
	TVPI	1.21	0.40	0.72	1.00	1.18	1.35	1.78	1.19	0.46	0.67	0.88	1.11	1.35	2.01
	PME	1.04	0.35	0.62	0.85	1.00	1.17	1.59	0.98	0.39	0.55	0.72	0.93	1.13	1.67
If Resolved or Older than 8yrs	Number of Distributions	38	30	9	19	30	47	92	23	16	5	11	19	31	52
	Number of Capital Calls	38	31	7	20	32	48	86	20	17	3	9	16	24	48
	% of Quarters w/ Flows	32.4	9.1	18.0	26.0	32.0	38.0	48.0	25.5	8.0	13.0	20.0	25.0	31.0	38.0

Panel B: Follow-on Fundraising by Current Fund Age (if Resolved or Older than 8 years)

		Years Before Next Fund Raised										During	After	None
		1	2	3	4	5	6	7	8	9	10+	Life	Finish	So Far
		Buyout												
Fund Count	All Buyout	6	55	86	71	76	41	17	3	4	8	369	2	94
	No Previous Funds	1	15	23	32	28	17	6	3	3	1	129	0	40
	One Previous Fund	2	8	21	16	16	9	5	0	0	3	80	0	22
	Two or More	3	32	42	23	32	15	6	0	1	4	160	2	32
	Low Market	1	25	45	20	12	4	2	0	0	3	112	0	27
	Med Market	3	23	26	32	24	14	7	2	4	5	141	1	35
	High Market	2	7	15	19	40	23	8	1	0	0	116	1	32
Fund Means	Vintage Year	1999	1997	1998	1998	1998	1998	1998	1995	1996	1992	1998	1999	1998
	Size ($ mln)	1036.7	919.3	969.5	654.5	1008.8	895.1	969.9	159.3	206.8	923.9	884.5	665.0	497.0
	Final PME	1.6	1.3	1.4	1.3	1.4	1.1	1.5	1.7	1.6	1.1	1.3	0.9	1.0
	Final IRR	30.0	10.0	20.0	20.0	20.0	10.0	20.0	20.0	20.0	10.0	20.0	3.0	5.0
		Venture												
Fund Count	All Venture	37	116	123	88	71	27	18	6	2	10	527	29	193
	No Previous Funds	4	26	24	22	15	5	4	3	1	7	115	4	54
	One Previous Fund	9	14	16	17	17	7	5	2	1	1	95	6	51
	Two or More	24	76	83	49	39	15	9	1	0	2	317	19	88
	Low Market	1	48	66	25	19	6	6	0	0	5	180	4	38
	Med Market	19	40	37	33	18	5	5	5	1	4	182	15	75
	High Market	17	28	20	30	34	16	7	1	1	1	165	10	80
Fund Means	Vintage Year	1998	1996	1995	1995	1995	1996	1994	1994	1993	1990	1995	1996	1996
	Size ($ mln)	305.4	217.1	182.9	233.1	283.1	358.4	186.8	121.2	43.5	199.4	231.8	236.0	279.1
	Final PME	1.2	2.3	1.6	0.9	1.0	1.0	1.0	1.0	1.1	1.4	1.4	0.9	0.7
	Final IRR	2.0	40.0	30.0	8.0	8.0	20.0	9.0	1.0	10.0	20.0	20.0	10.0	−0.3

Table 2: Performance Tercile Transition Probabilities

This table reports transition probabilities between interim and final performance terciles. We define performance based on IRR-to-date within each fund peer group (vintage year and strategy). Panel A reports results for buyout funds and Panel B reports results for venture funds. Only the funds that have raised a follow-on fund within ten years since inception are included. The first row of each panel reports the probability of being in the respective to-date tercile at the end of a funds life (*Final*), conditional on being in the bottom to-date tercile in the quarter preceding the follow-on funds first capital call (*At Fundraising*). Similarly, the second (third) row reports Final performance tercile conditional on being in the middle (top) performance tercile *At Fundraising*. The last row of each panel reports the unconditional distribution of funds across *Final* terciles, while the last column reports how many funds were in each fundraising tercile and the respective fraction in the total number of funds in this analysis. The peer group is all funds of the same strategy incepted within one year from the fund vintage year. Since follow-on fundraising occurs at a different time for each of the funds and fund life varies, neither *At Fundraising* nor *Final* terciles need to have an equal number of funds.

Panel A: Buyout

		Final				
		Btm	Mid	Top	Fund Count	
At Fundraising	Btm	61.2%	26.9%	11.9%	67	(18.8%)
	Mid	36.9%	42.3%	20.8%	130	(36.5%)
	Top	13.2%	25.2%	61.6%	159	(44.7%)
	All	30.9%	31.7%	37.4%	356	(100%)

Panel B: Venture

		Final				
		Btm	Mid	Top	Fund Count	
At Fundraising	Btm	55.6%	36.7%	7.7%	117	(22.9%)
	Mid	31.8%	41.3%	26.8%	179	(35.1%)
	Top	14.5%	25.2%	60.3%	214	(42.0%)
	All	30.0%	33.5%	36.5%	510	(100%)

Table 3: Do LPs Vote With Their Feet?

This table reports results from a linear probability model of a follow-on fund being raised. Results are reported separately for buyout (Panel A) and venture (Panel B) funds. We only include funds that were resolved or operated for at least 10 years. The event time is defined by the quarter in which the follow-on fund made its first capital call or, in the case of unsuccessful fundraising, the 13^{th} quarter preceding the last NAV report if the fund is resolved or 10^{th} year of fund life if the fund is unresolved. The main explanatory variables are defined as: *PME drop (after)* equals 1 if the value of Kaplan-Schoar PME at resolution is lower that at the event time; *PME run-up (before)* equals 1 if the value of Kaplan-Schoar PME 1 year before the event time is lower than at the event time; *Large Distribution (before)* equals 1 if the sum of distributions over the year preceding the event time exceeds 20% of NAV; *Top tercile-to-date* equals 1 if fund is in the top (highest) IRR-tercile across vintage and strategy peers at the event time and zero otherwise, and *Bottom tercile-to-date* equals 1 if the fund is in the bottom (lowest) IRR-tercile at the event time and zero otherwise. All specifications include the interaction of the fund vintage year and industry (GICS sectors) fixed effects. In specifications (3) and (4) we include the level of PME at the event-time as well a dummy indicating where market return was positive in the pre-event year. t-statistics reported in parentheses are robust to error clustering at the event year, */**/*** denotes significance at 10/5/1% confidence level.

	Panel A Buyout				**Panel B** Venture			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
PME drop after	-0.132^{**}	-0.116^{**}	-0.127^{**}	-0.111^{**}	-0.106^{**}	-0.085^{*}	-0.090^{*}	-0.087^{*}
	(-2.65)	(-2.54)	(-2.74)	(-2.66)	(-2.05)	(-1.84)	(-1.92)	(-1.88)
PME run-up before	-0.076^{*}	-0.064^{*}	-0.088^{**}	-0.170^{***}	-0.122^{**}	-0.129^{**}	-0.131^{**}	-0.183^{***}
	(-1.73)	(-1.74)	(-2.40)	(-3.07)	(-2.29)	(-2.58)	(-2.74)	(-3.37)
Large Distribution				0.007				0.019
				(0.23)				(0.36)
Large Distribution × PME run-up before				0.157^{**}				0.180^{**}
				(2.17)				(2.29)
Top IRR Tercile		0.095^{***}	0.049^{**}	0.048^{**}		0.102^{***}	0.085^{***}	0.075^{***}
		(0.23)	(0.23)	(0.23)		(0.36)	(0.36)	(0.36)
Bottom IRR Tercile		-0.188^{*}	-0.154^{*}	-0.142^{*}		-0.064^{**}	-0.059^{*}	-0.058^{**}
		(-2.04)	(-1.81)	(-1.82)		(-2.07)	(-1.97)	(-2.05)
PME level (event)			0.116^{**}	0.097^{**}			0.018	0.014
			(2.26)	(2.12)			(1.57)	(1.35)
Market run-up before			0.042	0.055			0.049	0.052
			(0.50)	(0.64)			(0.85)	(0.91)
Controls	Vintage Year × Industry FE							
Observations	541	541	541	541	763	763	763	763
R-squared (%)	26.5	33.0	34.4	35.6	26.6	29.3	29.7	31.0

Table 4: Fund Timing and Peer-Chasing

This table reports the parameter estimates a linear regression model estimated separately for buyout (Panel A) and venture (Panel B) funds. The dependant variable measures risk- and cash flow-adjusted changes in NAV for quarter t that is constructed to be unpredictable under the null of reported NAVs being unbiased estimators of true asset values. The market beta of the fund assets is assumed to be 1.7 [2.4] in specifications (3) and (4) for buyout [venture] subsample and 1 everywhere else. Explanatory variables of interest include *FundTiming* which is the natural log of one plus time spent to-date without a follow-on fund in excess of two years, *PeerChasing* which is the difference between fund i reported Internal Rate of Return to-date for the calendar quarter corresponding to $t-1$ quarter of fund i life and its peers as measured by the median IRR-to-date across all funds of the same strategy incepted within one year from fund i vintage year. Specifications (2) and (4) also include the interaction of *FundTiming* and *PeerChasing* variables. All specifications include fund fixed effects, fund distributions and capital calls over the current quarter scaled by the end of quarter NAVs, and year-quarter fixed effects. t-statistics reported in parentheses are robust to heteroskedasticity and autocorrelation, */**/*** denotes significance at 10/5/1% confidence level.

	Panel A Buyout				**Panel B** Venture			
	$\beta = 1.0$		$\beta = 1.70$		$\beta = 1.0$		$\beta = 2.40$	
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
FundTiming	0.080***	0.057***	0.076***	0.053**	0.051***	0.043***	0.054***	0.046***
	(4.22)	(3.00)	(3.63)	(2.57)	(3.62)	(3.08)	(3.78)	(3.26)
PeerChasing	−0.205***	0.131**	−0.202***	0.117**	−0.175***	0.045	−0.180***	0.037
	(−6.51)	(2.55)	(−5.46)	(2.09)	(−9.18)	(1.21)	(−9.21)	(0.99)
FundTiming × PeerChasing		−0.304***		−0.289***		−0.202***		−0.200***
		(−6.61)		(−5.62)		(−6.52)		(−6.29)
Observations	12,150	12,150	12,150	12,150	15,124	15,124	15,124	15,124
R-squared	0.237	0.242	0.420	0.423	0.305	0.309	0.607	0.608
RMSE	0.158	0.158	0.180	0.180	0.120	0.120	0.124	0.124
Controls	Cash Flows, Fund Fixed Effects, and Year-Qtr Fixed Effects							

Table 5: Cross-Section of To-Date Performance

This table reports results of estimating a linear regression model explaining fund abnormal performance. The dependent variable measures risk- and cash flow-adjusted changes in NAV for quarter t that is constructed to be unpredictable under the null of reported NAVs being unbiased estimators of true asset values. The model is estimated separately for buyout (Panel A) and venture (Panel B) funds. Explanatory variables include: *FundTiming* is the natural log of one plus time spent to-date without a follow-on fund in excess of two years; *PeerChasing* is the difference between fund i reported Internal Rate of Return to-date for the calendar quarter corresponding to *t1* quarter of fund *i* life and its peers as measured by the median IRR-to-date across all funds of the same strategy incepted within one year from fund *i* vintage year. *Rookie* is indicator variable denoting if the PE firm had less than two funds before fund *i*, *Top* (*Btm*) is indicator variables denoting if fund i was in the top (bottom) tercile as measured by IRR-to-date as of quarter *t1* across the fund's peers. The market beta of each fund's assets is assumed to be 1.7 (2.4) in specification (4) for buyout (venture) subsample and 1 everywhere else. Control variables in all specifications include fund fixed effects, year-quarter fixed effects as well as fund distributions and capital calls over the current quarter scaled by the end-of-quarter NAVs. t-statistics reported in parentheses are robust to heteroskedasticity and autocorrelation, */**/*** denotes significance at 10/5/1% confidence level.

	Panel A Buyout				**Panel B** Venture			
	$\beta = 1.0$			$\beta = 1.70$	$\beta = 1.0$			$\beta = 2.40$
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
FundTiming	0.088^{***}	0.082^{***}	0.066^{***}	0.063^{***}	0.053^{***}	0.053^{***}	0.040^{***}	0.043^{***}
	(4.67)	(4.31)	(3.47)	(3.07)	(3.74)	(3.81)	(2.86)	(3.03)
PeerChasing	-0.138^{***}	-0.191^{***}	-0.038	-0.025	-0.167^{***}	-0.182^{***}	-0.127^{***}	-0.126^{***}
	(-3.03)	(-4.99)	(-0.64)	(-0.38)	(-7.55)	(-6.81)	(-3.23)	(-3.10)
Rookie $\times$ FundTiming	-0.015		-0.017^{*}	-0.019^{*}	-0.007		-0.003	-0.002
	(-1.43)		(-1.70)	(-1.71)	(-0.96)		(-0.54)	(-0.55)
Rookie $\times$ PeerChasing	-0.134^{**}		-0.114^{*}	-0.123	-0.022		-0.025	-0.031
	(-2.15)		(-1.77)	(-1.62)	(-0.54)		(-0.46)	(-0.60)
TopTercile-to-date		0.046^{**}	0.023	0.021		0.024^{**}	0.004	0.003
		(1.99)	(0.96)	(0.74)		(2.13)	(0.33)	(0.24)
Top $\times$ FundTiming		-0.041^{***}	-0.021	-0.017		-0.025^{***}	-0.019	-0.018
		(-2.92)	(-1.38)	(-0.96)		(-3.49)	(-1.43)	(-1.26)
Top $\times$ PeerChasing		-0.026	-0.111	-0.123		0.045	0.005	0.010
		(-0.37)	(-1.39)	(-1.35)		(0.96)	(0.10)	(0.19)
BtmTercile-to-date			-0.073^{***}	-0.070^{***}			-0.053^{***}	-0.050^{***}
			(-3.94)	(-3.50)			(-4.21)	(-3.90)
Btm $\times$ FundTiming			0.051^{***}	0.050^{***}			0.041^{***}	0.039^{***}
			(5.03)	(4.74)			(5.23)	(4.90)
Btm $\times$ PeerChasing			-0.206^{**}	-0.207^{*}			-0.103	-0.107
			(-2.11)	(-1.89)			(-1.59)	(-1.63)
Controls	Cash Flows, Fund Fixed Effects, and Year-Qtr Fixed Effects							
Observations	12,150	12,150	12,150	12,150	15,124	15,124	15,124	15,124
R-squared	0.238	0.238	0.241	0.423	0.305	0.306	0.323	0.608
Pr(F-stat>F[*FundTiming by Top*])		0.301				0.234		

Table 6: Fund Timing and Peer-Chasing: Dynamic Panel Specifications

This table reports results of estimating a linear regression model explaining fund abnormal performance. The dependent variable measures risk- and cash flow-adjusted changes in NAV for quarter t that is constructed to be unpredictable under the null of reported NAVs being unbiased estimators of true asset values. Explanatory variables (X) include: *FundTiming* is the natural log of one plus time spent to-date without a follow-on fund in excess of two years; *PeerChasing* is the difference between fund i reported Internal Rate of Return to-date for the calendar quarter corresponding to *t-1* quarter of fund i life and its peers as measured by the median IRR-to-date across all funds of the same strategy incepted within one year from fund i vintage year. Models are estimated separately for buyout (Panel A) and venture (Panel B) funds. All specifications are estimated in first differences by fund-quarters via two-step GMM with the optimal weighting matrix. Everywhere except in specifications (3), we use two lagged levels of X to instrument for the difference whereas in (3) we use two lagged levels of *ExcessFundTiming* and *ResidualPeerChasing* as the instruments (both defined in Section VI.A). In all specifications, control variables include year and quarter fixed effects as well as fund distributions and capital calls over the current quarter scaled by the end of quarter NAVs. Specifications (4) also includes ($PME_T - PME_{t+1}$), a difference between the next period PME-to-date and the final PME for the funds that were fully resolved by the end of March 2012. t-statistics reported in parentheses are robust to heteroskedasticity and autocorrelation, */**/*** denotes significance at 10/5/1% confidence level.

	Panel A Buyout				**Panel B** Venture			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
FundTiming	0.165***	0.144**	0.143**	0.159**	0.235***	0.213***	0.157***	0.284***
	(2.96)	(2.57)	(2.45)	(2.13)	(5.01)	(4.70)	(3.21)	(4.87)
PeerChasing	−0.315***	0.100	−0.196**	−0.310***	−0.366***	0.286***	−0.117**	−0.403***
	(−5.72)	(0.72)	(−2.50)	(−3.67)	(−7.80)	(2.80)	(−1.97)	(−6.25)
FundTiming × PeerChasing		−0.735***				−1.253***		
		(−3.07)				(−6.60)		
(PME_T-PME_{t+1})				−0.036				0.023
				(−1.27)				(1.00)
Fund Effects	First-Differences							
Controls	Year and Quarter Fixed Effects, Cash-Flows							
Observations	12,003	12,003	12,003	5,875	14,979	14,979	14,979	7,119
R-squared	0.099	0.146	0.08	0.108	0.106	0.211	0.064	0.112
F-stat[*1st stage*]	35.3	33.8	33.2	9.2	16.8	18.5	14.5	7.4

Appendix A.

In this Appendix, we provide a more detailed discussion of the primary variables we utilize in our analysis. We start by explaining why simple measures such as changes in IRR-to-date and PME-to-date can provide misleading metrics (where 'to-date' measures utilize the NAV at a particular date as though it were the final cash flow from a fund). Figure A.1 illustrates the inconsistency of IRR-to-date for the purpose of measuring NAV bias by studying the cash flow and abnormal return patterns of two hypothetical funds (1 and 2). Fund 1 considers a hypothetical fund in existence from 1993 through 2003 and Fund 2 considers a different hypothetical fund in existence from 1998 through 2008. The value process in both cases is defined as, $FundValue_t = FundValue_{t-1}(1 + r_{S\&P500,t} + \alpha_t) + Calls_t - Distrib_t$. That is, the fund's return over a period equals the return to the S&P 500 plus an abnormal return (α_t).

Panel A of A.1 plots the alpha and the cash-flow patterns for both cases. For Fund 1, the alpha is fixed at 4% across all periods. Whereas for Fund 2, the alpha is initially 5% per period but than decays to zero over the life of the fund. Panel B plots the total return to the S&P 500 index over each hypothetical fund's life. Panel C plots the resulting PMEs-to-date and IRRs-to-date. These two cases show that IRR-to-date may provide completely misleading indications of when 'gaming' of fund NAVs could be taking place. Specifically, the fund with constant alpha (Fund 1) exhibits an apparent decline in IRR-to-date after the fund's fifth year. In contrast, the fund with declining alpha (Fund 2) shows an increasing IRR-to-date after the fund's fifth year. The PME-to-date analysis exhibits nearly similar patterns for each fund and therefore may not be informative either. These examples show the challenges of measuring interim abnormal performance for closed in investment vehicles like buyout and venture funds. Consequently, we subsequently develop a method for identifying abnormal returns that unwinds the flattening effect that intermediate distributions have on the PME-to-date.

Next, we show how the intuitive approach of regressing the fund-level changes in NAVs on dummies measuring the time since fundraising is prone to revealing non-existent patterns in excess returns. Using our sample of funds discussed in the main text, we examine the finding of Jenkinson et al. (2013) with regards to the unrealized performance peaking around the quarter of a follow-on fund closing. Specification (1) in Panel A of Table A.1 replicates the Jenkenson et al. methodology. Using their interpretation of the results, the evidence of NAV overstating around the new fund launch dates appears convincing. Just as in Table 3 of Jenkinson et al., quarters shortly before the new fund launch have significantly positive coefficients, suggesting abnormally positive growth rate in NAVs of the existing fund while GPs are seeking new capital commitments from investors. Meanwhile, the negative coefficients on years after fundraising indicate abnormally low growth rate in NAVs, consistent with the previously built-up upward valuation bias getting gradually unwound. We note also that the coefficient estimates on cash flows and market returns are also very similar to those in Jenkinson et al.

However, specification (2) and (1) of Panel A A.1 should raise concerns about consistency of these estimates. Dropping cash flows and market return should increase the noise in the disturbance (if no NAV overstating is indeed the null hypothesis of this statistical model). Instead, we see that the humped shape in the reported returns around the next fund launch gets more pronounced. To determine if these results are caused by mispecification of the Jenkinson et al. model, we apply their methodology to funds where the actual growth in NAV is replaced with a placebo based on public equity portfolios (defined in detail later in this appendix). The results of this experiment are reported in Panel B A.1. Similar to Panel A, we see that some coefficients are significantly positive in the quarters before launch of a new fund and some are significantly negative after the launch of a new fund in. Just as in Panel A, we see that the humped-shape returns trajectory gets more pronounced as we remove cash flow controls in specification (2), and then the market return in specification (3). These results indicate that the methodology of Jenkinson et al. is likely generating at least part of the pattern of excess returns they document.

The inconsistency of estimates in Table A.1 arises from two sources: (i) a positive correlation between public market returns and private equity fund formation, and (ii) the correlation between cash flow measurement and the dependant variable. The former is essentially the result of insufficient risk adjustment. Specifically, controlling for contemporaneous market returns should be absorbing market risk, however, unlike the placebo series in Panel B, the actual fund quarterly returns are subject to appraisal smoothing as evidenced by a very low coefficient on the market return in Panel A (implying a beta of just 0.26). Thus, including just the contemporaneous market return results in an insufficient risk adjustment. As for (ii), section V discusses why this measurement error is present in the panel when the dependant variable is a function of fund-level NAVs (and how our analysis navigates this challenge). With such correlated events like PE fund distributions and fundraising, it is hard to assess the impact of this measurement error. For example, as one can see from specification (3) of Panel B, a dummy variable for the fourth (calendar) quarter is a significant explanatory variable for excess returns when the placebo series are not risk-adjusted. So the "Santa Clause Effect" that Jenkinson et al. document is also likely to be (at least partially) driven by the combination of (i) and (ii) rather than a tendency for PE funds to indeed report higher returns in the December quarter.

Even absent econometric biases, the interpretation of results in the framework of Jenkinson et al. is difficult because the fund (and time since inception) fixed effects obscure the inference about whether the abnormal returns are on average negative after fundraising. The negative coefficients in A.1 only say that the changes in NAVs tend to be lower than the average of other periods. Meanwhile, as discussed in Section IV.A, lower but still positive abnormal returns after fundraising, are consistent with many other alternative explanations besides the NAVs being overstated ahead of the launch of a follow-on fund.

I. Key Variable Definitions

We start by considering the Kaplan and Schoar (2005) Public Market Equivalent index

$$PME = \frac{\sum_{t=0}^{T-1}\{D_t \prod_{\tau=t}^{T-1} R_{\tau+1}\} + D_T}{\sum_{t=0}^{T-1}\{C_t \prod_{\tau=t}^{T-1} R_{\tau+1}\} + C_T}, \tag{A.1}$$

where D_t and C_t are, respectively, the fund distributions and capital calls end of period t while R_τ is public market gross return over period τ. While PME is typically calculated using all cash flows associated with a fund (i.e., the full life of a fund), our analysis requires the use of an interim measure of performance. Consequently, we define a measure of performance from fund inception through an interim date that is analogous to PME. Intuitively, we think of it as a measure of PME-to-date for any time $t*$, $0 < t* < T$. To construct the measure we simply consider the stated net asset value (NAV) at date $t*$ as a terminal distribution and ignore all subsequent cash flows. Thus, we can define PME-to-date at time $t*$ as

$$
\begin{aligned}
PME_{t*} &= \frac{\sum_{t=0}^{t*-1}\{D_t \prod_{\tau=t}^{t*-1} R_{\tau+1}\} + D_{t*} + NAV_{t*}}{\sum_{t=0}^{t*-1}\{C_t \prod_{\tau=t}^{t*-1} R_{\tau+1}\} + C_{t*}} \\
&= \frac{\sum_{t=0}^{t*-1}\{D_t \prod_{\tau=t}^{t*} R_{\tau+1}\} + D_{t*}}{\sum_{t=0}^{t*-1} C_t \prod_{\tau=t}^{t*-1} R_{\tau+1}\} + C_{t*}} + \frac{NAV_{t*}}{\sum_{t=0}^{t*-1} C_t \prod_{\tau=t}^{t*-1} R_{\tau+1}\} + C_{t*}}
\end{aligned} \tag{A.2}
$$

To simplify the notation, we can rewrite A.2 as:

$$
PME_t = PME_t^{exNav} + \frac{NAV_t}{fv_t(C)}, \tag{A.3}
$$

so that $fv_t(C)$ represents the time t future value of all capital calls calculated using the public market returns from the respective date of each capital call while PME_t^{exNav} is the PME-to-date value as of time t if NAV is assumed to be 0.

The change in PME-to-date from the previous period can be thought of as a product of the abnormal fund return over the period t and the ratio of NAV_t to the future value of cumulative capital calls to date. This is the case because, absent capital calls at t, it follows from A.1 and A.2 that:[31]

$$
\begin{aligned}
PME_t^{exNav} &= PME_{t-1}^{exNav} \cdot \frac{R_t}{R_t} + \frac{D_t}{fv_t(C)} \\
&= PME_{t-1}^{exNav} + \frac{D_t}{fv_t(C)}
\end{aligned} \tag{A.4}
$$

[31] The assumption that $C_t = 0$ applies through equation A.7 only and does not affect the intuition. If we drop this assumption, (A.3) will in addition have $-\frac{C_t \cdot PME_{t-1}^{exNav}}{fv_{t-1}R_t + C_t}$ on the right-hand (as the denominator of PME_t^{exNav} is not just a R_t scale of PME_{t-1}^{exNav} in this case) while (A.7) will have three additional terms: $\frac{C_t}{fv_t(C)} + (k_t - 1)PME_{t-1}^{exNav} + (R_t^{nav} - R_t)\frac{NAV_{t-1}}{fv_t(C)}$, where $k_t = \frac{fv_{t-1}(C)R_t}{fv_t(C)} \in (0,1)$ (e.g. for $t = 3$, $k_t = [(C_1R_2 + C_2)R_3] \, / \, [C_1R_2R_3 + C_2R_3 + C_3]$. The first term is positive and tends to be large when $k_t \ll 1$, the second term has a negative sign and cancels out with the first term when $PME_{t-1}^{exNav} = 1$. The sign on the third term is negative while the magnitude increases in the first term too. We study the implications of this measurement error via a simulation.

where we are adding the ratio of period t distributions to the period t value of cumulative capital calls to-date to PME^{exNav}_{t-1}. Because we can express reported return, R^{nav}_t, as a solution to

$$NAV_t = NAV_{t-1}R^{nav}_t - D_t + C_t, \tag{A.5}$$

the change in PME from $t-1$ to t can written as

$$\begin{aligned}
\Delta PME_t &= PME^{exNav}_t - PME^{exNav}_{t-1} + \frac{NAV_t}{fv_t(C)} - \frac{NAV_{t-1}}{fv_{t-1}(C)} \\
&= \frac{D_t}{fv_t(C)} + \frac{NAV_t}{fv_t(C)} - \frac{NAV_{t-1}}{fv_{t-1}(C)} \cdot \frac{R_t}{R_t} = \frac{D_t}{fv_t(C)} + \frac{NAV_t}{fv_t(C)} - \frac{NAV_{t-1}R_t}{fv_t(C)} \\
&= \frac{NAV_t + D_t - NAV_{t-1}R_t}{fv_t(C)}.
\end{aligned} \tag{A.6}$$

After substituting NAV_t from A.5 into A.6, a change in PME can be witten as

$$\Delta PME_t = (R^{nav}_t - R_t)\frac{NAV_{t-1}}{fv_t(C)}. \tag{A.7}$$

The intuition behind this expression is that the excess return of the fund (as a difference between fund return as implied by NAV-change and the public market return) gets scaled down by the prior-period NAV as a percent of paid-in-capital adjusted for the market returns. Thus, keeping the mean and variance of excess return unchanged, one would observe a leveling-out in abnormal performance (as measured by PME-to-date) once a fund starts distributions, as the ratio of $NAV_{t-1}/fv_t(C)$ will typically drift downwards. That is, ΔPME_t will keep the sign but trend toward 0 over time, all else the same.[32] The same leveling-out will occur to the money-multiple ($TVPI$) which can be thought of as a special case of PME-to-date where R_τ is assumed to equal 1 for all τ.

When analyzing a cross-section of funds, the ΔPME_t is a useful metric since it effectively represents a weighting scheme for fund returns. The weight is proportional to the sensitivity of the performance-to-date to NAV. Multiplying the cross-sectional mean ΔPME_t by mean $NAV_{t-1}/fv_t(C)$ removes the downward bias due to the scale effect and obtains the average fund returns weighted

[32] Again, with net-negative cash flows in period t the expression get less clear but the intuition remains the same: ΔPME_t tends to be positive so long as $R^{nav} - R$ is positive. In simulation (Section I.1), we verify that the additional terms (when C_t are positive) do no affect the inference about the path of the PME to-date pooled over a cross-section of funds.

by the fraction of unrealized NAVs in the market-return-adjusted sum of capital calls-to-date. The same re-weighting can be applied to mean money-multiple changes. Similarly, weighted-ΔPME_t nests mean fund NAV-returns and excess returns ($R_t^{nav} - R_t$) as special cases with $NAV_{t-1}/fv_t(C)$ being equal across funds in both cases (and market returns being zero in the former).

We design a Monte-Carlo experiment to study the time-series properties of weighted PME-to-date. We draw a fund's β from two normal distributions, $N(1, 0.125)$ and $N(2, 0.166)$ whereas α's come from a common distribution, $N(0.05, 0.05)$. Here α and β are in the context of the standard market model. The same Poisson process drives all cash flows independent of market and idiosyncratic shocks to returns. Figure A.2 suggests that a misspecification of fund-level β does not confound inference about the question of interest, i.e., the trajectory of cross-sectional mean abnormal returns. Also, it follows that if more successful funds (higher α) tend to not distribute capital as fast as their less successful peers, WPME should be convex in time since inception under the null hypothesis of constant lifetime excess returns. This is because funds with higher excess returns tend to have relatively higher ratios of residual NAV-to-capital as fund life progresses. Introducing heteroscedasticity and reasonable correlations in the data generating process does not change these conclusions.[33]

I.1. Monte Carlo Experiment

Because our weighted PME change measure of returns has not been utilized in previous studies, we conduct a series of Monte-Carlo experiments and examine how this measure of excess returns compares to simpler measures based on raw returns and money-multiples (that we show to be its special cases). For this exercise, we assume that fund i asset value at time t ($V_{i,t}$) evolves as:

$$V_{i,t} = V_{i,t-1} exp \{\alpha_i + \beta_i r_{m,t} + e_{i,t}\},$$

where $\alpha_i = \bar{\alpha} + e_\alpha$ is the abnormal return for fund i; $\beta_i = \overline{\beta_{H(L)}} + e_{H(L)}$ is the level of systematic (factor) risk for fund i; $r_{m,t} = \mu + e_{m,t}$ is the net return on the market index; $e_{(\cdot)}$ are all independently

[33] For brevity, we do not report these results.

drawn from a normal distribution $N(0, \sigma^2_{(\cdot)})$. For our experiments we let $\mu = 0.04\, per\, annum$ and $\bar{\alpha} = 0.05\, per\, annum$. The specification for β_i allows us to have funds with low risk ($\overline{\beta_L} = 1.0$) or high risk $\overline{\beta_H} = 2.0$). We set the standard deviations of $e_{(\cdot)}$ al follows: $\sigma_i = \sigma_m = 0.300\, per\, annum$; $\sigma_L = 0.125$; $\sigma_H = 0.167$; $\sigma_\alpha = 0.05$.

At time t fund i distributions, D_{it}, and contributions, C_t, are independent Poisson processes. The parameters of the cash flow process are calibrated so they closely match the cross-sectional moments of actual funds cash flows in our sample. Specifically, we set

$$D_s = V_s \varphi \eta_{ds}\; if\; s > \lfloor f_d \cdot T \rfloor$$
$$C_s = \varphi \eta_{cs}\; if\; s < \lfloor f_c \cdot T \rfloor,$$

where we set $T = 300$ as a fund maximum life in bi-weekly intervals, $\eta_{(\cdot)}$ are independent Poisson distributions $Pois(\lambda_{(\cdot)})$ with $\lambda_d = 0.1$ and $\lambda_c = 0.07$. We let $f_c = 0.5$, $f_d = 0.3$, and $\varphi = 0.2$.

For our experiment we draw 30 paths of market returns, $r_{m,t}$, at a daily frequency. For each market path we draw 40 α_i and β_i, half with a mean of $\overline{\beta_L}$ and half with $\overline{\beta_H}$. Given the set of α_i and β_i, we draw 40 paths of idiosyncratic returns at a daily frequency, and 40 paths of distributions and contributions at a bi-weekly frequency. We then construct the series of quarterly NAVs and cash flows for each market path. Finally, we compute PMEs-to-date for the simulated funds and average ΔPME_q and $NAV_{q-1}/fv_q(C)$ across all (30×40) market paths and funds. Results are presented in Figure A.2 and discussed in Appendix AI.

II. A proxy for NAV bias change

Central to our analysis is the idea that reported NAV can be a biased estimate of the true value. We next formulate our specific measure of the NAV bias that we examine in our empirical tests in section V. We start by defining V_t as the true (unbiased) asset value at the end of period t and Γ_t as a gross valuation bias such that reported $NAV_t \equiv V_t \cdot \Gamma_t$. We next define the gross abnormal return in period t as $R^\varepsilon_t = exp\{\delta \cdot \varepsilon_t\}$ where δ is a constant (for a given fund) and ε_t is a mean-zero random error arbitrary distributed. If we further define $R_{\beta,t}$ as gross return due to risk factor (market) exposure β then,

$$V_t + D_t = V_{t-1} R_t^{\varepsilon} R_{\beta,t} + C_t. \tag{A.8}$$

Recalling that D_t and C_t are, respectively, the fund distributions and capital calls at t, we define the evolution of the gross valuation bias as $\Gamma_t = \Gamma_{t-1} e^{g(\cdot)}$. Substituting this definition into A.8 yields the following NAV identity:

$$NAV_t = NAV_{t-1} R_t^{\varepsilon} R_{\beta,t} e^{g(\cdot)} + \Gamma_{t-1} e^{g(\cdot)} (C_t - D_t). \tag{A.9}$$

We assume that returns $R_{\beta,t+1}$ and ε_{t+1} are unpredictable. We would like to estimate per period change in bias, $g_i(\cdot)$, for each fund (henceforth we add subscript i to each variable) from the following model:

$$log \left[\frac{NAV_{i,t}}{NAV_{i,t-1} R_{\beta_i,t} - \frac{\Gamma_{i,t-1}}{R^{\varepsilon} i,t} (D_{it} - C_{it})} \right] = g(\cdot)_{i,t} + \delta_i + \varepsilon_{i,t}. \tag{A.10}$$

Since we have relatively few observations per fund and do not know β_i and $\Gamma_{i,t-1}/R^{\varepsilon}_{i,t}$, a feasible alternative to estimating A.10 is an average effects linear panel model:

$$\widetilde{\Delta bias_{it}} \equiv log \left[\frac{NAV_{i,t}}{NAV_{i,t-1} R_{\beta=1,t} - D_{it} + C_{it}} \right] = \gamma' X_{i,t} + \delta_i + \eta_i + \varepsilon_{i,t} + \zeta_{i,t}, \tag{A.11}$$

where η_i and $\zeta_{i,t}$ are (additional to δ_i and $\varepsilon_{i,t}$) fund fixed effects and disturbance shocks that arise due to the mismeasurement of the left-hand side and the misspecification of the right-hand side of A.11 relative to A.10.[34] We note that the measurement error also constrains the set of covariates $X_{i,t}$ to not be contemporaneously correlated with market returns and fund cash flows, D_{it} and C_{it}.

Unlike in A.10, the expression in the logarithm in A.11 is not guaranteed to be positive. Therefore, in our implementation we Winsorize the values at the 2% level which results in all arguments for the log being greater than zero in our sample. In addition, we drop fund-quarters where ending Net Asset Values represent less than 2% of capital committed, and fund-quarters where the

[34] i.e. $log \left[\frac{NAV_{i,t}}{NAV_{i,t-1} R_{\beta_i,t} - \frac{\Gamma_{i,t-1}}{R^{\varepsilon}_{i,t}} (D_{it} - C_{it})} \right] = log \left[\frac{NAV_{i,t}}{NAV_{i,t-1} R_{\beta=1,t} - 1(D_{it} - C_{it})} \right] + \eta_i + \zeta_{i,t}$

previous available report was more than one quarter ago.

To verify that A.11 is a sensible estimator of γ, the average bias loading on the covariates of interest, we also use a placebo dependent variable constructed as follows:

$$\widetilde{\Delta bias}_{it}^{placebo} \equiv log\left[\frac{NAV_{it}R_{\{FF100\},t}}{NAV_{it}R_{\beta=1,t}-(R_{\{FF100\},t}-R_{\beta=1,t})(D_{ti}-C_{it})}\right] \tag{A.12}$$

where $R_{\{FF100\},t}$, referred to $R_t^{placebo}$ in the main text, is the return in period t of a public equity portfolio constructed from Fama-French 100 U.S. Equity Research Portfolios (henceforth, FF100). We randomly select a subset of the FF100 portfolios and take average returns for these to generate a placebo return series for a specific fund. Once assigned, the portfolio remains the same across all periods for the given fund. For buyout funds we limit our selection to the subset of FF100 that includes only the 25 highest Book-to-Market portfolios out of the 50 lowest market value portfolios and scale (lever) each return series by a factor of 2 (by taking gross returns squared).

For venture funds we select returns from the 25 lowest Book-to-Market portfolios out of the 50 smallest market value portfolios. In the random placebo portfolio matching, we only condition on placebo to-date returns for a given fund being in the same tercile among its peers as the actual fund IRR as of the 28^{th} quarter since inception.[35] Peers are funds incepted in the same or adjacent vintage years and having the same strategy (Buyout, Early Stage Venture, Biotech Venture, Other Venture).

We arrive at the expression for $\widetilde{\Delta bias}_{it}^{placebo}$ by substituting $NAV_{it}/R_{\{FF100\},t}$ for NAV_{it-1} in A.11 in order to obtain the growth in NAVs from the previous period that would have occurred if $R_{\{FF100\},t}$ had been the return generating process. In addition, A.12 allows us to test whether the cash flow dependency of the disturbance term in A.11 is sufficiently attenuated by controlling for concurrent cash flows. Just as for $\widetilde{\Delta bias}_{it}$, we Winsorize the right-hand side of the expression at the 2% level before taking the log.

[35] or the last quarter in the sample for funds younger than 28 quarters as of the sample end date, December 2011

III. FASB 157 Adoption

We undertake two simple tests in an attempt to identify effects that might be attributable to accounting changes related to SFAS 157. First, Figure B.5 plots median fund performance during this period based on changes in PME indexed to 2003:Q4 value of 1.0. The figure shows that in 2008 PMEs for both buyout and venture funds increase significantly, regardless of the performance and fundraising success. This is consistent with funds marking-to-market undervalued investments en masse. However, if this were the case, we would expect PMEs to stay at this new level after being marked up. Instead PMEs drop substantially in 2009 so that the combined net change in PME is close to zero over the period from 2007-2009. Panel A also shows that the net effect is similar for both funds that are, and are not, successful at raising a next fund though it is more pronounced for those that are not. A likely explanation for the pattern in PMEs is that funds did not mark their portfolios down as far as the public market returns in 2008 nor up as much in 2009. Consequently, PMEs give the appearance of outperforming in 2008 and underperforming in 2009. Panel B shows similar plots based on performance tercile as of 2006:Q1. Panel C shows similar plots based on performance tercile as of the end of a funds life. In all cases fund relative returns as measured by PME appear to jump in 2008 and then drop in 2009 and it is difficult to attribute this return pattern to SFAS 157.

Our second test compares estimates of return autocorrelation before and after the adoption of SFAS 157. Specifically, we estimate the following AR(1) model:

$$NAVret_{it} = \mu + fas157_t + \rho_1 \cdot NAVret_{it-1} + \rho_2 \cdot NAVret_{it-1} \cdot fas157_t + \nu_{i,t}$$

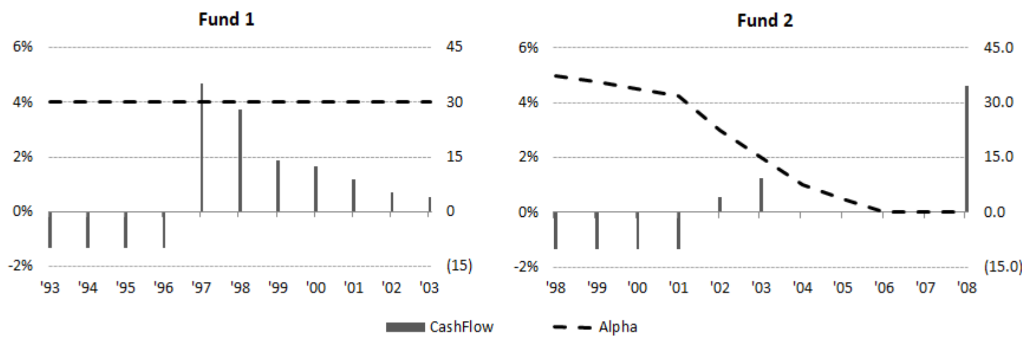
and compare the estimates of ρ_1 and ρ_2. Given our previous analysis (as well as many others in context of marking illiquid assets), we expect to find positive values of ρ_1 consistent with positive return autocorrelation. A material impact from SFAS 157 (in the direction of timely and unbiased marking) would be consistent with a negative ρ_2 and the sum of ρ_1 and ρ_2 being insignificantly different from zero.

Table B.7 reports results from the AR(1) model above for both buyout and venture funds for the full sample of funds and a variety of subsamples. We also examine both raw returns and de-meaned returns (i.e., returns accounting for fund fixed effects). Panel A reveals the expected significant positive values for ρ_1 in most samples. Values for ρ_2 are sometimes negative, but only weakly significant in two cases for de-meaned returns (i.e., specifications 3 and 6 which are for funds with weaker performance). Panel B reports results for venture funds. We again find generally positive and significant coefficients for $_1$. However, for venture funds values for $_2$ are often negative and significant. These results suggest that adoption of SFAS 157 may have had an important impact on NAV reporting for venture funds but not for buyout funds. The results for venture funds are consistent with the findings of Cumming and Walz (2009) regarding the effects of accounting standards on the private equity fund financial reporting.

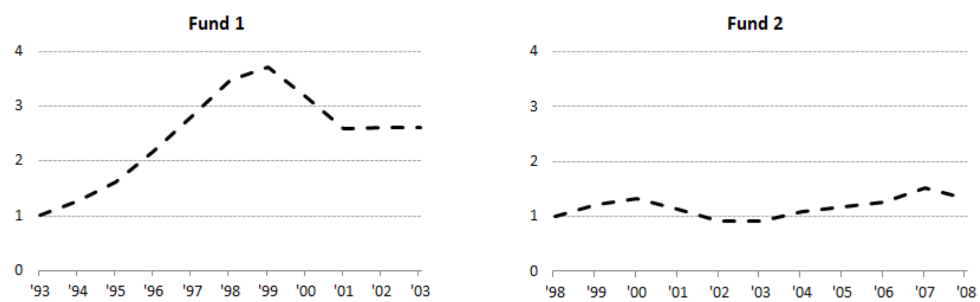
Figure A.1: Why not simply plot IRRs since inception? A Simple Case Study

This figure illustrates the inconsistency of IRR-to-date for the purpose of NAV bias assessment by studying two hypothetical cash-flow and abnormal return patterns (i.e., funds) described in Appendix AI. Panel A plots the alpha and the cash-flow patterns for both cases. Panel B plots the total return to the S&P 500 index over each hypothetical fund's life (rescaled to 1.0 at inception). Panel C plots the resulting PMEs-to-date and IRRs-to-date.

Panel A: Cash-flows and true abnormal returns



Panel B: Public market paths



Panel C: Fund to-date performance indicators

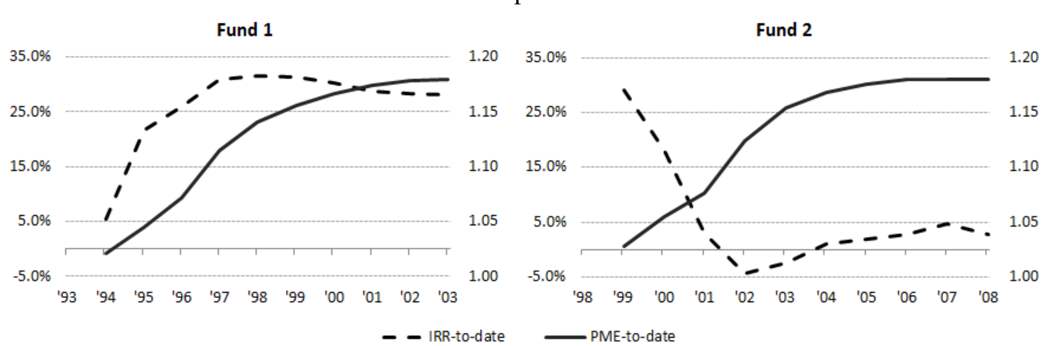


Figure A.2: Average Fund Performance Paths: Simulated Data

This figure reports results of the Monte Carlo Experiment described in Appendix AI.1 to suggest a null hypothesis appropriate for average fund to-date performance as measured by the proposed metric: weighted-PME cumulative changes. A change in a given quarter is a weighted average of PME-to-date changes from the previous period across the simulated funds for a given quarter since inception. The weights are ratios of NAV to cumulative capital calls since inception adjusted for market returns. The simulated funds differ by their market betas and abnormal returns. Fund cohorts have different market return paths as well. The solid line represents the mean over 600 funds drawn from a distribution with a high mean β. The dashed line stands for the mean over 600 funds drawn from a distribution with a low mean β. The top-right panel reports weighted money-multiple cumulative changes while bottom-left(right) panel reports mean NAV excess(raw) returns. All are shown to be a special case of the NAV-weighted PME change in Appendix AI.

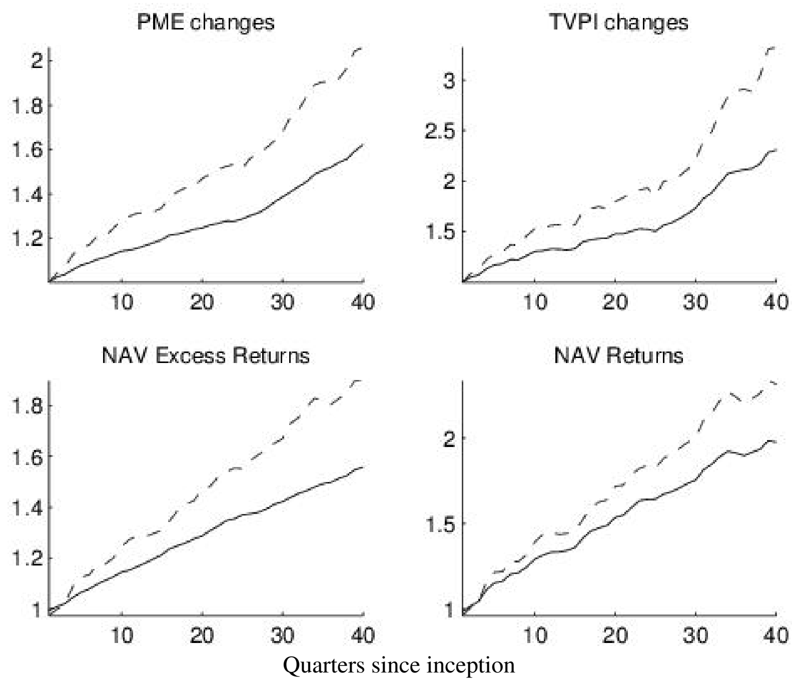


Table A.1: NAV-based returns and Fundraising Quarter dummies

This table reports the parameter estimates a panel regression model of quarterly changes of PE fund NAVs as a function of time periods around the quarter a follow-on fund was raised by the same GP. For example, *I(4th quarter before NF)* is a dummy variable that is equal to zero unless fund i had a follow-on fund started making investments 5 quarters after quarter t. The sample includes all buyout and venture capital non-missing NAV fund-quarters. Distributions and capital calls during quarter t are present as additional explanatory variables in specification (1) while market return in quarter t is included in specifications (1) and (2). All specifications also include a dummy denoting 4^{th} quarter (i.e. ending in December), quarter since fund inception fixed effects, and fund fixed effects. In Panel A, the dependant variable is a change in fund NAV from quarter $t-1$ to t. In Panel B, NAV_t values are replaced with the following placebo counterpart: $NAV_t \cdot R_t^{pla} - NetDistribution_t$, where R_t^{pla} is a gross return of style- and size-matched public equity portfolio. Public equity portfolios returns are constructed using subsets of Fama-French 100 U.S. Equity research portfolios as described in Appendix A. NAVs, capital calls, and distributions are normalized by the fund size. t-statistics reported in parentheses are robust to heteroskedasticity and autocorrelation, */**/*** denotes significance at 10/5/1% confidence level.

	Panel A Fund returns			**Panel B** Placebo returns		
	(1)	(2)	(3)	(1)	(2)	(3)
Cash in	1.040***			0.957***		
	(39.98)			(22.02)		
Cash out	−0.503***			−0.372***		
	(−7.82)			(−3.14)		
Market return	0.271***	0.262***		1.078***	1.073***	
	(15.10)	(14.50)		(50.26)	(48.24)	
I(Fourth calendar quarter)	0.0040*	0.0041*	0.0116***	0.0050	0.0053	0.0372***
	(1.84)	(1.69)	(4.68)	(1.00)	(1.00)	(6.89)
I(5th quarter before NF)	0.0058	0.0085	0.0105	−0.0009	0.0023	0.0117
	(0.63)	(0.81)	(0.99)	(−0.06)	(0.17)	(0.82)
I(4th quarter before NF)	0.0246***	0.0262***	0.0273***	−0.0023	0.0007	0.0073
	(2.71)	(2.71)	(2.82)	(−0.16)	(0.05)	(0.51)
I(3rd quarter before NF	0.0329***	0.0341***	0.0347***	0.0031	0.0059	0.0152*
	(3.57)	(3.88)	(3.93)	(0.16)	(0.31)	(1.73)
I(2nd quarter before NF)	0.0308**	0.0305**	0.0305**	0.0366**	0.0386**	0.0408**
	(2.27)	(2.15)	(2.13)	(2.09)	(2.22)	(2.29)
I(1st quarter before NF)	0.0212*	0.0183	0.0147	0.0345*	0.0339*	0.0211
	(1.93)	(1.56)	(1.25)	(1.68)	(1.75)	(1.07)
I(Next fund start quarter *[∼ NF]*)	0.0034	0.0185	0.0126	0.0033	−0.0081	−0.0308
	(0.66)	(1.40)	(0.95)	(0.15)	(−0.37)	(−1.39)
I(1st year after NF)	0.0110	−0.0132**	−0.0169***	0.0217**	0.0020	−0.0105
	(1.48)	(−2.05)	(−2.58)	(2.35)	(0.28)	(−1.45)
I(2nd year after NF)	0.0029	−0.0187**	−0.0230***	0.0073	−0.0103	−0.0246***
	(0.43)	(−2.53)	(−3.03)	(0.80)	(−1.46)	(−3.38)
I(3rd year after NF)	−0.0095**	−0.0204***	−0.0250***	0.0030	−0.0105*	−0.0261***
	(−2.26)	(−3.97)	(−4.81)	(0.44)	(−1.74)	(−4.39)
I(4th year after NF)	−0.0068*	−0.0167***	−0.0178***	−0.0085	−0.0203***	−0.0229***
	(−1.71)	(−5.25)	(−5.62)	(−1.41)	(−4.09)	(−4.79)
I(5th year after NF)	−0.0048*	−0.0129***	−0.0116***	−0.0083*	−0.0160***	−0.0095**
	(−1.66)	(−3.89)	(−3.53)	(−1.70)	(−3.32)	(−2.07)
I(6th year after NF)	−0.0038	−0.0072**	−0.0061*	−0.0089*	−0.0139***	−0.0086*
	(−1.18)	(−2.13)	(−1.81)	(−1.76)	(−2.68)	(−1.75)
Controls	Fund fixed effects, Life-quarter fixed effects					
Observations	56,602	56,602	56,602	56,602	56,602	56,602
R-squared (%)	17.6	2.0	1.1	8.0	5.0	0.5

Appendix B. Supplementary Figures and Tables

Table B.2: Performance Tercile Transition Probabilities: *PME*

This table reports transition probabilities between interim and final performance terciles. We define performance based on *PME-to-Date* within each fund peer group (vintage year and strategy). Panel A reports results for buyout funds and Panel B reports results for venture funds. Only the funds that have raised a follow-on fund within ten years since inception are included. The first row of each panel reports the probability of being in the respective to-date tercile at the end of a funds life (*Final*), conditional on being in the bottom to-date tercile in the quarter preceding the follow-on funds first capital call (*At Fundraising*). Similarly, the second (third) row reports Final performance tercile conditional on being in the middle (top) performance tercile *At Fundraising*. The last row of each panel reports the unconditional distribution of funds across *Final* terciles, while the last column reports how many funds were in each fundraising tercile and the respective fraction in the total number of funds in this analysis. The peer group is all funds of the same strategy incepted within one year from the fund vintage year. Since follow-on fundraising occurs at a different time for each of the funds and fund life varies, neither *At Fundraising* nor *Final* terciles need to have an equal number of funds.

Panel A: Buyout

		Final				
		Btm	Mid	Top	Fund Count	
At Fundraising	Btm	61.2%	26.9%	11.9%	67	(18.8%)
	Mid	36.9%	42.3%	20.8%	130	(36.5%)
	Top	13.2%	25.2%	61.6%	159	(44.7%)
	All	30.9%	31.7%	37.4%	356	(100%)

Panel B: Venture

		Final				
		Btm	Mid	Top	Fund Count	
At Fundraising	Btm	56.7%	31.3%	11.9%	67	(21.8%)
	Mid	32.0%	43.2%	24.8%	125	(35.8%)
	Top	10.4%	21.6%	68.1%	214	(42.4%)
	All	26.8%	31.0%	42.2%	355	(100%)

Table B.3: Performance Quartile Transition Probabilities: *IRR*

This table reports transition probabilities between interim and final performance *quartiles*. We define performance based on IRR-to-date within each fund peer group (vintage year and strategy). Panel A reports results for buyout funds and Panel B reports results for venture funds. Only the funds that have raised a follow-on fund within ten years since inception are included. The first row of each panel reports the probability of being in the respective to-date quartile at the end of a funds life (*Final*), conditional on being in the bottom to-date quartile in the quarter preceding the follow-on funds first capital call (*At Fundraising*). Similarly, the second (third) row reports Final performance quartile conditional on being in the middle (top) performance quartile *At Fundraising*. The last row of each panel reports the unconditional distribution of funds across *Final* quartiles, while the last column reports how many funds were in each fundraising quartile and the respective fraction in the total number of funds in this analysis. The peer group is all funds of the same strategy incepted within one year from the fund vintage year. Since follow-on fundraising occurs at a different time for each of the funds and fund life varies, neither *At Fundraising* nor *Final* quartiles need to have an equal number of funds.

Panel A: Buyout

		Final					
		Btm	3rd	2nd	Top	Fund Count	
At Fundraising	Btm	55.0%	20.0%	17.5%	7.5%	40	(11.2%)
	3rd	40.7%	34.1%	16.7%	6.6%	91	(25.6%)
	2nd	16.4%	22.7%	40.0%	20.9%	110	(30.9%)
	Top	12.2%	9.6%	22.6%	55.6%	115	(32.3%)
	All	25.6%	21.1%	26.4%	27.0%	356	(100%)

Panel B: Venture

		Final					
		Btm	3rd	2nd	Top	Fund Count	
At Fundraising	Btm	48.1%	27.3%	20.8%	3.9%	77	(15.1%)
	3rd	33.0%	36.5%	20.9%	9.6%	115	(22.5%)
	2nd	18.5%	23.8%	29.1%	28.5%	151	(29.6%)
	Top	7.2%	11.4%	23.9%	57.5%	167	(32.8%)
	All	22.5%	23.1%	24.3%	30.0%	510	(100%)

Table B.4: Additional Summary Statistics

This table reports summary statistics for the variables used in section V as defined in the main text. Appendix A provides details on variable construction.

Panel A: Buyout sample

	mean	sd	min	p5	p25	p50	p75	p95
$\widetilde{\Delta bias\_it}\|\beta = 1$	0.0069	0.19	−3.11	−0.19	−0.066	−0.004	0.087	0.26
$\widetilde{\Delta bias\_it}\|\beta = 1.7$	−0.0047	0.25	−4.10	−0.28	−0.11	−0.021	0.12	0.32
$\widetilde{\Delta bias}_{it}^{placebo}\|\beta = 1$	−0.0061	0.36	−1.07	−0.65	−0.23	0.015	0.23	0.58
$\widetilde{\Delta bias}_{it}^{placebo}\|\beta = 1.7$	−0.015	0.34	−0.95	−0.60	−0.24	−0.003	0.21	0.54
FundTiming	1.26	0.38	0	0.56	1.01	1.32	1.56	1.79
Excess FundTiming	1.35	0.39	0	0.56	1.01	1.39	1.66	1.91
PeerChasing	0.004	0.13	−0.30	−0.22	−0.086	0	0.086	0.22
Residual PeerChasing	−0.078	0.20	−1.35	−0.43	−0.18	−0.061	0.036	0.22
Placebo PeerChasing	0.005	0.087	−0.98	−0.11	−0.028	0.007	0.044	0.13
Distributions /NAV	0.059	0.25	0	0	0	0	0.038	0.26
Capital Calls /NAV	0.12	6.07	0	0	0	0.0094	0.072	0.27
Distributions/Fund size	0.030	0.079	0	0	0	0	0.025	0.16
Capital Calls/Fund size	0.031	0.052	0	0	0	0.0054	0.042	0.14
Calender year of the quarter	2004.7	5.24	1987	1994	2002	2006	2009	2011

Panel B: Venture sample

	mean	sd	min	p5	p25	p50	p75	p95
$\widetilde{\Delta bias\_it}\|\beta = 1$	−0.017	0.16	−2.05	−0.22	−0.089	−0.026	0.050	0.22
$\widetilde{\Delta bias\_it}\|\beta = 1.7$	−0.043	0.24	−2.12	−0.39	−0.18	−0.062	0.066	0.38
$\widetilde{\Delta bias}_{it}^{placebo}\|\beta = 1$	−0.0099	0.30	−0.78	−0.50	−0.21	−0.0064	0.19	0.48
$\widetilde{\Delta bias}_{it}^{placebo}\|\beta = 1.7$	−0.036	0.31	−0.85	−0.55	−0.25	−0.037	0.17	0.48
FundTiming	1.25	0.40	0	0.56	0.92	1.32	1.56	1.83
Excess FundTiming	1.36	0.40	0	0.56	1.10	1.45	1.70	1.91
PeerChasing	−0.0060	0.12	−0.30	−0.21	−0.084	−0.0013	0.072	0.20
Residual PeerChasing	−0.059	0.19	−1.77	−0.39	−0.14	−0.038	0.045	0.21
Placebo PeerChasing	0.0041	0.057	−0.77	−0.069	−0.019	0.0016	0.026	0.083
Distributions NAV	0.035	0.17	0	0	0	0	0	0.18
Capital Calls NAV	0.058	0.087	0	0	0	0.0069	0.093	0.24
DistributionsFundsize	0.022	0.10	0	0	0	0	0	0.11
Capital CallsFundsize	0.027	0.040	0	0	0	0.0042	0.049	0.10
Calendar year of the quarter	2003.2	6.06	1986	1991	2001	2004	2008	2011

Table B.5: Fund Timing and Peer-Chasing: Additional Specifications

This table reports the parameter estimates a linear regression model estimated separately for buyout (Panel A) and venture (Panel B) funds. The dependant variable measures risk- and cash flow-adjusted changes in NAV for quarter t that is constructed to be unpredictable under the null of reported NAVs being unbiased estimators of true asset values. The market beta of the fund assets is assumed to be 1.7 [2.4] in specifications (6) and (7) for buyout [venture] subsample and 1 everywhere else. Explanatory variables of interest include *FundTiming* which is the natural log of one plus time spent to-date without a follow-on fund in excess of two years, *PeerChasing* which is the difference between fund i reported Internal Rate of Return to-date for the calendar quarter corresponding to $t-1$ quarter of fund i life and its peers as measured by the median IRR-to-date across all funds of the same strategy incepted within one year from fund i vintage year. Specifications (4), (5) and (7) also include the interaction of *FundTiming* and *PeerChasing* variables. All specifications include fund fixed effects, all except (1) include fund distributions and capital calls over the current quarter scaled by the end of quarter NAVs. Specifications (3) and (5) through (7) include year-quarter fixed effects, others have year and quarter fixed effects instead. t-statistics reported in parentheses are robust to heteroskedasticity and autocorrelation, */**/*** denotes significance at 10/5/1% confidence level.

	$\beta = 1$					$\beta = 1.70B/2.4V$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			Panel A: Buyout				
FundTiming	0.060***	0.059***	0.080***	0.038**	0.057***	0.076***	0.053**
	(2.78)	(3.13)	(4.22)	(2.02)	(3.00)	(3.63)	(2.57)
PeerChasing	−0.198***	−0.202***	−0.205***	0.123**	0.131**	−0.202***	0.117**
	(−5.95)	(−6.31)	(−6.51)	(2.31)	(2.55)	(−5.46)	(2.09)
FundTiming × PeerChasing				−0.295***	−0.304***		−0.289***
				(−6.22)	(−6.61)		(−5.62)
Observations	12,150	12,150	12,150	12,150	12,150	12,150	12,150
R-squared	0.046	0.094	0.237	0.098	0.242	0.420	0.423
RMSE	0.184	0.172	0.158	0.172	0.158	0.180	0.180
			Panel B: Venture				
FundTiming	0.029**	0.026*	0.051***	0.018	0.043***	0.054***	0.046***
	(2.08)	(1.89)	(3.62)	(1.34)	(3.08)	(3.78)	(3.26)
PeerChasing	−0.151***	−0.168***	−0.175***	0.068*	0.045	−0.180***	0.037
	(−7.91)	(−8.53)	(−9.18)	(1.79)	(1.21)	(−9.21)	(0.99)
FundTiming × PeerChasing				−0.217***	−0.202***		−0.200***
				(−6.88)	(−6.52)		(−6.29)
Observations	15,124	15,124	15,124	15,124	15,124	15,124	15,124
R-squared	0.110	0.118	0.305	0.121	0.309	0.607	0.608
RMSE	0.136	0.135	0.120	0.135	0.120	0.124	0.124
			Controls in Both Panels:				
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cash Flows	No	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	No	Yes	No	No	No
Quarter FE	Yes	Yes	No	Yes	No	No	No
Year-Qtr FE	No	No	Yes	No	Yes	Yes	Yes

Table B.6: Cross-Section of To-Date Performance: *Placebo*

This table reports the parameter estimates a linear regression model estimated separately for buyout (Panel A) and venture (Panel B) funds. The dependant variable measures a fund adjusted return for quarter t if its NAVs were tracking a same style public equity portfolio based Fama-French 100 U.S. equity portfolios (Appendix A provides details). *FundTiming* is the natural log of one plus, essentially, time spent to-date without a follow-on fund in excess of two years. Specifications (1) through (4) have *PeerChasing* is a difference between fund i to-date average public portfolio cumulative return-to-date for the calendar quarter corresponding to $t-1$ quarter of fund i life and that of its peers. *Rookie* is a dummy for whether the PE firm had less than two funds before i. *Top* and *Btm* are dummies denoting if to-date return of the assigned public equity portfolio was in Top(Bottom) tercile by return-to-date as of quarter $t-1$ among those assigned to the fund peers. Control variables in all specifications include funds fixed effects, year-quarter fixed effects as well as fund distributions and capital calls over the current quarter scaled by the end of quarter NAVs. t-statistics reported in parentheses are robust to heteroskedasticity and autocorrelation, */**/*** denotes significance at 10/5/1% confidence level.

	Panel A Buyout				**Panel B** Venture			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
FundTiming	−0.002	0.013	0.007	0.018	0.017	−0.013	−0.005	−0.013
	(−0.08)	(0.51)	(0.36)	(0.61)	(0.73)	(−0.76)	(−0.35)	(−0.61)
PeerChasing	0.039	0.014	0.031**	0.015	−0.011	0.007	−0.009	0.001
	(1.26)	(0.72)	(2.00)	(0.67)	(−0.38)	(0.48)	(−0.56)	(0.06)
Rookie × FundTiming		0.011		0.005		0.007		0.008
		(0.32)		(0.15)		(0.28)		(0.32)
Rookie × PeerChasing		0.009		0.008		−0.001		0.006
		(0.34)		(0.32)		(−0.06)		(0.24)
TopTercile-to-date			−0.030*	−0.029*			−0.008	−0.008
			(−1.86)	(−1.79)			(−0.64)	(−0.67)
Top × FundTiming			0.049	0.036			−0.018	−0.015
			(0.99)	(0.71)			(−0.52)	(−0.41)
Top × PeerChasing			−0.011	−0.000			0.046**	0.035
			(−0.32)	(−0.01)			(2.03)	(1.42)
BtmTercile-to-date				0.003				0.002
				(0.19)				(0.15)
Btm × FundTiming				−0.033				0.011
				(−0.91)				(0.40)
Btm × PeerChasing				0.078				−0.044
				(1.10)				(−1.21)
Controls	Fund FE, Year-Qtr FE, Cash-Flows							
Observations	12,150	12,150	12,150	12,150	15,131	15,131	15,131	15,131
R-squared	0.467	0.477	0.436	0.436	0.191	0.194	0.169	0.169

Table B.7: Autocorrelation of Reported Returns Before and After FAS157

This table reports the parameter estimates for the following linear regression model::

$$NAV\,ret_{it} = \mu + fas157_t + \rho_1 \cdot NAV\,ret_{it-1} + \rho_2 \cdot NAV\,ret_{it-1} \cdot fas157_t + \nu_{i,t}$$.

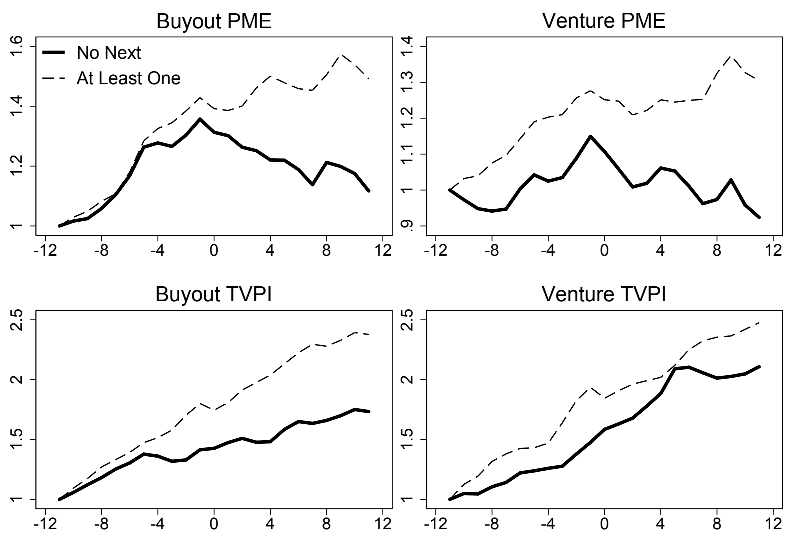
The model is estimated separately for buyout (Panel A) and venture (Panel B) funds. We report results from two estimation methods, *Fund FE* and *Pooled*, and four subsamples. In the Pooled method $NAV\,ret_{it}$ is fund i reported return for quarter t as measured by NAV change adjusted for net distributions during that quarter. In *Fund FE*, $NAV\,ret_{it}$ is fund i reported return for quarter t de-meaned over each funds lifetime. $fas157_t$ is an indicator variable taking a value of one for quarters after 2Q09 and zero otherwise. All includes all Funds in our sample, so that the control group includes funds already resolved by end of 2006 as well as earlier reports by fund that remained active after 2Q09. *Btm*, *Mid*, *Top* are subsamples of funds that remain active end of 2006 and were in the respective performance tercile according to reported IRR-to-date. We drop reports for 10 quarters between 1Q07 and 2Q09 for all funds in each subsample to insure that our inference is not confounded by developments during the adoption period, the onset of the 2008 crisis and the subsequent rebound in liquid market prices. Also, we drop all reports by funds younger than 8 quarters since inception. t-statistics reported in parentheses are robust to heteroskedasticity and autocorrelation, */**/*** denotes significance at 10/5/1% confidence level.

	Fund FE				Pooled			
	All	Btm'06	Mid'06	Top'06	All	Btm'06	Mid'06	Top'06
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Panel A: Buyout				
ρ_1	0.137***	0.204*	0.023	0.130***	0.116**	0.207*	0.001	0.0943**
	(3.30)	(2.02)	(0.44)	(3.18)	(2.20)	(1.98)	(0.02)	(2.24)
ρ_2	−0.069	−0.278**	−0.149	0.041	−0.030	−0.236	−0.026	0.228
	(−0.80)	(−2.44)	(−1.29)	(0.39)	(−0.50)	(−1.76)	(−0.19)	(1.65)
Pr(F-stat> $[\rho_1 + \rho_2]$)	0.423	0.356	0.203	0.237	0.145	0.766	0.820	0.078
Observations	9,181	1,675	2,047	1,867	9,181	1,675	2,047	1,867
				Panel B: Venture				
ρ_1	0.063	0.172***	0.108*	0.182***	0.0781*	0.190***	0.112*	0.178***
	(1.62)	(6.18)	(1.93)	(5.15)	(1.93)	(7.59)	(1.95)	(4.83)
ρ_2	−0.216***	−0.344***	−0.279**	−0.292***	−0.125	−0.322***	−0.241	−0.180***
	(−3.75)	(−3.93)	(−2.43)	(−5.83)	(−1.45)	(−3.69)	(−1.76)	(−3.19)
Pr(F-stat> $[\rho_1 + \rho_2]$)	0.000	0.090	0.131	0.034	0.490	0.230	0.316	0.965
Observations	15,230	2,624	2,873	3,430	15,23	2,624	2,873	3,430

Figure B.3: Alternative Definitions of the Fundraising Event Date

Panel A plots values starting 25 quarters preceding the minimum of the fund resolution quarter or the funds 10^{th} anniversary. Panel B plots values since the quarter that corresponds to inception plus the median time it took to raise a follow-on fund by the fund's vintage-year peers. As described in equations (1) and (2), the change in a given quarter is a mean PME-to-date change (or TVPI-to date change) from the previous period across a subset of funds multiplied by the average ratio of NAV to market-adjusted paid-in capital to date. Appendix A shows that the inference about the path of the PME-based variable is robust to misspecification of the fund's systematic risk while the TVPI-based path is a special case where the market return is assumed to be zero. *No Next* (*At Least One*) denotes the subset of funds without (with) at least one follow-on fund for in our sample.

Panel A: Event = 12 Quarters Before the Resolution



Panel B: Event = 12 Quarters After the Median Fundraising

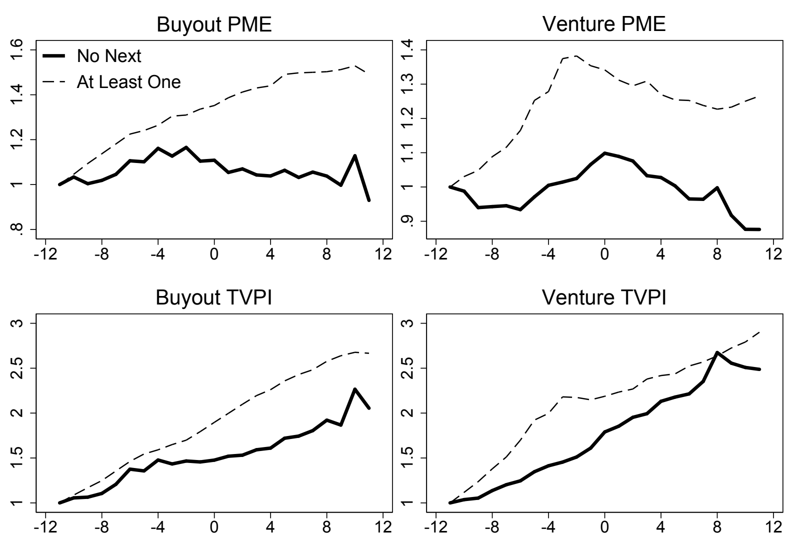
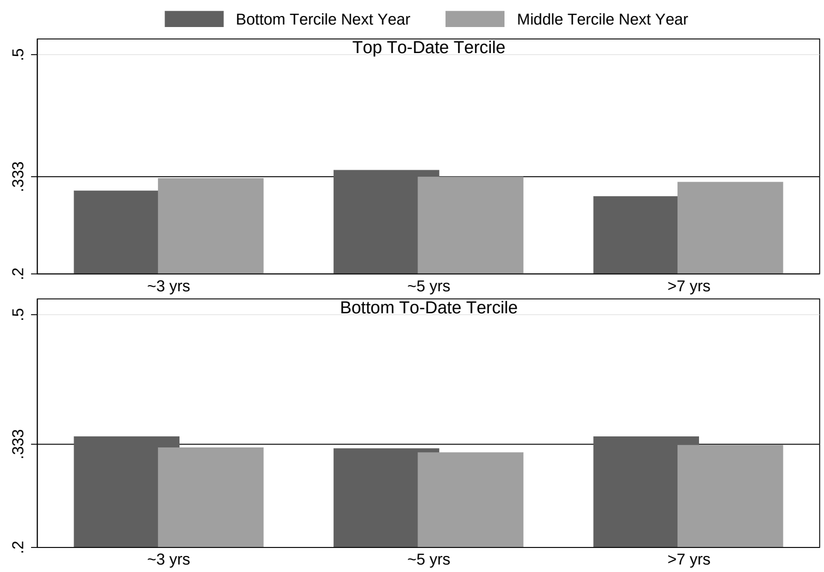


Figure B.4: Next Year PME Growth Conditional on To-Date Performance: Placebo

This figure reports the probabilities of a fund's excess returns over the next 4 quarters being in the top (bottom) tercile conditional on the fund's to-date performance tercile. We plot results separately for Buyout (Panel A) and Venture funds (Panel B). We define the fund peer group for to-date and next year terciles as all funds of the same strategy incepted within one year from the fund vintage year. The top chart of each panel reports results for top to-date tercile funds as of 8 to 17 quarters since inception (∼3yrs), 18 to 27 quarters since inception (∼5yrs), and more than 27 quarters (>7yrs). The bottom chart of each panel reports values for the bottom tercile to-date funds. Unlike Figure 4 which uses actual fund returns and IRRs-to-date, here we randomly assign public equity portfolios to the same set of funds and compute to-date performance as the average return of that portfolio since the fund inception. Public equity portfolios returns are constructed using subsets of Fama-French 100 U.S. Equity research portfolios as described in Appendix A.

Panel A: Buyout funds mimicking portfolios



Panel B: Venture funds mimicking portfolios

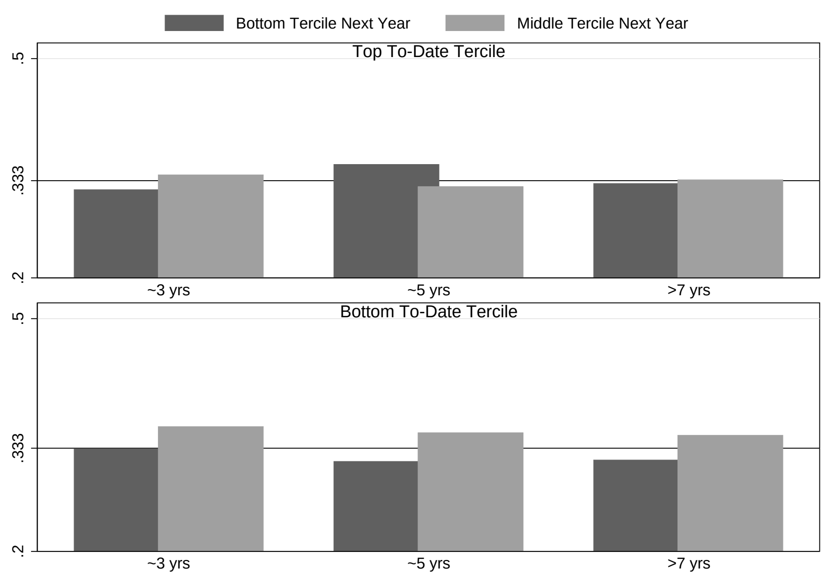
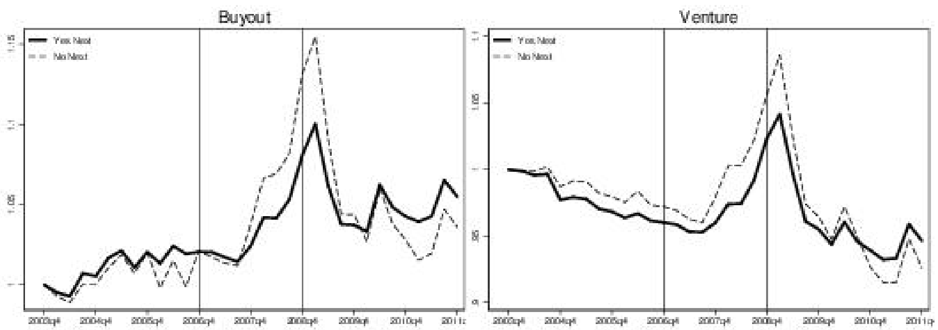


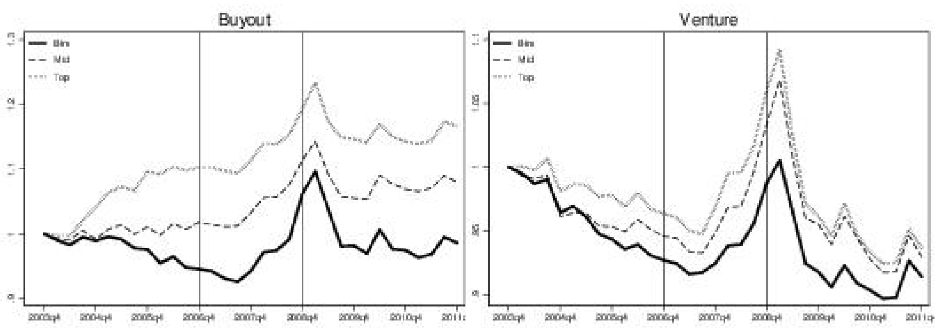
Figure B.5: Median Fund Performance Over SFAS157 Adoption Period

This figure reports cumulative excess returns over a public equity index as measured by PME around SFAS157 adoption period. We plot results separately for buyout and venture funds. Panel A splits the sample into groups based on whether or not a follow-on fund was raised. Panel B (C) splits the sample into groups based on performance rank as of the end of 2006 (upon resolution). A change in a given quarter is a median PME-to-date change from the previous period across the respective subset of funds.

Panel A: By Fundraising Success



Panel B: By Performance Tercile as of 4Q'06



Panel C: By Performance Tercile End of Life

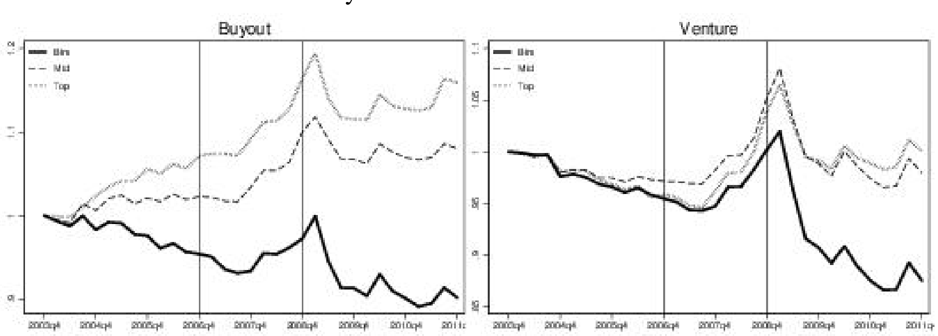
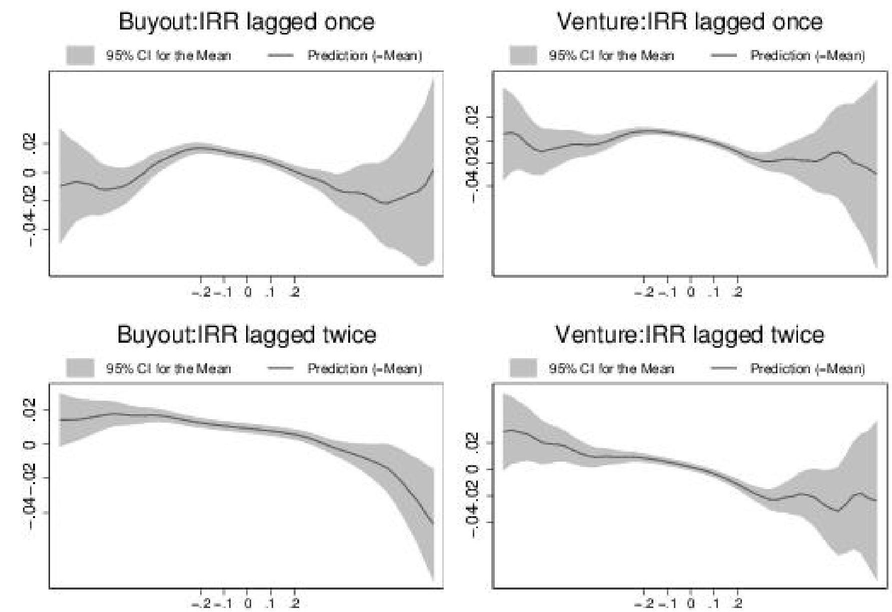


Figure B.6: Peer-Chasing: Non-Parametric Evidence

This figure reports local polynomial regression fits of fund excess returns on lagged to-date IRR relative to that of peer median. The models are estimated separately for buyout and venture funds. Reported returns orthogonalized with respect to fund cash flows are in Panel A with one and two period lagged IRR being in the top and bottom row, respectively. Panel B reports results from a similar exercise based on placebo returns. Placebo returns are constructed using subsets of Fama-French 100 U.S. Equity research portfolios as described in Appendix A.

Panel A: Actual Data



Panel B: Placebo - Public Equity Portfolios