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CYCLICALITY, PERFORMANCE MEASUREMENT, AND CASH FLOW LIQUIDITY IN PRIVATE EQUITY

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ABSTRACT

Public and private equity waves move together. Using quarterly cash-flow data for a large sample of venture capital and buyout funds from 1984-2010, we investigate the implications of this co-cyclicality for understanding private equity cash flows and performance. In the cross-section, varying the beta used to assess relative performance has a large effect on inference near a beta of zero, but only a modest effect for more reasonable beta estimates. A similar message comes through in the time series. Though funds raised in hot markets underperform in absolute terms, this underperformance is sharply reduced by a comparison to the S&P 500, and disappears entirely at the levels of beta recently estimated in the literature. These findings imply that high private equity fundraising forecasts both low private equity cash flows and low market returns, suggesting a positive correlation between private equity net cash flows and public equity valuations. Examining cash flows directly, we find that this is indeed the case. While both capital calls and distributions rise with public equity valuations, distributions are more sensitive than calls. Net cash flows are therefore procyclical and private equity funds are liquidity providers (sinks) when market valuations are high (low). Venture cash flows and performance are considerably more procyclical than buyout. Debt market conditions also have a significant impact on private equity cash flows. At the same time, most cash-flow variation is idiosyncratic across funds, and most predictable variation is explained by the age of the fund.

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I. Introduction

Private equity has emerged as a major feature of financial markets over the last thirty years, with tremendous fundraising growth since the mid-1990s. This recent period is also notable for its episodes of extreme cyclicality, including the venture capital (VC) boom and bust of the late 1990s and early 2000s, and the buyout boom and bust of the mid- and late 2000s. Private equity cycles broadly mirror those of public equity (and debt) markets. The most recent VC boom and bust coincided with the broader boom and bust of the internet era, and the buyout boom of the mid-2000s coincided with high public equity valuations and a low cost of debt, ending with the financial crisis and recession of 2007-2009.

How does the co-movement of public and private capital markets affect our understanding of private equity cash flows and returns? In this paper, we focus on two aspects of this question. First, we study how co-movement affects inferences about the relative performance of private equity, both in the cross-section and over time. Second, we investigate how macroeconomic fundamentals and overall market conditions impact the behavior of cash flows into and out of private equity funds, which in turn determine the returns that investors receive.

These questions are important for both practical and theoretical reasons. At the practical level, investors in a private equity fund are contractually obligated to provide capital to the fund when it is called (and not, in general, all at once when the investment decision is made), and in return receive distributions when the fund's investments are exited. Consequently, the impact of broader market conditions on the timing and magnitude of these calls and distributions, which in turn determines whether private equity funds are liquidity providers or sinks over the business cycle, is essential for understanding the opportunity costs and benefits of private equity investments relative to other asset classes. In addition to their practical importance, these questions contribute to a broad research stream in economics and finance that seeks to understand the covariance of returns across different asset classes, the implications of this covariance for performance measurement, and the impact of economic conditions and business cycles on asset cash flows and returns (e.g. Fama and French, 1989).

The chief obstacle hampering study of these questions has been lack of recent data on private equity cash flows. Our analysis overcomes this obstacle using a proprietary database of quarterly cash flows for 837 buyout and venture capital funds from 1984 to 2010, representing almost $600 billion in committed capital. The dataset is the first available for academic research to include cash flow information for a large sample of private equity funds raised after the pre-1995 period first studied by Kaplan and Schoar (2005).[1,2]

The data come directly from the internal accounting system of a large, anonymous limited partner, and are free from the self-reporting and survivorship biases that plague standard private equity databases (Harris, Jenkinson, and Stucke, 2010). The portfolio is also in part randomly selected, because it was assembled over time through a series of mergers occurring for reasons unrelated to each company's private equity exposure. We discuss the coverage and representativeness of the data in the next section.

We begin with an analysis of the effect of private/public equity return co-movement on performance inferences. This co-movement is measured by the beta of private equity. The nature of private equity reporting makes estimating beta a difficult task, even at the industry level, let alone the fund level. As a result, different studies have reached different conclusions.[3] Given the difficulties and lack of clear consensus, we put forth a complementary approach that asks how sensitive performance inferences are to beta. We ask the question: How do inferences about fund performance change if one believes the true beta is 1.5 rather than 1.0, or that the Nasdaq matches the fund's systematic risk better than the S&P 500?

To address these questions, we offer two extensions to the public market equivalent (PME) performance measure pioneered by Kaplan and Schoar (2005). The standard PME compares a private equity fund's performance to the S&P 500 by forming the ratio of discounted distributions to discounted calls, using the S&P return as the discount rate. As Kaplan and Schoar (2005) point out, this procedure implicitly assumes a beta of one.

Our first extension replaces the S&P benchmark return with narrower indexes more closely tailored to a fund's investment strategy. These indexes produce "tailored PMEs"

[1] The data also include the key terms of the management contract between private equity fund managers and their investors, including manager compensation and ownership. We explore issues relating to management contracts in a companion paper, Robinson and Sensoy (2011).

[2] In a new and complementary paper, Harris, Jenkinson, and Kaplan (2011) study average performance using a different large, recent sample of absolute and relative private equity returns.

[3] See Gompers and Lerner (1997), Peng (2001), Woodward and Hall (2003), Cochrane (2005), Korteweg and Sorensen (2010), Jegadeesh, Kraussl, and Pollet (2010), and Driessen, Lin, and Phalippou (2011) for estimates and discussions of the issues.

that allow beta to differ from one implicitly, through the beta of the tailored benchmark.

Our second extension explicitly introduces a beta to the PME calculation. By varying beta, we lever the S&P benchmark return used in the PME calculation, allowing us to trace out the "levered PME"-beta relation for each fund. The levered PMEs nest as special cases both the standard PME and the undiscounted ratio of distributions to calls (TVPI).

In the cross-section, we find that moving from a beta of zero (TVPI) to a beta of one (PME) has a significant impact on performance assessments. The average TVPI for buyout funds in our sample is 1.57, indicating an unadjusted return of 57% over the life of the fund, while the average buyout PME is 1.18. However, further increases in beta have strongly diminishing effects on inferences (i.e., the levered PME-beta relation is convex). In particular, performance inferences are remarkably insensitive to beta around the levels of beta estimated from prior work on private equity portfolio companies. Surprisingly, raising the beta to 1.5 (the high end of buyout beta estimates in the literature) lowers the average levered PME only slightly, to 1.12. Similarly, tailored PMEs offer essentially the same inferences as the standard PME. Venture capital funds display similar patterns. These results contrast with intuition from standard asset pricing models used to benchmark the performance of other asset classes like mutual funds, in which relative performance inferences are linear in beta. An implication of these analyses is that for many purposes, it may be less important to know the exact beta than to have a sense of its likely range.

We also apply these tools to performance in the time-series. Kaplan and Strömberg (2009), investigating buyout funds, find evidence for counter-cyclicality in fundraising and performance: the absolute performance (IRR) of buyout funds raised in boom fundraising years is significantly worse than that of funds raised in bust periods. We find the same pattern, for both buyout and venture, which squares with received wisdom among industry observers. However, as noted above, private equity fundraising booms and busts are strongly correlated with public equity booms and busts. This co-cyclicality raises the question of whether cycles in absolute private equity performance show up intact in cycles in relative performance, or instead are differenced out by differences in the returns to public equities.

When we replace absolute performance measures with the relative performance measurement implied by PMEs, we find that the underperformance of funds raised in hot markets vanishes altogether for buyout funds, and is reduced in magnitude by about two-thirds for venture funds. Tracing out the levered PME-fundraising relation, we find that the relation ceases to be reliably negative above a beta of about 0.5 for buyout funds and about 1.5 for venture funds. Both of these betas are below recent estimates of portfolio company betas in the literature (which tend to be in the range of 0.8-1.5 for buyout and 2-3 for venture). Consequently, at the levels of beta estimated by recent work on portfolio companies, there is not a negative relationship in our sample between private equity fundraising and relative performance. These results occur because times of high private equity fundraising coincide with public market booms, and presage broader market downturns.

These findings lead to the second aspect of co-cyclicality that we study, which moves beyond fund-level performance to the behavior of the cash flows that comprise returns. Our results on fundraising and performance imply that times of high fundraising activity forecast both low levels of distributions relative to capital calls and low public market returns (or discount rates). This in turn suggests that when public market valuations are low, in the midst of downturns, net cash flows (distributions minus calls) at the fund level are also low.

Examining quarterly calls, distributions, and net cash flows directly, we find that this is indeed the case. Holding fund age fixed, both capital calls and distributions rise with public equity valuations.[4] We also show that distributions are more sensitive than calls. Consequently, net cash flows to funds of a given age are procyclical and private equity funds are liquidity providers (sinks) when public market valuations are high (low).

We also find a significant role for the independent information in debt market conditions above and beyond public equity conditions. Both calls and distributions are negatively related to the yield spread, a measure of the cost of financing to private equity firms when they make investments in portfolio companies and to would-be acquirers of those companies in subsequent M&A transactions. Distributions are more sensitive than calls, so net cash flows are negatively related to the yield spread.[5] Of course, public equity and debt market

[4]These results on buyout calls are consistent with theoretical predictions of Axelson, Strömberg, and Weisbach (2009) that buyout investments are procyclical.

[5]The sensitivity of buyout calls to the yield spread is consistent with and complements Axelson et al. (2010), who show that, conditional on making a buyout investment in a portfolio company, deal leverage and pricing are higher when the yield spread is lower. Our results imply that the likelihood that a buyout fund makes an investment in the first place is also greater when the yield spread is low. At the same time, the primary channel through which the yield spread affects private equity cash flows is through distributions

conditions reflect, and contain independent information about, underlying macroeconomic fundamentals (Fama and French, 1989). Our results thus establish, in unprecedented detail at the level of individual capital calls and distributions, a clear link between private equity activity and business-cycle variation in broader economic conditions.

At the same time, we find that such business-cycle variables explain only a small fraction of the predictable variation in private equity cash flows. Further, most variation in cash flows is not predictable, but is idiosyncratic across funds of a given age at a given point in time. For example, for buyout funds, fund age and calendar quarter fixed effects explain only 7.9% of the variation in net cash flows, which represents an upper bound on the variation that is potentially explainable by fund age and macroeconomic variables. This leaves 92.1% as idiosyncratic variation. Of the 7.9% upper bound, fully 7.2% is explained by fund age fixed effects alone. Adding market valuation and yield spread variables (instead of time fixed effects) brings the total to 7.4%. Similar conclusions hold for capital calls and distributions individually. Thus, by an order of magnitude, lifecycle effects captured by the age of the fund are a stronger predictor of private equity cash flows than macroeconomic conditions.

All of these cash flow results hold for both venture and buyout, and have important implications for our understanding of the liquidity properties of private equity as an asset class. On the one hand, the fact that net cash flows are indeed more negative during broader market downturns raises the possibility of having to liquidate public equity investments at unfavorable prices to meet capital calls. In other words, the illiquid nature of private equity investments, together with their procyclicality, raises the specter of adverse liquidity shocks. On the other hand, there is little reason to believe that private equity should command a large liquidity premium. Adverse liquidity events are predictable with a low R^2. Moreover, the large idiosyncratic component of cash flows suggests substantial benefit to diversification across funds, and most predictable variation is explained by the age of the portfolio. The broad lesson is that despite the possibility of adverse liquidity shocks, managing the liquidity exposure implied by a portfolio of private equity funds is largely a matter of diversification across fund ages and across funds of a given age.

We also find strong differences in cyclicality between buyout and venture funds. Venture

rather than calls, as a rising yield spread makes it more difficult to exit investments.

capital calls, distributions, net cash flows, and performance over fundraising cycles all exhibit substantially more cyclicality than in buyout. These findings are consistent with prior work finding a higher beta of venture portfolio companies compared to buyout, but they are not implied by this prior work. Higher beta would suggest a greater sensitivity of distributions to market conditions for a given investment, but might, a priori, be offset in a net cash flow sense by an even larger sensitivity of capital calls to market conditions. Our results are consistent with Berk, Green, and Naik (2004), whose theory emphasizes that the real option properties of venture companies can generate substantial cyclicality.

Our work is related to several strands of prior literature. Perhaps most closely related is work using earlier data on private equity cash flows. Kaplan and Schoar (2005) and Phalippou and Gottschalg (2009) use cash flow data from Venture Economics to provide early estimates of private equity performance. Jones and Rhodes-Kropf (2003) use the same data to investigate how private equity returns relate to idiosyncratic risk. Ljungqvist and Richardson (2003) and Ljungqvist, Richardson, and Wolfenzon (2007) use a different sample of buyout funds for which they have data on cash flows for the full LP-GP-portfolio company chain. They focus on understanding how portfolio companies and the timing of investments vary across funds and over a fund's lifecycle. In all of these papers, the cash flow data ends by 2003, and is limited to funds with vintage years prior to 1995.

Our work is also related to work studying aspects of cyclicality in private equity (cf. Kaplan and Schoar (2005), Gompers et al. (2008), Axelson, Strömberg, and Weisbach (2009), and Kaplan and Strömberg (2009)). No prior work either investigates cyclicality in fund-level cash flows or examines the impact of public and private equity co-movement on private equity performance inferences. In its broadest goals, our paper adds to this literature in taking early steps toward integrating private equity into the broad research stream in economics and finance that seeks to understand the impact of business cycles on asset returns and the predictability of payoffs to risky assets. The fundamental illiquidity of private equity investments makes private equity a unique and challenging setting for investigating these central questions in asset pricing.

The remainder of the paper proceeds as follows. Section II describes the data. Section III develops the tailored and levered PME tools, and presents our results on performance inference and co-movement in the cross-section. Section IV applies these tools to the time-series of performance with respect to fundraising conditions. Section V investigates the cyclical behavior of cash flows. Section VI discusses the implications of this work and concludes.

II. Data and Sample Construction

A. Coverage, Variables, and Summary Statistics

Our analysis uses a confidential, proprietary data set obtained from a large, institutional limited partner with extensive investments in private equity. The dataset provided to us includes 990 unique private equity funds, including buyout, venture capital, real estate, debt (including distressed and mezzanine), and fund-of-funds. In this paper, we focus on the 837 buyout and venture capital funds, the two most important and widely-studied forms of private equity. Of this total, over 85% are U.S. funds, with the remainder mostly European. The funds collectively represent almost $600 billion in committed capital spanning vintage years (fund start dates) of 1984 to 2009.

For each fund, the data contain capital calls, distributions, and estimated market values at the quarterly frequency extending to the second quarter of 2010, comprising over 34,000 time-series observations. Capital calls are payments from LPs to GPs; these payments draw down the balance of committed, as-yet-unfunded capital and are used to fund the investments that GPs make in portfolio companies. Distributions occur when GPs exit investments; the proceeds net of the GP's carried interest profit share are returned to the LPs. We also have data on fund sequence number and fund size, and we know whether any two funds belong to the same partnership. The data were anonymized before they were provided to us, therefore we do not know the identity of the GPs or the names of the funds, and our agreement with the data provider precludes us from reverse engineering this information.

The characteristics of funds in our sample are presented in Table 1. Our coverage is significantly stronger for buyout than for venture. We have 542 buyout funds, for a total capitalization of $535 billion. Our U.S. buyout funds represent 56% of the total capital committed to U.S. buyout funds over the same period (data from Venture Economics, VE). Our data include only $61 billion in committed venture capital, or around 16% of the VE universe of U.S. committed capital. Overall, we have about 40% of the VE universe of committed capital. On average, one-third of our funds are first time funds raised by a firm, 23% are second funds, and 16% of the funds are third-sequence funds. These sequence distributions are similar to those for the sample used by Kaplan and Schoar (2005).

Because many of the funds in our sample have recent vintage years and are still active, we also present summary statistics for the sample of funds that had vintage years 2005 or earlier and were either officially liquidated by end of the sample period (6/30/2010) or had no cash flow activity for the last six quarters of the sample. This "Liquidated Sample" forms the basis of much of our analysis of co-movement and performance, because we wish performance assessments to be based on actual cash flows. This sample includes about two-thirds of all funds in the total sample, and represents about half of the total committed capital in the full sample. It is important to stress, however, that none of our performance assessments are sensitive to the inclusion of non-liquidated funds. In general, we find no evidence to suggest that stated pre-liquidation market values are a biased estimate of the realized market value of the fund.

The composition of first, second, and third funds is roughly equivalent across the full sample and the liquidated sample. The mean fund size is smaller by some $150 million in the liquidated sample. This is largely a result of the growing prevalence of large buyout funds in the post-2005 vintage portion of the sample.

B. Representativeness and Comparison to Commercial Databases

As noted above, our data comprise a sizable fraction of the universe of private equity funds. In addition, they are at least partially randomly selected in the sense that the data provider's overall private equity portfolio was assembled over time through a series of mergers that were unrelated to each company's private equity portfolio.[6] Nevertheless, given that our data come from a single (albeit large) limited partner, the representativeness of the sample is a natural concern.

[6] On occasion, multiple formerly independent business units had invested in the same private equity fund. These cases are clearly indicated in the data, which allows us to avoid double-counting these funds. In addition, on occasion a co-investment alongside a GP in a portfolio company is listed as a separate investment (as its own "fund"). We exclude these from our sample. Neither business-unit duplicates nor co-investments are included in the count of 990 unique funds.

Assessing representativeness is inherently difficult because the universe of private equity funds (and portfolio investments) is not available, making representativeness a concern that applies to all research in private equity. The commercially available databases most often used in academic research and for performance benchmarking in the industry are VE, Preqin, and Cambridge Associates (CA). Unfortunately, these sources provide inconsistent accounts of private equity performance, and potentially suffer from reporting and survivorship biases (Harris, Jenkinson and Stucke, 2010). These biases are not a concern in our data. Nevertheless, despite the issues with commercially available data, comparisons to such data are one way to gauge the representativeness of our sample.

The performance data available from these commercial sources are fund-level IRRs or value multiples.[7] Table A-1 in the Appendix compares coverage and fund-level IRRs to commercial databases. All comparisons are based on U.S. funds, the focus of Harris, Jenkinson, and Stucke (2010), our source for information on commercial coverage. As the table illustrates, our data contain over 80% as many buyout funds as the number for which fund-level IRR information is available on VE, Preqin, or CA over the same time period. Hence our coverage of buyout funds compares well to commercial sources. As noted above, our coverage of VC funds is less comprehensive; our data comprise about one-third of the number of VC funds for which Preqin has fund-level IRR information but only around one-fifth of the counts in the VE and CA data.

Coverage, particularly of buyout funds, is especially good in the 1994-2001 period, after which coverage falls. The fall reflects a shift away from private equity investments after the tech crash, and not any change in investment strategy (or access to funds) within the private equity sphere. Such cohort effects are not an issue for our cash flow analyses; the fund age fixed effects in those analyses control for cohort effects. Cohort effects in the data could in principle influence our analysis of performance over time as it relates to fundraising conditions; however those results are not driven by differences in the 1994-2001 period and the rest of the sample.

Table A-1 also shows performance statistics (IRR) by vintage year for our sample and

[7] These sources contain virtually no cash flow data that is available for research, with the exception of the VE data used by prior research, which extends to 2003 and covers a sample of funds raised before 1995.

these data sources. Without knowledge of the sample variation within each commercially available database it is difficult to construct reasonable test statistics for the difference between our performance numbers and those of commercially available databases. Ignoring this, we can compute naïve test statistics of the difference between our sample average and the point estimates reported by each vendor, which essentially treats each vendor's point estimate as a population mean (thereby understating the standard error of the difference). In terms of the time series presented in Table A-1, there is no significant difference between the time-series of the cross-sectional mean IRRs from our data and the VE or Preqin (nor, for buyout, CA). In a cross-sectional analysis, which has more power, we find evidence that our sample of VC funds have lower IRRs than those in either VE or Preqin, but there remain no significant differences for buyout funds. If instead we were to assume that commercial data had a sampling variation equal to that of our data, we would fail to reject the null of performance equality in all pairwise tests for differences.

Despite these reassuring results, it is possible that the fact that some (but not all) of these tests reveal lower VC IRRs in our sample than in commercial databases is driven by a lack of top performing VC funds in our data. This would be consistent with Lerner, Schoar, and Wongsunwai (2007), who show that such access to the top venture groups is essentially limited to one class of investor, university endowments. They also show that the investment experience of endowments is an outlier, and not representative of that of most investors in private equity. Moreover, our main conclusions rely on correlations, and we believe it is unlikely that any lack of top groups would bias our conclusions. On the contrary, we think it is likely that if anything, greater coverage of top performing venture groups would only strengthen our conclusions. We discuss these issues in some detail as we present our results in the text.

Further consistent with this discussion, a new and complementary paper by Harris, Jenkinson, and Kaplan (2011), focusing on average performance a in large, recent sample of private equity funds, finds very similar buyout performance as we do. In fact, they find the exact same average buyout PME of 1.18 (defined in the next section) as we do (please see Table 2). Our venture PMEs are somewhat below theirs, which is driven by very high performance of venture funds in their sample in the late 1990s. Our venture PMEs are close to theirs for other periods. This, again, is suggestive of the GP/LP matching mechanism described in Lerner, Schoar, and Wongsunwai (2007), whereby a small number of top tier VC groups, access to whose funds is very limited, dramatically outperform the rest of the industry.

Ultimately, however, the universe of private equity funds is not available, and summary statistics from VE, Preqin, and CA differ systematically from one another (Harris, Jenkinson and Stucke, 2010). Consequently, it is impossible to know whether any differences are a function of sample selection, self-reporting, and survivorship biases that creep into commercially available data sources, whether they reflect characteristics of the LP/GP matching process in private equity (Lerner, Schoar, and Wongsunwai, 2007), or whether they are evidence of sample selection bias in our data. Clearly, our results should be interpreted with these caveats in mind.

III. Private and Public Equity Return Co-Movement and Performance Measurement

In this section, we assess the impact of co-movement between private and public equity returns on the performance assessment of private equity funds in the cross-section. We also update some of the key cross-sectional patterns in performance identified by Kaplan and Schoar (2005) in light of the enormous growth in the industry since their sample period.

A. Performance Measures

Most private equity research (and industry practitioners) expresses the performance of private equity funds in terms of IRR or TVPI (the undiscounted ratio of total distributions to total capital calls), because these are the only performance measures available from the main commercial databases. From an economic perspective, the chief drawback to these measures is that they are purely absolute measures of performance. They make no attempt at risk-adjustment, and so completely fail to account for the opportunity cost of private equity investments, which is driven by the co-movement of public and private equity returns.

Kaplan and Schoar (2005), recognizing this deficiency, develop the public market equivalent (PME) performance measure, which is equal to the ratio of the sum of discounted distributions to the sum of discounted calls. The PME uses the realized total return on the S&P 500 from the fund's inception (or any arbitrary reference date) to the date of the cash flow as the discount rate. For concreteness, the PME is:

$$\text{PME} = \frac{\sum_{t=0}^{T} \frac{1}{\prod_{\tau=0}^{t} 1+r_\tau} D_t}{\sum_{t=0}^{T} \frac{1}{\prod_{\tau=0}^{t} 1+r_\tau} C_t}. \tag{1}$$

In this expression, D_t and C_t are, respectively, distributions and calls occurring at time t, and r_τ is the (time-varying) realized return on the S&P 500.

The PME produces relative performance assessments that assume a β of one, i.e., a one-for-one co-movement of public and private equity returns. As Kaplan and Schoar (2005) point out, the PME does not account for the true opportunity cost of private equity investments if the true β is not equal to one.

Unfortunately, the nature of private equity reporting, and the lack of objective interim market values for ongoing investments, makes estimating β a difficult task. This is true even at the industry level, let alone the fund level. As a result, different studies have reached different conclusions, sometimes sharply so. Estimates of venture β range enormously. Earlier studies find β about 0.8 (Peng, 2001; Woodward and Hall, 2003) to 1.4 (Gompers and Lerner, 1997). More recent studies find higher βs of 2.5 to 2.7 (Korteweg and Sorensen, 2010; Driessen, Lin and Phalippou, 2011). Cochrane (2005) also reports a range of venture β from 0.5 to 2.0 depending on the specification and sample. Buyout β estimates range from a low of about 0.7 to 1.0 (Jegadeesh, Kraussl, and Pollet, 2010) to a high of 1.3 (Driessen, Lin, and Phalippou, 2011).

Adding to the already substantial uncertainty, private equity GPs commonly claim they have betas less than one, which if true would strengthen the diversification case for investing in private equity. On the other hand, low β for buyout seems hard to square easily with the high leverage used in buyout investments. Moreover, with the exception of Jegadeesh, Kraussl, and Pollet (2010), each of these estimates of buyout and venture β is an estimate of the β associated with portfolio investments, not the β experienced by an LP investing in a portfolio of funds. Finally, like every paper in private equity, each of the above referenced papers employ samples that may (or may not) be representative of the private equity universe.

We do not attempt to estimate β. Instead, given the difficulties and lack of clear consensus, we put forth a complementary approach that asks how sensitive performance inferences are to the magnitude of public/private equity co-movement. We ask: How do inferences about fund performance change if one believes the true beta is, say, 1.5 or 0.0 rather than 1.0, or that the fund's systematic risk is better matched by the Nasdaq than the S&P 500?

To address these questions, we offer two extensions to the standard PME described above. Our first extension replaces the S&P benchmark return with narrower indexes more closely tailored to a particular fund's investment strategy. For venture funds, we use the Nasdaq index in place of the S&P 500. For buyout, we group funds into size terciles and accordingly match them to the size tercile returns from the Fama-French research data available on Ken French's website. The use of size portfolios is motivated by size effects in average returns (e.g. Fama and French, 1992) and the fact that the size of a buyout fund is strongly correlated with the size of the portfolio companies that become buyout targets. These "tailored PMEs" involve β different from one implicitly, through the β of the tailored benchmark.

Our second extension explicitly introduces a β to the PME calculation. We define the "Levered PME" as follows:

$$\text{Levered PME}(\beta) = \frac{\sum_{t=0}^{T} \frac{1}{\prod_{\tau=0}^{t} 1+\beta r_\tau} D_t}{\sum_{t=0}^{T} \frac{1}{\prod_{\tau=0}^{t} 1+\beta r_\tau} C_t}. \tag{2}$$

By varying β, we alter the discount rate used in the PME calculation, allowing us to trace out the "levered PME"-β relation for each fund. The levered PMEs nest as special cases both the standard PME ($\beta = 1$) and the TVPI (β=0).[8]

[8] An alternative would be to use the realized return $r_{f\tau} + \beta(r_\tau - r_{f\tau})$, where $r_{f\tau}$ is the riskfree rate, in place of βr_τ. The disadvantage of this specification is that it does not nest the TVPI—a commonly used practitioner metric—as a special case. Nevertheless, our conclusions are otherwise unaffected by this alternative.

B. Results

The tailored and levered PMEs allow us to assess the way in which performance inferences depend on the magnitude of the covariance between private and public equity returns. Table 2 reports IRR, TVPI, PME, and tailored PME performance for both the liquidated and full samples of funds, while Figure 1 plots the cross-sectional average levered PME for liquidated funds as β ranges from 0 to 3 in steps of 0.01. We (not our data provider) calculate each of these performance measures from quarterly net-of-fee fund cash flows and ending NAVs.[9]

The main message from Table 2 is that, for both venture and buyout, moving from β=0 (TVPI) to β=1 (PME) has a significant impact on performance assessments, while tailored PMEs offer essentially the same inferences as standard PMEs. Liquidated buyout funds have an average TVPI of 1.57, an average PME of 1.18, and an average tailored PME of 1.10. For venture funds, the progression is from 1.44 to 1.03 to 1.06. Medians display similar patterns.

Table 2 reveals two other facts. First, for all performance measures and both fund types, performance statistics for the full sample are almost identical to those of the liquidated sample. This suggests that pre-liquidation market values, although self-reported by GPs, are not a biased estimate of the realized market value of the fund. Second, all performance measures indicate wide dispersion in the returns to individual funds, with venture displaying considerably more dispersion than buyout.

Turning to Figure 1, we see that while moving from β=0 to β=1 has a major impact, further increases in beta have strongly diminishing effects on inferences (i.e., the levered PME-beta relation is convex). In particular, performance inferences are remarkably insensitive to beta around the typical levels of beta estimated from prior work on private equity portfolio companies. Moving β from 1.0 to 1.5 for buyout funds moves average levered PME from 1.18 to 1.12. The minimal value of levered PME is achieved at β about 2.2. Only in this extreme range does the lower bound of the buyout 95% confidence interval drop below 1. For β above 2.2, average levered PME begins to increase again, as the early calls of funds

[9] We treat ending NAVs as true values, as do Kaplan and Schoar (2005). This is necessary to compute performance for the full sample, and a choice for the liquidated sample. Phalippou and Gottschalg (2009) recommend writing ending NAVs for liquidated funds down to zero, but we find this has only a very slight impact on our estimates of performance. By construction, most liquidated funds have zero reported final NAV. Further, though not shown in Table 2, we find similar PMEs as Kaplan and Schoar (2005) do when considering only their sample period.

started in rising markets get increasingly discounted.

Figure 1 also shows that the levered PME-β relation is flatter for venture, which is especially notable because the range of β estimates in the literature is wider for venture. Average levered PMEs are close to flat in the wide range of β between 1.5 and 3.

These results contrast with intuition from standard asset pricing models used to benchmark the performance of other asset classes like mutual funds, in which relative performance inferences are linear in beta. This is a consequence of the fact that a performance measure like the PME, which aggregates discounted cash flows over multiple time periods, is inherently nonlinear. An implication of the results in Table 2 and Figure 1 is that for many purposes, it may be less important to know the exact beta, especially given the measurement difficulties, than to have a sense of the likely range in which it falls.

C. Fund Performance and Fund Characteristics

We conclude our analysis of the cross-section of performance by revisiting some of the key results of Kaplan and Schoar (2005), who were the first to document many of the key stylized facts that shape our understanding of private equity performance. These include performance persistence, whereby the performance of early funds in a fund family predicts the performance of later funds of the same private equity group, as well as an increasing, concave size effect in performance. In view of the tremendous growth in the industry and changing competitive landscape since their sample period, the time is ripe to revisit these facts. Our data are particularly well suited to do so because unlike other work subsequent to theirs, we are able to compute Kaplan and Schoar's performance measure, the PME.

Table 3 explores these issues in our liquidated sample. Columns (1) and (6) reveal no significant linear relation between PME and (log) fund size. In columns (2) and (7) we include a quadratic in log fund size. Here, we see a statistically significant positive loading on the main effect of log fund size, with a statistically significant negative loading on the quadratic term, indicating concavity in the size/performance relation. The magnitude of the coefficients indicate more pronounced concavity relative to the coefficients in Kaplan and Schoar (2005). Thus, larger funds perform better in the cross-section, but this effect diminishes as size grows, and the diminishment appears to have grown stronger since Kaplan and Schoar's (2005) sample period.

Columns (3) and (8) add fund family fixed effects to examine the relation between within-family variation in fund size and fund performance. Like Kaplan and Schoar (2005), we find a statistically significant negative coefficient for venture funds and a negative, but statistically insignificant coefficient for buyout funds. (In a pooled regression with both fund type and adding a fund dummy, the coefficient is highly significant.) In terms of economic magnitude, the coefficient for venture is substantially larger than in Kaplan and Schoar (2005), while the coefficient for buyout is about the same.

Overall, our results on fund size and performance are consistent with Kaplan and Schoar (2005). If anything, they suggest that the poor relative performance of very large funds they document has only worsened since their sample period. The recent increase in competition in the industry is one explanation consistent with this finding.

Turning to persistence, Columns (4) and (9) show that for both buyout and venture, the current fund's PME loads positively on the PME of the prior fund of the firm, indicating performance persistence as documented by Kaplan and Schoar (2005). The coefficient on buyout is about the same as in Kaplan and Schoar (2005), while the coefficient on venture is lower. While it is possible that the lower venture coefficient is driven by a lack of top-performing venture groups, we find a similar coefficient as Kaplan and Schoar (2005) do in their sample period.

In these persistence specifications, we adopt the convention in Kaplan and Schoar (2005) and estimate the performance persistence relation using vintage year fixed effects. This shuts down any component of persistence that is driven by the possibility that the endogenous choice to launch a follow-on fund based on past performance will be stronger in good years (on average) than in bad years, because it only allows for the variation across second- or third-funds within a given year to drive the estimation. This convention is thus conservative. When we drop vintage year fixed effects in Columns (5) and (10), the venture loading roughly doubles, while the buyout loading is essentially unchanged. These results suggest that performance persistence has persisted.

IV. Cyclicality in Private Equity Performance over Time

In this section, we apply the tools developed in the previous section to performance in the time-series. Kaplan and Strömberg (2009), investigating buyout funds, find evidence for counter-cyclicality in fundraising and performance: the absolute performance (IRR) of buyout funds raised in boom fundraising years is significantly worse than that of funds raised in bust periods. However, as noted above, private equity fundraising booms and busts are strongly correlated with public equity booms and busts. This co-cyclicality raises the question of whether cycles in absolute private equity performance show up intact in cycles in relative performance, or instead are differenced out by differences in the returns to public equities.

Table A-2 in the Appendix provides an initial indication that cyclicality in private equity performance may be largely differenced out by the returns to public equities. The table displays size-weighted cross-sectional average performance by vintage year for the sample of liquidated funds (the story is similar for the full sample). IRR, PME, and tailored PME all vary over time. The time-series variability of IRR is much greater than that of PME or tailored PME. For buyout funds, the ratio of the time-series standard deviation of IRR to the time-series mean of IRR is about two-thirds. The corresponding ratios for PME and tailored PME are less than one-fifth. Venture gives a similar message while displaying greater time-series variability than buyout. Venture IRR over time displays a standard deviation to mean ratio of almost two, while the corresponding ratios for venture PME and tailored PME are about one-third. Simply put, there is much less time-series variability in aggregate PME or tailored PME than in aggregate IRR.

A. Main Results

Table 4 and Figure 2 provide formal tests. We relate a fund's ultimate performance to fundraising conditions when the fund is raised. Table 4 uses two measures of performance: TVPI for absolute performance and PME for relative performance. We use TVPI instead of IRR to clearly demonstrate the progression from $\beta = 0$ to $\beta = 1$, but we obtain similar results with IRR. Following Kaplan and Strömberg (2009), our measure of fundraising conditions is the total capital committed to all funds of the same type in the same vintage year (data from VE), divided by total U.S. stock market capitalization at the end of the vintage year (data from CRSP). This variable, "Flows", is expressed as a percentage rather than a ratio in the tests.

Panel A of Table 4 focuses on the liquidated sample. Columns (1) and (5) show a strongly negative relation between TVPI and Flows, for both buyout and venture, with venture displaying a somewhat stronger coefficient. These results echo Kaplan and Strömberg (2009), although they look only at buyout funds. In short, funds that are initiated in boom years have low absolute performance.

The picture changes markedly when we replace absolute performance measures with the relative performance measurement implied by PMEs (which is not possible without cash flow data). Columns (2) and (6) display the results. The underperformance of funds raised in hot markets vanishes altogether for buyout funds. For venture funds, the coefficient remains significantly negative, but is reduced in magnitude by about three-quarters. Like the summary statistics in Table A-2, these results suggest greater cyclicality of venture performance compared to buyout.

We next consider how these conclusions vary in the cross-section of fund size. In columns (3), (4), (7) and (8), we repeat the analysis with Flows interacted with venture and buyout-specific size tercile dummies. (The specifications include size-tercile level effects, but these are suppressed for brevity.) If fund sizes grow with capital inflows, and the larger funds perform worse, then we should see especially poor performance among the largest funds in the boom periods. On the other hand, if boom fundraising times permit the entry of relatively unskilled GPs, but do not allow them to raise as large funds as their more proven counterparts, we would see poor performance more concentrated in smaller funds raised in boom periods. Columns (3) and (7) indicate that the former effect better describes buyout, while the latter better describes venture. We find that the negative fundraising/TVPI relation is driven by the larger two terciles for buyout, but the smaller two terciles for venture.

When we switch from absolute to relative performance and look at PMEs in Columns (4) and (8), the fund-flow/size/performance interactions largely vanish. The exception is the evidence that small buyout funds outperform.[10]

Panel B of Table 4 repeats the analysis for the full sample of funds. The results are virtually identical to Panel A. The exception is some evidence that the largest buyout funds raised in boom years underperform in PME terms. Because the full sample includes funds that are still active, conclusions about ultimate performance are more tentative.[11]

Figure 2 extends the analysis of Table 4 by tracing out the levered PME-Flows relation for values of β between 0 and 3 in steps of 0.01, which nests as special cases the TVPI and PME used in the Table. The Figure uses the liquidated sample, and plots the coefficient and 95% confidence interval from a regression of levered PME on Flows. Figure 2 shows that the levered PME-Flows relation increases monotonically with β. The relation ceases to be reliably negative above a beta of about 0.5 for buyout funds and about 1.5 for venture funds. Both of these betas are below recent estimates of portfolio company betas in the literature (which tend to be in the range of 1-1.5 for buyout and 2-3 for venture). Moreover, the coefficient itself turns positive above a β of about 0.8 for buyout and 2 for venture. Consequently, at the levels of beta estimated by prior work on portfolio companies, there is not a negative relationship between private equity fundraising and relative performance.

B. Implications

Clearly, failing to control for co-cyclicality between private equity and broader market performance can lead to misleading inferences about the relative performance of private equity as an asset class over time. The results occur because times of high private equity fundraising coincide with public market booms, and presage broader market downturns. Indeed, in unreported analyses we find a significantly negative relation between fundraising activity in a fund's vintage year and returns to the S&P 500 over the fund's lifetime. Moreover, this relation is stronger for buyout funds than for venture. These results help explain

[10]For venture, the fact that each flows-size interaction is insignificant in Column (8) indicates a lack of power compared to the pooled test in Column (6).

[11]In unreported robustness tests, we ensure that the results in Table 4 are not driven solely by the 1994-2001 period in which, as discussed in Section II.B., our sample coverage is greatest. Also, to the extent our sample lacks the top performing venture groups, we believe that any bias would likely cause us to *understate* the attenuation in the performance-fundraising relation when we switch from absolute to relative performance measures. The top groups are likely to be those whose relative performance is least sensitive to the fundraising environment.

why the attenuation in the performance/fundraising relation when moving from TVPI to PME is stronger for buyout compared to venture.

At a deeper level, viewed through the lens of predictive regressions, the results on fundraising and performance imply that times of high fundraising activity forecast both low levels of distributions relative to capital calls (i.e., low TVPI) and low public market returns (or discount rates). This in turn suggests that when public market valuations are low, in the midst of downturns, net cash flows (distributions minus calls) at the fund level are also low. We explore this and related ideas in the next section.

V. Cash Flows, Liquidity, and Macroeconomic Conditions

In this section, motivated in part by our findings in the previous section, we investigate how broader equity (and debt) market conditions, and by implication macroeconomic fundamentals, impact the behavior of cash flows into and out of private equity funds.

Our analysis proceeds in three main steps. First, we present graphical evidence of aggregate call and distribution activity. Then we proceed to predictive regressions in which we gauge the extent of predictable variation in net cash flows, calls, and distributions, and assess the importance of market conditions and lifecycle effects to the predictable component of cash flows. Finally, we consider the behavior of cash flows in the 2007-2009 financial crisis, and explore the links between fund characteristics and call, distribution, and net cash flow behavior.

A. Aggregate Call and Distribution Activity over Time

Figure 3 plots the overall fraction of uncalled capital that is called in a given quarter, for venture and for buyout. The initially higher of the two jagged lines (in blue) is the ratio of calls to uncalled capital for venture, the lower (in green) is for buyout. Because the series contain a good deal of semi-annual fluctuation, we superimpose a locally weighted least squares regression line on each series. Time runs along the horizontal axis, and we indicate the year and quarter of pivotal dates on the figure along the horizontal axis legend.

The figure indicates that buyout limited partners could expect about 10%-15% of their unfunded (as yet uncalled) commitments to be called in any given quarter, consistent with most funds investing their capital over a 2-5 year window. In general, the figure illustrates the fact that aggregate call activity grows as market conditions heat up, and declines when markets cool. This was true both in the technology boom of the 1990s, the tech crash of 2000, and the subsequent private equity boom of the mid-2000s. Call activity grows initially as the cycle heats up, and then stabilizes as more committed capital flows into the sector, lowering the overall fraction called in any given quarter.

Figure 3 also shows what happened to aggregate calls during the crisis of 2007-2009. As with other downturns, calls dropped in the crisis. However, the first quarter of the crisis (the third quarter of 2007) saw a spike in buyout capital calls comparable in magnitude to that of the second quarter of 2005. Buyout capital calls spiked unexpectedly in the third quarter of 2007.

Figure 4 plots a similar time-series for distributions, expressed as a fraction of the total committed capital at a point in time. During the buyout boom, buyout funds were consistently distributing an average of around 5-6% of the fund's total committed capital each quarter. This crashed to near zero in the wake of the financial crisis. In contrast, venture funds experienced extremely high distributions during the technology boom of the late 1990s, but since then have produced uniformly low distribution yields.

B. Cash Flows, Lifecycle Effects, and Macroeconomic Conditions

We now turn to predictive regressions in which we gauge the extent of predictable versus idiosyncratic variation in net cash flows, calls, and distributions. We analyze the cyclicality of cash flows, and assess the importance of market conditions and lifecycle effects (i.e., fund age) to the predictable component of cash flows.

The analyses are presented in Table 5. The unit of observation is a fund-calendar quarter (the cash flow data are at the quarterly frequency). Panel A provides OLS estimates, focusing on net cash flows, expressed as a percentage of committed capital, as the dependent variable. Panels B and C provide Tobit estimations focusing, respectively, on distributions and calls. The dependent variables are, respectively, the natural log of (1 + distributed capital as a percentage of committed capital) and he natural log of (1 + called capital as a percentage of committed capital). In each Panel, Columns (1)-(6) focus on buyout funds, while Columns (7)-(12) include only venture funds. Standard errors are clustered by calendar quarter. Clustering by fund or by both fund and calendar quarter yield generally lower standard errors.

Table 5 yields a number of insights. We discuss each in turn in the subsections below.

B.1. Predictable and Idiosyncratic Variation

In Columns (1) and (7) of each Panel of Table 5 we report a model that includes only time period (calendar quarter) and fund age (measured in quarters) fixed effects. This model gives us a non-parametric theoretical upper bound on the explanatory power that we could hope to obtain from a model including age fixed effects plus variables capturing macroeconomic fluctuations at the quarterly level. In the net cash flow models of Panel A, the R^2 values from these specifications are 0.079 for buyout and 0.075 for venture. Thus, for buyout 92.1% of the variation in net cash flows is idiosyncratic across funds of a given age at a given point in time. For venture, idiosyncratic variation is 92.5% of the total.

The absolute magnitude of the pseudo-R^2 values in the tobit specifications of Columns (1) and (7) of Panels B and C are not, by themselves, easily interpretable. They do naively suggest, however, that most variation in distributions and calls is likewise idiosyncratic, with distributions less predictable than calls. The R^2 values from analogous OLS regressions (unreported) confirm this conclusion.

B.2. Fund Age and Lifecycle Effects

Columns (2) and (8) in each Panel drop the time fixed effects, and retain fund age fixed effects. These specifications tell us how much of the predictable variation in cash flows is predictable solely from the age of the fund. A priori, this could be substantial. Private equity funds, unlike mutual funds or hedge funds, have contractually specified, finite lives. Typically, the lifespan is 10 years with an option to extend for 1-3 more. As a result, funds tend to call capital early in their lives to make investments, and distribute capital later after those investments have been realized. This suggests a lifecycle pattern of negative net cash flow early in a fund's life, turning positive later.[12]

Comparing Columns (2) and (8) to Columns (1) and (7) of Panel A indicate that fund age fixed effects explain a substantial fraction of the predictable variation in net cash flows. For buyout funds, dropping the time fixed effects reduces R^2 by just 0.007, from 0.079 to 0.072. For venture, fund age fixed effects alone produce an R^2 of 0.038, compared to the 0.075 with time fixed effects as well.

We can conduct similar comparisons for calls and distributions individually because, in contrast to their absolute levels, comparing pseudo-R^2 values across Tobit models with the same dependent variable is meaningful.[13] Examining Columns (1), (2), (7), and (8) of Panels B and C, we see that similar to net cash flows, fund age alone accounts for a large portion of the predictable variation in distributions and calls individually. This is especially true for capital calls.

B.3. Cyclicality and Cash Flow Liquidity

Columns (3) and (9) in Table 5 begin the investigation of co-cyclicality between broader market conditions and private equity cash flow behavior. We maintain the fund age fixed effects, and replace the calendar quarter fixed effects with a single forecasting variable, the log of the Price/Dividend ratio on the S&P 500 (from Robert Shiller's website). We measure ln(P/D) on the last day of the prior calendar quarter, so these are predictive regressions. By using P/D as our primary forecasting variable, we are in keeping with the large literature in asset pricing that focuses on P/D as a predictive variable (see Cochrane, 2011, for a summary). P/D is also highly correlated with the business cycle (Fama and French, 1989), lending a natural interpretation to our results as relating fund-level private equity cash flow activity to macroeconomic fundamentals.[14]

[12]This conventional wisdom is borne out when we examine the coefficients on the fund age fixed effects in the net cash flow regressions. The coefficients start off negative, cross the zero threshold at about 3-4 years of age, and monotonically increase to about 8 years of age, remaining roughly flat thereafter. For brevity, we do not tabulate these patterns in fund age fixed effects.

[13]The difference in pseudo-R^2 across two Tobit models with the same dependent variable is equal to the difference in the model log likelihoods scaled by the log likelihood of a constant-only model. Thus, the difference in pseudo-R^2 is informative of the relative difference in goodness of fit.

[14]P/D is also highly correlated with other variables, such as IPO and M&A activity, that are likely to be related to investment and exit opportunities in private equity (see Gompers et al., 2008 for some evidence on this point). In general, P/D can be thought of as a proxy for all variables that capture variation in

Panel A shows that, holding fund age fixed, net cash flows are positively related to P/D. Thus, a four year old fund in times of strong market valuations (say, 2006) has more positive net cash flows than a four year old fund in times of low market valuations (say, 2002). Scanning down to Panels B and C, we see that distributions and calls both rise with improving market conditions, but distributions are more sensitive than calls, which explains the net cash flow result. The 0.37 coefficient for buyout distributions is not much larger than the 0.33 coefficient for buyout calls. However, because the distribution and calls specifications are log-log regressions, these coefficients are elasticities. Because distributions are much larger on average than calls, distributions actually have a much higher sensitivity to P/D than calls even though they have similar elasticities.

These results imply business cycle variation in the liquidity properties of private equity funds. Fund level net cash flows are positively related to P/D, so a given portfolio of funds is more likely to be a liquidity source when times are good and sink when times are bad. This corroborates the implications of the fundraising/performance analysis discussed in the previous section. The results lend little support to claims sometimes made by practitioners that private equity funds are close to market-neutral. The results on capital calls also suggest that it is not the case that private equity funds act as contrarian investors, snapping up targets in bad times. If this had been the systematic tendency, we would have expected to see a negative loading on P/D in the capital calls tests.

At the same time, the R^2 values in Columns (3) and (9), when compared to those in Columns (2) and (8) (all Panels), suggest that the incremental explanatory power of P/D in the presence of fund age fixed effects is rather low. This means that while there is a strong systematic tendency to distribute and call more capital in response to improving market valuations, and a tendency to distribute more than is called, there is nevertheless a large amount of idiosyncratic variation across funds. This, of course, is consistent with the wide dispersion in fund-level returns shown in Table 2.[15]

investment and exit opportunities that is related to market valuations.

[15] A loose analogy may be made to the case of a standard CAPM regression, in which stock-level R^2 tends to be low because stocks exhibit high idiosyncratic volatility. The extent of idiosyncratic volatility (1-R^2) is a quite separate issue from the magnitude of systematic variation in returns (β).

B.4. Population Effects

Columns (4) and (10) in Table 5 retain P/D but drop fund age fixed effects. With fund-age fixed effects, the regressions acknowledge that a 2 year-old fund, for example, is more likely to call capital than a 7-year old fund, and the point estimate measures the predictive power of market conditions on subsequent call activity on the margin. Without fund-age fixed effects, the regressions take into account that market conditions themselves influence how many 2 year old funds there are in our sample relative to 7 year old funds. As market conditions improve, the population of funds gets younger because of new fund starts (Kaplan and Schoar, 2005), and is increasingly tilted toward funds that are in the investment phase of their life-cycle.

Thus, the specifications without fund age effects speak to the overall cash flow behavior of the population of private equity funds, taking into account the fact that the characteristics of the population vary over time. in Table 5. Here, we see in Panel A that the sensitivity of net cash flows to market conditions at the population level is much lower than at the fund level (and in fact insignificant in buyout funds). Scanning to Columns (4) and (10) in Panels B and C, we see that this is driven by a much greater sensitivity of calls to P/D compared to the specifications with fund age fixed effects, as a result of the cohort entry effects described above. This in turn helps interpret some results from the literature on patterns in aggregate investments. For instance, Gompers et al. (2008) show that VCs make more investments in booms. Our results suggest that much of this is driven by the entry of new funds.

B.5. Debt Market Conditions

Columns (5) and (11) in Table 5 return to the fund-level analysis with age fixed effects. Here, we explore the role of the debt market conditions on cash flow activity. Of course, public equity and debt market conditions both reflect the same underlying macroeconomic fundamentals. We are interested in understanding whether private equity cash flows are related to the incremental information about fundamentals that is reflected in debt conditions, above and beyond the information already reflected in equity markets. Accordingly, we add to the specifications the natural logarithm of the Moody's Baa-Aaa yield spread, measured at the end of the prior calendar quarter. To ensure that we attribute only incremental information to this variable, we orthogonalize it with respect to the ln(P/D) variable.[16]

Columns (5) and (11) in Panel A show that net cash flows are negatively related to the yield spread. The same columns in Panels B and C show that both distributions and calls drop as the yield spread rises (i.e., as bond market liquidity and the cost of debt financing rise). Distributions are much more sensitive than calls. The sensitivity of buyout calls to the yield spread is consistent with and complements Axelson et al. (2010), who show that, conditional on making a buyout investment in a portfolio company, deal leverage and pricing are higher when the yield spread is lower. Our results imply that the likelihood that a buyout fund makes an investment in the first place is also greater when the yield spread is low. At the same time, the primary channel through which the yield spread affects private equity cash flows is through distributions rather than calls, as a rising yield spread makes it more difficult for would-be acquirers to finance acquisitions of private equity portfolio companies.

B.6. Uncalled Capital

Columns (6) and (12) in Table 5 add a control for the fund's committed but as-yet-uncalled capital as of the prior calendar quarter. Panel C shows that as expected, we find that holding constant fund age, a fund that has called less capital so far (and thus, by virtue of being the same age, has either encountered or acted upon fewer investment opportunities) is more likely to call capital going forward. Similarly, Panel B shows that, holding constant fund age, funds that have called less capital (so have made fewer or smaller investments) are less likely to distribute capital (or distribute smaller amounts). Consequently, the effect on net cash flows is unambiguously negative, as seen in Panel A. Holding constant fund age, a fund that has called less capital previously has lower net cash flows going forward.

These intuitive results do not affect the conclusions described in the previous subsections. The coefficients on the macroeconomic variables of interest are essentially unchanged by adding a control for uncalled capital.

[16]We obtain this variable from the FRED website. The Baa-Aaa spread is a broad measure of liquidity in the corporate bond market. Results are similar using other yield spread variables, in particular the Merrill high yield spread used in some prior work. The high yield spread is however specific to junk bonds, which may not be representative of the overall credit risk of securities issued in conjunction with the acquisition or exit of private equity portfolio companies.

B.7. Comparing Buyout and Venture Capital

So far, we have not focused on differences between buyout and venture capital funds in cyclicality and in the extent of predictable versus idiosyncratic cash flow behavior. In fact, important differences are revealed in Table 5 by comparing Columns (1)-(6), which focus on buyout funds, to Columns (7)-(12), which focus on venture capital funds.

The main message from these comparisons is that while both buyout and venture exhibit the general patterns described above, cash flow behavior in venture capital funds is both more procyclical, and, at the same time, more idiosyncratic than buyout funds.

The difference in cyclicality is evident when comparing Columns (3) and (9) in all three Panels. Venture capital net cash flows, distributions, and calls all have higher loadings on P/D than is the case in buyout. These results are consistent with the difference in the fundraising/performance results discussed in Section IV. Also, while these are predictive regressions and the loadings on P/D do not naturally yield estimates of β for venture or buyout, the greater cyclicality of venture cash flows certainly suggests a higher β of venture compared to buyout. This is consistent with recent work finding high βs of venture portfolio companies (Korteweg and Sorenson, 2010; Driessen, Lin and Phalippou, 2011), but at the same time is not implied by prior work. Higher β would suggest a greater sensitivity of distributions to market conditions for a given investment, but might, a priori, be offset in a net cash flow sense by an even larger sensitivity of capital calls to market conditions, if venture funds were sufficiently more likely than buyout funds to increase investments in response to improving market conditions.

The greater idiosyncratic cash flow behavior of venture compared to buyout funds is more of a conditional statement. Comparing the R^2 values in Columns (1) and (7) of Panel A, which include fund age and time period fixed effects, reveals only slightly more idiosyncratic variation in venture compared to buyout (R^2 of 0.075 compared to 0.079). However, time period fixed effects cannot be used for forecasting. In the predictive regressions using our full suite of forecasting variables in Columns (6) and (12) of Panel A, we see that the R^2 for venture is considerably lower than that of buyout. These findings are consistent with the higher variance of fund-level returns in venture compared to buyout documented in Table

2.[17]

As discussed in Section II, it is likely that our sample omits some of the top-performing venture groups. We believe that if anything, they would only strengthen our conclusions. Gompers et al. (2008) provide evidence that the top venture capitalists alter their investments more in response to public market signals compared to other venture capitalists. Further, high returns to the top groups are primarily generated by IPOs, which correlate strongly with market valuations. Thus, it is likely that the calls and distributions of the top venture groups display higher than average cyclicality.

B.8. Further Implications

We conclude our discussion of Table 5 by considering the implications of these results for understanding the liquidity properties of private equity as an asset class, from the perspective of an investor concerned with predicting the liquidity demand from a portfolio of private equity funds. The bad news is that at the margin, the fact that net cash flows are indeed more negative during broader market downturns gives rise to the possibility of having to liquidate public equity investments at unfavorable prices to meet capital calls. In other words, the illiquid nature of private equity investments, together with their procyclicality, does raise the specter of adverse liquidity shocks. But there is much good news. Such an adverse event is predicted with a low R^2, the large idiosyncratic component of cash flows suggests substantial benefit to diversification across funds, and most predictable variation is explained by the age of the portfolio. The broad lesson is that despite the real possibility of adverse liquidity shocks, managing the liquidity exposure implied by a portfolio of private equity funds is largely a matter of diversification across fund ages and across funds of a given age.

C. Cash Flows and the 2007-2009 Financial Crisis

We next turn to an investigation of private equity cash flows in the recent financial crisis and ensuing recession. Anecdotally, the crisis had a clear effect on private equity activity.

[17] It is not meaningful to compare pseudo-R^2 across the buyout and venture capital distribution and call models in Panels B and C. The scale of Pseudo-R^2 values varies with the sample, and so they cannot be compared across models with different samples.

Exit, investment, and financing opportunities dried up, and with them the industry ground to a near halt. Yet, we know of no systematic investigation of private equity in the crisis. This gap is particularly important given that the crisis was, at least in the beginning, a crisis of liquidity that might be expected to have a profound impact on an inherently illiquid asset class such as private equity. An important open question is just what happened to private equity cash flows during the crisis, and whether these events were in fact unusual from a historical perspective.

Table 6 investigates these ideas. In essence, the Table adds a "Crisis" indicator variable to some of the specifications from Table 5. This indicator equal one for calendar quarters 2007:Q3 to 2009:Q1, inclusive. As before, Panel A focuses on net cash flows, Panel B on distributions, and Panel C on capital calls. The dependent variables, the other independent variables, are exactly as described for Table 5.

The results in Table 6 are easily summarized. Columns (1) and (3) of each panel include only fund age fixed effects and the crisis indicator, for buyout and venture, respectively. The negative loadings on the crisis indicator in Panels A and B indicate that net cash flows dropped during the crisis relative to other times, fueled by a drop in distributions, consistent with exit opportunities drying up. Examining the same columns in Panel C, we see that calls did not drop. For buyout, crisis calls were about the same as in other times, while for venture they actually increased, perhaps to take advantage of depressed asset values and the historic lack of other funding opportunities for small businesses that characterized the crisis.

Columns (2) and (4) of each Panel investigate whether these patterns in average cash flow activity are abnormal, or instead reflect changes in the same underlying macroeconomic variables that help explain cash flow behavior in normal times. During the crisis, market valuations dropped and the yield spread rose. Both of these are normally associated with lower net cash flows and distributions. Indeed, we find that when we add the macroeconomic variables and the uncalled capital controls from Table 6, the coefficient on the crisis indicator becomes insignificant in all specifications except the case of venture capital calls.

Thus, for the most part, the crisis appears to have been a non-event from the perspective of private equity cash flows in the sense that changes in cash flow behavior during the crisis are explained by changes in the same underlying fundamentals that explain cash flow behavior in normal times. The exception is the increased capital call activity for venture funds.

D. Cash Flows and Fund Characteristics

The preceding sections have demonstrated that an enormous amount of the overall variation in call, distribution and net cash flow activity is not explained by macro-fundamentals, but instead is idiosyncratic to specific funds at a point in time. Therefore, in a final step, we investigate what fund characteristics are associated with more or less sensitivity of cash flows to macroeconomic conditions, as well as cash flow behavior in the crisis. This allows us to explore whether certain types of fund characteristics account for this variation.

Table 7 presents the results. Table 7 extends the specifications in Tables 5 and 6 by interacting the P/D, yield spread, and uncalled capital variables, as well as the crisis indicator, with a variety of fund characteristics. As indicated in the Table in the line labeled "Additional Controls", each specification estimates, but for brevity does not report, fund age fixed effects. As before, Panel A focuses on net cash flows, Panel B on distributions, and Panel C on capital calls.

The characteristics of interest in Table 7 are whether the fund is a large or small fund, whether it is a firm's first fund, whether it is a poorly performing fund, and whether the fund had previously made a distribution (i.e, had an exit). Each of these characteristics is represented by an indicator variable ("Main Effect" in the Table). Large (small) funds are those in the highest (lowest) tercile of fund size (venture or buyout-specific). Low performing funds are those in the lowest performance tercile at any given point in time (by PME, in which the PME calculation treats the NAV at that point in time as if it were a cash flow).

The loadings on the "Main Effect" indicator variables captures differences in the magnitude of cash flows along fund characteristics, which tells us whether certain types of funds tend to be providers or users of net capital (Panel A), whether they distribute more or less capital (Panel B) or call more capital (Panel C) than other types of funds. Perhaps the starkest distinctions are between large and small buyout funds. Here we see that, holding fund age and amount of uncalled capital constant, large funds generate net cash for limited partners while small funds absorb net cash. The interpretation is as follows: if we compare two funds of the same age facing the same market conditions and with the same amount of uncalled capital, the larger fund will call more capital than the small fund, but will distribute much more capital than the small fund, on net implying that it provides net cash to the LP while the small firm absorbs it.

Going beyond the main effect indicators, the interaction effects measure the differential sensitivity of cash flow behavior along the characteristics in question. Focusing on the net cash flow results in Panel A, we find that cash flows of large buyout funds are less sensitive to market valuations (P/D) than other buyout funds, while small buyout funds and first-time time buyout funds are more sensitive. Although, again, these are not estimates of β, the findings are directionally consistent with higher systematic risk among small and first time buyout funds, and lower among large buyout funds. In contrast, in venture funds we find little variation along fund characteristics in the sensitivity of net cash flows to market conditions. Turning to the crisis interactions, we find essentially no differences in cash flow behavior in the crisis along fund characteristics, for neither buyout nor venture.

Panels B and C provide further detail on how the interactions in Panel A break down into distribution and call components. In general, these Panels show that several of the insignificant results in Panel A are in fact composed of offsetting call and distribution effects, with at least one of the component effects being statistically significant. For example, Column (8) of Panel C first-time venture funds are significantly more sensitive to market conditions in their capital calls compared to other venture funds. However, Column (8) of Panel B shows that their distributions are less sensitive (albeit not significantly so), resulting in no significant net effect in Column (8) of Panel A.

VI. Discussion and Conclusion

Valuation waves in public capital markets co-move with waves in private equity markets. This co-movement in part reflects the fact that exit opportunities in private capital markets are driven by fundamentals in public capital markets: times when IPO markets are favorable, or when M&A opportunities abound, are times when private equity funds can exit investments more readily. But at a more nuanced level, the connections between public and private capital markets reflect common exposure to underlying business conditions and investment opportunities.

Understanding the implications of this co-cyclicality for private equity cash flows and returns is an important first step towards ultimately understanding the risk/return trade-offs in private equity. To date, the lack of appropriate private equity data has posed a fundamental obstacle to answering these questions. This paper uses a large, proprietary database of private equity funds, comprising almost 40% of the U.S. Venture Economics universe from 1984-2010, to provide new evidence on the role of co-movement for private equity performance and cash flow behavior.

Our first set of findings centers around the beta of private equity. Rather than ask, "What is the beta of private equity?"—a vexing question which has generated a range of answers —we focus on a simpler and perhaps more pertinent question for performance assessment. We study how sensitive inferences about the relative performance of private equity as an asset class are to beta, i.e. to the magnitude of the co-movement between public and private equity returns.

As it turns out, the relation between beta and relative performance is highly convex. This convexity is important for understanding the implications of leverage for assessing private equity performance. Near a beta of zero, performance assessment is highly sensitive to changes in the beta: going from a beta of zero to a beta of one cuts the estimate of excess performance of buyout funds from 57% over the life of the fund to 18%. But changing the beta from 1.0 to 1.5 only lowers the excess performance assessment to 12%. Similar conclusions hold for venture funds. Given recent estimates of buyout and venture betas in the literature, our findings suggest that further refinements of beta estimates are unlikely to have substantive impact on our overall assessment of private equity performance. These findings also cast doubt on the oft-heard claim that buyout returns are largely generated by the over-reliance on leverage. If this were true, we would expect increasing the beta used to assess performance to have a more pronounced effect, because leverage-driven cash flows would be highly correlated with the market return.

Our second set of findings concerns consequences of this co-movement for time-series patterns in average performance. Prior work finds strong counter-cyclicality in fundraising and performance: the absolute performance of private equity funds raised in boom fundraising years is significantly worse than that of funds raised in bust periods. We find the same pattern, for both buyout and venture, which squares with received wisdom among industry observers. However, this hot-market underperformance largely vanishes when we use plausible estimates of beta in relative performance assessments. This is a direct consequence of the inter-connectedness of private and public capital markets: exit opportunities in private equity vanish as liquidity in public markets dries up, but this fact also spells low performance for public capital markets themselves.

Our final set of findings explores the liquidity properties of private equity cash flows in greater detail. To understand the liquidity properties of private equity, we must not only be concerned with how public market conditions affect exit opportunities (which affect private equity distributions) but also how they reflect investment opportunities, which affect private equity capital calls, and how these effects net out. The fact that capital calls are almost as pro-cyclical as distributions has first-order implications for our understanding of the liquidity premium that private equity *should* command. If private equity funds tend to call capital at economic troughs, when expected returns are high, then the implications for liquidity are very different than if calls occur when expected returns are low. If the former were the case, private equity should command a high premium in equilibrium, since the expected cost of unfunded commitments to private equity would be high. Conversely, because we find the latter to be case, the implication is that the ultimate liquidity exposure to private equity investors is probably modest. Or to put it differently, our findings suggest that discounts observed in the secondary market for private equity are more likely to be driven by the specific situations of particular investors rather than by systematic factors. Indeed, we find that most variation in cash flows is idiosyncratic, and most of the predictable variation is explained by the age of the fund, as young funds call capital to make investments and older funds focus on exiting the investments they have made.

Ultimately, our analysis raises questions about liquidity that go beyond the scope of this paper. Buyout and venture funds, after all, are not consumers of liquidity, they are financial intermediaries who pull liquidity from limited partners and distribute it to portfolio companies in the form of specifically structured investments. The general equilibrium properties of the liquidity redistribution that occurs from limited partners to the corporate sector through the private equity channel is an important topic for future research.

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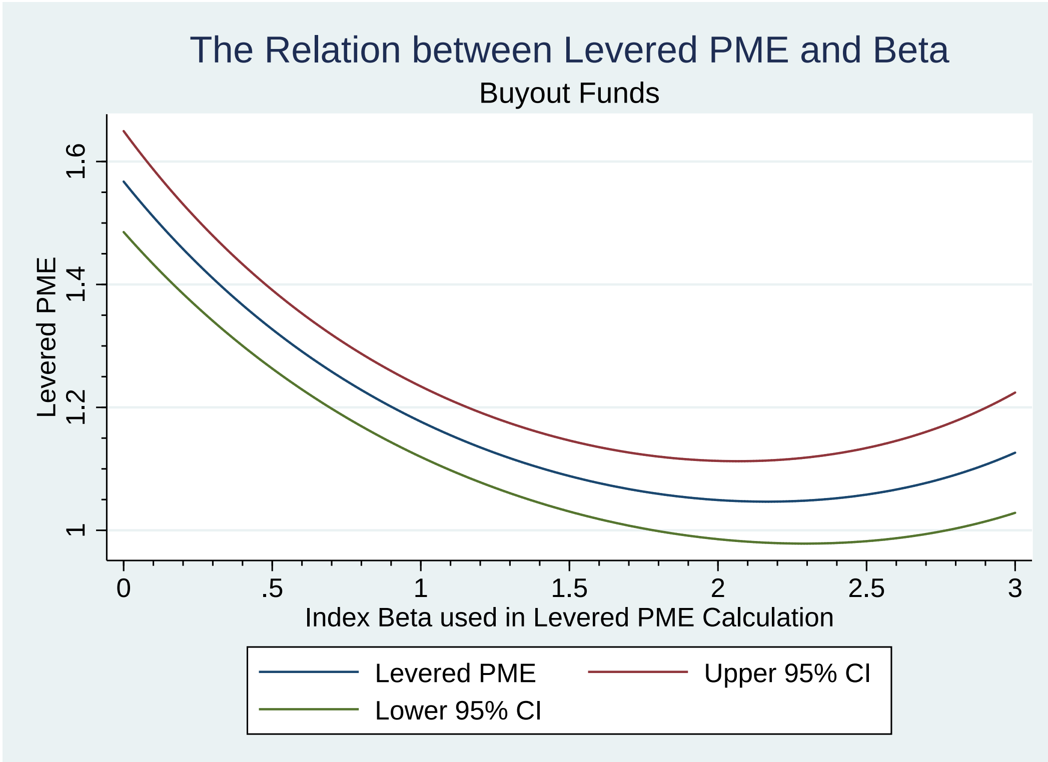
Figure 1: Levered PME-β Sensitivity

This figure displays cross-sectional averages and 95% confidence intervals for Levered PMEs, using the sample of liquidated funds, as the beta used in the Levered PME calculation varies from 0 to 3.



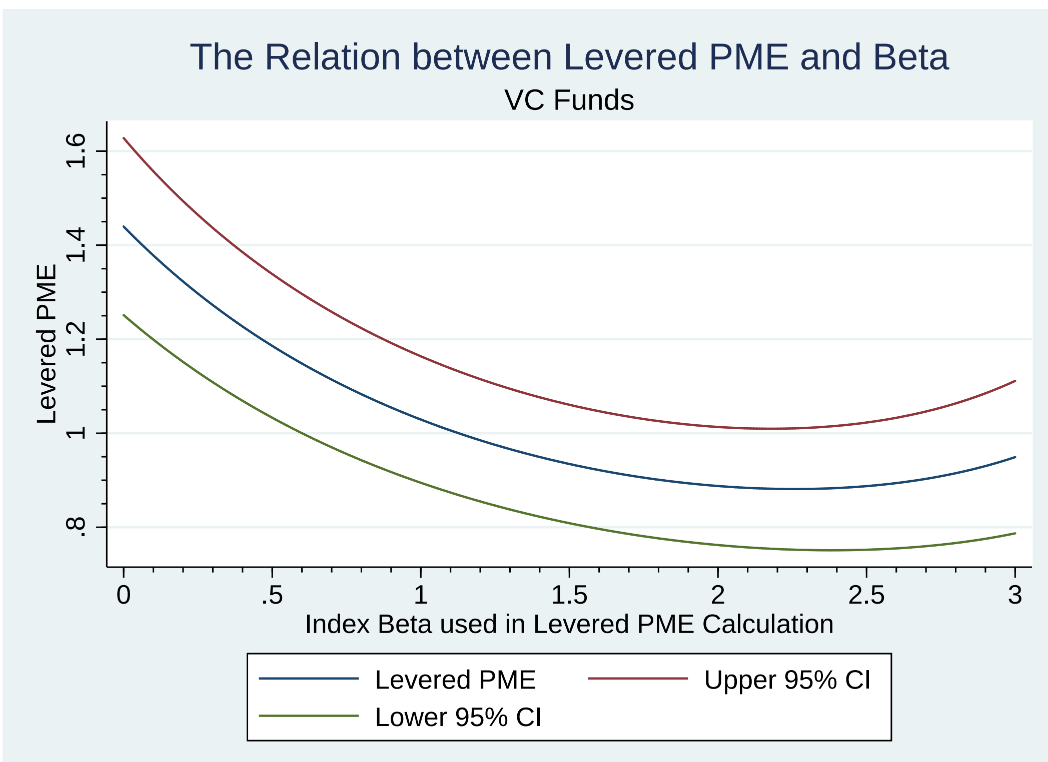
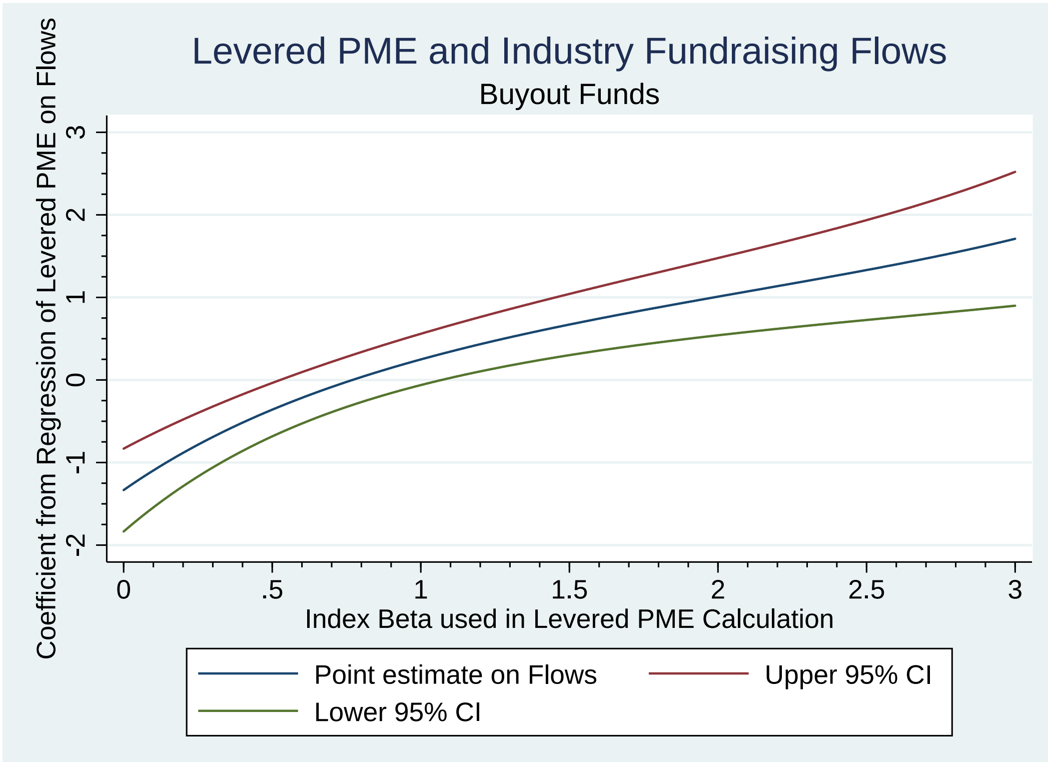


Figure 2: Fund Flow/Performance Relations for Alternative Levered PME Assumptions

This figure displays coefficients and 95% confidence intervals from regressions of Levered PME on Industry Flows expressed as a percentage of stock market capitalization (see Table 4), using the sample of liquidated funds, as the beta used in the Levered PME calculation varies from 0 to 3.



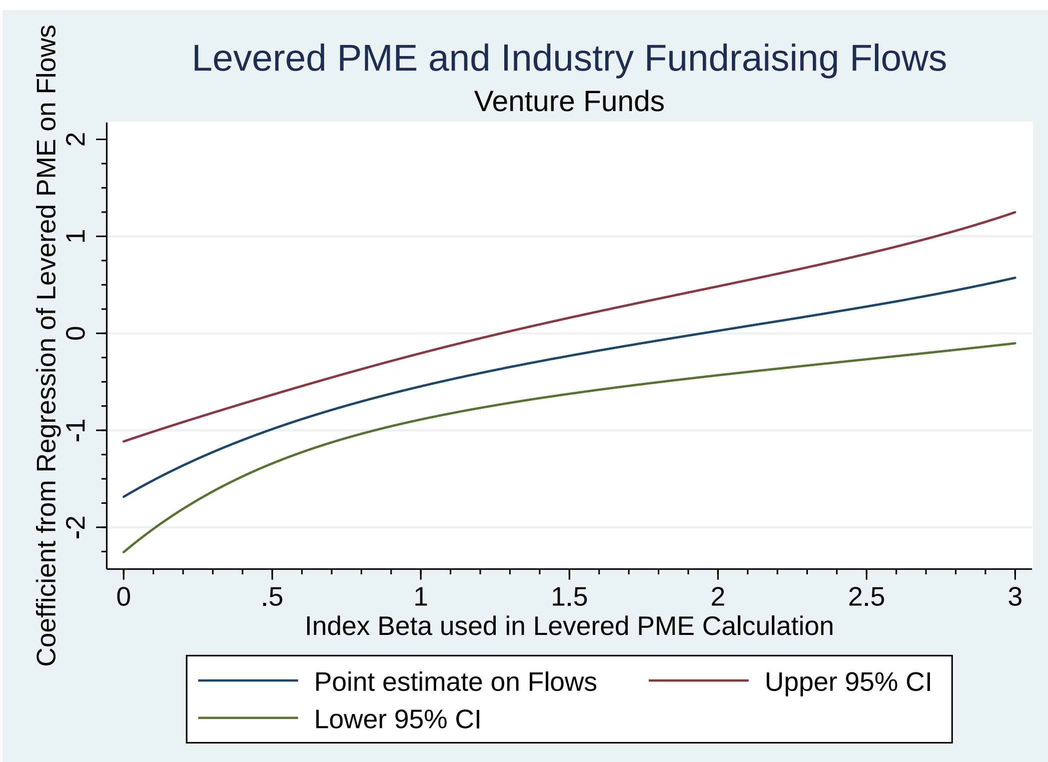


Figure 3: Market conditions and Capital Calls

This figure displays the aggregate fraction of uncalled capital that is called each quarter for buyout and venture capital. The smoothed line is a locally weighted least squares regression using the nearest 10% of the data surrounding a point.

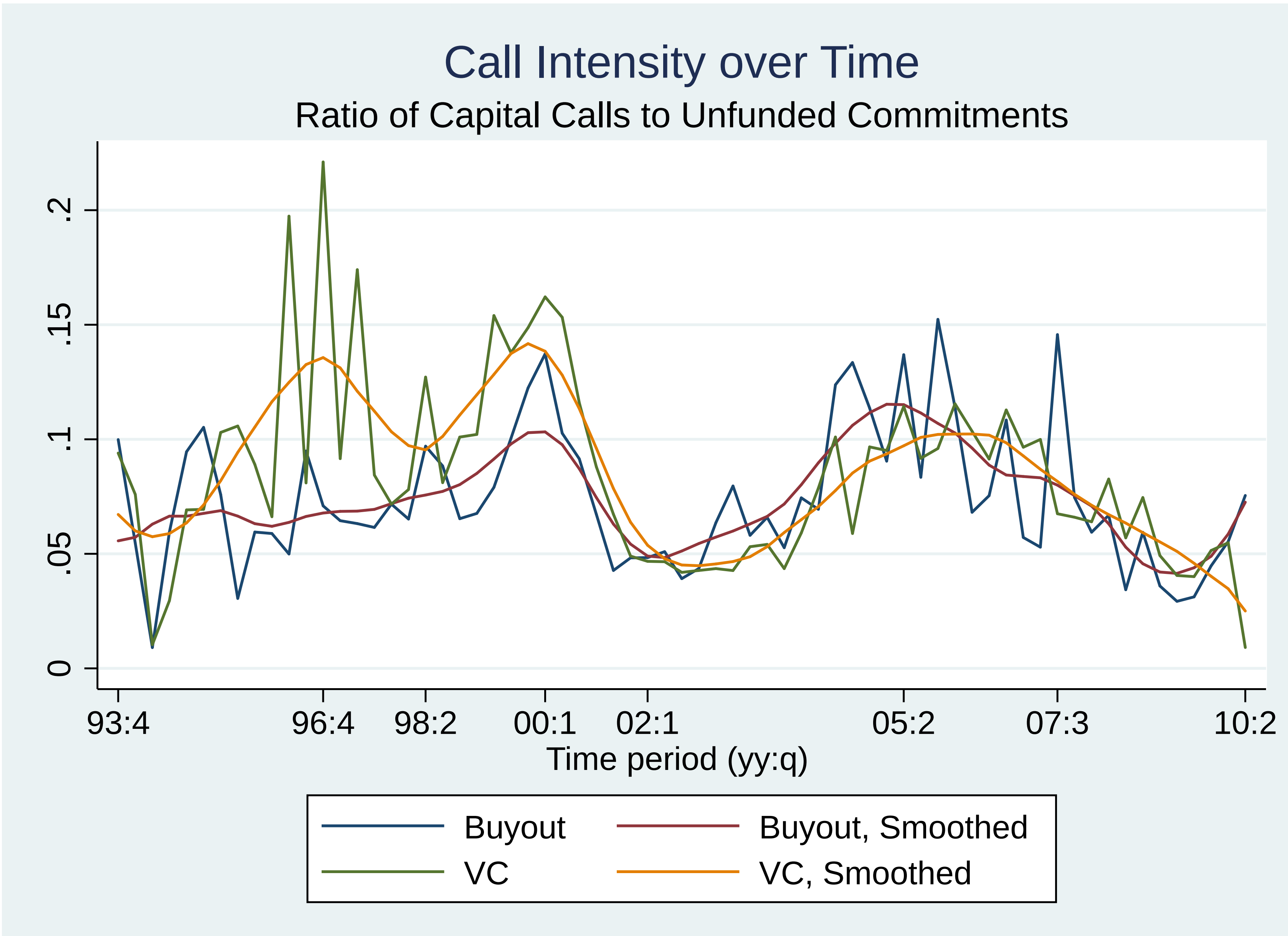


Figure 4: Market conditions and Distributions

This figure displays the aggregate fraction of committed capital that is distributed each quarter for buyout and venture capital.

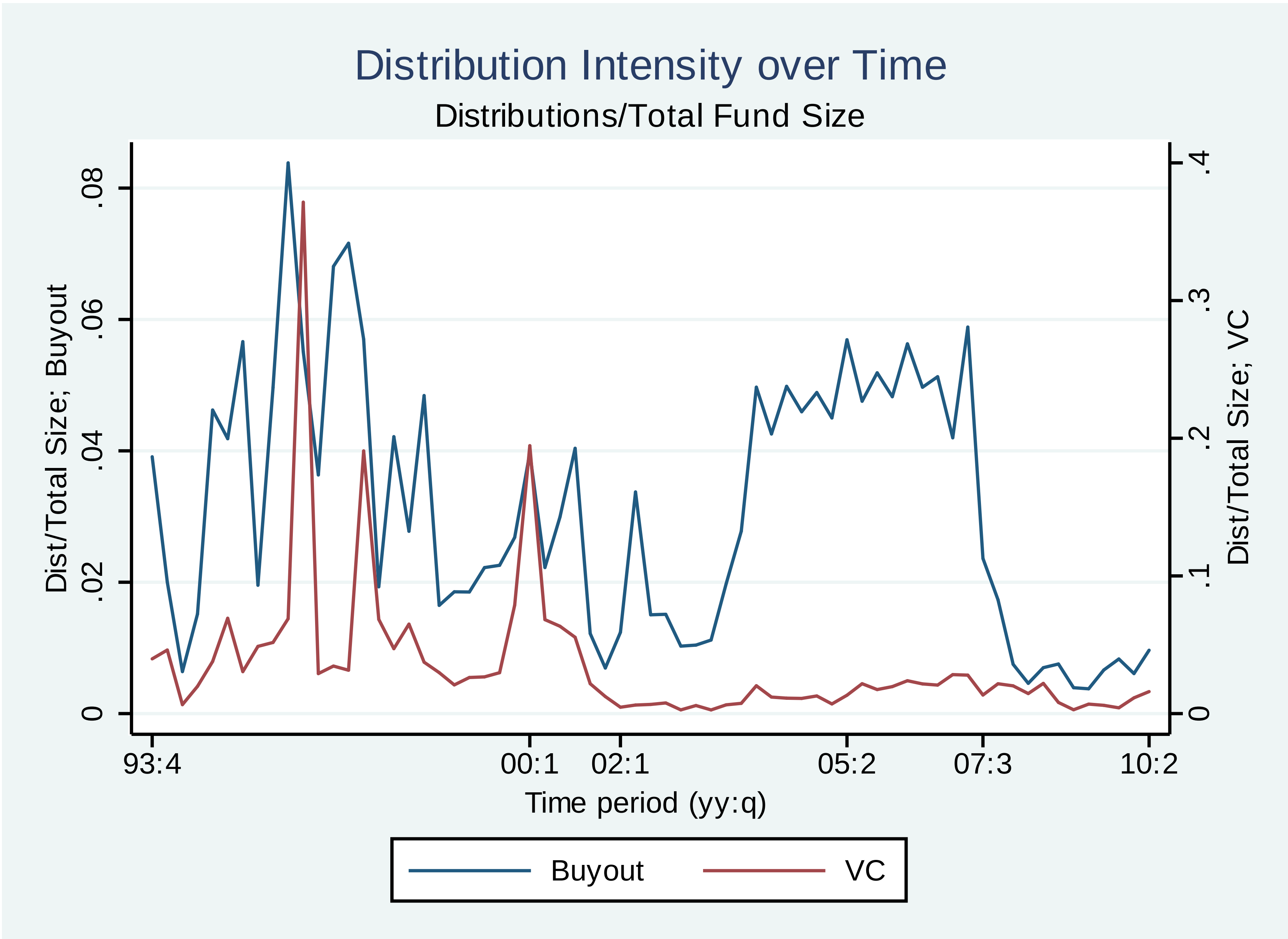


Table 1: Sample Summary

This table presents summary statistics for the venture capital (VC) and buyout (BO) private equity funds in our sample. Fraction of 1st, 2nd, and 3rd funds indicates the fraction of sample funds of that sequence number (position in a partnership's sequence of funds). Total Committed Capital is the aggregate amount of capital committed to our sample funds (i.e. the sum of the sizes of all sample funds). Total LP Capital and Total GP Capital indicate, respectively, the contributions of limited partners and general partners to this total. The % of VE universe is the total committed capital of the sample funds of a given fund type expressed as a percentage of the total committed capital to all funds of the same type reported on Venture Economics over the entire 1984-2009 sample period. The % of VE U.S. universe includes only U.S. funds. Fund Size is the committed capital of the fund. All dollar amounts are in millions of US dollars. The full sample includes all funds. Funds in the liquidated sample are those that had vintage years prior to 2006 and either were officially liquidated as of 6/30/2010 or had no cash flow activity for the last six quarters of the sample.

	All Funds	Buyout	Venture Capital
Full Sample:			
Number of Funds	837	542	295
Fraction of 1st Funds	0.30	0.32	0.25
Fraction of 2nd Funds	0.24	0.23	0.26
Fraction of 3rd Funds	0.16	0.16	0.15
Total Committed Capital	$596,843	$535,485	$61,358
Total LP Capital	$585,745	$525,276	$60,469
Total GP Capital	$11,088	$10,209	$879
% of VE universe	26.5%	41.6%	10.8%
% of VE U.S. universe	34.4%	55.7%	15.9%
Mean Fund Size ($M)	713.06	987.98	207.96
Median Fund Size ($M)	204.34	312.91	106.12
St. Dev. Fund Size ($M)	1887.61	2291.21	276.26
Liquidated Sample:			
Number of Funds	560	368	192
Fraction of 1st Funds	0.33	0.35	0.28
Fraction of 2nd Funds	0.23	0.23	0.23
Fraction of 3rd Funds	0.16	0.15	0.18
Total Committed Capital	$308,309	$271,183	$37,126
Total LP Capital	$302,165	$265,556	$36,609
Total GP Capital	$6,144	$5,627	$517
Mean Fund Size ($M)	550.55	736.91	193.37
Median Fund Size ($M)	172.90	266.72	83.46
St. Dev. Fund Size ($M)	1228.38	1467.87	284.51

Table 2: Summary Statistics on Cash Flow Performance

We calculate IRRs, TVPIs, and public market equivalents (PMEs) using actual fund cash flows. TVPI (total value to paid in capital) is the ratio of the undiscounted sum of distributions to the undiscounted sum of capital calls. S&P PME, following Kaplan and Schoar (2005), is the ratio of the discounted sum of distributions to the discounted sum of capital calls, where the discount rate is the return on the S&P 500 index. Tailored PMEs use different benchmarks: for venture, the Nasdaq index; for buyout, the Fama-French size tercile index according to whether the fund is a small-cap, mid-cap, or large-cap buyout fund. The table reports equal-weight cross-sectional statistics of fund-level final realized performance. The full sample includes all funds, with ending NAV treated as a liquidating cash flow for non-liquidated funds. The liquidated sample includes funds with pre-2006 vintage years that were either liquidated by 06/30/2010 or have no cash flow activity for the last six quarters of the sample.

	Buyout Funds		Venture Capital Funds	
Sample:	Full (N=542)	Liquidated (N=368)	Full (N=295)	Liquidated (N=192)
IRR:				
Mean	0.09	0.12	0.08	0.09
Median	0.09	0.10	0.01	0.02
St. Dev.	0.26	0.28	0.43	0.47
25^{th} %ile	-0.02	-0.01	-0.09	-0.08
75^{th} %ile	0.19	0.22	0.13	0.16
TVPI:				
Mean	1.51	1.57	1.38	1.44
Median	1.36	1.45	1.03	1.05
St. Dev.	0.86	0.80	1.45	1.33
25^{th} %ile	0.95	0.99	0.68	0.72
75^{th} %ile	1.84	1.90	1.51	1.65
S&P PME:				
Mean	1.19	1.18	1.06	1.03
Median	1.09	1.09	0.84	0.82
St. Dev.	0.61	0.56	1.15	0.95
25^{th} %ile	0.82	0.82	0.55	0.52
75^{th} %ile	1.46	1.46	1.21	1.13
Tailored PME:				
Mean	1.08	1.10	1.09	1.06
Median	0.96	1.00	0.85	0.83
St. Dev.	0.64	0.65	1.16	0.94
25^{th} %ile	0.74	0.77	0.56	0.54
75^{th} %ile	1.30	1.37	1.28	1.18

Table 3: Fund Performance, Size, and Persistence

This table presents cross-sectional fund-level OLS estimates of the relations between final fund performance and fund characteristics, including fund size, sequence, and the performance of the partnership's previous fund. The sample includes only liquidated funds, though we obtain similar results using the full sample of funds. The dependent variable is the PME with respect to the S&P 500. The first five specifications include only buyout funds, the next five only venture capital funds. Standard errors (in parentheses) are robust to heteroskedasticity and clustered at the partnership level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable = PME									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ln(Fund Size)	0.03	0.26**	-0.04			0.05	0.81**	-0.61**		
	(0.02)	(0.13)	(0.16)			(0.05)	(0.31)	(0.24)		
ln(Fund Size)^2		-0.02*					-0.09***			
		(0.01)					(0.03)			
ln(Fund No.)		-0.01	-0.13				0.17	0.85**		
		(0.06)	(0.38)				(0.12)	(0.37)		
Previous PME				0.22***	0.23***				0.17*	0.32***
				(0.06)	(0.06)				(0.10)	(0.10)
Constant	1.61***	0.99*	0.96	0.83***	0.90***	0.62**	-1.16	2.36**	0.50***	0.79***
	(0.38)	(0.51)	(0.96)	(0.16)	(0.09)	(0.30)	(0.82)	(0.99)	(0.03)	(0.14)
Sample	BO	BO	BO	BO	BO	VC	VC	VC	VC	VC
Vintage Year FE?	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
Fund Family FE?	No	No	Yes	No	No	No	No	Yes	No	No
Observations	368	368	368	152	152	192	192	192	73	73
R-squared	0.08	0.09	0.73	0.18	0.13	0.17	0.19	0.59	0.36	0.12

Table 4: Fund Performance and Market Conditions

This table presents fund-level OLS estimates of the relations between final fund performance and market conditions at time of fundraising. The main independent variable, "Flows", is equal to the total capital committed to all funds of the same type raised in the fund's vintage year (data from Venture Economics), expressed as a percentage of total U.S. stock market capitalization at the end of the vintage year (data from CRSP).Size Q1-3 are indicator variables for whether the fund's size falls into the bottom, second, or top tercile of the size distribution of all funds of the same type. Panel A reports results for the liquidated sample and Panel B for the full sample. In odd-numbered columns, the dependent variable is fund TVPI (undercounted ratio of total distributions to total calls). In even-numbered columns, the dependent variable is fund PME with respect to the S&P 500. A constant is estimated but not reported in all specifications. Size Q indicator variables (level effects) are estimated in specifications (3), (4), (7), and (8), but not reported for brevity. Standard errors (in parentheses) are robust to heteroskedasticity and clustered by vintage year. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Liquidated Sample								
	Buyout Funds				Venture Capital Funds			
	TVPI	PME	TVPI	PME	TVPI	PME	TVPI	PME
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Flows	-1.26***	0.25			-1.68***	-0.55***		
	(0.27)	(0.16)			(0.29)	(0.17)		
Flows×Size Q1			-0.62	0.74**			-1.47***	0.06
			(0.55)	(0.28)			(0.35)	(0.55)
Flows×Size Q2			-1.74***	0.17			-1.98***	-0.48
			(0.37)	(0.21)			(0.47)	(0.28)
Flows×Size Q3			-1.48***	-0.20			-0.98	-0.69
			(0.51)	(0.27)			(0.72)	(0.51)
Observations	368	368	368	368	192	192	192	192
R-squared	0.06	0.01	0.06	0.02	0.10	0.02	0.11	0.04

Panel B: Full Sample								
	Buyout Funds				Venture Capital Funds			
	TVPI	PME	TVPI	PME	TVPI	PME	TVPI	PME
Flows	-0.66***	-0.11			-1.65***	-0.70***		
	(0.13)	(0.07)			(0.28)	(0.19)		
Flows×Size Q1			-0.43	0.69**			-1.89***	-0.55
			(0.30)	(0.25)			(0.34)	(0.43)
Flows×Size Q2			-1.01***	-0.08			-1.66***	-0.55**
			(0.27)	(0.11)			(0.34)	(0.21)
Flows×Size Q3			-0.52***	-0.19***			-0.83	-0.57
			(0.14)	(0.04)			(0.56)	(0.40)
Observations	542	542	542	542	295	295	295	295
R-squared	0.06	0.00	0.07	0.03	0.09	0.03	0.10	0.03

Table 5: Cash Flows, Fund Age, and Macroeconomic Conditions

This table presents estimates of the determinants of net cash flows (distributions minus calls), distributions, and capital calls, all expressed as a percentage of the fund's committed capital. The unit of observation is a fund-calendar quarter. ln(P/D) is the natural logarithm of the price/dividend ratio of the S&P 500. ln(Yield Spread) is the natural logarithm of the yield spread. % Uncalled is the percentage of committed capital that has not yet been called. All of these variables are measured at the end of the previous calendar quarter, so these are predictive regressions. In the tests, (log) yield spread is orthogonalized with respect to (log) P/D. In each Panel, specifications (1)-(6) use only the sample of buyout funds, while specifications (7)-(12) use only the sample of VC funds. All specifications include a constant (unreported). Estimation is OLS in Panel A, and Tobit in Panels B and C. Standard errors (in parentheses) are robust to heteroskedasticity and clustered by calendar quarter. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Specifications (1)-(6): Buyout Funds						Specifications (7)-(12): Venture Capital Funds					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Dependent variable is net cash flow as percentage of committed capital												
ln(P/D)			1.36***	0.70	1.28***	1.04**			4.24**	2.61*	4.12**	3.85**
			(0.46)	(0.68)	(0.47)	(0.45)			(1.74)	(1.52)	(1.72)	(1.61)
ln(Yield Spread)					-0.62***	-0.59***					-0.81**	-0.70**
					(0.11)	(0.11)					(0.32)	(0.29)
ln(% Uncalled)						-1.12***						-1.52***
						(0.16)						(0.37)
Fund Age FE	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Time FE	Yes	No	No	No	No	No	Yes	No	No	No	No	No
Observations	21,687	21,687	21,684	21,684	21,684	21,684	13,032	13,032	13,029	13,029	13,029	13,029
Adjusted R-squared	0.079	0.072	0.072	0.000	0.074	0.084	0.075	0.038	0.043	0.002	0.045	0.055
Panel B: Dependent variable is log (distributions as percentage of committed capital + 1)												
ln(P/D)			0.37***	0.49**	0.37***	0.34***			1.38***	0.97***	1.39***	1.33***
			(0.14)	(0.20)	(0.12)	(0.13)			(0.35)	(0.29)	(0.37)	(0.35)
ln(Yield Spread)					-0.30***	-0.30***					-0.62***	-0.61***
					(0.04)	(0.04)					(0.12)	(0.12)
ln(% Uncalled)						-0.12***						-0.12***
						(0.02)						(0.05)
Fund Age FE	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Time FE	Yes	No	No	No	No	No	Yes	No	No	No	No	No
Observations	21,687	21,687	21,684	21,684	21,684	21,684	13,032	13,032	13,029	13,029	13,029	13,029
Pseudo R-squared	0.055	0.039	0.039	0.001	0.045	0.046	0.068	0.021	0.027	0.003	0.039	0.040
Panel C: Dependent variable is log (capital calls as percentage of committed capital + 1)												
ln(P/D)			0.33***	0.95***	0.35***	0.42***			0.82***	2.15***	0.90***	1.10***
			(0.09)	(0.20)	(0.09)	(0.09)			(0.20)	(0.26)	(0.21)	(0.20)
ln(Yield Spread)					-0.08***	-0.09***					-0.19*	-0.27**
					(0.03)	(0.03)					(0.11)	(0.11)
ln(% Uncalled)						0.32***						0.63***
						(0.02)						(0.03)
Fund Age FE	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Time FE	Yes	No	No	No	No	No	Yes	No	No	No	No	No
Observations	21,687	21,687	21,684	21,684	21,684	21,684	13,032	13,032	13,029	13,029	13,029	13,029
Pseudo R-squared	0.134	0.125	0.126	0.007	0.127	0.146	0.176	0.132	0.135	0.017	0.137	0.179

Table 6: Cash Flows and the 2007-2009 Crisis

This table presents estimates of the determinants of net cash flows (distributions minus calls), distributions, and capital calls, all expressed as a percentage of the fund's committed capital. The unit of observation is a fund-calendar quarter. "Crisis Indicator" is equal to one for calendar quarters 2007:Q3-2009:Q1 (inclusive) and zero otherwise. All other variables are defined in previous tables. In each Panel, specifications (1)-(2) use only the sample of buyout funds, while specifications (3)-(4) use only the sample of VC funds. All specifications include a constant and fixed effects for fund age in calendar quarters (unreported). Estimation is OLS in Panel A, and Tobit in Panels B and C. Standard errors (in parentheses) are robust to heteroskedasticity and clustered by calendar quarter. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Buyout Funds		Venture Capital Funds	
	(1)	(2)	(3)	(4)
Panel A: Dependent variable is net cash flow as percentage of committed capital				
Crisis Indicator	-1.27***	-0.34	-1.10***	0.48
	(0.38)	(0.32)	(0.40)	(0.75)
ln(P/D)		1.00**		3.89**
		(0.45)		(1.64)
ln(Yield Spread)		-0.56***		-0.75**
		(0.11)		(0.33)
ln(% Uncalled)		-1.12***		-1.52***
		(0.16)		(0.37)
	All specifications include fund age fixed effects			
Observations	21,687	21,684	13,032	13,029
Adjusted R-squared	0.072	0.084	0.039	0.055
Panel B: Dependent variable is log (distributions as percentage of committed capital + 1)				
Crisis Indicator	-0.34**	0.04	-0.80***	0.02
	(0.17)	(0.13)	(0.23)	(0.23)
ln(P/D)		0.35***		1.33***
		(0.13)		(0.35)
ln(Yield Spread)		-0.30***		-0.61***
		(0.05)		(0.12)
ln(% Uncalled)		-0.12***		-0.12***
		(0.02)		(0.05)
	All specifications include fund age fixed effects			
Observations	21,687	21,684	13,032	13,029
Pseudo R-squared	0.039	0.046	0.023	0.040
Panel C: Dependent variable is log (capital calls as percentage of committed capital + 1)				
Crisis Indicator	-0.07	0.08	0.47**	0.58**
	(0.05)	(0.09)	(0.20)	(0.24)
ln(P/D)		0.43***		1.13***
		(0.09)		(0.20)
ln(Yield Spread)		-0.10***		-0.30***
		(0.03)		(0.11)
ln(% Uncalled)		0.32***		0.63***
		(0.02)		(0.03)
	All specifications include fund age fixed effects			
Observations	21,687	21,684	13,032	13,029
Pseudo R-squared	0.125	0.146	0.132	0.180

Table 7: Cash Flows and Fund Characteristics

This table presents interactions of several fund characteristics ("Main Effects") with the focal variables of the prior two tables. Large and Small are indicators for whether the fund is in the largest or smallest tercile of the type-specific size distribution. First is an indicator for the first fund in a partnership's sequence. Low PME is an indicator for whether the fund's PME up to the previous quarter placed in the lowest tercile of all funds of the same type. Prior Dist. is an indicator for whether the fund had previously distributed capital prior to that quarter. All other variables are defined in previous tables. All specifications include but do not report the level crisis indicator, the level ln(P/D), ln(Yield Spread), and ln(% Uncalled), a constant, and fixed effects for fund age in calendar quarters. Estimation is OLS in Panel A, and Tobit in Panels B and C. Robust standard errors (in parentheses) are clustered by calendar quarter. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels.

	Specifications (1)-(5): Buyout Funds					Specifications (6)-(10): Venture Capital Funds				
Main Effect =	Large	Small	First	Low PME	Prior Dist.	Large	Small	First	Low PME	Prior Dist.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Dependent variable is net cash flow as percentage of committed capital										
Main Effect	5.94**	-5.58**	-5.12*	3.23	-7.54*	5.82	-11.39	1.81	3.42	-19.06*
	(2.48)	(2.56)	(2.81)	(3.80)	(3.89)	(4.96)	(7.21)	(5.24)	(5.91)	(10.11)
Main Effect ×:										
ln(P/D)	-1.53**	1.39**	1.25*	-1.42	1.53	-1.82	2.80	-0.66	-1.36	5.42*
	(0.62)	(0.65)	(0.69)	(0.95)	(0.96)	(1.33)	(1.98)	(1.39)	(1.64)	(2.78)
ln(Yield Spread)	0.09	0.17	-0.10	0.30*	-0.97***	0.50*	0.41	0.40	0.33	-1.23**
	(0.18)	(0.20)	(0.19)	(0.17)	(0.32)	(0.27)	(0.28)	(0.27)	(0.25)	(0.55)
ln(% Uncalled)	0.13	-0.01	0.05	0.39***	0.68*	0.14	0.22	0.33**	0.43	0.16
	(0.13)	(0.12)	(0.14)	(0.11)	(0.37)	(0.20)	(0.32)	(0.16)	(0.28)	(0.31)
Crisis	-0.18	0.59	0.25	0.19	-1.17	-1.03*	0.40	1.10	-0.48	0.11
	(0.46)	(0.54)	(0.58)	(0.34)	(1.19)	(0.59)	(0.65)	(0.69)	(0.45)	(1.39)
Additional Controls:	*Crisis indicator, fund age fixed effects, ln(P/D), ln(Yield Spread), ln(% Uncalled)*									
Observations	21,684	21,684	21,684	21,684	21,684	13,029	13,029	13,029	13,029	13,029
Adjusted R-squared	0.084	0.084	0.084	0.087	0.085	0.056	0.056	0.055	0.057	0.060
Panel B: Dependent variable is log (distributions as percentage of committed capital + 1)										
Main Effect	3.93***	-1.26*	1.02*	1.07*	2.41***	-2.72	-1.02	1.19	0.77	2.66
	(0.65)	(0.68)	(0.61)	(0.65)	(0.87)	(1.69)	(1.18)	(1.14)	(1.51)	(1.67)
Main Effect ×:										
ln(P/D)	-0.75***	0.08	-0.37**	-0.49***	-0.15	0.78*	0.06	-0.46	-0.36	-0.21
	(0.16)	(0.16)	(0.15)	(0.16)	(0.22)	(0.42)	(0.30)	(0.28)	(0.37)	(0.41)
ln(Yield Spread)	0.04	-0.06	-0.07*	0.01	-0.13*	0.17	0.18**	0.01	-0.06	-0.14
	(0.06)	(0.06)	(0.04)	(0.04)	(0.07)	(0.11)	(0.08)	(0.10)	(0.10)	(0.15)
ln(% Uncalled)	-0.10***	0.07***	0.11***	0.11***	-0.08	-0.16***	0.12***	0.13***	-0.02	0.05
	(0.02)	(0.03)	(0.03)	(0.02)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.07)
Crisis	-0.54***	0.42***	0.09	0.12	-0.45**	-0.08	0.14	-0.09	-0.35	-0.54
	(0.17)	(0.13)	(0.21)	(0.13)	(0.20)	(0.19)	(0.26)	(0.29)	(0.25)	(0.77)
Additional Controls:	*Crisis indicator, fund age fixed effects, ln(P/D), ln(Yield Spread), ln(% Uncalled)*									
Observations	21,684	21,684	21,684	21,684	21,684	13,029	13,029	13,029	13,029	13,029
Pseudo R-squared	0.054	0.055	0.048	0.054	0.057	0.041	0.043	0.042	0.044	0.053
Panel C: Dependent variable is log (capital calls as percentage of committed capital + 1)										
Main Effect	1.91***	-0.72*	1.94***	0.05	2.51***	2.24**	-1.24	-2.29***	0.60	3.75***
	(0.45)	(0.42)	(0.43)	(0.50)	(0.57)	(0.93)	(0.84)	(0.89)	(0.82)	(1.34)
Main Effect ×:										
ln(P/D)	-0.25**	-0.07	-0.50***	-0.04	-0.30**	-0.38*	0.12	0.47**	-0.19	-0.81**
	(0.11)	(0.10)	(0.10)	(0.12)	(0.13)	(0.22)	(0.20)	(0.21)	(0.20)	(0.32)
ln(Yield Spread)	-0.02	-0.03	-0.03	0.01	0.00	-0.06	0.08	0.04	0.31***	0.04
	(0.04)	(0.04)	(0.03)	(0.03)	(0.04)	(0.09)	(0.06)	(0.07)	(0.06)	(0.13)
ln(% Uncalled)	-0.17***	0.13***	0.00	0.04***	-0.27***	-0.07*	0.02	-0.01	-0.01	-0.10*
	(0.02)	(0.02)	(0.01)	(0.01)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	(0.05)
Crisis	0.07	0.05	-0.38***	0.17	-0.13	0.16	-0.72***	-0.61**	-0.22	1.29**
	(0.08)	(0.06)	(0.11)	(0.12)	(0.23)	(0.23)	(0.22)	(0.27)	(0.22)	(0.57)
Additional Controls:	*Crisis indicator, fund age fixed effects, ln(P/D), ln(Yield Spread), ln(% Uncalled)*									
Observations	21,684	21,684	21,684	21,684	21,684	13,029	13,029	13,029	13,029	13,029
Pseudo R-squared	0.154	0.159	0.147	0.146	0.149	0.184	0.187	0.183	0.181	0.181

Appendix

Table A-1 compares coverage and performance statistics for our sample to the samples available from publicly-available commercial databases Venture Economics (VE), Preqin, and Cambridge Associates. These data sources provide fund-level IRRs only, and not PMEs or underlying cash flows. Our source for information on the coverage of these databases is Harris, Jenkinson, and Stucke (2010), Tables 9 and 12. Table A-1 displays coverage and IRR statistics by vintage year. See Section II.B for a discussion of these comparisons.

Table A-2 reports average final fund performance by vintage year for our sample of liquidated funds. Performance is measured three ways: IRR, S&P PME, and Tailored PME. Following Kaplan and Schoar (2005), performance statistics are size-weighed within vintage year and fund type.

Table A-1: Comparison to Public Databases

This table presents comparisons of our sample coverage of U.S. buyout and venture capital funds to those of publicly-available commercial databases produced by Venture Economics (VE), Preqin, and Cambridge Associates (CA). The number of funds in our sample by vintage year are given for the full sample and for U.S. funds only; comparisons use only the U.S. funds. Our source for the coverage of these databases is Harris, Jenkinson, and Stucke (2010), Tables 9 and 12. Ave. IRR is the simple average IRR of all funds in a given vintage year (in percent). The exception is the CA average IRR for VC funds, which is a pooled IRR created by combining the cash flows from all funds within a vintage year. Wtd. Ave. IRR is the size-weighted average IRR by vintage year (in percent). Panel A compares buyout funds and Panel B compares venture capital funds. CA does not provide weighted-average IRRs. In Panel A, comparisons begin in 1986 and end in 2008, the interval for which Harris et al. report the needed data. In Panel B, comparisons end in 2007 because we have no VC funds raised after 2007.

	Number of funds					Ave. IRR				Wtd. Ave. IRR		
	Our Sample											
Vintage	Full	U.S.	VE	Preqin	CA	Our Sample	VE	Preqin	CA	Our Sample	VE	Preqin
Panel A: Buyout funds												
1984	3	3										
1985	5	5										
1986	1	1	10	6	7	13.2	18.0	18.3	15.4	13.2	20.9	21.7
1987	9	8	25	6	10	15.7	9.8	24.6	15.9	20.6	13.4	24.3
1988	14	14	14	8	11	9.3	8.7	14.6	10.8	8.7	9.7	14.0
1989	16	16	23	10	14	14.8	13.8	35.0	21.5	19.4	25.6	31.3
1990	7	7	9	10	4	21.5	5.0	21.9	16.7	27.6	11.3	22.4
1991	2	2	5	7	7	6.3	13.7	29.4	31.8	15.8	13.2	25.9
1992	4	4	15	13	6	30.5	20.0	15.3	34.4	37.3	23.9	22.1
1993	9	9	22	16	18	40.2	18.9	22.1	21.0	36.4	21.1	20.8
1994	25	24	26	21	13	22.8	14.0	22.1	13.3	25.7	15.9	24.1
1995	28	24	24	18	22	16.2	9.3	20.4	13.5	19.4	10.1	15.8
1996	49	41	26	22	25	10.2	8.3	12.2	9.1	8.3	6.6	8.2
1997	49	40	41	28	37	5.4	6.0	8.1	4.8	10.7	8.8	8.4
1998	78	59	55	44	38	4.8	5.5	6.0	7.7	3.9	1.3	2.2
1999	69	59	41	29	41	2.1	4.2	6.0	11.6	-4.1	7.7	6.6
2000	83	68	48	43	52	6.6	10.6	15.4	14.1	6.8	11.1	16.2
2001	33	26	27	18	12	12.0	11.3	22.0	25.5	3.6	11.1	25.8
2002	7	5	15	21	24	17.9	9.9	12.4	17.2	25.1	12.4	16.3
2003	8	8	11	20	19	37.5	9.1	15.7	13.1	48.2	17.3	26.7
2004	4	3	19	26	49	18.8	14.2	12.9	6.3	18.9	10.7	12.3
2005	2	2	20	50	44	-1.1	0.4	4.1	-0.8	-0.6	-3.9	4.8
2006	8	8	26	43	41	-18.3	-7.1	-6.3	-5.6	-4.6	-9.6	-7.8
2007	7	6	19	47	45	-17.6	-2.9	-5.5	-9.0	-14.6	-8.2	-7.4
2008	15	12	14	34	22	-17.7	-7.7	-7.0	-22.2	-30.3	-19.9	-8.5
2009	7	7										
Total (86-08)		446	535	540	561							
Panel B: Venture capital funds												
1984	6	6	64	14	32	10.6	5.0	13.7	8.6	10.2	6.1	12.4
1985	5	5	46	17	25	11.4	8.2	14.5	12.9	12.2	9.2	13
1986	3	3	43	16	31	-27.7	7.0	11.0	14.6	-10.1	10.2	12.8
1987	6	6	63	18	34	3.8	7.6	14.2	18.3	5.8	13.5	13.9
1988	9	9	44	21	27	12.0	12.3	22.7	21.1	15.3	19.8	24.9
1989	10	10	54	28	37	13.5	12.3	23.7	19.2	18.4	16.2	28.5
1990	1	1	22	15	15	14.9	17.5	18.9	35.2	14.9	24.4	23.3
1991	-	-	-	-	-	-	-	-	-	-	-	-
1992	4	4	28	19	24	6.8	25.2	27.3	34.8	8.5	29.1	30.7
1993	5	5	40	23	38	24.5	22.0	32.6	47.1	35.5	28.7	42.1
1994	8	7	39	23	42	61.8	25.2	32.3	55.6	62.5	32.8	48.9
1995	13	13	48	23	34	26.9	45.4	65.3	88.0	27.1	57.0	66.4
1996	14	13	36	21	41	22.7	74.1	39.1	99.3	24.2	59.2	32.3
1997	22	19	62	37	75	31.6	49.1	45.7	85.1	36.8	45.7	55.5
1998	43	36	76	32	81	12.4	25.0	24.8	12.4	18.9	23.0	26.4
1999	44	40	110	59	114	-10.1	-4.9	-5.3	-2.1	-22.6	-6.7	-6.2
2000	68	55	125	76	161	-6.6	-2.0	-1.2	-1.3	-9.4	-0.1	-1.2
2001	21	18	57	51	53	-8.8	0.8	-2.2	0.8	-10.4	0.8	0.8
2002	10	7	20	29	33	37.0	-0.6	-2.4	-0.3	7.5	-0.5	-0.1
2003	-	-	-	-	-	-	-	-	-	-	-	-
2004	-	-	-	-	-	-	-	-	-	-	-	-
2005	1	1	23	32	57	-5.9	0.8	-2.6	-0.9	-5.9	1.6	-0.5
2006	-	-	-	-	-	-	-	-	-	-	-	-
2007	2	2	23	41	52	-8.9	-4.2	-5.2	-4.2	-6.4	-5.8	-8.7
Total (84-07)		260	1023	595	1006							

Table A-2: Performance by Vintage Year for Liquidated Funds

This table reports size-weighted average final fund performance for our sample funds, measured by IRRs, S&P and Tailored PMEs, by vintage year. These variables are defined in prior tables. The table includes only the sample of liquidated funds.

	Buyout				Venture			
Vint.	N	IRR	S&P PME	Tail. PME	N	IRR	S&P PME	Tail. PME
1984	3	0.38	1.56	1.60	6	0.10	0.78	0.85
1985	5	0.24	1.27	1.31	5	0.12	0.92	1.03
1986	1	0.13	0.93	0.96	3	-0.10	0.78	0.79
1987	9	0.20	1.28	1.32	6	0.06	0.73	0.69
1988	14	0.09	0.77	0.78	9	0.15	1.02	0.97
1989	15	0.20	1.15	1.15	10	0.18	1.17	1.09
1990	7	0.28	1.35	1.36	1	0.15	1.01	0.96
1991	2	0.16	0.84	0.83	-	-	-	-
1992	4	0.37	1.31	1.40	3	0.06	0.84	0.79
1993	6	0.44	1.49	1.56	5	0.36	1.19	1.17
1994	22	0.28	1.28	1.37	6	0.52	1.87	1.69
1995	24	0.18	1.33	1.37	11	0.21	1.22	1.17
1996	36	0.09	1.07	1.01	6	0.27	1.27	1.10
1997	30	0.13	1.41	1.35	16	0.42	1.80	1.58
1998	54	0.06	1.25	1.10	26	0.30	1.54	1.54
1999	37	-0.03	1.20	1.07	30	-0.27	0.61	0.75
2000	60	0.06	1.14	1.06	34	-0.11	0.71	1.00
2001	22	0.04	1.03	0.97	8	-0.22	0.67	0.64
2002	6	0.27	1.25	1.24	6	0.03	0.85	0.85
2003	7	0.50	1.43	1.41	-	-	-	-
2004	2	0.17	1.04	1.03	-	-	-	-
2005	2	0.14	1.04	1.03	1	-0.06	0.80	0.79