Do Private Equity Funds Game Returns?☆

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By their nature, private equity funds hold assets that are hard to value. This uncertainty in asset valuation gives rise to the potential for fund managers to manipulate reported net asset values (NAVs). Managers may have an incentive to game valuations in the short-run if returns on existing funds are used by investors to make decisions about 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 NAV manipulation. We find evidence of managers boosting reported NAVs during times that fundraising activity is likely to occur. However, this behavior is mostly limited to firms that are subsequently unsuccessful at raising a next fund which suggests that investors see through the manipulation. In contrast, we find evidence that top-performing funds under-report returns. This conservatism is consistent with these firms insuring against future bad luck that could make them appear as though they are NAV manipulators. Our results are robust to a variety of specifications and alternative explanations.

Keywords: Private Equity, Venture Capital, Mutual Funds, Institutional Investors
JEL Classification: G23, G24, G30

☆First version: May 28^{th}, 2013; This version: May 28^{th}, 2013

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Helpful comments and suggestions provided by Bob Harris, Diego Garcia, James Kocis, James Bachman, and seminar participants at the 2012 Global Private Investing Conference. We thank Burgiss and especially Brandon Renkart for providing research support. This reseach has benefited from the support of the Private Equity Research Consortium (PERC) and the UAI Foundation. Kaplan has consulted to private equity general partners and limited partners. He also has invested in private and public equities.

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Abstract

By their nature, private equity funds hold assets that are hard to value. This uncertainty in asset valuation gives rise to the potential for fund managers to manipulate reported net asset values (NAVs). Managers may have an incentive to game valuations in the short-run if returns on existing funds are used by investors to make decisions about 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 NAV manipulation. We find evidence of managers boosting reported NAVs during times that fundraising activity is likely to occur. However, this behavior is mostly limited to firms that are subsequently unsuccessful at raising a next fund which suggests that investors see through the manipulation. In contrast, we find evidence that top-performing funds under-report returns. This conservatism is consistent with these firms insuring against future bad luck that could make them appear as though they are NAV manipulators. Our results are robust to a variety of specifications and alternative explanations.

I. Introduction

Recent press articles indicate that the SEC is investigating the reported returns of private equity funds.[1] The SEC inquiries center on the potential for private equity partners to overstate portfolio net asset values (NAVs) in an attempt to attract investors to future funds. Because there is no liquid market for most assets held by private equity funds, investors must rely on estimates of NAVs that are provided by general partners (GPs). Increasingly, NAVs are determined by outside valuation consultants and auditors, but the process is nonetheless subjective and potentially manipulated by data produced by the portfolio companies themselves (that are directly owned by the funds). Of course, the profitability of manipulating NAVs depends 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.

In this paper we examine the empirical evidence on NAV manipulation using a large dataset of private equity funds – both buyout and venture capital funds – obtained from Burgiss, a solutions provider catering to private capital investors. Our findings suggest that little manipulation of NAVs goes unnoticed by institu-

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

tional investors. Some GPs of poorly performing funds appear to game returns in a last ditch effort to raise a follow-on fund. However, these attempts are unsuccessful in so far as those firms are ultimately unable to raise a new fund. In contrast, we find evidence of conservatism among the GPs of the best performing funds. This is consistent with a concern on the part of GPs about being wrongly labeled a manipulator. This also suggests that the equilibrium behavior of GPs in reporting NAVs is influenced by the potential for gaming reported values.

In our analysis, we focus primarily on measures of risk-adjusted abnormal returns derived from the public market equivalent (PME) method of Kaplan and Schoar (2005). It is important to take risk-adjustments seriously in our analysis because public market returns are positively correlated with subsequent private equity fund formation. Insufficient risk-adjustment could falsely identify firms as NAV manipulators by making return estimates early in a funds life look abnormally good (during a bull market) and returns later in a funds life look abnormally low (during a bear market). We also address risk-related concerns by conducting a variety of simulations where we create placebo samples of private equity funds using portfolios of public equities with similar properties. Experiments with these placebo portfolios make us confident that our analyses are not affected by unmodeled risk factors that affect both public and private company values.

We examine both buyout and venture funds and find generally consistent results across both types of funds. Both the average buyout and average venture fund in our sample experience a positive lifetime abnormal return. Abnormal returns are somewhat greater during the early years of the average fund's life but remain positive in later years. The slowing in performance late in life is more pronounced for venture funds than buyout funds.

To see if fundraising for a subsequent fund is related to abnormal returns, we align returns around the first capital call for a firm's next fund. If there is no next fund, we assume an event date occurs 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). We observe a decline in performance around these events for both the average buyout and venture fund so we examine the source of the change in more detail by separating funds into three groups that raise a next fund early, late, 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 reversal in returns late in life. 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. We further condition our analysis on public market returns as a proxy for the fundraising environment. We find that these effects are typically more pronounced when the fundraising environment is difficult (i.e., market returns are low). Overall, this evidence is consistent with substantial NAV manipulation primarily by poor performing funds that are making a last ditch effort to raise a fund.

We also examine how NAV changes depend on the performance of peer funds (i.e., those of similar vintage and strategy). We find strong evidence of peer-chasing where top performing funds report lower returns and bottom performing funds report higher returns. The former is consistent with conservatism among top funds that is widely discussed among practitioners and documented by Harris et al. (2013). Our results are robust to a variety of methods and alternative tests.

The paper proceeds as follows: Section II provides a more detailed discussion of the game managers and investors might play. Section III describes the data used in the analysis. Section IV provides our main results. Section V provides a detailed discussion of additional empirical tests that more carefully examine the issue of causality. Section VI discusses robustness tests. Finally, Section VII concludes.

II. Reporting NAVs with Incomplete and Asymmetric Information

In this section we describe the relationship between general partners (GPs) in a private investment firm and the outside investors (LPs) that make investments in the funds operated by the GPs.

LPs seeking to make investments in private funds face the problem of deciding which GPs to invest with. Very little, if anything, is known about what specific investments will be undertaken by the GPs after capital has been committed to a fund. Consequently, investors are forced to rely largely on reported values of previous funds and soft information about the value-relevant qualities of GPs (e.g., access to deal flow, reputation in the industry, etc.) when selecting private equity managers.

Given that valuations from existing and past funds represent most of the hard information available to investors, it is not surprising that anecdotal evidence suggests that LPs make decisions under a prior belief of persistent performance of general partners (GPs). Academic evidence suggests that this is likely to be a valid process. For example, Kaplan and Schoar (2005) document that absolute and relative performance of early funds predicts that of subsequent funds managed by the same private equity firm.[2] 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). However, this study documents a drop in persistence for buyout funds with inception dates after 2000. 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. Because a typical firm seeks to raise a new fund every few years, these findings suggest that investors using current fund performance to evaluate managers must rely largely on net asset values (NAVs) reported by the fundraising GPs. This is particularly relevant for buyout funds since performance of already resolved funds (e.g., third and fourth back in a sequence) appears to contain little predictive power on average.

The GPs make investments in companies that are (or will be) privately held, and thus market prices are not observable for most of the fund's assets. GPs have a 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. Public market information is important because it is used as a basis for comparable company valuation analyses, the value for exiting existing investments (e.g., through IPOs and sales), as well an indication of the value of future investments.

In addition, GPs observe, but only with a lag, the performance of their competition—that is the performance of other funds of similar vintage and investment strategy. Given this information set, GPs have an incentive to assign valuations in a way that maximizes the value of the fund management firm. This problem includes maximizing not only the return from the current fund, but also possible future funds. Metric and Yasuda (2010) and Chung, Sensoy, Stern, and Weisbach (2011) show that the expected income from subsequent funds comprises a larger fraction of a GP's lifetime income than the income from the GP's current fund. Chung et al. propose and find empirical support for a rational learning model where follow-on funds represent an indirect pay for performance to GPs. This channel is stronger when management skills are

[2] The persistence appears notably stronger for venture capital funds. Sorensen (2007), Hochberg, Ljungqvist, and Lu (2010), Cai, Sevilir and Tian (2012), Ewens and Rhodes-Kropf (2013) suggest a micro-foundation for such persistence at the firm-level based on portfolio entrepreneur rational self-selection, institutional network effects as well as individual skill.

(perceived) to be more scalable, so that future commitment size, and expected compensation, can increase faster.[3] Taken together, the extant evidence suggests that GPs have an incentive to overstate recent fund performance in an attempt to assist in fundraising. We call this *Fund Timing*.

Fund timing, however, could be a two-edged sword. A practice of "aggressive" portfolio marks by GPs could become an equilibrium outcome and not provide a valuable signal to potential investors. Given the informational asymmetry, it might also be difficult for GPs to credibly convey that their portfolio marks are more conservative than those of their peers. A further complication derives from the fact that many LPs are sophisticated institutional investors and often other investors view commitments to a new fund by prominent LPs as a quality certification. If sophisticated LPs can determine that GPs manipulate reported returns this could jeopardize future fundraisings. Thus, GPs likely face a set of trade-offs in deciding whether or not to game reported NAVs.

Given the environment the LPs and GPs operate in, it is unclear to what extent modest NAV timing in the past may tarnish a GP's reputation enough to outweigh a marginal increase in the odds (and size) of a commitment for an upcoming fund. 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 a new fund. Second, there are idiosyncratic shocks affecting the path of a given fund's asset values. This can make it difficult to identify with confidence a "nefarious" change in reported performance due to manipulation even with additional information such as details about fund holdings. Thus, a GP would need to weigh the extent of NAV biases against the probability of being discovered.[4] Third, there exists substantial heterogeneity in LPs performance (Lerner, Schoar and Wongsunwai, 2007) and it is unclear what equilibrium the most sophisticated LPs would prefer given the apparent difficult access to some top funds. Specifically, LPs can punish *ex post* for what looks like bias by cutting back on participation in a GP's subsequent funds. At the same time, there is a "bad luck" possibility that cannot always be credibly conveyed to LPs. This suggests that top performing funds would have an incentive to be conservative with their portfolio valuation in order to reduce the odds of being mistakenly classified as manipulators. Such long-term reputational stains would

[3] Arguably, this is more relevant for buyout firms that are more commonly obligated to deliver a certain net-of-fee return to LPs before being entitled to performance-based compensation. See Metric and Yasuda (2010).

[4] This suggests that biases may be larger for venture funds where assets are riskier and harder to value as opposed to a typical buyout fund where publicly traded comparable firms are frequently available.

be less of a concern for GPs who are less likely to raise a new fund because of weaker performance of their current fund.

Given this motivation, we propose a specific set of testable hypotheses:

1. GPs of poorly performing funds are more likely to manipulate NAVs upward.

2. Average performing funds also have an incentive to overstate NAVs during fundraising, but only to the extent that it increases the expected profits from current and future successful fundraising.

3. Top performing funds may understate NAVs to build in some insurance against bad idiosyncratic shocks that could be misconstrued by investors as manipulations (i.e., overstatements) of NAVs.

4. Manipulation is likely to be more pronounced when capital is scarce. That is, when fewer new funds are being raised and so the benefit to manipulation has a greater potential impact on the probability of fundraising success.

The framework we outline makes an unambiguous prediction that poorly performing funds will overstate NAVs because even if they are found out, the alternative outcome is the same. However, in the case of funds with good performance, the net effects of incentives are an empirical issue and may time-vary with the fundraising environment.

Our work relates to other existing work. Conceptually, our paper is related to the large literature on information asymmetries in financial intermediation. Perhaps the setting most analogous to ours is described in Chemmanur and Fulghieri (1994) where investment banks are hired to underwrite issues by firms of unknown quality and must rely on their reputations to place issues. On the empirical front, Jenkinson, et al. (2013) examines a similar issue and finds evidence of wide-spread NAV manipulation in a set of CALPERS funds. More broadly, similar tensions for under-performing and over-performing managers have been detected in the context of mutual funds competing for investors' assets. Starting with Brown, Harlow, and Starks (1996), researchers have found that mutual funds with relatively bad performance tend to increase portfolio risk relative to other funds towards year-end. Private equity funds have very limited ability to change the riskiness of their portfolios through asset re-allocation.[5] Instead, a GPs discretion is related to

[5] Unlike mutual funds however, private equity GPs have discretion over company operational and investment policies subject to

reporting of values of assets and the corresponding reputational risk. Yet, the underlying incentives induced by the compensation scheme are analogous: the adverse long-term implications are important only so long as that ”long-term” is likely to exist.

III. Data

Private equity fund cash flows and NAVs for this study come from Burgiss. The dataset is sourced exclusively from LPs and includes the complete transactional and valuation history for their primary fund investments. In most cases, data are supplied by GPs directly to Burgiss. Burgiss rescales flows to be representative of the full fund. The Burgiss data include all funds and cash flows from the LPs that provide data. Data are provided by 220 investment programs and represent over $1 trillion in committed capital. The Burgiss LP base consists of approximately 60% pension funds (a mix of public and corporate) and 20% endowments or foundations with the remainder an assortment of other institutional investors such as funds-of-funds and sovereign wealth funds. Once aggregated, the data is supplemented with classifications and scaled to be representative of the full fund. The resulting dataset maintains confidentiality by removing all names and identifications.

The Burgiss dataset has been utilized in other academic studies. Harris, Jenkinson, and Kaplan (2012) 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 high degree of accuracy resulting from cross-checks among investors in the same funds and a direct recording of the fund accounting information disseminated to LPs. This feature is very important for our research question in particular since it likely insures against breaks in voluntary reporting by GPs or selection biases in reporting resulting from Freedom of Information (FOIA) requests to certain LPs.

Table 1 reports summary statistics for the 1,781 U.S.-focused funds in our sample by fund type (i.e., buyout or venture). Results in Panel A indicate the well-known heterogeneity and positive skew in performance among both already resolved and still active funds as well as the generally larger commitment amounts for buyout 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. The median buyout (venture) fund makes a distribution or capital call in

constraints from portfolio company creditors and equity co-investors.

32% (25%) of active quarters. Fewer than half of funds are resolved within 12 years (as often stipulated per fund terms) with a quarter of funds remaining active after 14 years.[6]

The dataset allows us to track each fund's affiliation with an investment firm so that we are able to generate fund sequences.[7] Panel A of Table 1 also shows that for firms with at least two funds the (inner-quartile) time between a particular fund's inception and a follow-on fund generally 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 first capital call. In addition, we tabulate fund counts (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. Overall, Panel B of Table 1 suggests that bigger, better performing funds by more experienced firms are more likely to have a follow-on fund, yet the relation is not monotonic.

IV. Primary Results

We start our analysis by examining the patterns in fund returns since inception and around fundraising events. Most generally, we are trying to detect the presence of a reporting bias in NAVs. Before 2009, GPs had a large amount of discretion in valuing their portfolios. Many chose to value their portfolio assets at cost until there was an explicit valuation change. Since 2009, topic 820 of the Financial Accounting Standards Board (FASB) 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 directly examine this question in a subsection at the end of the paper.

For Level 3 assets (i.e., those whose fair value cannot be determined using observable measures) the push toward fair-value accounting does not necessarily constrain valuations because a GP can still potentially

[6] See also Metric and Yasuda (2010).

[7] It is possible, however, that we do not have information for all the funds for a given firm. We will treat those potentially missing funds as none-existent in our analysis which is likely to generate a bias against finding significant relationships.

influence the valuation process. From conversations with Burgiss, we know that about 80% of fund holdings are reported as Level 3 assets.[8]

A bias could enter NAVs in several ways. First, valuing companies using comparable firms requires judgment as to which set of firms constitutes the best group of comparables and which metrics are the most appropriate for determining value. Alternatively, valuing companies using cash flow models requires a set of modeling assumptions about variables such as growth rates and discount rates that can be highly subjective. Finally, a bias in NAVs can derive from the timing of revaluation versus historical cost, particularly for venture funds. Specifically, fund managers typically have some flexibility on when to switch valuation methods.

While many funds use external valuation advisors and have audited procedures, the valuation process is inherently subjective and therefore allows for the possibility of negotiation around the valuation of portfolio companies. This type of back-and-forth is also common in other areas of corporate and security evaluation such as bond ratings. In the case of private equity funds, not only are external advisors paid by GPs, but their assessments could be prone to selective disclosure of value-relevant information by GPs.

A. Return Timing

So, do private equity firms inflate their existing fund NAVs to boost to-date-performance numbers during new fundraisings? If they do, these actions should result in a deterioration of subsequent performance of the existing funds relative to the preceding periods. The unwinding of such biases is not necessarily immediate but it is inevitable as all fund returns are eventually determined by actual cash flows. We start our analysis by averaging quarterly performance as a function of time since inception across many funds. This should help reveal return patterns by averaging out idiosyncratic shocks. In essence, we want to learn if there is any "suspicious" time variation in mean returns through time.

Table 2 reports transition probabilities between IRR-to-date terciles within each fund peer group for both buyout and venture funds. The first row of each panel reports the probability of being in the respective to-date tercile in the end of a fund's life conditional on being in the bottom to-date tercile in the quarter preceding the follow-on fund's first capital call. Likewise, the second (third) row reports the final performance terciles

[8] Of those not categorized as Level 3, the majority are categorized as Level 1 and represent portfolio companies that have already been sold to the public partially or that have never been delisted.

conditional on being in the middle (top) tercile at the next fund's launch. The last row of each panel reports the unconditional distribution of funds across life-end terciles, while the last column reports how many funds were in each fundraising tercile and the respective fraction in total fund count. Note that neither fundraising nor life-end terciles have to have equal numbers of funds since peer groups overlap, next funds are raised at different points in time for different funds, and funds have different lifetimes. (Nonetheless, the life-end terciles are almost distributed evenly for both buyout and venture funds.)

For both buyout and venture funds, top and bottom performers during the fundraising period are most likely to remain in the same performance tercile. However, there are some funds that start in the bottom tercile and migrate to the top tercile and vice versa. For example, only about 20% of successful venture fundraisers were in the bottom tercile during that process yet more than 40% finished in the middle or top tercile. This suggests that investors may have been able to identify quality funds that have better prospects than would be indicated by to-date performance. However, for both buyout and venture funds many more middle-tercile funds transition to the bottom tercile than to the top tercile. This is suggestive of some of these funds inflating NAVs towards the end of their respective fundraising periods. The top-tercile funds at fund raising are less likely than mid-tercile funds to move to another performance group by life-end. This pattern holds for both buyout and venture funds.

Because internal rate of return (IRR) is a time-weighted mean, quarterly changes in the IRR are noisy measures of the performance in that period. IRRs depend on previous period returns and the schedule of fund cash flows. The money-multiple (MM) or multiple of invested capital is the ratio of all fund distributions and remaining NAV to total capital calls to date. Quarterly changes in MMs do not depend on the previous period returns (as do IRRs). However, as funds return capital to investors, MMs reflect a diminishing weight of NAV and the current period distributions that carry information about the current period performance. If firms tend to make substantial distributions from previous funds before raising a new fund (as they typically do), then changes in a previous fund's MM may get smaller in magnitude subsequently even if the relative performance has increased.[9] The same critique would apply to changes in a benchmark-adjusted multiple, such as the Public Market Equivalent (PME) index of Kaplan and Schoar (2005). Consequently, analyzing returns from reported NAVs is challenging for a number of technical reasons.

[9] This weighting effect would not explain MM average changes becoming negative from positive and vice-versa.

In the appendix, we show that a change in the money-multiple 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, most of our analysis relies on a change in PME measure defined as

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

where R^{mkt} and R^{NAV} are, respectively, the public equity index return and the fund gross return.[10] 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. $(R_t^{NAV} - R_t^{mkt})$ is the excess return of a fund's invested assets over period t and captures all the information about the funds excess return in that period that either a PME or MM measure can convey. However, the information embedded in the second term of equation (1) captures the relative importance of a last-period NAV change in the performance numbers that investors get to observe.[11] Intuitively, if the remaining investment valuation does not matter for the performance metric that investors use in their performance assessment, why would a firm bother to game it? To the contrary, the temptation to game might be stronger if the investors' assessment is more highly dependent on how aggressively the fund marks the remaining assets.[12] We therefore compute the following metric for the periods and cross-section S of funds i and call it the Weighted-PME (WPME) between periods a and b so that

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

In a Monte-Carlo experiment described in detail in Appendix B, we show that excess returns and, correspondingly, WPME changes yield sharper estimates of time trends in mean excess returns than do raw returns and money-multiples.[13]

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[10] We use CRSP Value-Weighted return as the proxy for the market.

[11] The other reasons to down-weight observations with low NAV-to-capital ratios are: (1) to reduce presumably excessively high variance of returns towards the run-off phases of fund lives when only few investments remain in place; (2) to attenuate an effect where a lack of GPs may cause the performance to falter as fund life increases.

[12] For example, it may matter what performance percentile the fund falls into within various peer-groups. Here we assume investors do not regularly conduct a sensitivity analysis of the unresolved fund rankings on the NAV valuation bias.

[13] In this simulation we draw a funds 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

Figure 1 presents the WPMEs across all buyout and venture funds in our sample since fund inception (Panel A) and +/-12 quarters around firms next fundraising events. 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 in our dataset, the event quarter is the 13^{th} quarter preceding the fund resolution or the last available NAV report after the eleventh year if the fund remains unresolved.

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. Interestingly, the change in slope appears to occur near the typical time for follow-on fund launches.

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 overall. This evidence suggests that gaming positive excess returns around fundraising events that must then be reversed soon after (and the result in negative excess returns) is not the norm. However, the noticeable change in slope around fundraising suggests that some funds may undertake this gaming. Alternatively, it may be that successful fundraising is at least partially conditional on realizing a certain level of excess returns, and thus the subsequent moderation in returns is due to a selection effect by LPs. In addition, it is possible that broad market conditions in the buyout and venture segments (e.g., access

all cash flows independently of market and idiosyncratic shocks to returns. Figure B.6 suggests that a misspecification of fund-level β does not confound inference about the question of interest, the time trajectory of cross-sectional mean abnormal returns. Also, it follows that if more successful funds (as measured by PME) tend to not distribute capital faster as compared to their less successful peers, the null hypothesis for constant life-time excess returns should be a convex WPME-trajectory. 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 the qualitative results.

to exits) determine the timing of fundraising. Thus much of our subsequent analysis seeks to differentiate among these explanations.

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 and the No Next Fund group is defined as those funds for which we do not observe a follow-on fund. Recall that we define a hypothetical fundraising event for the No Next Fund group as the thirteenth quarter before the funds resolution or its 10^{th} year anniversary if still unresolved. We also sort funds into two groups, based on median 5-year rolling public markets returns as of the 13^{th} quarter of the funds life and call these High and Low Market funds.

Panel A of Figures 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 successful at fundraising. For both buyout and venture funds that are successful at raising another fund, the moderation is only apparent for those 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.

Panels B of Figures 2 shows the most interesting results. For both buyout and venture funds, the excess returns of funds that are unable to raise a next fund show obvious patterns consistent with funds gaming returns. In both cases, excess returns increase in the few years during which a firm is likely to be making a last ditch effort to raise a next fund only to reverse returns in the final years of the fund (as final actual cash flows are realized). 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 (largely institutional) market for buyouts and venture funds appears to look through attempts at gaming NAVs and determine the actual quality of a fund. It is also interesting to note that the apparent leveling off of excess returns evident in Figure 1 is diminished or nonexistent for buyout funds regardless of whether they are early or late to raise a next fund and for venture funds that raise a next fund early.

In Figure 3, we further refine the analysis by considering these groups during weak market periods. We consider public market performance as exogenous variation in return generating environments for the current fund (as well as for investors risk appetite for prospective funds).[14] In contrast, the sort based on the time it takes to raise a new fund is likely to be determined by a fund's to-date performance, among other factors (as noted above). As we expect, both buyout and venture funds have higher excess returns prior to fundraising when market returns are low suggesting a higher bar for raising funds during a weak market. The evidence for No Next Funds shows that the degree of gaming also appears to be more pronounced during low markets.

While the evidence presented in Figures 1-3 is quite suggestive, it does not provide a statistical test of whether there are return reversals around fundraising events. We start our more formal statistical analysis by estimating regressions that measure the economic and statistical significance of excess return patterns. Table 3 reports results of these tests. The dependent variable is the difference between quarterly growth of fund NAVs, net of fund cash flows to investors, and the public market return for that quarter. $PreFund$ $(PostFund)$ is a dummy variables taking a value of one for 12 quarters before (after) the fundraising event as defined above. We control for funds heterogeneity with vintage year and industry fixed effects and allow for possible correlation of errors within fund vintage year and event year. Our results are consistent with the plots in Figures 1-3. We only find evidence of a meaningful decline in performance for the subset of funds that are unable to raise a next fund (last column). We find this for both buyout and venture funds though the difference is only significant for buyout funds. The only other significant difference in this table is for venture funds that are late to raise a new fund in a high market and these funds tend to show better performance after a successful fundraising.

B. Peer-Chasing

There is little that a private equity firm can do about overall flows of capital to the asset class and systematic risk exposures of investments. Consequently, the extent and nature of any strategic behavior regarding NAV reporting is likely to also 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. Some large LPs even apply tougher evaluation and compliance procedures for prospective fund commitments when the firm's previous fund performance falls short of the comparable vintage year

[14] The pro-cyclical fundraising waves are well documented in the literature. Likewise, an intertemporal CAPM with liquid and illiquid risky assets can provide a rational for this demand from an investor perspective, see Ang et al. (2011).

peer group.[15] As described above, a peer-chasing behavior may cause NAV manipulation to spread across all firms as a strategic response by GPs to the presence of the informational asymmetry between GPs and LPs. Thus, underperforming funds have an incentive to report upward-biased NAVs, but there may also be incentives for a fund to game NAVs when to-date performance has been well above peers.

Empirically, this peer-chasing would appear as mean-reversion in reported performance. As a first pass at identifying peer-chasing, we compare transition probabilities across performance terciles conditional on to-date performance. Specifically, for each fund-quarter we compute the 4-quarter ahead reported returns by performance tercile (as measured by IRR to date) for funds of similar vintage year.[16] We repeat the calculation for different fund-life periods, specifically, 8 to 15 quarters since inception (denoted as ˜3yrs), 16 to 23 quarters since inception (˜5yrs), and 24 or more quarters (>7yrs). Given the strong dependence of 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 indeed present in the unobservable true return generating process. To address this question we also construct placebo return series for each fund in our dataset as a sum of style-matched public equity portfolio returns and a random innovation. 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.[17] Once the weights are selected, they remain fixed over the fund life-time while the placebo returns correspond to the actual fund operation periods. We assume that, although unknown, the return generating process is the same for private and public equities, up to a constant and an unpredictable error. Hence, if private equity funds were to simply mark their holdings to some fixed set of public equities, fund transitions across performance percentiles on short horizons must be similar to those of the public equities being referenced. Essentially, this placebo comparison can be thought of as deriving from a Monte-Carlo simulation where we draw factor-returns from a sample of actual paths rather than taking a stand on the underlying data generating process explicitly. An advantage of this approach is that it retains the cross-sectional heterogeneity in the actual time-series of public equity returns (including any anomalies).

[15] For example, CALPERS has such a policy.

[16] +/- one year from the vintage year of the focus fund. Please refer to Appendix for details.

[17] To better match the placebo series to the underlying fund assets, we utilize just the below-median size portfolios. Then, for buyout funds we use the 25 highest book-to-market portfolios and lever their returns by a factor of two. For venture funds we take actual returns of the 25 lowest Book-to-Market portfolios.

Results for these tests are reported in Figure 5 for buyout funds and Figure 6 for venture funds. In each figure, actual returns are reported in Panel A while placebo returns are in 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 that are not present in public placebo portfolios. For example, in Panel A of Figure 5, a buyout fund that is in the top to-date tercile after 3 years is much more likely to be in the bottom tercile of performers over the next year. This effect persists but is weaker for to-date performance at the 5-year horizon. At the $>$7-year horizon the effect disappears. Similarly, for the 3-year horizons, buyout and venture funds in the bottom tercile to-date are much less likely to remain in the bottom tercile over the next year. For both buyout and venture funds, the reversal patterns are not present at longer horizons for bottom tercile funds. This suggests that the peer-chasing effect fades as reported returns increasingly reflect actual cash flows rather than subjective NAV assessments. The placebo returns generated from public portfolios (shown in Panel B of each figure) indicate that comparable public market returns exhibit no meaningful return-reversal patterns.

The evidence in this section reveals interesting, and economically significant, patterns in reported NAVs. These patterns appear related to some poor performing funds manipulating returns around fundraising as well as more widespread evidence of peer-chasing. The findings are not generally consistent with fundraising success driven by NAV manipulation or even good luck experienced by funds in their early years. If these hypotheses were true, we might expect that excess returns would be lower (or negative) after early fundraising events. Instead positive excess returns appear to persist for funds that are early to raise a next fund. Moreover, since luck is unpredictable, we would not expect a tougher fundraising environment (as measured by low market returns), to be associated with a larger change in excess returns. Thus, it appears that a decline in excess returns following a few lucky years cannot account for the shift in excess returns around follow-on fund launches observed in Figures 1-3. However, the analysis thus far is incomplete in so far as we have not attempted to examine how fund timing and peer-chasing interact nor have we provided a full assessment of the statistical significance of these results. In the next section, we examine peer-chasing and fund-timing simultaneously in settings that allow for better inference.

V. A Comprehensive Look and Causality

Given the variety of factors that may affect NAV, focusing on just cross-sectional mean changes for excess returns is limiting in many regards. Ideally, we would like to understand how excess returns covary with explanatory variables in a multivariate setting. However, the unobservable nature of an NAV bias makes this a potentially tricky problem. 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 about it using fund-level reported returns rather than portfolio individual holdings. We say that the NAV-bias is a ratio of reported NAV to an unbiased assessment. By construction this ratio will have a value greater than zero and equal to one at inception and resolution—times when there is no possibility of bias because valuations are determined only by cash flows.[18] It is natural to model this bias in terms of change from the previous period. Starting from a valuation identity, a change in bias over a period can be written as:

$$\Delta bias_t = \log(NAV_t) - \log(NAV_{t-1} \times FactorRet_t - K_{t-1} \times CF_t) - \log(IdRet_t), \tag{3}$$

where $IdRet_t$ and $FactorRet_t$ are, respectively, idiosyncratic and priced risk-factor gross returns, both are unpredictable with the $t-1$ information set; CF_t represents net distributions to fund investors over that period and K_{t-1} is defined as $BiasLevel_{t-1}/IdRet_t$.[19] An Appendix provides further details.

Neither $FactorRet_t$ nor K_{t-1} are observable, so we must replace them with their estimators.[20] Note that whether $\hat{K_{t-1}}$ is consistent or not, we cannot identify the effect that cash flows have on the change in bias because the measurement error on the resulting proxy for $\Delta bias_t$ will be correlated with concurrent net distributions. The error due to $FactorRet_t$ mismeasurement does not cause similar problems because it is presumably unpredictable as of t-1 (e.g., by rational expectations arguments). However, the expectation of $IdRet_t$ and this additional error are likely correlated with variables, X_{it}, that are good candidates for explaining the bias so we should not rely on pooled OLS or random-effects panel models. A fixed-effects model is not a safe choice either since interesting candidates for X_{it} almost certainly correlate with fund to-date returns which are a function of $IdRet_\tau$, $\tau = 1, \ldots, t-1$. Furthermore, slopes may be specific to

[18] So long as distributions are cash rather than other assets.

[19] $Value_t = Value_{t-1} \times GrossReturn_t - NetDistributions_t$.

[20] Even if we know the priced risk-factor, the fund loadings are unknown.

$IdRet_{1,\ldots,\tau}$ path realizations, causing t-error dependency on long lags of X. Hence, the strict exogeneity assumption required for a fixed-effects model may result in biased estimates in our case. The bias of the estimates is decreasing in panel length but still can be sizeable in the case of highly persistent regressors.[21]

A primary fix for these econometric difficulties is to use a first-difference (FD) estimator to remove fund-level unobserved heterogeneity and to control for CF_t. Besides allowing for the error dependency on leads of explanatory variables, the use of a FD estimator also provides us with power against specific alternatives for fund-timing and peer-chasing effects. The identifying assumption is that any real changes to a fund's return generating process do not happen in a short interval (e.g., one quarter) whereas manipulated changes to NAV resulting in a change in the bias do.

As discussed in the previous section, absent any valuation biases, the abnormal performance trend may nonetheless deteriorate after a follow-on fund launches because of a lack of manager attention, changes in asset composition, etc. Pooled OLS and conventional fixed effect models will disregard such changes in intercepts during funds lives and falsely relate them to X. Provided that these "real" trend changes are gradual, subtracting the previous quarter observation per fund (rather than the life-time mean) will yield slope estimates that are more robust to such drifts in unobserved effects. Thus, estimated coefficients for explanatory variables would better measure marginal effects on NAV-bias changes.

There is still a potential concern regarding endogenous variables so long as parts of X_{it} depend on $t-1$ period returns. Therefore, we instrument ΔX_{it} with two lagged levels, X_{it-1} and X_{it-2}.[22] Provided that the process for X is persistent and carries information about unobserved heterogeneity among funds and true asset returns are unpredictable, lagged levels are valid instruments for the difference.[23] We do not include more lags for a few reasons. First, the interpretation of loadings may change as lag depth progresses. Second, we want to remain vigilant about possible deep-lag dependency.

Our preferred specification then estimates β via a two-step panel GMM with an optimal weighting matrix, robust to heteroscedasticity and autocorrelation, and instruments $Z_{ti} = (X_{it-1}\, X_{it-2}\, \Delta Controls_{it})$ from the following model:

$$\Delta y_{it} = \Delta X_{it}'\beta + \Delta Controls_{it} + \Delta e_{it}\,.$$

[21] See, for example, Wooldridge (2002).

[22] We follow Wooldridge (2002) with this treatment of sequentially exogenous models.

[23] For consistency of FD we need $E\left[X_t e_{t-1}\right] = 0$, $E\left[X_t e_{t+1}\right] = 0$ and $E\left[X_t e_t\right] = 0$ as per $E\left[\Delta X_t \Delta e_t\right] = 0$.

A. Variable Proxies and Enhanced Placebo Series

We keep making use of the placebo returns series obtained from style-matched Fama-French public equity portfolios to verify that the coefficient estimates are unrelated to market return predictability on a quarterly horizon. We also construct a placebo dependent variable that allows us to verify that the way we soak-up variations due to cash flows is not inducing spurious correlations with the variables of interest.

We obtain a proxy for the change in bias, $BiasPxy_t$, from equation (3) assuming K_t and $IdRet_t$ are equal to 1 while $FactorRet_t$ is the value-weighted CRSP equity index return for all funds. Substituting $(NAV_t + CF_t)/R_t^{placebo}$ for NAV_{t-1} in equation (3) while keeping $K_t = 1$, yields the following placebo counterpart for $BiasPxy_t$

$$BiasPlacebo_t = \log(R_t^{placebo}) - \log\left(R_t^{CRSP} + (R_t^{CRSP} - R_t^{placebo})\frac{CF_t}{NAV_t}\right). \quad (4)$$

In essence, $BiasPxy_t$ is just (market and cash flow) adjusted NAV growth between $t-1$ and t, and we refer to it subsequently as *adjusted excess return*. Correspondingly, $BiasPlacebo_t$ is the excess return of placebo portfolios that are constructed to be correlated with respective fund cash flows in a way similar to $BiasPxy_t$. If controlling for cash flows nonetheless results in spurious correlations of residuals, $BiasPxy$ and X, then we should observe similar spurious correlations with $BiasPlacebo$ and X. Similarly, if R^{CRSP} or idiosyncratic returns are correlated with lags of X, this will also be the case for $BiasPlacebo$. In other words, these placebo-regressions will indicate the direction and magnitude of the econometric bias in the estimates arising from unaddressed omitted variable problems as well as an invalid sequential exogeneity claim (e.g., from the economic restriction put on the short-term asset return-generating process). We report those results in the Appendix and discuss in the robustness section.

Our two primary variables of interest are $FundTiming$ and $PeerChasing$. $FundTiming$ is defined as the natural log of one plus the number of years after the second year of a fund's life spent without a follow-on fund. It is a proxy for a growing incentive to boost NAV as a firm proceeds through the timeline for raising a follow-on fund.[24]

[24] We do not observe dates when funds get enough commitments from investors to stop the marketing campaign. Instead, we rely on the first cash flow date of a fund to indicate the start of the investment period. Of course, the interval between those dates can vary across funds.

FundTiming represents a simple way to capture the non-linearity in motivation to engage in NAV gaming given a fund's limited life-span. By construction, the incremental change in *FundTiming* will be smaller for each subsequent quarter without a fund. A drawback of this variable is the potential for a "blind spot" with respect to early/frequent fundraisers that may nonetheless inflate NAVs early and aggressively and experience steep drops in reported returns towards the end of their funds' lives.

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 before (i.e., as we did for Figures 4 and 5) to consist of other funds of the same strategy and adjacent vintage years (including already resolved funds) as of the previous quarter. We also construct a *PeerChasing* series from placebo returns since the respective funds inception.

PeerChasing captures how a fund performs relative to its peers based on knowledge available in the current period (i.e., a fund cannot know how it compares to its peers until the next quarter). Under the null of unbiased i.i.d. NAV changes, de-trended returns should not correlate with their own lags. Additional details on the construction of both variables are presented in the Appendix.

Since we want to focus on NAV reports that can be plausibly manipulated and yet 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. Further, to reduce the impact of outliers and remain realistic about the extent 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. This approximately corresponds to censoring observations with regards to *PeerChasing* at 5% from each side for Buyout funds and 5% and 10% for Venture.

B. Are Fund Timing and Peer-Chasing Necessarily Nefarious?

It is possible that reverse causality drives the relationship between upward-biased NAVs and follow-on fund launches. 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, but also experience a fall in risk-aversion causing excess optimism about their current investments portfolio "true value". In other words, GPs may make honest mistakes that induce correlation between reported returns and a new fund launch.

There is also a possibility that some GPs simply lag behind their peers in updating their portfolio valuations reports (i.e. until there is some "real need") because updating or staying current is costly. Such firms may nonetheless have to bring stale NAVs more up to-date when it is time to start marketing a new fund as the investment period and the undrawn commitments of the current one vanish. Thus, managerial style may result in mean-reversion of returns that is stronger when it has been awhile since the previous fund inception.

To address the stale reports concern, we instrument *PeerChasing* with its residual from a regression on four lags of median-IRR by peer group, allowing for fund-varying slopes. This should disregard the variation due to lack of timely updating by some funds. We address time-varying sentiment by instrumenting the *FundTiming* variable with the one identically constructed, but using predicted rather than actual follow-on fund start dates. Those predictions are only conditional on fund vintage year and whether a follow-on fund was eventually raised during the fund's life-time.

C. Results

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

(i) $BiasPxy_{it} = [FundTiming_{it}\ PeerChasing_{it}]\beta + Controls_{it} + v_{it}$

(ii) $BiasPxy_{it} = [FundTiming_{it}\ PeerChasing_{it}\ FundTiming_{it} \times PeerChasing_{it}]\gamma + Controls_{it} + u_{it}$,

The two models are estimated by three methods. The first set of estimates, labeled FD IV, come from a first-difference GMM with two lags of both dependent variables used as instruments. FD-IV2 uses *Residual PeerChasing* and *Imputed FundTiming*, constructed as described in the previous section. Finally, FE-set is obtained with a conventional fixed-effect estimator by mean-differencing of the dependent and explanatory variables. In all cases, control variables are year dummies, quarter dummies and fund concurrent cash-flows.

For buyout funds (Panel A), estimation results for model (i) indicate a positive and significant coefficient on *FundTiming* and a negative and significant coefficient on *PeerChasing* across all estimations. The corresponding results for the venture sample, as per Panel B of Table 4, show relations of similar magnitude and statistical significance with the exception of *FundTiming* in the FE-method that comes out indistinguishable from zero. These coefficients constitute a prediction of next period fund reported return up to a trend. In the case of FE, we impose the trend to be fixed over the fund's lifetime.

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 5% per year (0.17*log(2)-log(1)). The coefficient on *PeerChasing* indicates how much the average fund excess return increases next quarter if it is above the peer group median to-date-IRR by 1.0%. For example, the estimate in the first column of Table 4 of -0.316 for buyout funds suggests a reversion of about 30%.

In model (ii), we examine the interaction between fund timing and peer chasing. For both buyout and venture funds, the inclusion of the interaction term results in the coefficients on $FundTiming$ being somewhat smaller and less significant. However, in this case, the marginal effects of $FundTiming$ are for when *PeerChasing* equals zero whereas in model (i) the effects are implicitly evaluated at a mean level of other variables. The coefficient *PeerChasing* becomes insignificant or switches sign, suggesting that when $FundTimingVariable$ is zero (up to a trend) there is no reversion in returns.

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. In the robustness section below we verify that this interaction term is unlikely to be spuriously significant. Because the effect is stronger when incentives are large, this finding is consistent with NAV manipulation rather than alternative explanations. However, for the interaction term we cannot rule out the alternative hypotheses of stale NAVs or over-optimism by fund managers. According to FD IV2, this term is similar in magnitude for buyout funds but not statistically significant and essentially zero for venture funds.

From Table 4, we conclude that the fixed-effects estimator biases the coefficients of interest towards zero. We nonetheless chose it as the method to estimate the cross-sectional effects of peer-chasing and fund timing as the instruments are not strong enough to identify the dummy interaction terms. [25]

[25] This part is still a work in progress.

D. Cross-sectional differences

We now further investigate how cross-sectional differences affect fund timing and peer-chasing. We extend model (i) by including the interactions of $FundTiming_{it}$ and $PeerChasing_{it}$ with the following dummy variables:

- $Rookie_i$, 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.

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. $Rookie_i$ is a time-invariant characteristic for a given fund so only its interaction terms are present in the model.

Table 5 reports three specifications for buyout and venture funds. Specification (1) examines the *Rookie* effect, (2) examines the $TopTercile$ effect, and (3) includes all effects (thus the base case is middle tercile funds with two or more previous funds from the same firm). We first consider the results from specification (1) for buyout venture funds. We note that the effects related to fund timing and peer-chasing are similar to those in Table 4. 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 large negative coefficients on the interaction between fund timing and top tercile indicate that these high performing funds actually have lower adjusted excess returns during their fundraising periods than other funds. The coefficient on the interaction between peer-chasing and top tercile suggests that the top performers exhibit on average the same extent of peer-chasing as funds with a medium performance to-date. Although the sum of coefficients involving $FundTiming$ is not different from zero, negative combined loading on *PeerChasing* suggests that these top performing funds report conservative NAVs during the 6^{th} to 28^{th} quarters of their lives.

In specification (3), we focus even more closely on the evidence for fund timing. For venture funds, the large positive coefficients for the interaction between bottom performance tercile and fund timing (combined with the insignificant coefficient on peer-chasing) shows that only bottom performers are fund-timing. For buyout funds, we continue to find some evidence of fund timing for middle (base case) but it is considerably stronger in the bottom tercile funds as evidenced by the interaction with *FundTiming* variable. The coefficients on the interaction between peer chasing and bottom tercile show that poor performing funds do seem to peer- chase more than middle tercile funds (both buyout and venture).

E. Are LPs Aware?

The existence of follow-on funds is a testament to the trust LPs have in GPs. We now examine this issue directly by looking at the determinants of follow-on fund existence and size. We examine a probit model estimation where the dependent variable equals one if we observe a follow-on fund and zero otherwise. We consider the following explanatory variables:

- $\Delta LogPME$ is the difference between log of fund PME at resolution and PME at the event time, as defined in Section III.A,
- *NegPost* equals 1 if $\Delta LogPME$ is negative and zero otherwise,
- *TopTercile* equals 1 if fund is in the top (highest) IRR-tercile at the event time and zero otherwise, and
- *BtmTercile*, equals 1 if is in the bottom (lowest) IRR-tercile at the event time and zero otherwise

Table 6 reports the results of this analysis. The findings for specification (1) indicate that a negative change in PME from the event date is negatively associated with the probability of raising a follow-on fund for both buyout and venture funds. Specification (2) suggests that the magnitude of the post-fundraising performance change is positively albeit not significantly related to the probability of successful fund raising. Specification (3) suggests that the sign of post-fundraising performance change is important even after controlling for fund to-date performance information in addition to fund vintage year and industry fixed effects.

We interpret these results as evidence that LPs scrutinize GPs and are not systematically mislead by their over-optimism, nefarious or not. Since GP reporting assessments have some bearing on LPs decisions, GPs may seek to be conservative with their unrealized investment valuations to an extent their true performance permits.

VI. Other Tests and Robustness

A. Alternative Explanations for Trends in Abnormal Returns

We want to be careful to understand possible alternative explanations for these results. One alternative hypothesis consistent with the stylized facts presented above is that investors hold priors about managers' abilities and reporting accuracy. Coupled with heterogeneity in fund excess returns, this would cause the less credible managers to have to realize their best investments first and spend more effort marketing a follow-on fund, particularly when investment capital is scarce. Similarly, a GP may face operating capacity constraints. If fundraising efforts distract from value-added portfolio management then we might expect deterioration in subsequent performance to increase in the extent of that distraction. This effect might be stronger for smaller firms with few employees. It is also possible that firms allocate their best investments to newly raised funds at some expense of their older funds for reasons that existing and prospective investors are supportive of (or at least aware of). For example, a fund may need a sufficient investment horizon or adequate capital available to maximize return potential.

Another possible complication for our analysis is the possibility of self-correcting valuation errors. Since NAVs are estimated with error and eventually this error must decay there is a natural self-correcting mechanism in asset valuation that could be confused with fund timing or peer chasing. Our preferred specification in first-differences addresses much of this concern and we are careful in our interpretation of the results because of this possibility. However, in additional tests, we conduct tests for self-correcting valuation error in the main specification by controlling for the difference between the current PME and the final PME. Thus, any long-run bias in value that must be undone is accounted for. This correction does not affect the interpretation of our results.

B. Placebo Cross-Section

We also examine a set of specifications similar to those in Table 5 but use *BiasPlacebo* as the dependent variable and other variables computed using the placebo returns to-date. Essentially, we estimate how style-matched public equity returns associate with:

1. their lagged means relative to those of random subsets of style-matched portfolios (*PeerChasing*), sorted into terciles by absolute mean returns (via *TopTercile* and *BtmTercile* dummies and the interactions), with the windows over which those means are computed corresponding to since-inception periods of the *actual* funds;

2. the *actual* calendar time patterns in subsequent funds starts versus current (via *FundTiming*);

3. the *actual* calendar time periods that funds with less than three predecessors were operating in (via *Rookie* dummy interactions).

The results reveal a small positive relation for *FundTiming* suggesting that the null hypothesis may not be an effect exactly equal to zero. However, this result suggests even weaker effects for funds (in most cases) than those we document. We observe no evidence of peer-chasing in the baseline and no interaction effects with the exemption of younger venture firms (where we found nothing with real fund returns).

C. 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. Because of the timing of FAS 157 adoption, the implementation 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 complicates the analysis.

We undertake two simple tests in an attempt to identify effects that might be attributable to accounting changes related to SFAS 157. First, Figure 6 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:

$$NAV\,ret_{it} = \mu_1 + \mu_2 \cdot fas157_t + \rho_1 \cdot NAV\,ret_{it-1} + \rho_2 \cdot NAV\,ret_{it-1} \cdot fas157_t + \nu_{i,t}$$

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 coefficient for ρ_2 and the sum of ρ_1 and ρ_2 being insignificantly different from zero. Table 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 ρ_1. However, for venture funds values for ρ_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.

In subsequent drafts we hope to provide evidence of whether *FundTiming* and *PeerChasing* intensities have changed post-2008 and construct a control group to better address a possibility of varying autocorrelation of reported returns during fund lives.

D. Other Tests

We undertake some additional tests to gain further insight into our results. For brevity we do not table these results. As noted previously, Jenkinson, et al. (2013) examine similar issues and find evidence consistent with wide-spread NAV manipulation in a set of CALPERS funds. This raises the question of why our results differ from their findings. While the sample used in their analysis includes different funds over a different time period, we do not think that this accounts for the main differences in our findings. Instead, the differences derive from methodology. Jenkinson, et al. estimate regressions with fund changes in NAV as the dependent variable and market returns, dummy variables for periods relative to fundraising, and other controls as independent variables. Jenkinson, et al. interpret the pattern of positive coefficients on dummy variables prior to fundraising followed by negative coefficients on dummy variables after fundraising as evidence of NAV run-ups and reversals. However, it appears that their results are due to insufficient risk adjustment of NAVs combined with the positive correlation between fundraising and market returns. Specifically, the authors estimate market exposures (i.e. betas) on the order of 0.3 which is very low. This result may be due to the smoothed nature of reported NAVs which would lead to an underestimate of risk in their regression framework. Because fundraising is more successful during times when market returns are high and less successful when market returns are low, the understatement of risk generates a spurious pattern of positive dummy-variable coefficients prior to fundraising and negative dummy-variable coefficients after fundraising. In fact, we are able to replicate their findings using our dataset of funds from Burgiss and the placebo portfolios for both buyout and venture funds. In addition, if we instead use their method but define the dependent variable as changes in PMEs, we find some significant excess returns in quarters prior to fundraising, but no consistent evidence of reversals.[26] In effect, we observe coefficients on the time dummy variables that are consistent with the excess return patterns plotted in Figure 1.

We have also conducted tests where we relax the parametric assumptions imposed on the relationship between lagged to-date performance and next-period reported returns. We estimate local polynomial regressions of $BiasPxy_{it}$ and $BiasPlacebo_{it}$ on $PeerChasing_{it-1}$ and $PeerChasing_{it-2}$ constructed from actual and placebo returns. For the actual series, both variables are residuals from regressions on cash flows and a constant (estimated separately for each fund). The results are plotted in the Appendix (Figure C.2). We find a negative association between returns and peer-chasing when returns are close to zero (Panel A). However, far from zero, the relationship is unstable and not different from zero. This suggests that peer-chasing is only important within a certain range where it might be credible. The results are quite different from the

[26] Specifically, we find a mix of insignificant and significant positive and negative coefficients with a net effect near zero.

largely flat relations for the placebo return series (plotted in Panel B).

For some funds there are quarterly return estimates that are quite large in magnitude and we also include some funds with investments outside the U.S. To make sure these large returns are not driving our results we drop all funds that exhibit reversion in reported returns of more than 50% over the course of six consecutive quarters and also drop funds with global investments to ensure that our U.S. benchmark is appropriate. Results using this much more restrictive sample are qualitatively similar to those presented here in the main text. We have also conducted a series tests using alternative specifications for much of our analysis. For example, we examine portfolio returns based on quartiles instead of terciles for our analysis in Figure 4 and Table 2. These results are reported in Appendix C. While the quartile results are more common in industry analysis, they are harder to interpret for our tests because there will be multiple groups (either higher or lower) to transition to from the middle groups. However, in all cases the results are qualitatively very similar to those presented in the main text tables and figures.

VII. Conclusion

We investigate whether there is evidence that private equity firms manipulate their NAV reports to investors. We find that some reported returns are abnormally high during periods when firms are likely to be marketing their new funds to prospective investors. We show that it is unlikely to be driven by reverse causality, such as manager-specific time-varying optimism about the investment opportunity set. However, this fund timing pattern appears limited to the subset of underperforming funds. Moreover, it does not go unnoticed by the investors as firms reporting run-ups and reversals typically fail to raise a follow-on fund.

We also find that during periods when NAVs comprise a large fraction of reported to-date performance, most private equity fund managers exhibit abnormal reversion to the median to-date returns of their peer funds. Such peer-chasing for top-performing firms is consistent with an "underpricing equilibrium" that emerges as a response to asymmetric information problem present between fund managers (GPs) and their investors (LPs). LPs appear to punish GPs for what looks like dishonest interim reporting in the midst of the GPs' next fundraising by not providing capital to subsequent funds. Correspondingly, top performing GPs try to safeguard their long-term reputation from a "bad luck" event in later stages of fund lives by reporting conservative NAVs, particularly when it does not jeopardize their high relative performance rank.

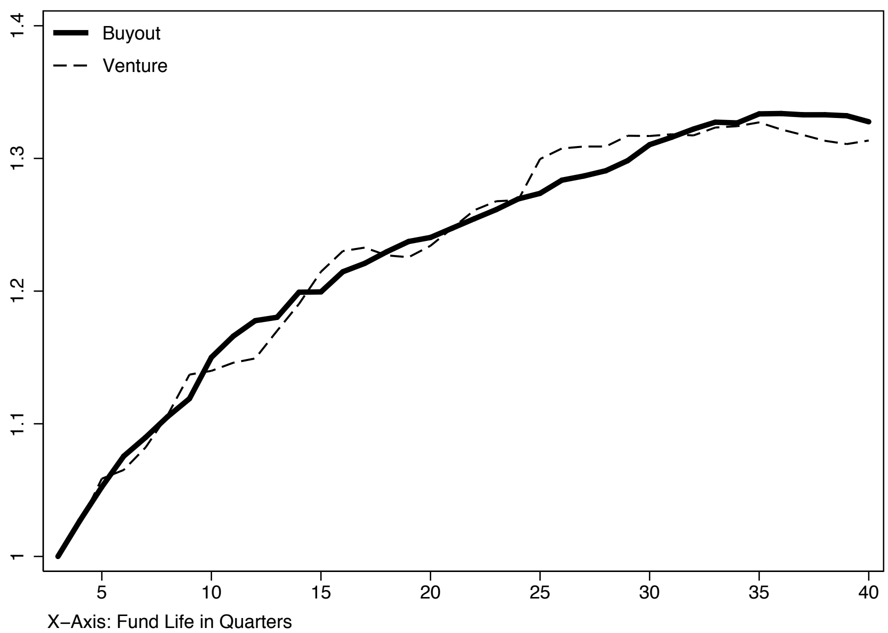
For underperforming GPs, these long-term reputational concerns appear to be dominated by a short-term survival requirement to raise a next fund. Therefore, they are incentivized to boost to-date results to the extent the gap is not too large.

There are some limitations to our analysis. Because our data are sourced from institutional investors, it is possible that NAV manipulation is different for funds in which institutional investors choose not to invest. In addition, if a small amount of NAV manipulation has an important effect on LP's investment decisions, our tests may not be able to detect the true influence of managers' actions. Because our analysis relies on observing return patterns between the 2nd and 7th year of a fund's life, we might not detect manipulation if it is confined to shorter periods and reverses quickly (or to a small subset of funds only). Finally, if manipulation is negatively correlated with market-wide time-variation in risk premiums we may understate the magnitude of the effects we measure.

Figure 1: Average Fund Performance

This figure reports cumulative adjusted NAV-weighted excess returns of private equity funds over the public market index: Panel A plots values since inception and Panel B plots values since twelve quarters preceding the follow-on funds first capital call. A change in a given quarter is a mean PME-to-date change from the previous period across a subset of funds multiplied by their average ratio of NAV over market-adjusted capital-to-date. Appendix A shows that this is equal to a weighted-average Excess return. We define subsets of funds in the legends of respective subfigures. In case there were no follow-on funds for this firm-fund in our sample (*No Next*), the Event quarter is the 13^{th} quarter preceding the funds resolution or its 10^{th} anniversary of the fund if still unresolved.

Panel A: Since Inception



Panel B: Around Fundraising

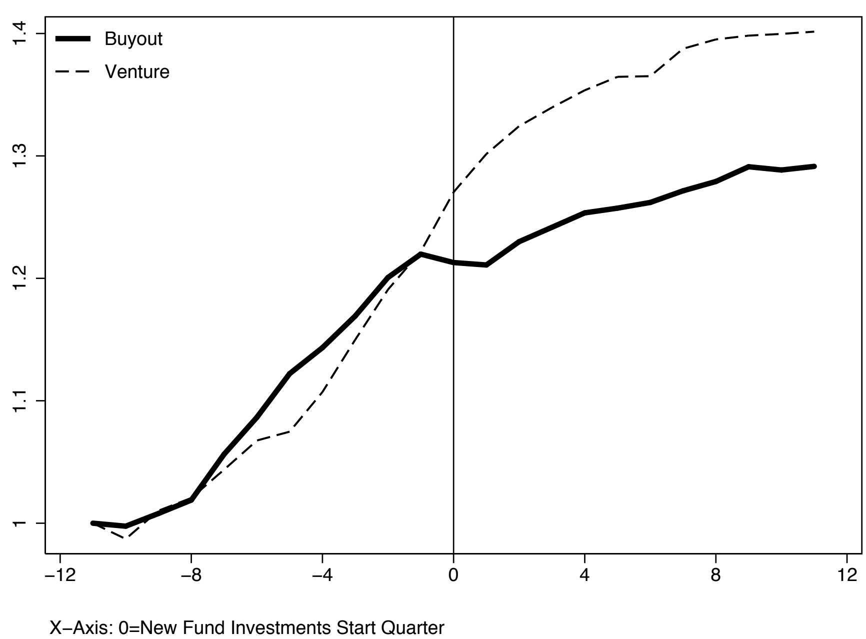
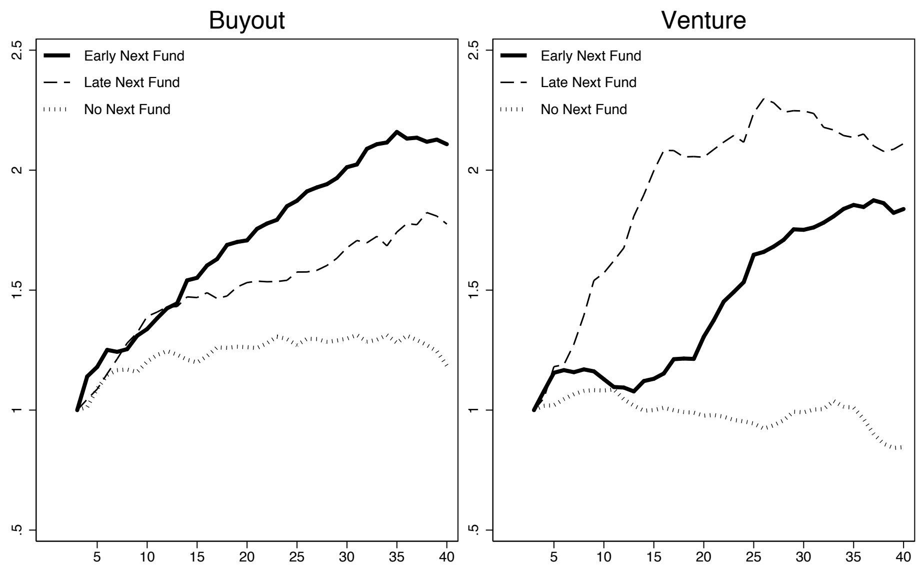


Figure 2: Average Performance Paths by Time Until Next Fund

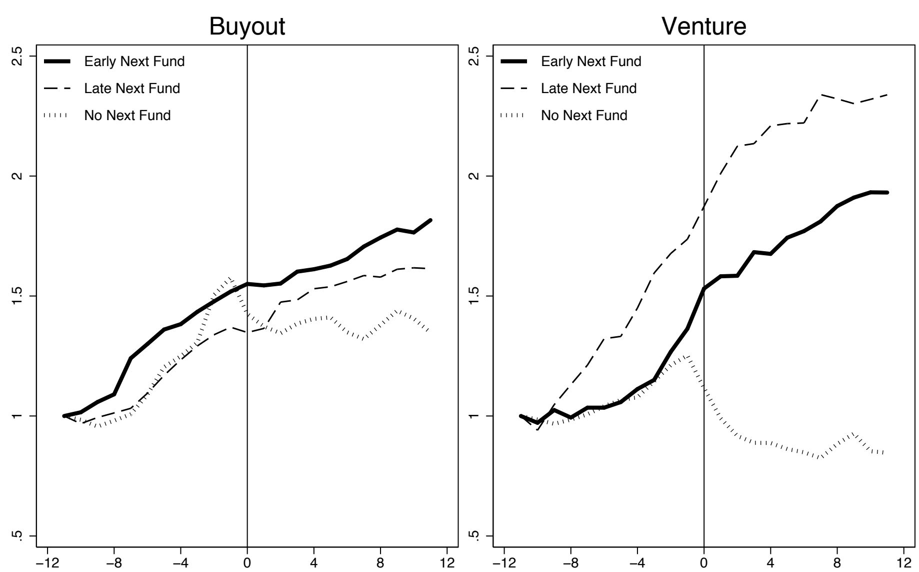
This figure reports cumulative adjusted NAV-weighted excess returns of private equity funds over the public market index: Panel A plots values since inception and Panel B plots values since twelve quarters preceding the follow-on funds first capital call. A change in a given quarter is a mean PME-to-date change from the previous period across a subset of funds multiplied by their average ratio of NAV over market-adjusted capital-to-date. Appendix A shows that this is equal to a weighted-average Excess return. The text discusses why this particular weighting scheme is good for our research question. We define subsets of funds in the legends of respective subfigures. In case there were no follow-on funds for this firm-fund in our sample (*No Next*), the Event quarter is the 13^{th} quarter preceding the funds resolution or its 10^{th} anniversary of the fund if still unresolved. *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



X−Axis: Fund Life in Quarters

Panel B: Around Fundraising

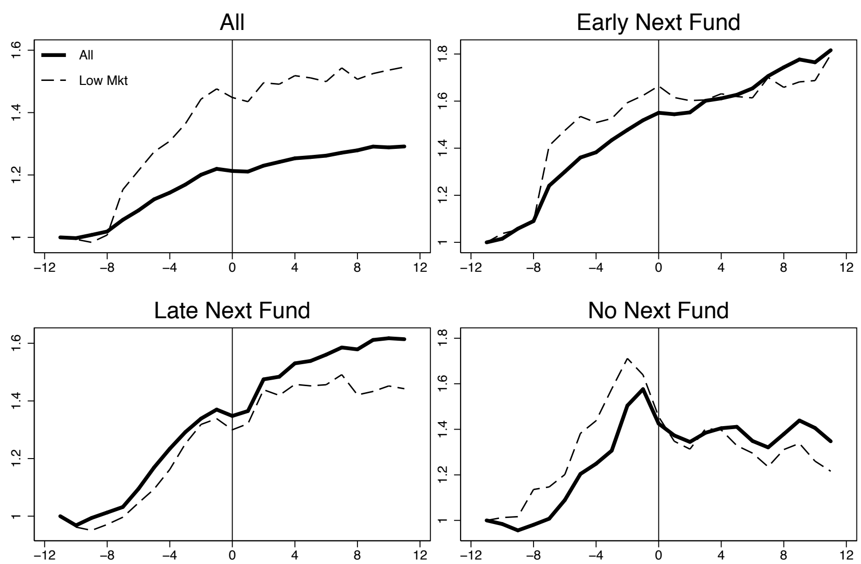


X−Axis: 0=New Fund Investments Start Quarter / (Last−12th) Quarter of life if No Next Fund

Figure 3: Average Fund Performance Path Around Fundraising

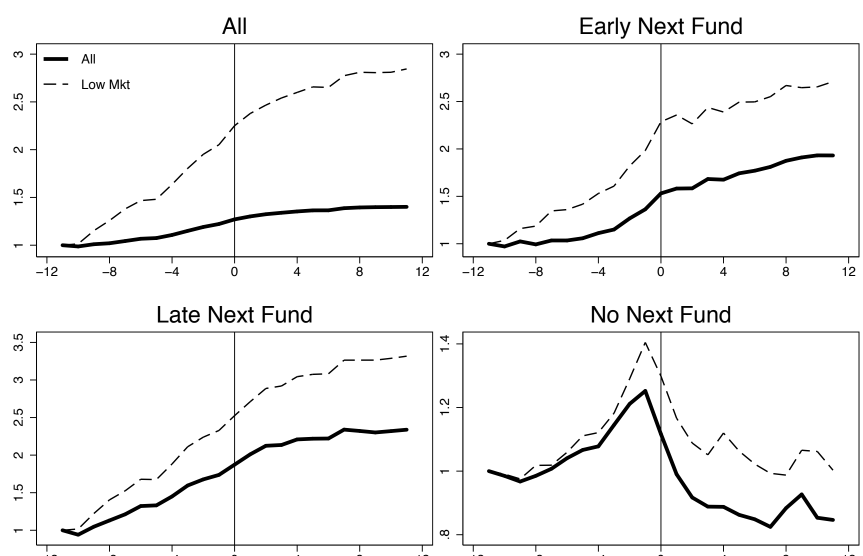
This figure reports cumulative adjusted NAV-weighted excess returns of private equity funds over the public market index: Panel A plots values since inception and Panel B plots values since twelve quarters preceding the follow-on funds first capital call. A change in a given quarter is a mean PME-to-date change from the previous period across a subset of funds multiplied by their average ratio of NAV over market-adjusted capital-to-date. Appendix A shows that this is equal to a weighted-average Excess return. The text discusses why this particular weighting scheme is good for our research question. We define subsets of funds in the legends of respective subfigures. In case there were no follow-on funds for this firm-fund in our sample (*No Next*), the Event quarter is the 13^{th} quarter preceding the funds resolution or its 10^{th} anniversary of the fund if still unresolved. *Late(Early)* denotes whether the follow-on fund was later(earlier) than the sample median across all buyout and venture funds respectively. *Low Mkt* denotes whether public markets 5-year rolling return as of the 13^{th} quarter of the fund life was below the sample median.

Panel A: Buyout



X–Axis: 0=New Fund Investments Start Quarter / (Last–12th) Quarter of life if No Next Fund

Panel B: Venture

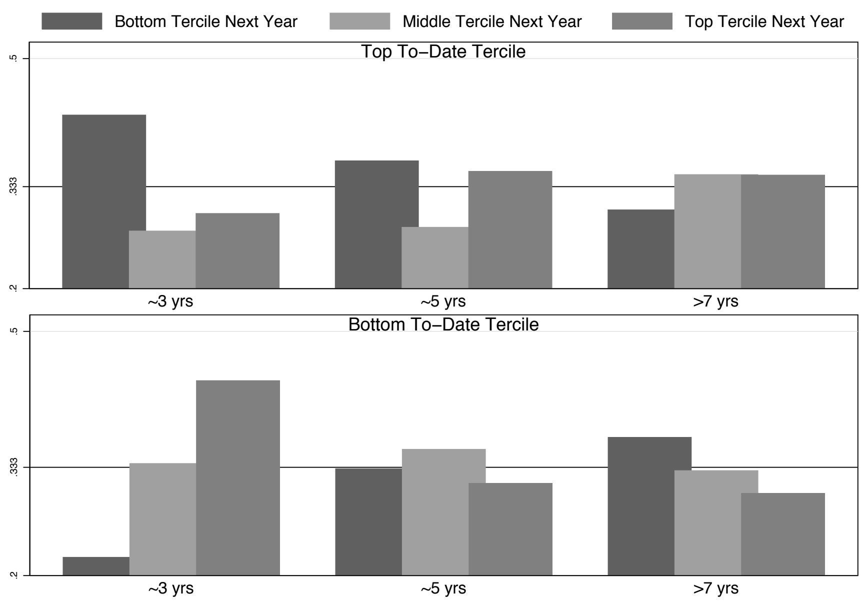


X–Axis: 0=New Fund Investments Start Quarter / (Last–12th) Quarter of life if No Next Fund

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

This figure reports the probabilities of for a buyout fund's excess returns over the next 4 quarters being in the top(bottom) tercile conditional on the funds to-date performance tercile and time elapsed since its inception. 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 15 quarters since inception (3yrs), 16 to 23 quarters since inception, and more than 23 quarters. The bottom chart of each panel reports values for the bottom tercile to-date funds. Panel A uses actual fund returns and IRRs-to-date while Panel B is a placebo experiment with public equity portfolios returns assigned to the same set of funds and to-date performance computed as the average return of that portfolio since the fund inception. Placebo returns are constructed using subsets of Fama-French 100 U.S. Equity research portfolios as described in Appendix A.

Panel A: Actual - Reported Returns



Panel B: Placebo - Public Portfolios

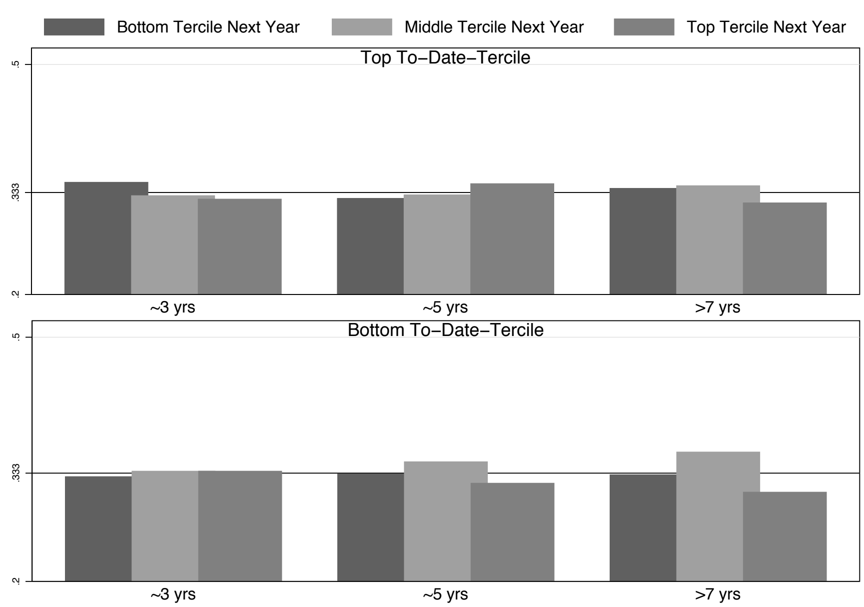
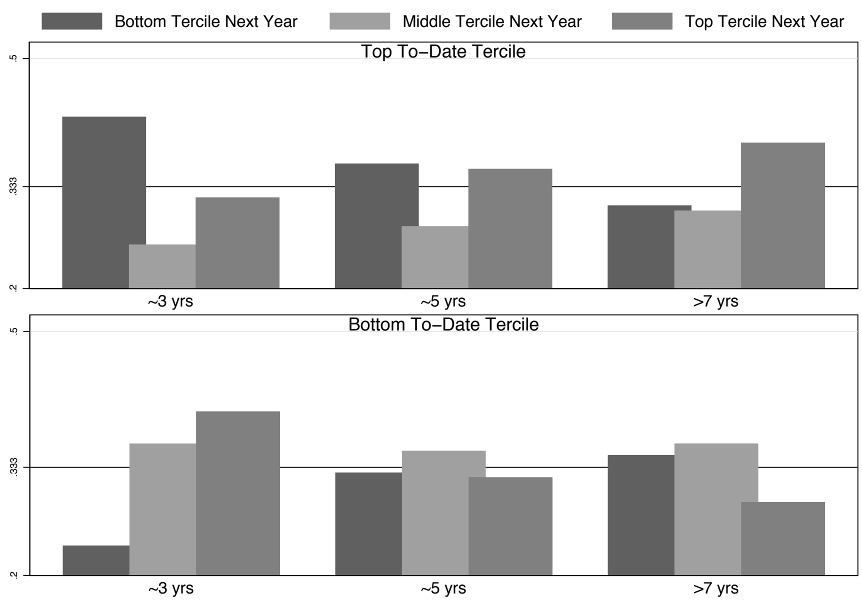


Figure 5: Next Year PME Growth Conditional on To-Date Performance: **Venture**

This figure reports the probabilities of for a venture fund's excess returns over the next 4 quarters being in the top(bottom) tercile conditional on the funds to-date performance tercile and time elapsed since its inception. 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 15 quarters since inception (3yrs), 16 to 23 quarters since inception, and more than 23 quarters. The bottom chart of each panel reports values for the bottom tercile to-date funds. Panel A uses actual fund returns and IRRs-to-date while Panel B is a placebo experiment with public equity portfolios returns assigned to the same set of funds and to-date performance computed as the average return of that portfolio since the fund inception. Placebo returns are constructed using subsets of Fama-French 100 U.S. Equity research portfolios as described in Appendix A.

Panel A: Actual - Reported Returns



Panel B: Placebo - Public Portfolios

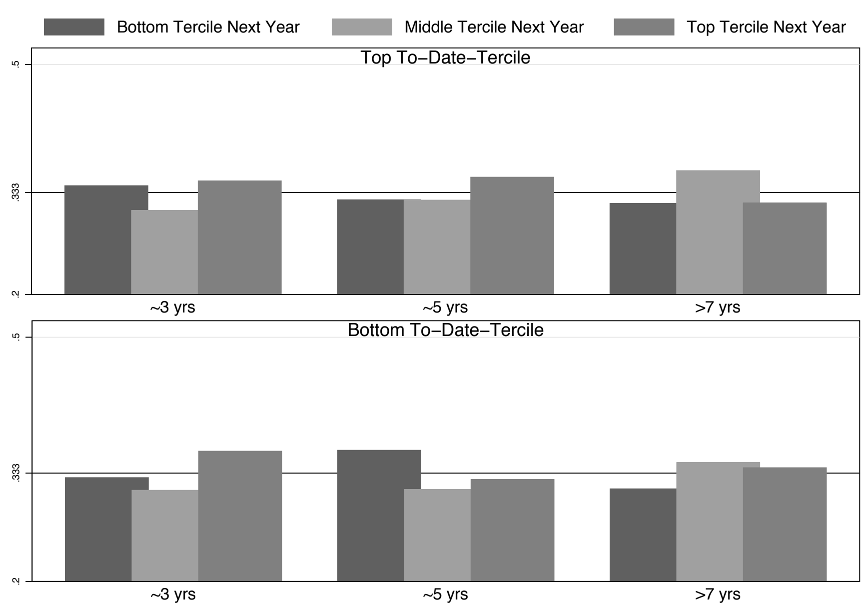
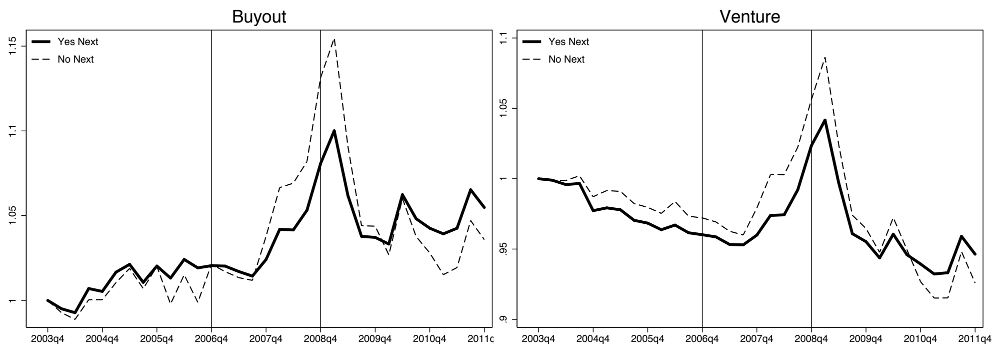


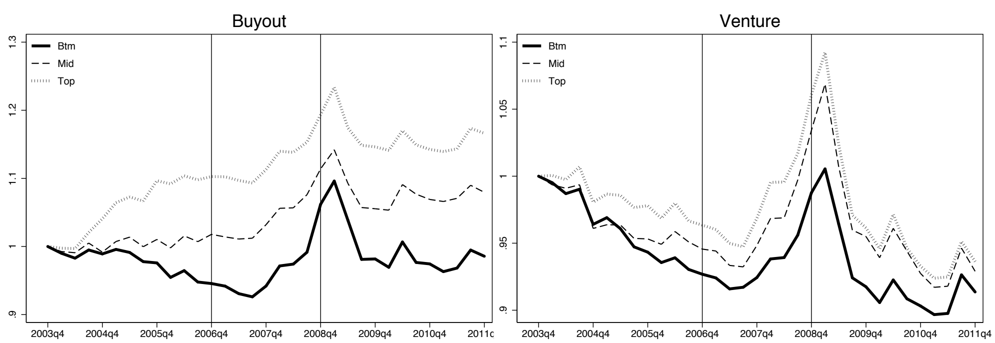
Figure 6: Median Fund Performance Over SFAS157 Adoption Period

This figure reports cumulative excess returns over a public equity index as measured by PME around SFAS157 adoption period, seperately for buyout and venture funds. Panel A additionally breaks down the funds into groups based on whether or not a follow-on fund was raised. Panel B(C) breaks the funds into groups based on perfromance 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

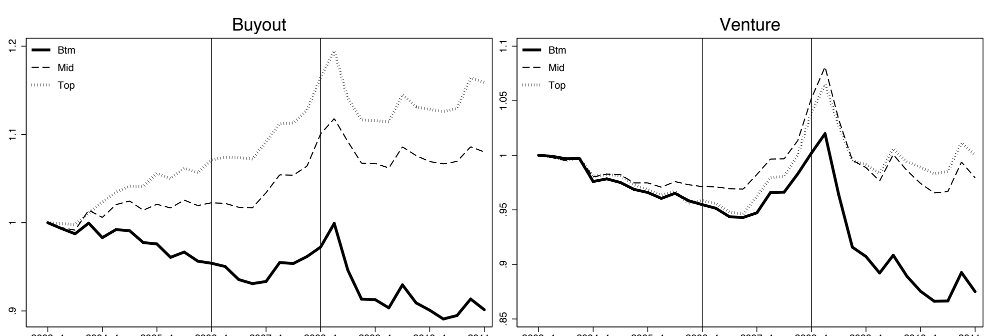


Table 1: Summary Statistics

This table reports summary statistics for the 997 buyout and 1,074 venture funds in our sample. We limit our sample to U.S.-dollar denominated buyout(venture) funds with more than $25(10) million in capital commitments. 641(910) focus on North America. 488(323) remain active (unresolved) as of March 2012. For each fund we have: (1) industry sector according to Global Industry Classification Standard; (2) amount of capital committed; (3) strategy description; (4) affiliation within firm; (5) dated amounts of cash in-flows and out-flows as well as reported Net-Asset Values (NAVs).

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
	Peer-Adjusted Size (%)	100	300	10	20	40	100	370	100	170	10	40	70	120	220
	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 IRR-to-date terciles within each fund peer group estimated separately for Buyout and Venture funds in Panel A and Panel B respectively. The first row of each panel reports the probability of being in the respective to-date tercile at the end of a funds life (*At Life End*) conditional on being in the bottom to-date tercile in the quarter preceding the follow-on fund's first capital calls (*At Fundraising*). The second(third) row reports *At Life End* tercile conditional on being in the middle(top) *At Fundraising* tercile. The last row of each panel reports the unconditional distribution of funds across *At Life End* terciles, while the last column reports how many funds were in each fundraising tercile and the respective fraction in the total fund count. The peer group is all funds of the same strategy incepted within one year from the fund vintage year. Since peer groups overlap, and follow-on fundraising at different points of life of the current funds, and funds duration varies, neither *At Fundraising* nor *At Life End* terciles need to have an equal number of funds.

Panel A: Buyout

		At Life End			
		Btm	Mid	Top	Fund Count
At Fundraising	Btm	61.19%	26.87%	11.94%	67 (18.82%)
	Mid	36.92%	42.31%	20.77%	130 (36.52%)
	Top	13.21%	25.16%	61.64%	159 (44.66%)
	All	30.90%	31.74%	37.36%	356 (100%)

Panel B: Venture

		At Life End			
		Btm	Mid	Top	Fund Count
At Fundraising	Btm	55.56%	36.75%	7.69%	117 (22.94%)
	Mid	31.84%	41.34%	26.82%	179 (35.10%)
	Top	14.49%	25.23%	60.28%	214 (41.96%)
	All	30.00%	33.53%	36.47%	510 (100%)

Table 3: Reported Excess Returns by Fund Group

This table reports the parameter estimates from a linear regression model of funds excess returns by different groups of buyout (Panel A) and venture (Panel B) funds. The dependant variable is the difference between quarterly growth of a fund NAV, net of the fund cash flows, and public market return for that quarter. The groups are based on: (1) if public markets 5-year rolling return as of the 13^{th} quarter of the fund life was above (*High*) or below (*Low*) the median for all the funds of the same type (buyout or venture) in the sample; (2) if a follow-on fund was raised later in the current funds life (*Late*) or earlier (*Early*) than the median. *Yes New* and *No New* denote if a follow-on was raised at all. *PreFund (PostFund)* is a dummy variables taking a value of one for the three years before(after) the quarter when the next fund by the same firm made its first capital call. If no such next fund exists in our database, we use the 13^{th} quarter preceding the funds resolution or its 10^{th} anniversary if still unresolved. t-statistics reported in parenthesis are based on standard errors corrected for clustering at vintage year and event year.

	All Funds	Early∩High	Early∩Low	Late∩High	Late∩Low	Yes New	No New
			Panel A: Buyout				
PreFund	0.0376***	0.042	0.0238*	0.0456***	0.027	0.0317***	0.0469**
	(3.54)	(0.91)	(1.95)	(3.27)	(0.89)	(3.60)	(2.30)
PostFund	0.0336***	0.039	0.0229**	0.0441***	0.036	0.0322***	0.0126*
	(5.83)	(1.21)	(2.17)	(5.63)	(1.14)	(5.57)	(1.89)
p-value for F-test [PreFund=PostFund]	0.641	0.872	0.909	0.899	0.409	0.943	0.044
Observations	20,856	1,905	4,855	4,948	4,090	15,843	4,718
R-squared (%)	0.34	0.17	0.15	0.65	0.10	0.24	0.40
			Panel B: Venture				
PreFund	0.0248*	−0.011	0.0221**	−0.011	0.000	0.011	0.0392*
	(1.73)	(.)	(2.49)	(−0.61)	(0.01)	(0.87)	(1.85)
PostFund	0.0217***	0.007	0.009	0.0252**	−0.026	0.012	0.0165***
	(2.98)	(0.48)	(0.77)	(2.19)	(−1.59)	(1.37)	(3.56)
p-value for F-test [PreFund=PostFund]	0.822	0.238	0.347	0.0001	0.297	0.930	0.282
Observations	33,185	3,599	6,454	6,132	6,675	23,920	8,968
R-squared (%)	0.23	0.21	0.11	0.85	0.24	0.04	0.62
			Controls in Both Panels				
Vintage FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Industry FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

Table 4: Fund Timing plus Peer-Chasing

This table reports the parameter estimates for two X_{it} specifications of a following linear regression model estimated separately for Buyout and Venture funds in Panel A and B respectively:

$$BiasPxy_{it} = X_{it}\,\beta + Controls_{i,t} + \nu_{i,t}$$

The dependant variable measures a fund adjusted return 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):*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. Specification (2) also includes the interaction of *FundTiming* and *PeerChasing* variables. *FD IV-GMM* are GMM estimations in first-differenes over t for each fund i with instuments being 2 lagged levels of X. *FD IV2-GMM* is identical but uses *Imputed FundTiming* and *Residual PeerChasing* levels as instruments, both are defined in the text. *Fund FE* are OLS estimations with fund fixed effects. Control variables include year and quarter dummies and fund-specific cash flows. t-statistics reported in parentheses are robust to heteroskedasticity and autocorrelation.

	FD IV-GMM		FD IV2-GMM		Fund FE	
	(1)	(2)	(1)	(2)	(1)	(2)
Panel A: Buyout						
FundTiming	0.170***	0.148***	0.148***	0.105	0.058***	0.034*
	(3.04)	(2.63)	(2.70)	(1.23)	(2.96)	(1.75)
PeerChasing	−0.316***	0.097	−0.283***	0.181	−0.200***	0.168***
	(−5.74)	(0.69)	(−5.49)	(0.93)	(−6.21)	(3.18)
FundTiming × PeerChasing		−0.729***		−0.540		−0.333***
		(−3.05)		(−1.61)		(−7.24)
Observations	12,003	12,003	12,003	9,100	12,064	12,064
R-squared (%)	9.89	14.60	9.57	12.50	8.07	8.63
p-value for J-test	0.142	0.541	0.019	0.005		
Panel B: Venture						
FundTiming	0.234***	0.210***	0.216***	0.189***	0.022	0.015
	(5.01)	(4.66)	(4.75)	(2.64)	(1.59)	(1.13)
PeerChasing	−0.364***	0.284***	−0.339***	−0.151	−0.152***	0.078**
	(−7.79)	(2.77)	(−7.98)	(−0.94)	(−8.25)	(2.11)
FundTiming × PeerChasing		−1.246***		−0.003		−0.211***
		(−6.55)		(−0.01)		(−6.90)
Observations	14,979	14,979	14,979	11,649	15,035	15,035
R-squared (%)	10.60	21.00	10.30	7.69	11.40	11.70
p-value for J-test	0.001	0.004	0.000	0.003		
Controls in both Panels						
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Cash Flows	Yes	Yes	Yes	Yes	Yes	Yes

Table 5: Cross-Section of To-Date Performance

This table reports the parameter estimates from three X_{it} specifications of a following linear regression model estimated separately for Buyout and Venture funds:

$$BiasPxy_{it} = X_{it}\,\beta + Controls_{i,t} + \nu_{i,t}$$

The dependant variable measures a fund adjusted return 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):*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. *Rookie*, *Top* and *Btm* are dummies denoting if the PE firm had less than two funds before i, if i was in Top(Bottom) tercile as measured by IRR-to-date as of quarter $t-1$ across the peers. Control variables include funds, year and quarter dummies and fund-specific cash flows. t-statistics reported in parentheses are robust to heteroskedasticity and autocorrelation.

	Buyout			Venture		
	(1)	(2)	(3)	(1)	(2)	(3)
FundTiming	0.065***	0.061***	0.044**	0.023*	0.026*	0.010
	(3.31)	(3.14)	(2.29)	(1.66)	(1.88)	(0.73)
PeerChasing	−0.130***	−0.173***	−0.050	−0.135***	−0.158***	−0.087**
	(−2.82)	(−4.38)	(−0.84)	(−5.92)	(−6.07)	(−2.12)
Rookie × FundTiming	−0.014		−0.017	−0.005		−0.005
	(−1.31)		(−1.59)	(−0.65)		(−0.64)
Rookie × PeerChasing	−0.139**		−0.116*	−0.049		−0.039
	(−2.16)		(−1.75)	(−1.24)		(−0.97)
TopTercile-to-Date		0.062**	0.037		0.022**	0.000
		(2.54)	(1.48)		(1.97)	(−0.02)
Top × FundTiming		−0.053***	−0.032**		−0.025***	−0.007
		(−3.68)	(−2.12)		(−3.54)	(−0.92)
Top × PeerChasing		−0.062	−0.117		0.053	0.008
		(−0.88)	(−1.45)		(1.09)	(0.15)
BtmTercile-to-Date			−0.079***			−0.066***
			(−4.12)			(−4.92)
Btm × FundTiming			0.052***			0.046***
			(4.95)			(5.75)
Btm × PeerChasing			−0.187*			−0.146**
			(−1.96)			(−2.18)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Cash Flows	Yes	Yes	Yes	Yes	Yes	Yes
Fund Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,064	12,064	12,064	15,035	15,035	15,035
R-squared (%)	8.20	8.27	8.57	11.40	11.50	11.70

Table 6: Do LPs Vote With Their Feet?

This table reports marginal effects from a Probit model with the dependant variable equal to one if a follow-on fund fund was raised (and zero otherwise). The following explanatory variables comprise three specifications estimated for buyout and venture separately: Δ *LogPME* - the difference between log of fund PME at resolution and PME at the fundrasing *event time*, as defined in the text; *NegPost* - a dummy equal to one if Δ *LogPME* is negative; *Top Tercile*(*BtmTercile*)- a dummy equal to one if the fund is in the highest(lowest) IRR-tercile at *event time*.

	Buyout			Venture		
	(1)	(2)	(3)	(1)	(2)	(3)
NegPost	-0.128^{**}		-0.0927^{*}	-0.172^{***}		-0.182^{***}
	(−2.39)		(−1.77)	(−4.27)		(−3.44)
ΔlogPME		0.362	0.145		0.209	−0.007
		(0.22)	(0.18)		(0.87)	(−0.08)
Top Tercile			0.101^{**}			0.198^{***}
			(2.03)			(4.24)
Btm Tercile			-0.109^{*}			−0.062
			(−1.90)			(−1.23)
Vintage Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	539	539	519	774	774	735
Pseudo R-squared (%)	8.14	9.82	17.00	11.50	10.70	16.20

Table 7: Autocorrelation of Reported Returns Before and After FAS157

This table reports the parameter estimates for a following linear regression model estimated separately for buyout and venture funds in Panel A and B respectively:

$$NAV\,ret_{it} = \mu_1 + \mu_2 \cdot fas157_t + \rho_1 \cdot NAV\,ret_{it-1} + \rho_2 \cdot NAV\,ret_{it-1} \cdot fas157_t + \nu_{i,t}$$

for two specifications, *Fund FE* and *Pooled*, and four subsamples. $NAV\,ret_{it}$ is fund i reported return for quarter t as measured by NAV change adjusted for net distributions during that quarter in *Pooled* while de-meaned over each fund's lifetime in *Fund FE*. $fas157_t$ is a dummy taking value of one for quarters after 2Q09 and zero otherwise. *All* includes all fund in our sample, so that the contol 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 subsample of funds that were active as of end 2006 and belong respective perfromance tercile based on reported IRR-to-Date. We drop reports for 10 quarters between 1Q07 and 2Q09 for all fund in each subsample to insure that our inference is not confounded by developments during the adoption period, 2008 crises onset and the subseqent rebound in liquid market prices. Also, we drop all reports by funds younger than 8 quarters since inception.

	Fund FE				Pooled			
	All	Btm'06	Mid'06	Top'06	All	Btm'06	Mid'06	Top'06
				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)
p-value for F-test $[\rho_1 + \rho_2 = 0]$	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)
p-value for F-test $[\rho_1 + \rho_2 = 0]$	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

Appendix

AppendixA. Key Variable Definitions

PME Change

Consider Kaplan&Schoar(2005) Public Market Equivalent index

$$PME = \frac{\sum_{t=0}^{T}(D_t)\prod_{\tau=t}^{T}R_\tau}{\sum_{t=0}^{T}C_t\prod_{\tau=t}^{T}R_\tau}, \tag{A.1}$$

where D_t and C_t are, respectively, the fund distributions and capital calls between periods t and $t-1$ while R_τ is public market gross return over period τ.

Analogously, we can compute PME-to-date Index as of any time $t*$, $0 < t* < T$ by plugging NAV value as of time $t*$ and ignoring all distributions and capital calls onwards.

$$PME_{t*} = \frac{\sum_{t=0}^{t*}(D_t + NAV_{t*})\prod_{\tau=t}^{t*}R_\tau}{\sum_{t=0}^{t*}C_t\prod_{\tau=t}^{t*}R_\tau} \tag{A.2}$$

Absent of Capital Calls during period $t*$, the change in PME-to-date from that of the previous period is a product of the abnormal fund return over the period $t*$ and the ratio of NAV_{t*-1} to $t*$-value of cumulative capital calls to date.

Denote

$$\begin{aligned} fv_{t*}(C) &\equiv \sum_{t=0}^{t*}C_t\prod_{\tau=t}^{t*}R_\tau \\ NAV_t &= NAV_{t-1}R_t^{nav} - D_t + C_t \\ PME_t^{exNav} &\equiv PME_t - \frac{NAV_t}{fv_t(C)}. \end{aligned}$$

Then

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

Therefore,

$$\Delta PME_t = (R_t^{nav} - R_t)\cdot\frac{NAV_{t-1}}{fv_t(C)}. \tag{A.3}$$

Thus, keeping the degree of excess return unchanged, it is possible to observe a leveling-out in positive performance as measured by PME-to-date or TVPI-to-date once a fund started distributions causing the ratio of $NAV_{t-1}/fv_t(C)$ to drift downwards. This should not affect the sign of the drift however since the ratio is always positive.

When analyzing a cross-section of funds, the ΔPME_t is a useful metric since it effectively represents a weighting scheme for fund returns. Multiplying average ΔPME_t by respective average of $NAV_{t-1}/fv_t(C)$ removes bias due to scale effect and obtains the average fund returns weighted by the fraction of unrealized NAVs in the market-return-adjusted sum of capital calls-to-date.

Bias Change Proxy

Denote V_t and Γ_t as the true (unbiased) asset value at the end of period t and a gross valuation bias such that $NAV_t \equiv V_t \cdot \Gamma_t$. The following identity must hold, provided that $A_t = exp\{\delta \cdot \varepsilon_t\}$ is gross abnormal return over the period, $R_{\beta,t}$ is return due to risk factor exposure β and D_t and C_t are, respectively, the fund distributions and capital calls between periods t and $t-1$:

$$V_t + D_t = V_{t-1} A_t R_{\beta,t} + C_t. \tag{A.4}$$

Assume that the gross valuation bias evolves as $\Gamma_t = \Gamma_{t-1} e^{g(\cdot)}$. Substituting this definition into A.4 yields the following NAV identity:

$$NAV_t = NAV_{t-1} A_t R_{\beta,t} e^{g(\cdot)} + \Gamma_{t-1} e^{g(\cdot)} (C_t - D_t) \tag{A.5}$$

By rational expectations arguments, under the proper risk neutral probability measure Q, $\mathtt{E}_{\mathtt{t}}^{\mathtt{Q}}[\varepsilon_{t+1}] = 0$, so as $\mathtt{E}_{\mathtt{t}}^{\mathtt{Q}}[R_{t+1}] = 0$. Hence, we obtain the following econometric model where we wish to estimate $g_i(\cdot)$ for each fund i:

$$log\left[\frac{NAV_{i,t}}{NAV_{i,t-1} R_{\beta_i,t} - \frac{\Gamma_{i,t-1}}{A_{i,t}} (D_{it} - C_{it})}\right] = g(\cdot)_{i,t} + \delta_i + \varepsilon_{i,t}. \tag{A.6}$$

Since we have relatively few observations per fund and do not know β_i and $\Gamma_{i,t-1}/A_{i,t}$, our best feasible alternative to estimating A.6 might be an average effects linear panel model:

$$BiasPxy_{it} \equiv log\left[\frac{NAV_{i,t}}{NAV_{i,t-1} R_{1,t} - 1 (D_{it} - C_{it})}\right] = \gamma' X_{i,t-1} + \delta_i + \eta_i + \varepsilon_{i,t} + \zeta_{i,t}, \tag{A.7}$$

where η_i and $\zeta_{i,t}$ are additional fund fixed effects and disturbance shocks due to the above-mentioned mismeasurement of the left-hand side of A.7 relatively to A.6. We note that the mismeasurement also constrains the set of covariates $X_{i,t}$ to not be contemporaneously correlated with market returns and fund cash flows. Therefore, to rule out spurious correlations, we lag $X_{i,t}$ and contemporaneous cash flows, D_{it} and C_{it}, normalized by NAV level in all models of $BiasPxy_{it}$ we examine since $t-$period fund cash flows may be predicatble based on the $t-1$ information set. Although, δ_i can be thought of as a fund i mean abnormal return, μ_i from **??** should not be confused with it (or with its upper/lower bounds). This is because we generally cannot sign η_i and so there is little interest in estimating μ_i. However, $\texttt{var}[\nu_{i,t}]$ can be thought of as the upper bound for a funds idiosyncratic return variance estimate since $\varepsilon_{i,t}$ is orthogonal to $\zeta_{i,t}$ by construction.

Unlike in A.6, the expression under logarithm in A.7 is not guaranteed to be positive. Therefore, to insure that we do not introduce a bias from possibly non-random omissions of observations as well as to reduce the impact of outliers, we windsorize the values under logs at the 2% level which leaves us with all arguments for the log being greater than zero in our sample. In addition, we drop the first two quarters of each funds life, fund-quarters where ending Net Asset Values represent less than 2% of capital committed, and fund-quarters where the previous available report was more than one quarter ago.

Placebo

To verify that A.7 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:

$$BiasPlacebo_{it} \equiv log\left[\frac{NAV_{it}R_{\{FF100\},t}}{NAV_{it}R_{1,t}-(R_{\{FF100\},t}-R_{1,t})(D_{ti}-C_{it})}\right]$$

where $R_{\{FF100\},t}$ is the $t-$period return of a public equity portfolio constructed as a random linear combination of a constrained universe of Fama-French 100 U.S. Equity research portfolios (henceforth, FF100). Once assigned, the portfolio remains the same across all periods for the given fund.

We arrive at the expression for $BiasPlacebo_{it}$ by substituting $NAV_{it}/R_{\{FF100\},t}$ for NAV_{it-1} in A.7 in order to obtain the growth in Net Asset Values from the previous period that would have occurred if $R_{\{FF100\},t}$ had been the return generating process. In addition, **??** allows us to test whether the cash flow dependency of the disturbance term in A.7 is sufficiently attenuated by subtraction of the linear projection of the dependent variable on the set of concurrent cash flows. Just as for $BiasPxy_{it}$, we windsorize the right-hand side of the expression for $BiasPlacebo_{it}$ at 2% level before taking the log (to guarantee the respective values are all positive for our sample).

For buyout funds we limite the FF100 to include only the 25 highest Book-to-Market portfolios out of 50 lowest Market Value portfolios and lever-up each return series by 2. For venture funds we take unlevered returns from the 25 lowest Book-to-Market portfolios out of the 50 smallest market value portfolios.

AppendixB. Monte Carlo Experiment

For our Monte Carlo experiments we assume that fund asset value changes follow:

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

where

- $r_{sdf,t} = \mu + e_{sdf,t}$;$\alpha_i = \bar{\alpha} + e_{\alpha}$; $\beta_i = \overline{\beta_{H(L)}} + e_{H(L)}$
- $\mu = 0.04\, per\, annum$; $\bar{\alpha} = 0.05\, p.a.$; $\overline{\beta_L} = 1.0$; $\overline{\beta_H} = 2.0$
- $e_{(\cdot)} \perp$ drawn from $N(0, \sigma^2_{(\cdot)})$
- $\sigma_i = \sigma_{sdf} = 0.3\, p.a.$; $\sigma_L = 0.125$; $\sigma_H = 0.1666$; $\sigma_\alpha = 0.05$

Distributions, D_{it}, and Contributions, C_t, are independent Poisson processes. The parameters of the cash flow process are calibrated according to the cross-sectional moments of actual funds cash flows:

$$D_\tau = V_\tau \varphi \eta_{d\tau}\, \texttt{if}\, \tau > \lfloor f_d \cdot T \rfloor$$
$$C_\tau = \varphi \eta_{c\tau}\, \texttt{if}\, \tau < \lfloor f_c \cdot T \rfloor,$$

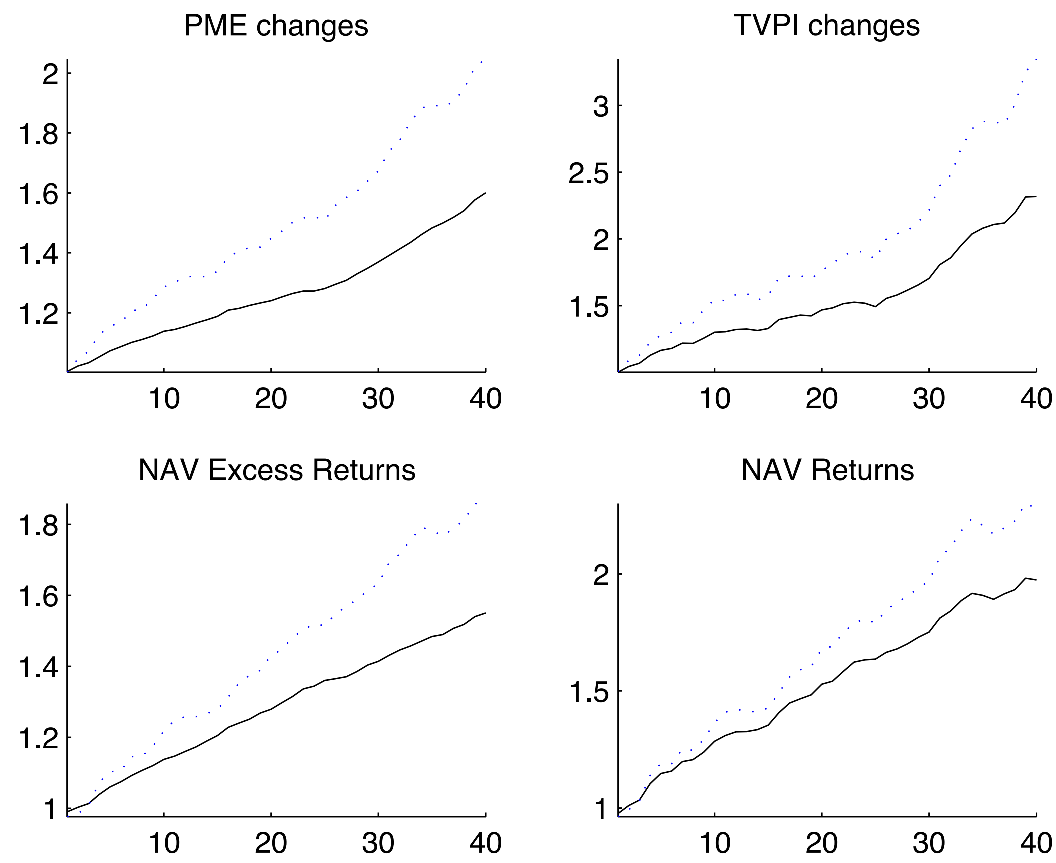
where

- $T = 300$, funds maximum life in bi-weekly intervals.
- $\perp \eta_{(\cdot)} \sim Pois(\lambda_{(\cdot)})$; $\lambda_d = 0.1$; $\lambda_c = 0.07$
- $f_c = 0.5$; $f_d = 0.3$; $\varphi = 0.2$

We draw 30 paths of market returns, $r_{sdf,t}$, 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, 40 paths of idiosyncratic returns drawn at daily frequency, and 40 paths of Distributions and Capital Call shocks drawn at bi-weekly frequency, we then construct the series of quarterly Net Asset Values and Cash Flows for each market path. Next, 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.

Figure B.1: Average Fund Performance Paths: Simulated Data

This figure reports results of the Monte Carlo Experiment described in Appendix B to suggest a null hypothesis appropriate for average fund to-date performance as measured by the proposed metric: Adjusted-Net-Asset-Value-weighted (henceforth ANAV-weighted) PME cumulative changes (top-left panel). 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 ANAV-weighted PME change in Appendix A.



AppendixC. Supplementary Figures and Tables

Table C.1: Performance Tercile Transition Probabilities: *PME*

This table reports transition probabilities between PME-to-Date terciles within each fund peer group estimated separately for buyout and venture funds in Panel A and Panel B respectively. Teh first row of each panel reports the probability of being in the respective to-date tercile at the end of a funds life (*At Life End*) conditional on being in the bottom to-date tercile in the quarter preceding the follow-on fund started its capital calls (*At Fundraising*). The second(third) row reports *Life End* conditional on being in the middle(top) *At Fundraising* tercile. The last row of each panel reports the unconditional distribution of funds across *At Life End* terciles, while the last column reports how many funds were in each fundraising tercile and the respective fraction in total fund count. The peer group is all funds of the same strategy incepted within one year from the fund vintage year. Since peer groups overlap, and follow-on fundraising at different points of life of the current funds, and fund duration varies, neither *At Fundraising* nor *At Life End* terciles need to have an equal number of funds.

Panel A: Buyout

		At Life End			
		Btm	Mid	Top	Fund Count
At Fundraising	Btm	61.19%	26.87%	11.94%	67 (18.82%)
	Mid	36.92%	42.31%	20.77%	130 (36.52%)
	Top	13.21%	25.16%	61.64%	159 (44.66%)
	All	30.90%	31.74%	37.36%	356 (100%)

Panel B: Venture

		At Life End			
		Btm	Mid	Top	Fund Count
At Fundraising	Btm	56.72%	31.34%	11.94%	67 (21.81%)
	Mid	32.00%	43.20%	24.80%	125 (35.76%)
	Top	10.43%	21.47%	68.10%	214 (42.44%)
	All	26.76%	30.99%	42.25%	355 (100%)

Table C.2: Performance Quartile Transition Probabilities: *IRR*

This table reports transition probabilities between IRR-to-Date quartiles within each fund peer group estimated separately for buyout and venture funds in Panel A and Panel B respectively. the first row of each panel reports the probability of being in the respective to-date quartile at the end of a funds life (*At Life End*) conditional on being in the bottom to-date quartile in the quarter preceding the follow-on fund started its capital calls (*At Fundraising*). The forth row reports *At Life End* conditional on being in the top (*At Fundraising* quartile. The second(third) row does so for the middle quartile that is closest to the bottom(top). The last row of each panel reports the unconditional distribution of funds across *At Life End* quartiles, while the last column reports how many funds were in each fundraising quartile and the respective fraction in total fund count. The peer group is all funds of the same strategy incepted within one year from the fund vintage year. Since peer groups overlap, and follow-on fundraising at different points of life of the current funds, and fund duration varies, neither *At Fundraising* nor *At Life End* quartiles need to have an equal number of funds.

Panel A: Buyout

		At Life End				
		Btm	3rd	2nd	Top	Fund Count
At Fundraising	Btm	55.00%	20.00%	17.50%	7.50%	40 (11.24%)
	3rd	40.66%	34.07%	16.68%	6.59%	91 (25.56%)
	2nd	16.36%	22.73%	40.00%	20.91%	110 (30.90%)
	Top	12.17%	9.57%	22.61%	55.65%	115 (32.30%)
	All	25.56%	21.07%	26.40%	26.97%	356 (100%)

Panel B: Venture

		At Life End				
		Btm	3rd	2nd	Top	Fund Count
At Fundraising	Btm	48.05%	27.27%	20.78%	3.90%	77 (15.10%)
	3rd	33.04%	36.52%	20.87%	9.57%	115 (22.55%)
	2nd	18.54%	23.84%	29.14%	28.48%	151 (29.61%)
	Top	7.19%	11.38%	23.95%	57.49%	167 (32.75%)
	All	22.55%	23.14%	24.31%	30.00%	510 (100%)

Table C.3: Cross-Section of To-Date Performance: *Placebo*

This table reports the parameter estimates for three X_{it} specifications of a following linear regression model estimated separately for buyout and venture funds:

$$BiasPlacebo_{it} = X_{it}\beta + Controls_{i,t} + \nu_{i,t} .$$

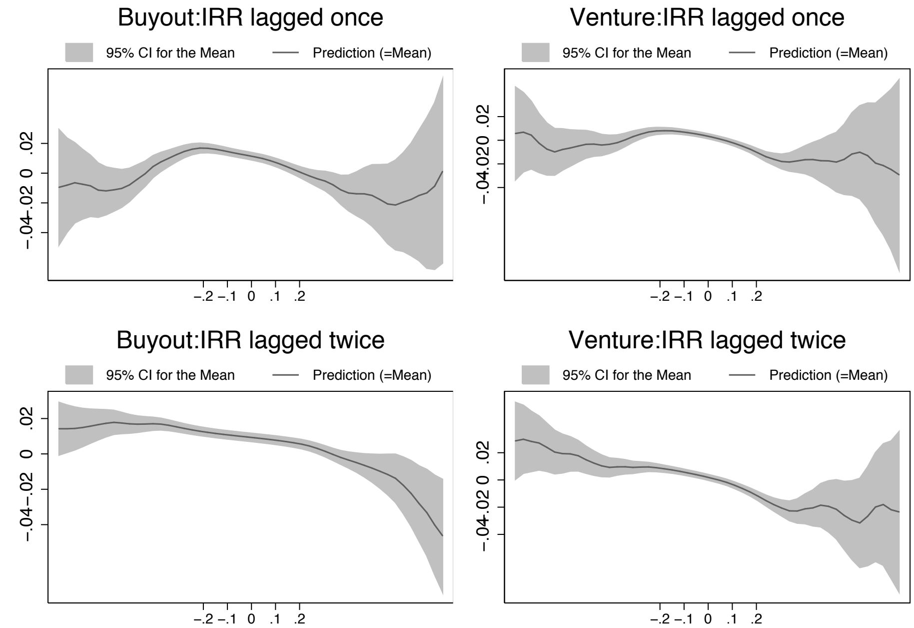
Appendix A provides details on the variables construction. The dependant variable measures a fund adjusted return for quarter t if its NAVs were tracking a same style public equity portfolio based Fama-French 100 U.S. equity portfolios. *FundTiming* is the natural log of one plus, essentially, time spent to-date without a follow-on fund in excess of two years. Specifications (1)-(3) 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. Controls include fund, year and quarter dummies and fund-specific cash flows. t-statistics reported in parentheses are robust to heteroskedasticity and autocorrelation.

	Buyout			Venture		
	(1)	(2)	(3)	(1)	(2)	(3)
FundTiming	0.022	0.021	0.025	0.006*	0.005	0.007*
	(1.46)	(1.40)	(1.49)	(1.81)	(1.36)	(1.93)
PeerChasing	0.080	0.043	0.086	0.021	−0.014	0.016
	(1.35)	(1.01)	(1.29)	(1.12)	(−0.72)	(0.66)
Rookie × FundTiming	−0.005		−0.005	−0.003*		−0.003*
	(−0.89)		(−0.84)	(−1.67)		(−1.66)
Rookie × PeerChasing	−0.041		−0.033	−0.073*		−0.071*
	(−0.54)		(−0.44)	(−1.82)		(−1.79)
TopTercile-to-Date		0.008	0.010		−0.005	−0.004
		(0.57)	(0.63)		(−1.44)	(−0.91)
Top × FundTiming		−0.006	−0.007		0.002	0.002
		(−0.67)	(−0.64)		(0.95)	(0.56)
Top × PeerChasing		0.064	0.038		0.026	0.024
		(0.97)	(0.52)		(1.01)	(0.83)
BtmTercile-to-Date			0.004			0.005
			(0.24)			(1.28)
Btm × FundTiming			−0.001			−0.002
			(−0.08)			(−0.71)
Btm × PeerChasing			−0.053			−0.001
			(−0.73)			(−0.05)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Cash Flows	Yes	Yes	Yes	Yes	Yes	Yes
Fund Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,720	8,720	8,720	11,320	11,320	11,320
R-squared (%)	16.0	16.0	16.0	20.9	20.9	21.0

Figure C.2: Peer-Chasing: Non-Parametric Evidence

This figure reports local polynomial regression fits of fund excess returns on lagged to-date IRR relatively to that of peer median 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 top and bottom row respectively. Panel B reports 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