Private Equity in the 21^{st} Century: Liquidity, Cash Flows, and Performance from 1984-2010*

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Abstract

Using detailed data on the quarterly cash flows for a large sample of venture capital and buyout private equity funds from 1984-2010, we investigate the times-series and cross-sectional properties of private equity cash flows and performance. On average, buyout funds in our sample have outperformed the S&P 500 on a net-of-fee basis by about 18% over the life of the fund, while venture funds have outperformed by about 3%. Performance and cash flows over time are highly correlated with public market conditions. Consequently, funds raised in hot markets underperform in absolute terms (IRR) but not relative to the S&P 500 (PME). Capital calls and distributions both increase when public equity valuations rise, but distributions are more sensitive than calls, implying that net cash flows are procyclical and private equity funds are liquidity providers (sinks) when valuations are high (low). Controlling for public equity valuations, there is little evidence for the common view that private equity is a liquidity sink, except during the financial crisis and ensuing recession of 2007-2009, when unexplained calls spiked and distributions plummeted.

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I. Introduction

Private equity has emerged as a central feature of financial markets over the last thirty years, with much of the growth occurring in the 21st century and the preceding technology boom. In spite of the size, importance, and growth of the private equity sector, we have a limited understanding of the returns and the behavior of cash flows in private equity. This is especially true for funds raised after 1995, which includes many of the most important events in the industry: the venture capital boom of the late 1990s, the technology bust of 2000-2001, the buyout boom of the mid-2000s, and the financial crisis and recession of 2007-2009.

This gap in our knowledge is largely due to lack of recent data on private equity cash flows; private equity is generally exempt from the disclosure regulations that apply to public equity markets. Moreover, as Harris, Jenkinson and Stucke (2010) show, commercially available databases do not offer a consistent picture of this asset class. In their words, "[t]he current state of private equity data clouds answers to basic practical questions."

This paper addresses some basic, yet central, questions in private equity using a proprietary database of 837 venture capital and buyout funds from 1984 to 2010. The data were provided to us by a large, anonymous institutional limited partner with extensive private equity investments, and represent almost $600 billion in committed capital. The data contain the quarterly cash flows between the funds and their investors, comprising nearly 35,000 fund-quarter observations extending through June 2010.[1] The dataset is the first available for academic research to include cash flow information for a large sample of private equity funds that extends beyond 2003 and includes funds raised after 1995.

We use these data to address some basic questions pertaining to the behavior of private equity cash flows, which in turn determine the returns that investors receive. When a limited partner (LP) invests in a private equity partnership, the LP enters into a commitment to provide capital to the general partners (GPs) when it is called, and in return receives distributions from GPs when investments are liquidated. The ultimate value of these calls and distributions depends on both their magnitude and their comovement with returns

[1] The data also include the key terms of the management contract between the limited and general partners, including the management fees and carried interest that the GPs earn as compensation and the GPs' own investment in the fund. In a companion paper working with these data, Robinson and Sensoy (2011), we explore issues relating to manager compensation and ownership in private equity.

to other investments. Capital calls in bad times, when liquidity is tight, entail a high opportunity cost, and distributions that occur in good times are less valuable than cash distributed when other investments are underperforming.

Given these considerations, we focus our analysis on a series of closely related questions. First, we examine the performance of our sample private equity funds relative to public equities. We start by following the methodology developed by Kaplan and Schoar (2005) and compute public market equivalents (PMEs) to measure the performance of private equity relative to that of the S&P 500. On average, our sample funds have public market equivalents (PMEs) of about 1.15, meaning they have outperformed the S&P 500 on a net-of-fee basis by about 15% over the life of the fund. This is especially true of buyout funds, where our data coverage is greatest: buyout funds in every vintage year since 1992 have outperformed the S&P, often by more than 25%.

These estimates are considerably higher than those in the earlier sample period studied by Kaplan and Schoar (2005) and Phalippou and Gottschalg (2009).[2] However, when we restrict attention to the portion of our sample that overlaps with Kaplan and Schoar's (2005) sample period, we find PMEs that are similar to theirs. We also find that VC funds significantly underperform buyout funds, in both IRR and PME terms.

We offer two extensions to the standard PME calculation. First, we replace the S&P return with narrower indices more closely tailored to a particular fund's investment strategy—the NASDAQ for venture funds and Fama French size portfolios for buyout. Using these "tailored PMEs" diminishes the underperformance of venture but does not change the basic message coming through from standard PMEs.

Second, we replace the S&P index return used in the PME calculation with levered S&P returns to account for the possibility that private equity investments have a beta with respect to the S&P that differs from one. By varying the exposure to the S&P, we nest certain calculations (such as TVPI) as special cases, and can also trace out the "levered PME"-beta relation for each fund. This allows us to assess the sensitivity of relative performance inferences to changes in beta. At the levels of beta estimated from prior work on private

[2] Both of these papers use cash flow data from Venture Economics. Their samples include funds with vintage years prior to 1995 (1993 in Phalippou and Gottschalg) and cash flows through 2003 (2001 in Kaplan and Schoar).

equity portfolio companies, buyout funds in our sample have an average levered PME reliably greater than one, while venture funds have levered PMEs less than one, though not reliably so. Our estimates imply that both types of funds in our sample outperform gross-of-fees, even using betas of 1.5-2.5.

In the cross-section, Kaplan and Schoar's (2005) findings of performance persistence and an increasing, concave relation between PME and fund size continue to hold in our sample, though the estimates weaken after their sample period, perhaps reflecting recent increases in capital and competition in the industry.

We also find that PMEs vary considerably over time. This finding leads us to the second main piece of our analysis, which asks how the co-cyclicality of broader public markets and private equity affect our understanding of the basic time-series properties of private equity performance. While it is well known that public and private equity markets have shared periods of boom and bust, the implications of this correlation for private equity investors are not well understood. We find that periods of high private equity fundraising are followed by low absolute private equity returns (i.e., low IRRs or TVPIs), particularly among the largest funds. This finding is consistent with Kaplan and Strömberg (2009), and squares with received wisdom. However, when we replace absolute performance measures with the relative performance measurement implied by PMEs, we find that this result vanishes altogether. That is, times of high fundraising are not generally followed by low PMEs, or put differently, funds raised in hot markets do not underperform relative to the S&P 500. These results emphasize the importance of using a relative performance measure to assess private equity performance over time.

Our third focus is on the liquidity properties of private equity cash flows, or more precisely, on the sensitivity of capital calls and distributions with respect to broader market conditions. Because limited partners invest in private equity through contractual arrangements that require them provide capital when they are called to do so, they inherently act as liquidity providers to an illiquid segment of the capital market. Thus, understanding the liquidity properties of private equity cash flows is of central importance to limited partners.

We find that more capital is both called and distributed when public equity valuations rise. Controlling for fund age, distributions are more sensitive to public markets than calls are, implying a positive correlation between public and private equity returns. The differential sensitivity of distributions and calls to public market valuations is highest for VC funds.[3] These results suggest that net cash flows are procyclical on the margin and private equity funds are liquidity providers (sinks) when public market valuations are high (low).

The financial crisis of 2007-2009 had a profound impact on liquidity conditions in private equity markets. Indeed, controlling for public market valuations, there is little evidence for the often-stated view that private equity is a liquidity sink, except during the financial crisis. In the third quarter of 2007, however, there was a dramatic spike in unexplained call activity. For the remainder of the crisis, capital calls were both lower and less sensitive to market conditions than before the crisis. At the same time, distributions plummeted throughout the crisis. These results suggest that, consistent with practitioner accounts, the crisis was associated with a greater abnormal liquidity demand by private equity funds, presumably reflecting concerns about acute, economy-wide liquidity shortages, even though the demand for capital driven by economic conditions dropped as a result of the economic downturn.

Finally, we document a great deal of heterogeneity across a number of fund characteristics in the propensity to call and distribute capital, the sensitivity of cash flows to market conditions, and the behavior of cash flows in the crisis. For instance, for both venture and buyout, first-time funds and small funds were less likely to call capital during the crisis, while first-time funds and poorly performing funds have a lower than average sensitivity of distributions to public market valuations. The heterogeneity in cash flow behavior associated with fund characteristics has important implications for limited partners interested in tailoring the liquidity properties of their private equity portfolios.

Although our dataset is the largest and most recent of its kind, and offers several unique advantages for studying these issues, a natural concern is whether the data we use are representative of the broad investment experience of the private equity industry. In Section II, we compare our data to alternative commercially available databases that do not offer cash flow data. The comparisons suggest that our data are highly representative of the

[3] This result is consistent with recent work demonstrating high market betas for VC portfolio companies (Korteweg and Sorensen, 2010; Driessen et al., 2011). The high sensitivity of VC calls to public markets is also consistent with Gompers et al.'s (2008) evidence that VCs adjust their investment activities in response to public market signals.

buyout funds documented in commercially available data.[4] Ultimately, however, any such comparison is tentative, because the population of private equity funds is not known, and it is therefore impossible to know whether any particular sample—ours or any other—is biased or unbiased. Our results clearly should be interpreted with this caveat in mind.

An important strength of our data is their source: they come directly from the LP's internal accounting system, and are thus free from the reporting and survivorship biases that plague commercially available private equity databases (Harris, Jenkinson, and Stucke, 2010). In addition, the data provider's overall portfolio was assembled over time as it acquired other institutions for reasons unrelated to each company's private equity exposure. This means that our sample is much broader (and more random) than it would otherwise be if it had been invested by a single limited partner. Nevertheless, our coverage of venture capital is significantly less comprehensive than our coverage of buyout, which likely reflects the GP/LP matching issues identified in Lerner, Schoar and Wongsunwai (2007).

Our work is most closely related to a series of papers working with private equity cash flow data. Kaplan and Schoar (2005) and Phalippou and Gottschalg (2009) use cash flow data from VE to assess the performance of private equity funds. Jones and Rhodes-Kropf (2003) also use VE data to investigate whether the idiosyncratic risk of private equity funds translates into higher returns. Ljungqvist, Richardson, and Wolfenzon (2007) use a different sample of private equity funds for which they have data on cash flows to and from portfolio companies as well as to and from LPs. Their focus is on understanding how the characteristics of portfolio companies and the timing of investments vary across funds and over the lifecycle of a fund. In all of these papers, the cash flow data does not extend beyond 2003, and is largely limited to funds with vintage years prior to 1995. The recency, breadth, and detail of our data allow us to extend prior work in important directions.

The remainder of the paper proceeds as follows. Section II describes the data. Section III offers evidence on the average performance of private equity funds, and the extent of cross-sectional and time-series variation in average performance. In this section we also

[4] Our dataset is large relative to the documented universe of U.S. private equity–we have over 50% of the Venture Economics (VE) universe of capital committed to U.S. buyout funds, and almost 40% of the overall VE U.S. private equity universe, during our sample period. We have about 80% as many U.S. buyout funds in our data as the number for which Venture Economics, Preqin, and Cambridge Associates report (only) fund-level IRRs.

develop and present several refinements to the PME measurement that allow us provide a number of robustness checks for our main performance findings. Section IV analyzes absolute and relative private equity performance over time, particularly with respect to fundraising conditions. Section V explores predictive regressions where we relate call and distribution activity (the components of private equity returns) to market conditions, and analyze the behavior of private equity cash flows during the financial crisis. 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 venture capital and buyout private equity funds. In total, there are 837 funds in our sample, representing almost $600 billion in committed capital spanning 1984-2009, or over 25% of the VE universe of total capital committed to venture capital and buyout funds over the same time period.

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 34,852 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; they return the net-of-carry proceeds from the investments 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.

The characteristics of funds in our sample are presented in Table 1. Our coverage is significantly stronger for buyout than for venture. Our data include only $61 billion in committed venture capital, or around 16% of the VE universe of U.S. funds, while we have 542 buyout funds, for a total capitalization of $535 billion, representing 56% of the total capitalization of the VE U.S. buyout universe over the 1984-2010 sample period.[5] On average, one-third of our funds are first funds, 23% are second funds raised by a firm, and 16% of the funds are third-sequence funds. These numbers 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 were either officially liquidated as of 6/30/2010, or had no cash flow activity for the last six quarters of the sample and had vintage years prior to 2006. This is called the "Liquidated Sample," and this sample forms the basis of much of our performance assessment, because we wish such assessments to be based on actual cash flows.[6] 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. Nevertheless, 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, but this is largely a function of the growing prevalence of large funds in the post-2006 vintage portion of the sample. Table 1 indicates that this is driven by large differences in average size of buyout funds across the two samples.

B. 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. Nevertheless, given that our data come from a single (albeit large) limited partner, the representativeness of the sample is a natural concern.

Assessing representativeness is inherently difficult because the main commercially available databases for private equity provide inconsistent accounts of private equity performance. In addition, these databases potentially suffer from reporting biases and survivorship biases

[5] Venture Economics has performance (fund-level IRR) information for only a small subset of the funds for which it has fund size.

[6] 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.

(Harris, Jenkinson and Stucke, 2010), which are not a concern in our data. In spite of these concerns, comparisons to commercially available data are one way to gauge the representativeness of our data.

The two commercially available data sources most commonly used in academic research are Venture Economics (VE) and Preqin. In the private equity industry, performance is also often gauged using data from Cambridge Associates (CA). These sources primarily focus on venture capital and buyout funds, and the performance data is fund-level IRRs or value multiples. These sources contain virtually no cash flow data that is available for research, with the exception of the VE data through 2003 used by prior research. As Table 2 illustrates, our data contain roughly 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.

Table 2 also shows performance statistics (IRR) by vintage year for our sample and 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, however, 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 2, 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 our sample variation were equal to that in the commercially available data, we would fail to reject all tests of the difference between the two series.

In any case, because summary statistics from VE, Preqin, and CA differ systematically from one another (Harris, Jenkinson and Stucke, 2010), 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 the private equity capital market (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. The Performance of Private Equity Funds

A. Aggregate Performance

We begin with an analysis of the aggregate ex-post cash flow performance of our sample of private equity funds, and compare it to the performance of the S&P 500. For this analysis, we rely on the sample of liquidated funds described in Section II, so that our inferences about performance are largely based on actual cash flows.[7] We begin by reporting performance at the fund level in two ways: (1) the IRR, which we (not our data provider) calculate from quarterly fund-level cash flows; and (2) the public market equivalent (PME) of the funds.

We first calculate PME following the methodology developed by Kaplan and Schoar (2005). We discount all cash outflows from the fund (distributions) using the realized total return of the S&P 500 from the fund's inception to the distribution date as the discount rate, and sum each discounted outflow to obtain the total discounted outflows from the fund. We similarly calculate the total discounted inflows (capital calls) to the fund. The ratio of the total discounted outflows to the total discounted inflows is the PME, and reflects the net-of-fee return to private equity investments relative to public equities.

A PME of 1.0 means that the fund exactly matched the performance of the S&P 500 over its life; at a PME of 1.0 an LP would have received exactly the same total return had she, instead of investing in the private equity fund, invested all capital calls in the S&P 500. A PME of 1.10 (0.90) means that the LP received 10% more (fewer) dollars from investing in the private equity fund compared to investing in the S&P 500. The PME is therefore a

[7]We treat ending NAVs as true values, as do Kaplan and Schoar (2005). Phalippou and Gottschalg (2009) recommend writing ending NAVs down to zero, which has only a very slight impact on our estimates of performance.

useful measure of performance for LPs who are interested in knowing whether investments in private equity outperform investments in public equities. At the same time, the PME is unlikely to be a measure of the true risk-adjusted returns to private equity funds (whether PME understates or overstates true risk-adjusted returns depends on whether the beta of private equity funds is less than or greater than one).

Table 3 reports statistics on aggregate IRR and PME, calculated from net-of-fee cash flows, by fund type for the full sample of liquidated funds. Several conclusions emerge.

The average (median) equally weighted fund IRRs are 11% (7%) for all funds taken together, 9% (2%) for VC funds, and 12% (10%) for buyout funds. On an IRR basis, therefore, the funds in our sample underperform those in the older sample (consisting of funds started before 1995) studied by Kaplan and Schoar (2005), who report aggregate average (median) IRRs of 17% (11%) for VC funds and 19% (13%) for buyout funds.

When examining PMEs, however, this conclusion reverses. The VC and buyout funds in our sample have an average (median) PME of 1.03 (0.82) for VC funds and 1.18 (1.09) for buyout funds, substantially greater than the PMEs of 0.96 (0.66) for VC funds and 0.97 (0.80) for buyout funds in Kaplan and Schoar's sample. Thus, unlike in Kaplan and Schoar's (2005) earlier sample, the more recent private equity funds in our sample have on average beaten the S&P 500 over the sample period, even net of fees. Though not shown in the table, we find similar PMEs as Kaplan and Schoar (2005) do when considering only their sample period.

The fact that IRRs are lower and yet PMEs are higher in our sample compared to that of Kaplan and Schoar (2005) reflects differences in the return to the S&P 500 over the sample periods (and potentially different timing of calls and distributions with respect to the market movements as well). These results clearly illustrate the potential for misleading conclusions using fund-level IRRs and highlight the importance of the cash flow data which enable us to calculate market-adjusted returns.

Table 3 also shows that there is wide dispersion in the returns of individual funds, and that the extent of the dispersion varies across different types of funds. VC funds display the most dispersion measured by the within-type standard deviation of PME (0.95, compared to 0.56 for buyout funds). Although the average funds in our sample outperform the S&P

500, a substantial fraction underperform.

In Table 3, size-weighted (i.e., weighted by committed capital) IRR and PME measures are similar on average and at the median to equally weighted measures. If anything, size-weighted performance is lower than equal-weighted performance. This is particularly true for VC funds.

Table 3 also shows that VC funds, as a group, have lower returns than other types of funds over the sample period. This contrasts with Kaplan and Schoar (2005), who find that VC funds outperform buyout funds on a size-weighted, PME basis. As we show in the following sections, this reflects the poor returns of VC funds, particularly of larger VC funds, beginning in response to the capital inflows following the technology boom of the late 1990s, which Kaplan and Schoar's (2005) sample period does not cover.

To guard against the possibility that the comparison between venture and buyout PMEs is unduly influenced by the choice of the S&P as the investable index, the bottom panel of Table 3 reports "tailored PMEs". These are public market equivalents that replace the S&P index with an index that more closely matches the fund in question. 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. (This is based on the fact that the size of the fund is highly correlated with the size of the portfolio companies that become buyout targets.)

Using tailored PMEs in place of Kaplan/Schoar PMEs raises the relative performance of venture and lowers the relative performance of buyout, but it does not reverse the general conclusion that venture underperformed buyout in our sample. For venture, the average tailored PME is 1.06, or roughly double the net relative performance based on standard PMEs. The difference owes largely to the fact that the NASDAQ crash was more severe than the decline of the S&P 500 during the crash that ended the technology boom of the late 1990s. For buyout, the tailored PME is 1.10, as opposed to 1.18 for the standard PME, and the median tailored PME drops from 1.09 to 1.0. This indicates that the returns of the median buyout fund were roughly identical to its size matched index. At the same time, we still find that the top quartile of buyout funds exceed the tailored benchmark return by 37% over the life of the fund. When we examine the commitment-weighted tailored PMEs, we see that they are higher for buyout but considerably lower for venture, indicating that the larger venture funds continue to underperform even relative to a benchmark that more closely tracks the underlying portfolio companies in question.

B. Fund Performance and Fund Characteristics

Previous work has established that private equity funds exhibit performance persistence—the performance of early funds in a fund family predicts the performance of later funds in the same fund family (Kaplan and Schoar, 2005). Kaplan and Schoar (2005) also establish a size effect in performance. Table 4 explores these issues in our sample.

We begin in Column (1) by estimating the relation between PME and the natural log of fund size across all 560 funds in our liquidated sample. We include a dummy for buyout fund and vintage year fixed effects, and find no meaningful relation between fund size and performance. Columns (4) and (7) repeat Column (1) but focus exclusively on venture and buyout, respectively. When we include a quadratic in log fund size (Columns (2), (5) and (8)), however, 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. Thus, larger funds perform better in the cross-section, but this effect diminishes as size grows.[8] This holds for buyout and venture separately.

Column (3) replaces fund size with past performance. The current fund's PME loads positively on the prior fund's PME, indicating performance persistence as documented by Kaplan and Schoar (2005). In Table 4 we have adopted the convention in Kaplan and Schoar (2005) and estimated the performance persistence relation using vintage year fixed effects. This shuts down the component of the persistence relation that is driven by the fact 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. Their convention is thus conservative. When we drop vintage year fixed effects, we obtain loadings that are roughly twice the size of those reported in Table 4 for venture and for buyout, with both subsamples

[8] In unreported tables we have also estimated Column (1) using fund family fixed effects; here we find a statistically reliable negative relationship between size and performance.

showing statistically significant performance persistence.

In sum, the cross-sectional performance characteristics in our sample match what has been documented in prior work, beginning with Kaplan and Schoar (2005). We find a concave size/performance relation in the cross section, but a negative within-family size/performance relation. Our data also show evidence of performance persistence. The persistence and size coefficients, however, weaken somewhat from the earlier sample period used in prior work. The strength of our performance persistence findings jumps by a factor of two when we omit vintage year fixed effects, allowing the clustering of follow-on fund formation following strong performance to inform the correlation between past performance and current performance.

C. Aggregate Performance over Time

The overall performance of private equity funds reported in Table 3 masks a great deal of variation in the returns to funds started at different points in time. To illustrate, Table 5 displays size-weighted average fund-level performance by vintage year for our sample of liquidated funds.

Of particular importance is the sharp decline in the returns of VC funds started between 1999-2002 compared to earlier in the 1990s. Between 1994 and 1998, the average equally weighted Kaplan/Schoar PME for venture in our sample is 1.54; funds with vintage years in the subsequent years earned PMEs that were approximately half that value. The severity of this swing is dampened considerably by replacing S&P-based PMEs with tailored PMEs, which not only deflate the high performance of the 1994-1998 vintages (because the NASDAQ was increasing faster than the S&P during this period), but also dampen the drop in performance of 1999 and 2000 vintages (because the NASDAQ crash was more severe than the decline in the S&P). In addition, Table 5 illustrates that the patterns in average performance over time for buyout and venture are more pronounced in IRRs than in PMEs.

The time-series variation in Table 5 reflects two separate forces at work. First, there is the fact that the performance of any given fund is determined by the investment opportunities available during the investment phase of the fund (generally the first few years of the fund's life). Second, perceptions surrounding expected future investment opportunities govern both the entry of new funds over time and the flow of new capital into the sector. We explore time-series patterns in performance in greater detail in Sections IV and V below.

D. Robustness: Levered PMEs for Alternative β Assumptions

Although PMEs capture the relative performance of private equity, they are agnostic on whether the differences in performance are attributable to differences in systematic risk or abnormal risk-adjusted performance. As a robustness exercise, in this subsection we consider how performance inferences change when we change assumptions about the underlying β implicit in the PME calculation.

For concreteness, consider first the standard PME calculation advanced by Kaplan and Schoar (2005):

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

where D_t and C_t are, respectively, distributions and calls occurring at time t. In this expression, r_τ is the (time-varying) return on an investable index (i.e., a quarterly return)—as discussed above, Kaplan and Schoar (2005) use the S&P return for r_τ, which assumes a beta of one. The PME is the ratio of the sum of discounted distributions to the sum of discounted calls. The calculation discounts each distribution and call by the total return (product of quarterly returns) from the fund inception date (or any arbitrary reference date) to the cash flow date. However, by changing the way r_τ is formed, we can nest several alternative measures. To consider the role of β in this calculation, we define the Levered PME as follows:

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

There is no clear consensus in the literature on the true betas of private equity investments, which are difficult to measure given the lack of objective interim market values and infrequent return observations.[9] Korteweg and Sorensen (2010) estimate β for VC portfolio investments,

[9]See Cochrane (2005) and Korteweg and Sorensen (2010) for a discussion of the issues involved.

find β in the neighborhood of 2.5. Driessen, Lin, and Phalippou (2011) report a β of 1.3 for buyout and a β of 2.7 for venture. But each of these estimates is an estimate of the β associated with the portfolio investments made by GPs in venture and buyout, not the β experienced by an LP investing in a portfolio of funds.

Given this range, we vary the β in the levered PME from 0.0 to 3.0, and plot cross-sectional average levered PMEs as a function of β in Figure 1 along with 95% confidence intervals (for the liquidated sample used in Table 3). The figure shows that the highest performance assessments are obtained when $\beta = 0$; this is the Total Value to Paid-In Capital (TVPI) measure that is simply the ratio of total distributions to total calls. As β increases, the performance assessment drops over a range, and then rises again. Moving beta from 1.0 to 1.5 for buyout funds moves average levered PME from 1.18 to 1.12. The minimal value of PME is achieved somewhere in the range of β about 2.2. Only in this range does the lower bound of a 95% confidence interval drop below 1. For values of β above 2.2, the PME begins to increase again, reflecting the complex interplay between market returns and the timing and magnitude of calls and distributions. In particular, for high values of β, early distributions, and those occurring in down/flat markets, receive high weights, while calls that occur in up markets are heavily discounted.

The lower panel of Figure 1 shows that the TVPI for venture funds is high, near 1.4, which in turn indicates that venture funds returned on average around 140% of the paid in capital to the fund. However, the levered PME deteriorates rapidly for venture funds, indicating that these high returns were earned precisely when broader markets were rising also. For values of β above 1.3, the levered PME is below 1 for venture funds, but not statistically significantly so. An increase in beta for venture funds from 1.0 to 2.5 results in an average levered PME of 0.89 rather than 1.03. At the PME minimizing value of β for venture, which is around 2.1, almost the entire 95% confidence interval lies below 1. Interestingly, however, the PME for venture begins to grow for values above 2.3, although it never crosses the PME=1 line for any β below 3.

Overall, Figure 1 shows that using the β values obtained from prior research on portfolio companies would yield low levered PMEs for venture funds, while buyout levered PMEs remain reliably above one. For both types of funds, varying β in the range 1.5 to 2.5 results in a sensitivity to β that is remarkably low.

While levered PMEs for VC are low, it is worth pointing out that this is a net-of-fee measure. For both venture and buyout, using what we know from the literature about the magnitude of fees in private equity (Gompers and Lerner, 1999; Metrick and Yasuda, 2010; Robinson and Sensoy, 2011), even using the βs estimated from prior work on portfolio companies yields gross-of-fee returns that exceed public equity benchmarks.

IV. Private Equity Performance and Industry Capital Flows

In Table 6 we take up the question of how private equity fundraising conditions are related to future performance with cross-sectional regressions of fund performance on market conditions at the time the fund was initiated. The key independent variables are *ln (Industry Flows)* (the natural logarithm of fundraising by fund type and vintage year, from VE) and *Adjusted Industry Flows* (Industry flows divided by total stock market capitalization at vintage year-end). The latter is the variable used by Kaplan and Strömberg (2009), who find a negative relation between buyout fund IRRs and Adjusted Industry Flows using data from VE. These are also interacted with dummies for the fund-type specific size tercile in which the fund resides. The question that Table 6 explores is then whether capital raising predicts performance, and how this varies with size.

We begin with Panel A, which considers all fund types together. All specifications use equally weighted performance measures, but we measure performance in two ways. First, in columns (1) and (5), we measure performance with TVPIs, building on the discussion in Section III.D. These are analogous to IRRs inasmuch as they reflect absolute, not relative, performance, and we obtain similar results with IRRs. Here we see that, across all funds, there is a negative and highly statistically significant relation between industry flows and performance, consistent with Kaplan and Strömberg (2009). In short, funds that are initiated in boom years have low performance, at least if performance is measured by TVPIs. This holds both for adjusted and unadjusted industry flows.

What happens if we measure performance with PMEs instead (which is not possible without cash flow data)? This answer is entirely different, as shown in Columns (2) and

(6). Namely, there is no relation at all between capital raising and performance if we use a performance measure that deflates cash flows by returns available to a publicly investable index.[10] In short, funds that are initiated in boom years might have low performance, but in general the so does the market as a whole over similar time periods. Relative to the public market, private equity performance is no different in high fundraising years than in low fundraising years.[11]

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 industry flows interacted with venture and buyout-specific size tercile dummies. If fund sizes grows with capital inflows, and the larger funds perform worse, then we should see especially poor performance among the largest funds in the boom periods. There is no industry flow/TVPI relation among the smallest funds of a given fund type when we examine unadjusted industry flows, but with adjusted industry flows we see modest negative performance among small funds growing monotonically with fund size. The fundraising/TVPI relation is about 50% stronger (more negative) in the top size tercile than in the middle two terciles. This reveals that the overall relation between industry flows and subsequent TVPIs is predominantly driven by the tendency of larger funds raised in peak fundraising years to deliver low TVPIs going forward.

Note, however, that this relationship is again purely driven by the choice of an absolute performance measure. When we switch from absolute to relative performance and look at PMEs, the fund-flow/size/performance interaction largely vanishes, depending on which measure of fund flows we use. If we use unadjusted fund flows (column (4)), there is only a modest negative relation at the third tercile, significant only at the 10% level. And there is evidence that small funds outperform. If we switch to adjusted fund flows (column (8)), the negative relation is present for the third tercile but not for the first two. This in turn suggests that at least part of the absolute underperformance of the largest funds in each asset class is driven by the fact that the peaks in the private equity market are highly correlated with peaks in the overall economy, and that overall economic performance wanes as private

[10]Note, too, that the R-squared values drop in half or more when we switch from TVPIs to PMEs. This is because we are asking the same set of regressors to explain not only the returns to the private equity funds themselves, but also the returns to the index against which the private equity returns are benchmarked.

[11]Because we include fund-type fixed effects in all specifications in Panel A, the results cannot be attributable to relative performance across different fund types of a given vintage year.

equity performance also wanes. This can be seen both in the comparison of the TVPI and the PME, and also by comparing adjusted and unadjusted fund flows: adjusted fund flows, which show the strongest flow/performance relation for PMEs, effectively separate private equity market conditions and public equity market conditions by deflating the former by the latter, and can be thought of as a measure of "abnormal" fundraising.

The results from Panel A of Table 6 indicate that if the returns to private equity are low following high fundraising years, then so are the returns to investable indexes outside of private equity. To explore differences across fund types, in Panel B we restrict attention only to venture funds, and in Panel C we restrict attention only to buyout funds. The results are similar in spirit to Panel A. The only statistically significant departure from Panel A is when we consider the relation between adjusted industry flows and PME for venture funds in Column (6) of Panel B. This shows the same negative relation as found with the TVPI, but column (8) shows this is driven by the performance of middle-sized funds. Comparing Panels B and C also suggests that VC funds are more prone to underperformance compared to buyout funds following times of high fundraising. These results are driven by the exceedingly low PMEs for venture funds in the 1999-2002 period.

As a further robustness check, Figure 2 asks where the breakpoint occurs between the negative fund-flow/performance relation found in TVPIs and the lack of a relation found using PMEs. It plots the coefficient on Flows in Column (1) of Table 6 Panel A, varying the β used in the levered PME calculation from 0 to 3, as described above. A standard confidence interval around the point estimate includes zero for all values of β ranging from around 0.7 to 1.3, meaning that the fund-flow/performance relation is reliably negative for TVPI and all levered-PMEs up to $\beta = 0.7$. For values of β greater than 1.3, using a levered-PME in place of TVPI actually produces a reliably positive (but generally quite modest) relation between fund flows and subsequent relative performance.

All in all, periods of high fundraising activity do not necessarily imply that returns going forward will be low because a glut of capital is chasing a dearth of investment opportunities in private equity. Rather, it appears that the periods of high fundraising activity presage broader market downturns. 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.

V. Cash Flows, Liquidity, and Macroeconomic Conditions

The analysis presented in the previous table indicates that private equity returns have a tendency to be low precisely when public equity returns are low, and that this is driving the difference between IRR- and PME-based performance measurement. These patterns in turn suggest that understanding how market conditions impact the timing of cash flows in and out of private equity is critical for understanding the performance of private equity funds relative to other investment opportunities. Moreover, the co-movement of private equity cash flows with broader market conditions— their liquidity properties— are of central importance to limited partners who must provide capital to GPs when it is called and whose returns consist of distributions provided by the GPs. We explore this issue in three steps. First, we present graphical evidence of aggregate call and distribution activity. Then we proceed to predictive regressions in which we predict next period's capital calls with current market conditions. Finally, we examine private equity distributions through the same lens of predictive regressions.

A. Aggregate Call and Distribution Activity

Figure 3 depicts the basic phenomena of interest. It plots the overall fraction of uncalled capital that is called in a given quarter, for venture and for buyout. The 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 x-axis, and we indicate the year and quarter of pivotal dates on the figure along the x-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 decline 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 middle of the first decade of the 21^{st} century. 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.

Buyout capital calls spiked unexpectedly in the third quarter of 2007. This can be seen in Figure 3 by the huge spike in the green line occurring at the 07:3 point along the x-axis. This spike in activity reflects two effects. One is a leverage effect. As GPs access to leverage deteriorated, more equity was required for deals that had been committed but not executed, causing the GPs to call more capital. At the same time, many GPs grew concerned that their LPs would be unable to meet capital calls, and thus they called capital in Q3:2007 for precautionary motives. As economic conditions began to deteriorate further, investment opportunities withered and capital calls ultimately dropped.

The spike in capital calls that occurred in the third quarter of 2007 is thus an illustration of the liquidity mechanism described in Brunnermeier and Pederson (2009), albeit in a different setting than their analysis envisions. General partners, in reaction to an exogenous contraction of liquidity in the market, endogenously called more capital, thereby amplifying the liquidity contraction that occurred. Indeed, some market observers at the time pointed to this liquidity shortage as a contributing factor behind the large fluctuations in public equities prices that occurred at that time, as investors rushed to sell more liquid securities to provide capital to meet these commitments.

Figure 4 plots a similar time-series for distributions, expressed as a fraction of the total committed capital at a point in time. It illustrates the fact that distributions of capital also plummeted for buyout during this same period. 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. Market Conditions and Capital Calls

In the remainder of the paper we turn from a graphical account of calls and distributions to predictive regressions that allow us to gauge the sensitivity of capital calls and distributions to market conditions at a point in time, and thus to assess the liquidity properties of private equity cash flows. In Tables 7 and 8 we analyze the behavior of capital calls over time for venture and buyout funds, respectively. The unit of observation is a fund-calendar quarter. The dependent variable is the natural log of (1 + called capital as a percentage of committed capital). Because both the dependent and key independent variables are in logs, the point estimates can be interpreted as the elasticity of capital calls with respect to market conditions.

In Column (1) we report a model that includes only time-period (calendar quarter) and fund-age fixed effects. Estimating a model with a fixed effect for each quarter, along with fund age fixed effects, gives us a non-parametric theoretical upper bound on the explanatory power that we could hope to obtain from a model that included variables capturing macroeconomic fluctuations. As we see from the R^2 in Column (1), the most we can hope to explain with time-series variables is about 17.6% of the total variation in the call behavior of venture funds. The analogous statistic from Table 8 is even lower, at 13.5%. Thus, most call decisions are idiosyncratic across funds of a given age (or vintage) and fund type at a given point in time.

Columns (2) and (3) 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), along with a dummy variable for the financial crisis. The crisis dummy equals one from 2007:Q3 to 2009:Q1, inclusive. By interacting the crisis dummy with the log price/dividend ratio, we allow the sensitivity of capital calls to market conditions to differ in the two regimes.

The R^2 in column (2) of Table 7 is 13.6%, in comparison to the 17.6% reported in Column (1). The fact that the price/dividend ratio alone achieves over three-quarters of the theoretical upper bound of a time-series model in our data suggests that we have indeed captured most of the explainable time-series movement in call activity with a highly parsimonious model of time-series fluctuations. A similar observation applies for buyout funds in Table 8.

Columns (2) and (3) differ inasmuch as Column (2) includes fund-age fixed effects, while

Column (3) does not. The difference in the loadings is pronounced. Columns (2) and (3) of Table 8 show similar patterns for buyout funds. 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 acknowledge 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, and is increasingly tilted toward funds that are in the investment phase of their life-cycle.

In Column (2) of Table 7, the point estimate indicates that before the crisis, a ten-percent increase in the price/dividend ratio predicts an 8.7% increase in venture call activity the next quarter. In Column (3), the analogous point estimate implies a 19.7% increase in call activity. Columns (2) and (3) also include a crisis dummy interacted with the price/dividend ratio. The negative loadings on the crisis interaction terms indicate that the sensitivity of call behavior to underlying macroeconomic fluctuations dampened significantly during this period. That is, capital calls were less sensitive to macroeconomic fluctuations during the crisis period than before the crisis period. Again, this supports the interpretation that the sensitivity of calls to macro conditions is a reflection of available investment opportunities outside the crisis period.

At the same time, the loading on the crisis dummy, which measures the unexplained call activity during the crisis, reflects the large spikes depicted in Figure 3 during the beginning of the financial crisis. The large call probability during the crisis reflects a precautionary motive, but as the underlying investment opportunities diminished, the sensitivity of calls with respect to macroeconomic fluctuation dampened. Indeed, during the Q3:2007-Q3:2009 period, capital calls were essentially unrelated to market conditions altogether. Tables 7 and 8 show that these conclusions hold for both venture and buyout funds.

Columns (4) and (5) include the treasury-eurodollar (TED) spread as a general measure of market liquidity. In Table 7, where the focus is on venture calls, we see that there is no relation between calls and liquidity conditions. However, in Table 8 there is a pronounced positive loading on the TED spread before the financial crisis. Following the 2000-2002 recession, the TED spread rises gradually, therefore the loading is partially picking up the fact that call activity is building gradually over the 2002-2007 period.[12]

In columns (6) and (7) we add the percentage of overall committed capital at the fund that is uncalled. The interpretations of the coefficients differ across the two columns. Because Column (6) include fund age fixed effects, the positive loading indicates that given two funds of exactly the same age, the one that has called less capital (and thus, by virtue of being the same age, has either encountered or acted upon fewer investment opportunities) is more likely to call capital in any given period. Holding this constant, however, we still see that calls load positively on valuation and liquidity measures, for both buyout and venture. Column (7) drops age fixed effects, allowing uncalled capital to vary as a function of fund age, and the conclusions remain.

To summarize the results thus far, we find that for both venture and buyout funds, improving valuation levels predict larger capital calls across the board. Venture funds, however, are about twice as sensitive to market conditions as buyout funds are. At the same time, the overall sensitivity of capital calls to market conditions is driven by two effects. First is the effect that for a given fund, improving market conditions predict improved investment opportunities, hence greater call activity. Second is the effect that improving market conditions pull new entrants into the sector, and younger funds are more likely to call capital than older funds. Comparing across specifications with and without fund-age fixed effects, we see that these two effects are of roughly equal magnitude. During the crisis, calls spike, the sensitivity of capital calls to valuation levels effectively vanishes, but sensitivity to liquidity conditions is largely unchanged.

The rightmost columns of Tables 7 and 8 dig deeper to explore which types of funds call capital, and under what circumstances. Columns (8)-(12) include dummy variables that sample on specific fund characteristics, and then interact that characteristic with the crisis dummy, log price/dividend, TED spread, and % uncalled capital. (The three-way interaction of crisis, fund characteristic and market conditions is not estimated, so the interaction of

[12]During this same period, the high-yield spread fell gradually as commercial credit became more plentiful. If we replace the TED spread with the the high-yield spread, we find a reliably positive and significant relation between calls and the high-yield spread in the pre-crisis period. Kaplan and Strömberg (2009) use the high-yield spread. Axelson et al. (2011) study how debt market conditions impact leverage and pricing in buyouts.

fund characteristic and market conditions is the weighted average of the pre-crisis and crisis values.) The characteristics of interest are whether a fund has made its first distribution (Column 8), whether it is a low performing fund (Column 9), whether it is a first fund (Column 10), whether it is small (11) or large (12). 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). Small funds and large funds are those in the lowest (respectively, highest) tercile of fund size (venture or buyout-specific). In Tables 7 and 8, as well as the distribution Tables 9 and 10, specifications interacting fund characteristics omit fund age fixed effects; including them produces qualitatively similar results. Because the interaction specifications include the characteristic in question as a level explanatory variable, they hold constant differences in the magnitude of cash flows across fund characteristics. The interaction terms thereby cleanly focus on differential sensitivities.

In Column (8) of Table 7, the loading on main effect × TED spread indicates that venture funds that have already distributed capital are more sensitive to liquidity conditions than those that have not. Similarly, the positive loading on the interaction with % Uncalled capital indicates that after distributions have occurred, funds tend to draw down uncalled capital more quickly the more uncalled capital they hold.

In Column (9), the positive loading on main effect × crisis indicates that low performing firms called more capital during the crisis. In contrast, first-time venture funds (Column 10) called less capital on average, called less capital during the crisis, but in general displayed higher sensitivity with respect to market conditions than later funds. Smaller venture funds called less capital during the crisis than middle-sized funds (Column 11), but larger funds were no different.

The differences across fund characteristics are considerably more pronounced for buyout funds. In Table 8, first-time buyout funds and large buyout funds called more capital on average before the crisis, and the magnitude of the main effect × crisis interaction indicates that this continues to hold during the crisis. At the same time, first-time buyout funds and large buyout funds show considerably lower sensitivity to market conditions than do later or smaller funds. Comparing the magnitude of the coefficient on ln(P/D) in the first row (i.e., the direct effect of the price/dividend) with the magnitude in the main effect × ln(P/D) row (i.e., the incremental effect attributable to being large or first-time) indicates that first funds and large funds display about half the overall sensitivity to market conditions than other funds.

C. Market Conditions and Capital Distributions

Tables 9 and 10 repeat the exact analysis conducted in Tables 7 and 8 but switch the focus from capital calls to distributions of capital back to limited partners. The dependent variable in each column is the natural log of 1 plus distributed capital as a fraction of total committed capital. Comparing columns (1) and (2) in each table, we see that distributions are inherently more idiosyncratic than capital calls. For example, even though venture distributions load more heavily on the price/dividend ratio than calls, the overall explanatory power of a non-parametric specification with fund age effects and quarter fixed effects explains around one-third as much of the variation in venture distributions as it explains of venture capital calls. Comparing Column (1) of Tables 8 and 10 indicates that time-series and fund-age specific variation in buyout distributions are less than one-half that of buyout capital calls. Models that drop fund age fixed effects have very low predictive power.

As with calls, Tables 9 and 10 indicate that distributions are positively related to P/D and the TED spread, and that these relations change in the crisis period. Likewise, the measured sensitivities of distributions to underlying market conditions changes markedly depending on whether age fixed effects are included in the specification: for venture funds, dropping age fixed effects reduces the distribution sensitivity by one-third, reflecting the fact that as market conditions improve, the average fund age drops, making distributions less likely. Holding constant fund age, the sensitivity of distributions to market conditions for venture funds is about 1.5 times that of capital calls.

Whereas capital calls grow less sensitive to market conditions in the wake of the crisis, distributions of capital—both for venture and buyout—grow more sensitive after the crisis. Indeed, Table 10 indicates that the sensitivity to market conditions during the crisis is about four times the sensitivity before the crisis. The crisis itself, however, caused a massive drop in the average level of distributions, as can be seen from the loading on the crisis dummy variable in both Tables 9 and 10.

Columns (8)-(12) of Tables 9 and 10 shed light on who distributes capital. The results are presented in a way that exactly matches the presentation of the capital calls, but this introduces the need for caution in interpreting some of the numbers. (For example, column (8) selects on whether or not the fund has made its first distribution, so the estimates compare the liquidity properties of the first distribution to subsequent distributions.) In Table 9, the main effect interactions indicate that low performing venture funds tend to distribute more capital on average, and with lower sensitivity to market conditions. The fact that these funds are in the lowest performance tercile at a point in time but at the same time distribute more capital on average reflects the fact that in venture, the bulk of the overall returns are generated by a few high-performing exits. Hence on average funds that have already had their big distributions move to the high-performing category. Large venture funds have lower average distributions, and more sensitivity with respect to market conditions.

In Table 10, columns (8) through (12) indicate that low performing, first-time, and large buyout funds distribute more capital on average, and have lower sensitivity to market conditions than other funds. The constant term on main effect in Column (12) indicates that the large fund effect for average distributions is especially large, but the interaction with the crisis dummy indicates that these funds distributed significantly less in the crisis than other funds. By comparison, average distributions for low performing funds and first-time funds actually increased modestly during the crisis.

D. Implications

Tables 7 through 10 allow us to take stock of how the liquidity properties of private equity vary with market conditions. Market conditions operate on private equity liquidity through two channels. First, they change the call and distribution patterns of any given fund, holding its age constant. Second, market conditions affect the age distribution of funds at a point in time by drawing new funds into the sector when market conditions improve. Skewing the age distribution of funds towards younger funds as conditions improve raises the average call sensitivity and lowers the average distribution sensitivity.

Comparing the magnitudes of the point estimates on ln(P/D) in Tables 7 through 10 shows that controlling for fund age, distributions are more sensitive to public market valuations than calls are, implying a positive correlation between private equity returns and public equity returns. The elasticities of venture distributions are more sensitive than those of venture calls. For buyout, elasticities are similar across calls and distributions. Because distributions are much larger than calls on average, the same elasticity across distributions and calls implies that the magnitude of distributions is more sensitive to P/D than the magnitude of calls. Thus, from a limited partner's perspective who wishes to know how market conditions impact (on the margin) the liquidity properties of a portfolio of funds, the results imply that net cash flows are procyclical and private equity funds are liquidity providers (sinks) when valuations are high (low).

Moreover, the difference between the sensitivities of distributions and calls to public equity valuations is larger for VC funds than for buyout funds. Although our regressions are predictive in nature, and do not naturally yield estimates of β for VC or buyout, the results are certainly suggest that VC investments have higher market betas than buyout investments, which is consistent with recent work demonstrating high betas for venture portfolio companies (Korteweg and Sorenson, 2010; Driessen, Lin and Phalippou, 2011).

As noted above, dropping fund age fixed effects greatly increases the sensitivity of capital calls to P/D as the population tilts to young funds, who are more likely to call capital, during times of high market valuations (during which many new funds are raised). This population effect is caused by the entry of young, pre-exit funds, and in turn causes overall calls to be more elastic to P/D than overall distributions, for both buyout and venture. This result, however, does not speak to the impact of market conditions on the liquidity properties of the cash flows of given portfolio of funds held by an LP.

Comparing the magnitudes of the point estimates on the TED spread in Tables 7 through 10 allows us to infer the behavior of private equity net cash flows with respect to liquidity conditions in the banking sector, controlling for public market valuations. Comparing across the tables, the elasticities with respect to distributions are larger than those with respect to calls for both buyout and venture, indicating that if anything, private equity funds tend to disburse slightly more than they called as liquidity conditions tightened in non-crisis periods. There is no evidence that private equity is a liquidity sink in the sense of absorbing liquidity when liquidity is tight during non-crisis times. In general, the loading of buyout calls and distributions to the TED spread (holding constant the level of public markets) is quite low.

During the crisis, however, unexplained calls surged in both number and size, while distributions plummeted. These results are consistent with practitioner accounts of serious difficulties faced by LPs in meeting capital calls from their private equity commitments during the crisis. Outside the crisis, there is little evidence for the widely-held view that private equity is a liquidity sink when liquidity conditions are poor.

Our estimates show that there exists a great deal of heterogeneity across a number of fund characteristics in the propensity to call and distribute capital, the sensitivity of cash flows to market conditions, and the behavior of cash flows in the crisis. For instance, for both venture and buyout, first-time funds and small funds were less likely to call capital during the crisis, while first-time funds and poorly performing funds have a lower than average sensitivity of distributions to public market valuations. The heterogeneity in cash flow behavior associated with fund characteristics has important implications for limited partners interested in choosing funds with an eye to tailoring the liquidity properties of their private equity portfolios.

VI. Discussion and Conclusion

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 determinants of private equity performance and cash flow behavior. Our analysis reinforces the understanding of private equity markets based on prior work and extends it in new directions, and our findings are important for understanding the basic economic forces that shape modern private equity markets.

Our first set of findings concerns performance. The private equity funds in our sample have on average out-performed public equities by around 15% over the life of a fund. This is especially true of the buyout sector, where our coverage of the overall investment universe is greatest. Venture funds, by contrast, outperform the S&P 500 only slightly. The out-performance of buyout is robust to tailoring the relative performance calculation to more closely match the type of fund. Buyout funds continue to outperform public indices even if the performance is measured relative to a levered position in the public index matching estimates of portfolio company betas from prior work. We illustrate the sensitivity of relative performance inferences to beta estimates, and find that the relation is, perhaps surprisingly, relatively flat in a range of betas from about 1.5 to 2.5.

Our second set of findings build on our performance assessment and concern the co-movement of public and private capital markets. Broad market fluctuations are correlated with fluctuations in the performance of private equity. This has consequences for relative versus absolute performance measurement. Private equity does not underperform public equity in relative terms even when the absolute performance of private equity is low, suggesting that co-movement between public and private capital markets is important for understanding the returns that investors experience.

Our final set of findings concerns the liquidity properties of private equity cash flows, and their behavior of private equity during the financial crisis and the recession that followed it. Outside of the recent financial crisis, private equity tends to be a modest liquidity sink as market conditions deteriorate, and a source of liquidity as market conditions improve. Venture capital exhibits a higher sensitivity to changes in market conditions than buyout funds. The overall sensitivity of capital calls to market conditions reflects two complementarity forces at work: as market conditions improve, a fund of any given age is more likely to call capital. At the same time, improving market conditions give rise to new funds being created, and since funds call more capital in the years immediately after being launched, this amplifies the sensitivity of calls to market conditions for the sector as a whole.

The financial crisis affected private equity cash flows through two distinct channels. As the economy slipped into recession, private equity investment opportunities shrank, lowering the demand for capital from limited partners. Thus, the sensitivity of private equity to market conditions dropped as investment opportunities dried up. At the same time, the onset of the financial crisis created an enormous unexplained demand for capital from limited partners, causing a spike in capital calls. This presumably reflected concerns about acute liquidity shortages and about default among limited partners. Because the spike in capital calls at the beginning of the crisis was so large, capital calls increased on average through the crisis even though most of financial crisis saw the quarterly draws of unfunded capital commitments drop to historic lows.

Our analysis raises questions about liquidity that go beyond the scope of this paper. Buyout funds and venture funds, after all, are not consumers of liquidity, they are distributors of liquidity: they 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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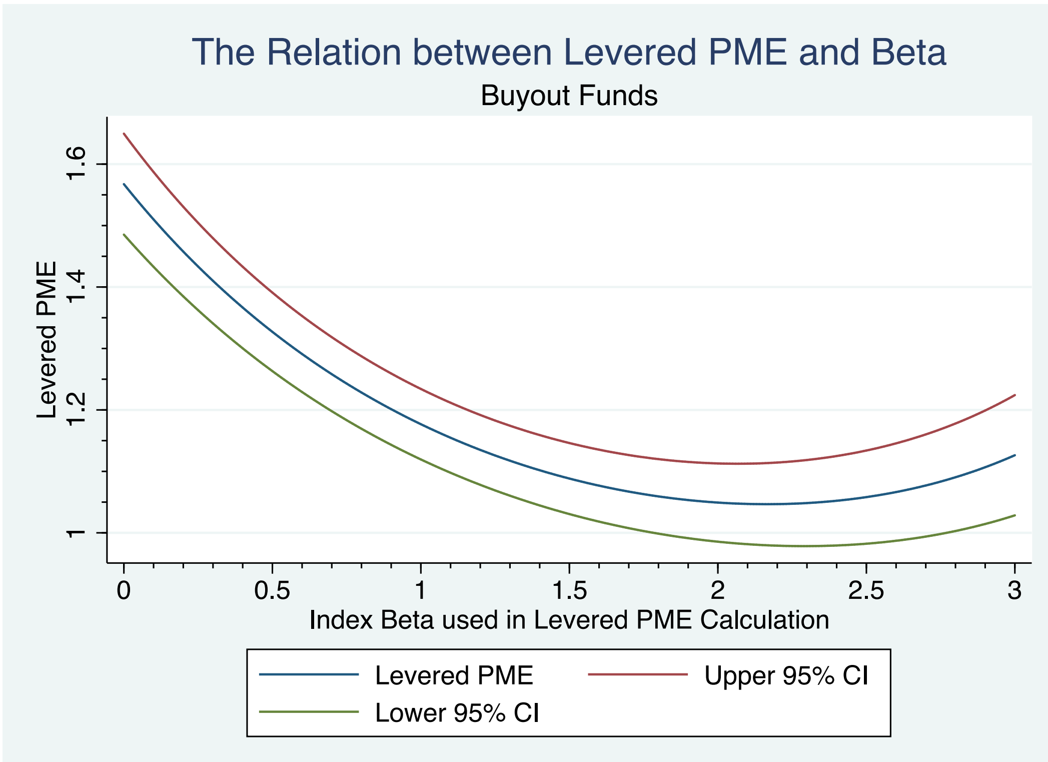
Figure 1: Levered PME-β sensitivity for Venture and Buyout

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



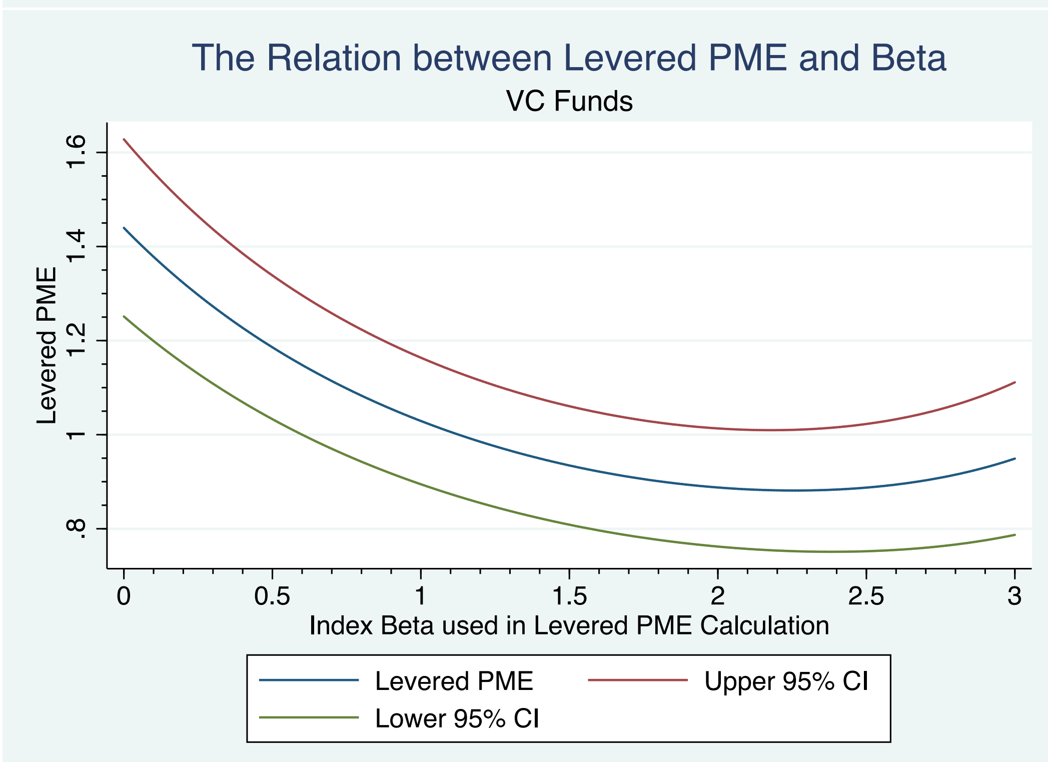


Figure 2: Fund Flow/Performance Relations for Alternative Levered PME Assumptions

This figure displays coefficients and 95% confidence intervals from regressions of Levered PME on Industry Flows (see Table 6) as the beta used in the Levered PME calculation varies from 0 to 3.

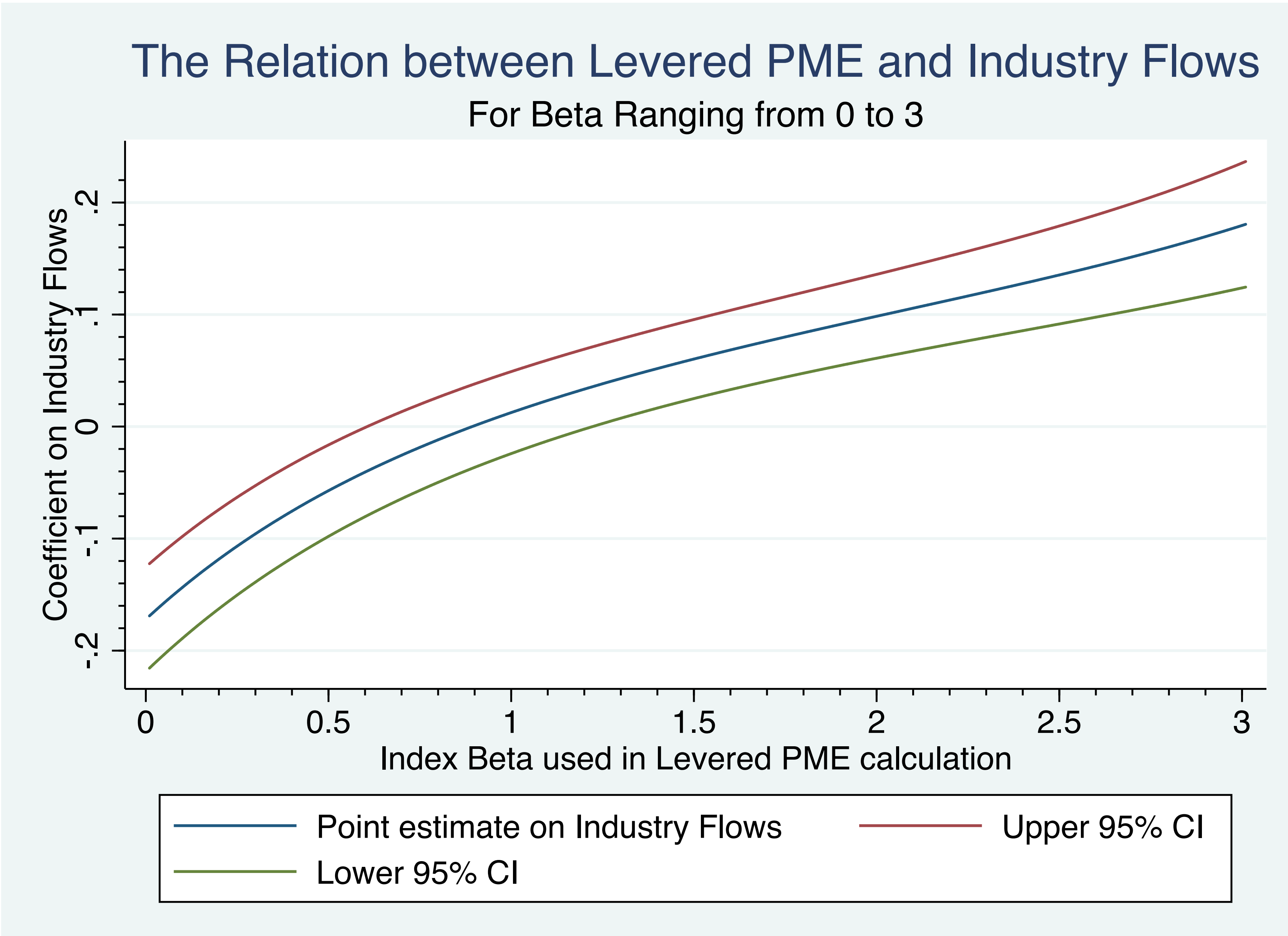


Figure 3: Market conditions and Capital Calls

This figure displays the 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.

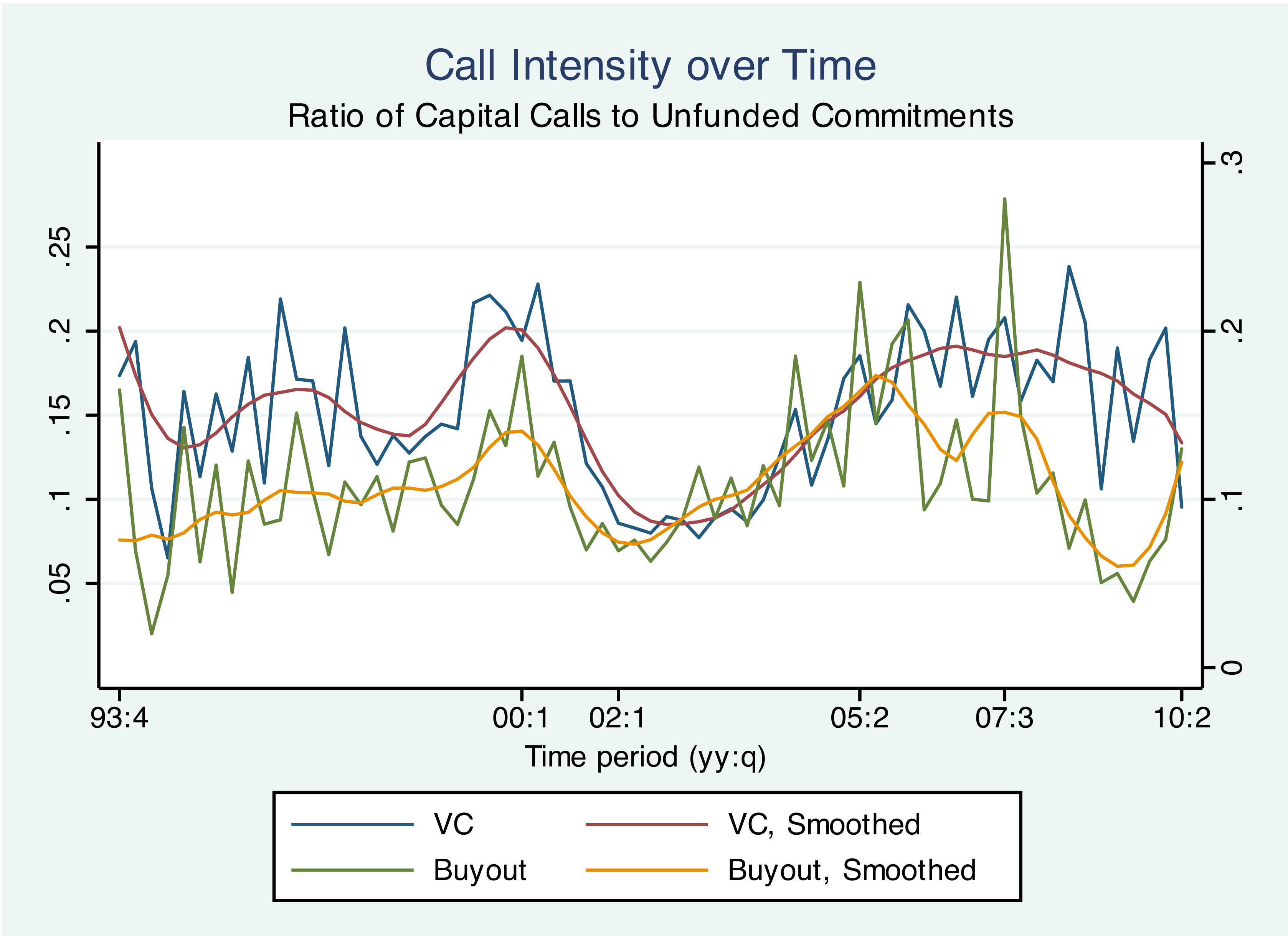


Figure 4: Market conditions and Distributions

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

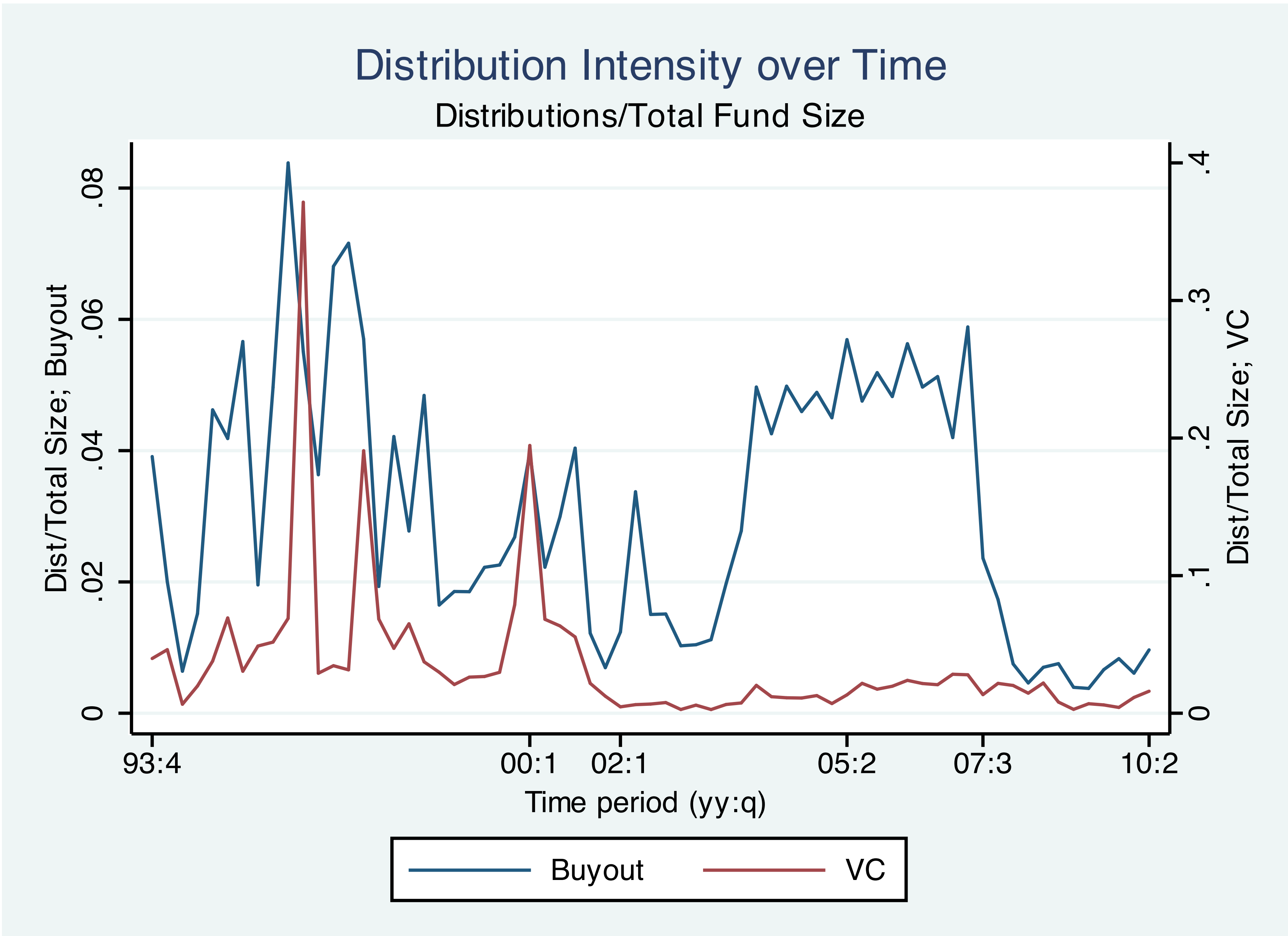


Table 1: Sample Summary

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. Funds in the liquidated sample are those that had vintage years prior to 2006 and were liquidated as of 6/30/2010.

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

Table 2: 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). 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, the first year 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.

Panel A: Buyout funds

	Number of funds				Ave. IRR				Wtd. Ave. IRR		
Vintage	Our sample	VE	Preqin	CA	Our sample	VE	Preqin	CA	Our sample	VE	Preqin
1986	1	10	6	7	13.2	18.0	18.3	15.4	13.2	20.9	21.7
1987	8	25	6	10	15.7	9.8	24.6	15.9	20.6	13.4	24.3
1988	14	14	8	11	9.3	8.7	14.6	10.8	8.7	9.7	14.0
1989	16	23	10	14	14.8	13.8	35.0	21.5	19.4	25.6	31.3
1990	7	9	10	4	21.5	5.0	21.9	16.7	27.6	11.3	22.4
1991	2	5	7	7	6.3	13.7	29.4	31.8	15.8	13.2	25.9
1992	4	15	13	6	30.5	20.0	15.3	34.4	37.3	23.9	22.1
1993	9	22	16	18	40.2	18.9	22.1	21.0	36.4	21.1	20.8
1994	24	26	21	13	22.8	14.0	22.1	13.3	25.7	15.9	24.1
1995	24	24	18	22	16.2	9.3	20.4	13.5	19.4	10.1	15.8
1996	41	26	22	25	10.2	8.3	12.2	9.1	8.3	6.6	8.2
1997	40	41	28	37	5.4	6.0	8.1	4.8	10.7	8.8	8.4
1998	59	55	44	38	4.8	5.5	6.0	7.7	3.9	1.3	2.2
1999	59	41	29	41	2.1	4.2	6.0	11.6	-4.1	7.7	6.6
2000	68	48	43	52	6.6	10.6	15.4	14.1	6.8	11.1	16.2
2001	26	27	18	12	12.0	11.3	22.0	25.5	3.6	11.1	25.8
2002	5	15	21	24	17.9	9.9	12.4	17.2	25.1	12.4	16.3
2003	8	11	20	19	37.5	9.1	15.7	13.1	48.2	17.3	26.7
2004	3	19	26	49	18.8	14.2	12.9	6.3	18.9	10.7	12.3
2005	2	20	50	44	-1.1	0.4	4.1	-0.8	-0.6	-3.9	4.8
2006	8	26	43	41	-18.3	-7.1	-6.3	-5.6	-4.6	-9.6	-7.8
2007	6	19	47	45	-17.6	-2.9	-5.5	-9.0	-14.6	-8.2	-7.4
2008	12	14	34	22	-17.7	-7.7	-7.0	-22.2	-30.3	-19.9	-8.5
Total	446	535	540	561							

Panel B: Venture capital funds

	Number of funds				Ave. IRR				Wtd. Ave. IRR		
Vintage	Our sample	VE	Preqin	CA	Our sample	VE	Preqin	CA	Our sample	VE	Preqin
1984	6	64	14	32	10.6	5.0	13.7	8.6	10.2	6.1	12.4
1985	5	46	17	25	11.4	8.2	14.5	12.9	12.2	9.2	13
1986	3	43	16	31	-27.7	7.0	11.0	14.6	-10.1	10.2	12.8
1987	6	63	18	34	3.8	7.6	14.2	18.3	5.8	13.5	13.9
1988	9	44	21	27	12.0	12.3	22.7	21.1	15.3	19.8	24.9
1989	10	54	28	37	13.5	12.3	23.7	19.2	18.4	16.2	28.5
1990	1	22	15	15	14.9	17.5	18.9	35.2	14.9	24.4	23.3
1991	-	-	-	-	-	-	-	-	-	-	-
1992	4	28	19	24	6.8	25.2	27.3	34.8	8.5	29.1	30.7
1993	5	40	23	38	24.5	22.0	32.6	47.1	35.5	28.7	42.1
1994	7	39	23	42	61.8	25.2	32.3	55.6	62.5	32.8	48.9
1995	13	48	23	34	26.9	45.4	65.3	88.0	27.1	57.0	66.4
1996	13	36	21	41	22.7	74.1	39.1	99.3	24.2	59.2	32.3
1997	19	62	37	75	31.6	49.1	45.7	85.1	36.8	45.7	55.5
1998	36	76	32	81	12.4	25.0	24.8	12.4	18.9	23.0	26.4
1999	40	110	59	114	-10.1	-4.9	-5.3	-2.1	-22.6	-6.7	-6.2
2000	55	125	76	161	-6.6	-2.0	-1.2	-1.3	-9.4	-0.1	-1.2
2001	18	57	51	53	-8.8	0.8	-2.2	0.8	-10.4	0.8	0.8
2002	7	20	29	33	37.0	-0.6	-2.4	-0.3	7.5	-0.5	-0.1
2003	-	-	-	-	-	-	-	-	-	-	-
2004	-	-	-	-	-	-	-	-	-	-	-
2005	1	23	32	57	-5.9	0.8	-2.6	-0.9	-5.9	1.6	-0.5
2006	-	-	-	-	-	-	-	-	-	-	-
2007	2	23	41	52	-8.9	-4.2	-5.2	-4.2	-6.4	-5.8	-8.7
Total	260	1023	595	1006							

Table 3: The Performance of Private Equity Funds: IRRs and PMEs

We calculate IRRs and public market equivalents (PMEs) using actual fund cash flows. S&P PMEs are calculated relative to the S&P 500, while Tailored PMEs are more closely tailored to the particular asset class in question: for venture, this is the NASDAQ return; for buyout, the size tercile return from the Fama French data is used according to whether the buyout is a large-cap buyout, mid-cap buyout, or small-cap buyout. The table reports cross-sectional statistics of fund-level final realized performance. The table includes only the sample of liquidated funds (those with vintage years prior to 2006 that were liquidated as of 6/30/2010; see Table 1).

	Equally weighted:			Size weighted:		
	All Funds (n=560)	Venture (n=192)	Buyout (n=368)	All Funds (n=560)	Venture (n=192)	Buyout (n=368)
IRR						
Mean	0.11	0.09	0.12	0.09	-0.07	0.12
Median	0.07	0.02	0.10	0.11	-0.03	0.13
St. Dev.	0.36	0.47	0.28	0.27	0.41	0.24
25^{th} %ile	-0.03	-0.08	-0.01	0.00	-0.11	0.04
75^{th} %ile	0.20	0.16	0.22	0.19	0.05	0.19
S&P PME						
Mean	1.13	1.03	1.18	1.14	0.84	1.18
Median	1.01	0.82	1.09	1.05	0.75	1.12
St. Dev.	0.72	0.95	0.56	0.47	0.65	0.42
25^{th} %ile	0.70	0.52	0.82	0.87	0.51	0.91
75^{th} %ile	1.41	1.13	1.46	1.42	0.94	1.44
Tailored PME						
Mean	1.09	1.06	1.10	1.10	0.93	1.12
Median	0.96	0.83	1.00	1.04	0.81	1.04
St. Dev.	0.76	0.94	0.65	0.51	0.84	0.45
25^{th} %ile	0.67	0.54	0.77	0.81	0.55	0.84
75^{th} %ile	1.32	1.18	1.37	1.43	1.01	1.43

Table 4: Fund Performance and Fund Characteristics

This table presents cross-sectional fund-level OLS estimates of the relations between final fund performance and fund size and the performance of the partnership's previous fund. The sample includes only liquidated funds. The dependent variable is the PME with respect to the S&P 500. All specifications include vintage year fixed effects. 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)
ln(Fund Size)	0.017	0.248**		0.047	0.823**		0.030	0.282**	
	(0.023)	(0.121)		(0.054)	(0.321)		(0.022)	(0.135)	
ln(Fund Size)^2		-0.022**			-0.089***			-0.022*	
		(0.010)			(0.031)			(0.011)	
ln(Fund No.)		0.031			0.173			-0.008	
		(0.056)			(0.120)			(0.060)	
Buyout Indicator	0.116	0.127	-0.077						
	(0.091)	(0.089)	(0.158)						
Previous Fund PME			0.263***			0.169*			0.221***
			(0.063)			(0.097)			(0.064)
Sample	All	All	All	VC	VC	VC	BO	BO	BO
Vintage Year FE?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	560	558	225	192	191	73	368	367	152
R-squared	0.059	0.063	0.180	0.168	0.189	0.357	0.057	0.062	0.169

Table 5: Performance by Vintage Year

This table reports size-weighted average final fund performance, measured by IRRs, S&P and Tailored PMEs, by vintage year for each type of fund in our sample, for all funds combined, and for VC and buyout funds combined. S&P PMEs are measured with respect to the S&P 500, while tailored PMEs are more closely tailored to the particular asset class in question: for venture, this is the NASDAQ return; for buyout, the size tercile return from the Fama French data is used according to whether the buyout is a large-cap buyout, mid-cap buyout, or small-cap buyout. The table includes only the sample of liquidated funds (those with vintage years prior to 2006 that were liquidated as of 6/30/2010; see Table 1).

	All				Venture				Buyout			
Vint.	N	IRR	S&P PME	Tail. PME	N	IRR	S&P PME	Tail. PME	N	IRR	S&P PME	Tail. PME
1984	9	0.20	1.06	1.12	6	0.10	0.78	0.85	3	0.38	1.56	1.60
1985	10	0.21	1.16	1.22	5	0.12	0.92	1.03	5	0.24	1.27	1.31
1986	4	0.03	0.87	0.88	3	-0.10	0.78	0.79	1	0.13	0.93	0.96
1987	15	0.19	1.23	1.26	6	0.06	0.73	0.69	9	0.20	1.28	1.32
1988	23	0.09	0.80	0.80	9	0.15	1.02	0.97	14	0.09	0.77	0.78
1989	25	0.20	1.15	1.15	10	0.18	1.17	1.09	15	0.20	1.15	1.15
1990	8	0.27	1.34	1.36	1	0.15	1.01	0.96	7	0.28	1.35	1.36
1991	2	0.16	0.84	0.83	0	.	.	.	2	0.16	0.84	0.83
1992	7	0.35	1.28	1.36	3	0.06	0.84	0.79	4	0.37	1.31	1.40
1993	11	0.42	1.42	1.48	5	0.36	1.19	1.17	6	0.44	1.49	1.56
1994	28	0.29	1.30	1.38	6	0.52	1.87	1.69	22	0.28	1.28	1.37
1995	35	0.18	1.32	1.36	11	0.21	1.22	1.17	24	0.18	1.33	1.37
1996	42	0.09	1.08	1.01	6	0.27	1.27	1.10	36	0.09	1.07	1.01
1997	46	0.16	1.45	1.38	16	0.42	1.80	1.58	30	0.13	1.41	1.35
1998	80	0.07	1.27	1.13	26	0.30	1.54	1.54	54	0.06	1.25	1.10
1999	67	-0.10	1.03	0.98	30	-0.27	0.61	0.75	37	-0.03	1.20	1.07
2000	94	0.03	1.07	1.05	34	-0.11	0.71	1.00	60	0.06	1.14	1.06
2001	30	0.00	0.98	0.92	8	-0.22	0.67	0.64	22	0.04	1.03	0.97
2002	12	0.24	1.20	1.19	6	0.03	0.85	0.85	6	0.27	1.25	1.24
2003	7	0.50	1.43	1.41	0	.	.	.	7	0.50	1.43	1.41
2004	2	0.17	1.04	1.03	0	.	.	.	2	0.17	1.04	1.03
2005	3	0.14	1.03	1.03	1	-0.06	0.80	0.79	2	0.14	1.04	1.03

Table 6: 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. In the first four columns, the variable Flows is equal to the natural logarithm of Industry Flows, the total capital committed to all funds of the same type raised in the fund's vintage year (data from Venture Economics). In the next four columns, the variable Flows is equal to Adjusted Industry Flows, which is Industry Flows 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 all funds, Panel B for VC funds, and Panel C for Buyout funds. In all specifications, a constant is estimated but not reported for brevity. In Panel A, fund type indicator variables are estimated but not reported. In columns (3), (4), (7), and (8) Size Q indicator variables (level effects) are estimated but not reported. All specifications use only the sample of liquidated funds. In odd-numbered columns, the dependent variable is fund IRR. In even-numbered columns, the dependent variable is fund PME with respect to the S&P 500. 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: All Funds

	Flows = ln(Industry Flows)				Flows = Adjusted Industry Flows			
	TVPI	PME	TVPI	PME	TVPI	PME	TVPI	PME
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Flows	-0.172***	0.011			-1.508***	-0.152		
	(0.022)	(0.017)			(0.208)	(0.143)		
Flows×Size Q1			-0.126***	0.052**			-1.321***	0.371*
			(0.035)	(0.022)			(0.270)	(0.213)
Flows×Size Q2			-0.184***	0.014			-1.809***	-0.140
			(0.033)	(0.021)			(0.277)	(0.201)
Flows×Size Q3			-0.242***	-0.057			-1.348***	-0.541**
			(0.067)	(0.038)			(0.451)	(0.245)
Observations	559	559	559	559	559	559	559	559
R-squared	0.107	0.016	0.117	0.036	0.102	0.017	0.107	0.036

Panel B: VC Funds

	Flows = ln(Industry Flows)				Flows = Adjusted Industry Flows			
	TVPI	PME	TVPI	PME	TVPI	PME	TVPI	PME
Flows	-0.197***	-0.017			-1.676***	-0.538***		
	(0.050)	(0.040)			(0.320)	(0.163)		
Flows×Size Q1			-0.127**	0.051			-1.599***	-0.059
			(0.057)	(0.044)			(0.298)	(0.362)
Flows×Size Q2			-0.172*	0.017			-1.971***	-0.480
			(0.086)	(0.056)			(0.467)	(0.279)
Flows×Size Q3			-0.357***	-0.207*			-0.994	-0.691
			(0.122)	(0.116)			(0.716)	(0.508)
Observations	191	191	191	191	191	191	191	191
R-squared	0.089	0.001	0.108	0.050	0.109	0.023	0.121	0.043

Panel C: Buyout Funds

	Flows = ln(Industry Flows)				Flows = Adjusted Industry Flows			
	TVPI	PME	TVPI	PME	TVPI	PME	TVPI	PME
Flows	-0.158***	0.028*			-1.334***	0.249		
	(0.025)	(0.016)			(0.256)	(0.158)		
Flows×Size Q1			-0.119**	0.055			-1.021**	0.745**
			(0.046)	(0.032)			(0.441)	(0.275)
Flows×Size Q2			-0.187***	0.017			-1.657***	0.171
			(0.023)	(0.018)			(0.362)	(0.211)
Flows×Size Q3			-0.194***	-0.004			-1.437***	-0.203
			(0.067)	(0.031)			(0.506)	(0.271)
Observations	368	368	368	368	368	368	368	368
R-squared	0.119	0.008	0.130	0.017	0.083	0.006	0.092	0.025

Table 7: VC Capital Calls and Macroeconomic Conditions

This table presents estimates of the relation between capital calls and macroeconomic conditions for venture capital funds. 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 at the end of the preceding calendar quarter. ln(TED) is the natural logarithm of the TED spread at the end of the preceding calendar quarter. % Uncalled is the percentage of committed capital that has not been called by the end of the previous calendar quarter. Crisis is a dummy for calendar quarters between 2007 Q3 and 2009 Q1 (inclusive). The dependent variable is the natural logarithm of one plus the amount of the capital call expressed as a percentage of committed capital. Columns (1)-(7) group all VC funds together. Columns (8)-(12) split the sample according to different criteria, and report the main effect associated with that criterion along with the interactions of that criterion with the Crisis dummy, ln(P/D), ln(TED), and ln(% Uncalled). Prior Dist. is a dummy for whether the fund had distributed capital prior to that quarter. Low PME is a dummy for whether the performance of the fund up to the previous quarter placed in the lowest tercile of all VC funds. First fund is a dummy for the first fund sequence number. Small and large are dummies for whether the fund is in the smallest (respectively, largest) tercile of the size distribution. All models are estimated by Tobit. 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.

								Main Effect=				
								Prior Dist.	Low PME	First Fund	Small	Large
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ln(P/D)		0.87***	1.91***	0.89***	1.96***	1.09***	1.33***	1.37***	1.31***	1.18***	1.26***	1.22***
		(0.207)	(0.266)	(0.209)	(0.237)	(0.185)	(0.167)	(0.175)	(0.190)	(0.190)	(0.189)	(0.177)
ln(TED)				0.15	0.51	0.36***	0.31***	0.16	0.41***	0.35***	0.36***	0.34***
				(0.127)	(0.121)	(0.102)	(0.088)	(0.104)	(0.092)	(0.099)	(0.096)	(0.099)
ln(% Uncalled)						0.63***	0.82***	0.75***	0.78***	0.82***	0.79***	0.84***
						(0.032)	(0.021)	(0.049)	(0.026)	(0.024)	(0.022)	(0.033)
Crisis		4.36***	1.46	3.46**	1.20	3.74***	1.66*	-0.12	1.68*	1.72*	1.60*	1.28
		(1.657)	(1.400)	(1.376)	(1.356)	(1.244)	(1.005)	(1.369)	(0.990)	(0.988)	(0.971)	(1.131)
Crisis×:												
ln(P/D)		-0.99**	-0.77**	-0.81**	-0.82**	-0.99***	-0.61**	-0.48	-0.70***	-0.62***	-0.60**	-0.59**
		(0.392)	(0.345)	(0.322)	(0.335)	(0.275)	(0.237)	(0.299)	(0.243)	(0.235)	(0.233)	(0.266)
ln(TED)				0.03	-.50***	-0.20	-0.25*	-0.40***	-0.15	-0.27**	-0.24**	-0.29**
				(0.154)	(0.178)	(0.127)	(0.126)	(0.133)	(0.119)	(0.125)	(0.120)	(0.127)
ln(% Uncalled)						-0.01	0.01	-0.00	0.00	0.03	0.06	0.06
						(0.071)	(0.051)	(0.050)	(0.054)	(0.058)	(0.054)	(0.053)
Main Effect								0.46	-0.59	-2.43***	-0.59	0.58
								(1.134)	(1.018)	(0.790)	(0.834)	(1.079)
Crisis×Main Effect								1.15	1.06***	-0.63*	-0.66***	0.13
								(0.795)	(0.314)	(0.322)	(0.257)	(0.297)
Main Effect ×:												
ln(P/D)								-0.11	-0.06	0.46**	-0.07	0.09
								(0.262)	(0.251)	(0.183)	(0.199)	(0.252)
ln(TED)								0.32***	-0.42***	-0.04	-0.06	0.09
								(0.108)	(0.131)	(0.097)	(0.111)	(0.110)
ln(% Uncalled)								0.13**	0.15***	-0.00	0.02	-0.14***
								(0.053)	(0.044)	(0.034)	(0.035)	(0.043)
Fund Age Fixed Effects	Yes	Yes	No	Yes	No	Yes	No	No	No	No	No	No
Time Fixed Effects	Yes	No	No	No	No	No	No	No	No	No	No	No
Observations	13,063	13,060	13,060	13,043	13,043	13,043	13,043	13,043	13,043	13,043	13,043	13,043
Pseudo R-squared	0.176	0.136	0.0243	0.137	0.137	0.178	0.157	0.159	0.159	0.161	0.166	0.162

Table 8: Buyout Capital Calls and Macroeconomic Conditions

This table presents estimates of the relation between capital calls and macroeconomic conditions for buyout funds. 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 at the end of the preceding calendar quarter. ln(TED) is the natural logarithm of the TED spread at the end of the preceding calendar quarter. % Uncalled is the percentage of committed capital that has not been called by the end of the previous calendar quarter. Crisis is a dummy for calendar quarters between 2007 Q3 and 2009 Q1 (inclusive). The dependent variable is the natural logarithm of one plus the amount of the capital call expressed as a percentage of committed capital. Columns (1)-(7) group all VC funds together. Columns (8)-(12) split the sample according to different criteria, and report the main effect associated with that criterion along with the interactions of that criterion with the Crisis dummy, ln(P/D), ln(TED), and ln(% Uncalled). Prior Dist. is a dummy for whether the fund had distributed capital prior to that quarter. Low PME is a dummy for whether the performance of the fund up to the previous quarter placed in the lowest tercile of all VC funds. First fund is a dummy for the first fund sequence number. Small and large are dummies for whether the fund is in the smallest (respectively, largest) tercile of the size distribution. All models are estimated by Tobit. 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.

								Main Effect=				
								Prior Dist.	Low PME	First Fund	Small	Large
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ln(P/D)		0.34***	0.78***	0.34***	0.78***	0.40***	0.62***	0.68***	0.62***	0.86***	0.58***	0.72***
		(0.095)	(0.201)	(0.095)	(0.192)	(0.089)	(0.092)	(0.109)	(0.093)	(0.101)	(0.104)	(0.090)
ln(TED)				0.12**	0.42***	0.16***	0.15***	0.16**	0.15***	0.15***	0.16***	0.18***
				(0.052)	(0.081)	(0.044)	(0.037)	(0.061)	(0.037)	(0.042)	(0.039)	(0.041)
ln(% Uncalled)						0.34***	0.53***	0.57***	0.50***	0.52***	0.50***	0.58***
						(0.021)	(0.011)	(0.031)	(0.012)	(0.013)	(0.012)	(0.014)
Crisis		2.56***	3.70***	2.07***	2.96***	2.57***	2.52***	3.48***	2.51***	2.94***	2.21***	1.95***
		(0.579)	(0.949)	(0.442)	(0.869)	(0.483)	(0.468)	(0.482)	(0.451)	(0.455)	(0.489)	(0.507)
Crisis×:												
ln(P/D)		-0.67***	-1.26***	-0.58***	-1.18***	-0.68***	-0.79***	-0.76***	-0.78***	-0.86***	-0.71***	-0.68***
		(0.147)	(0.234)	(0.107)	(0.205)	(0.111)	(0.107)	(0.119)	(0.106)	(0.105)	(0.112)	(0.117)
ln(TED)				-0.02	-0.33***	-0.06	-0.10**	-0.16***	-0.09**	-0.10**	-0.09*	-0.07
				(0.060)	(0.089)	(0.054)	(0.047)	(0.052)	(0.046)	(0.047)	(0.048)	(0.047)
ln(% Uncalled)						-0.12***	-0.10***	-0.20***	-0.09***	-0.09***	-0.09***	-0.11***
						(0.029)	(0.030)	(0.021)	(0.028)	(0.030)	(0.030)	(0.031)
Main Effect								0.72	-0.20	2.42***	-0.78*	2.20***
								(0.569)	(0.405)	(0.466)	(0.411)	(0.447)
Crisis×Main Effect								-1.07***	-0.07	-0.57***	-0.23**	0.30*
								(0.216)	(0.162)	(0.159)	(0.111)	(0.156)
Main Effect ×:												
ln(P/D)								-0.08	0.01	-0.62***	-0.03	-0.34***
								(0.130)	(0.096)	(0.112)	(0.097)	(0.106)
ln(TED)								0.04	-0.01	0.02	0.05	-0.03
								(0.072)	(0.054)	(0.060)	(0.057)	(0.055)
ln(% Uncalled)								0.00	0.09***	0.02	0.08***	-0.14***
								(0.030)	(0.018)	(0.014)	(0.023)	(0.017)
Fund Age Fixed Effects	Yes	Yes	No	Yes	No	Yes	No	No	No	No	No	No
Time Fixed Effects	Yes	No	No	No	No	No	No	No	No	No	No	No
Observations	21,789	21,786	21,786	21,775	21,775	21,775	21,775	21,775	21,775	21,775	21,775	21,775
Pseudo R-squared	0.135	0.127	0.0157	0.127	0.127	0.147	0.119	0.122	0.120	0.121	0.134	0.128

Table 9: VC Distributions and Macroeconomic Conditions

This table presents estimates of the relation between capital distributions and macroeconomic conditions for venture capital funds. 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 at the end of the preceding calendar quarter. ln(TED) is the natural logarithm of the TED spread at the end of the preceding calendar quarter. % Uncalled is the percentage of committed capital that has not been called by the end of the previous calendar quarter. Crisis is a dummy for calendar quarters between 2007 Q3 and 2009 Q1 (inclusive). The dependent variable is the natural logarithm of one plus the amount of the distributed capital expressed as a percentage of committed capital. Columns (1)-(7) group all VC funds together. Columns (8)-(12) split the sample according to different criteria, and report the main effect associated with that criterion along with the interactions of that criterion with the Crisis dummy, ln(P/D), ln(TED), and ln(% Uncalled). Prior Dist. is a dummy for whether the fund had distributed capital prior to that quarter. Low PME is a dummy for whether the performance of the fund up to the previous quarter placed in the lowest tercile of all VC funds. First fund is a dummy for the first fund sequence number. Small and large are dummies for whether the fund is in the smallest (respectively, largest) tercile of the size distribution. All models are estimated by Tobit. 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.

								Main Effect=				
								Prior Dist.	Low PME	First Fund	Small	Large
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ln(P/D)		1.28***	0.85***	1.35***	0.86***	1.30***	1.02***	-0.11***	1.53***	1.43***	0.99***	0.88***
		(0.368)	(0.299)	(0.301)	(0.266)	(0.293)	(0.286)	(0.016)	(0.314)	(0.330)	(0.325)	(0.292)
ln(TED)				0.99***	0.58***	0.95***	0.62***	-0.47***	1.05***	0.99***	0.65***	0.63***
				(0.146)	(0.146)	(0.142)	(0.139)	(0.053)	(0.144)	(0.146)	(0.150)	(0.148)
ln(% Uncalled)						-0.12***	-0.33***	-0.43***	-0.10**	-0.14***	-0.40***	-0.28***
						(0.041)	(0.046)	(0.020)	(0.046)	(0.042)	(0.050)	(0.042)
Crisis		-2.81	-5.98***	-4.50*	-7.26***	-4.85**	-7.19***	-3.99***	-5.90**	-4.95**	-7.51***	-6.64***
		(2.498)	(2.055)	(2.362)	(2.241)	(2.341)	(2.242)	(0.065)	(2.356)	(2.409)	(2.294)	(2.244)
Crisis×:												
ln(P/D)		0.53	1.44***	0.71	1.62***	0.74	1.39**	1.05***	1.03*	0.75	1.43**	1.24**
		(0.640)	(0.533)	(0.606)	(0.573)	(0.604)	(0.580)	(0.016)	(0.607)	(0.618)	(0.585)	(0.579)
ln(TED)				-0.74***	-0.40*	-0.67***	-0.41**	-0.71***	-0.67***	-0.69***	-0.43**	-0.41*
				(0.214)	(0.214)	(0.213)	(0.209)	(0.044)	(0.222)	(0.216)	(0.208)	(0.214)
ln(% Uncalled)						0.28***	0.57***	0.12***	0.25**	0.29***	0.57***	0.59***
						(0.107)	(0.109)	(0.022)	(0.109)	(0.109)	(0.109)	(0.112)
Main Effect								11.24***	3.35**	1.43	-0.98	-2.53**
								(0.065)	(1.439)	(1.053)	(1.089)	(1.088)
Crisis×Main Effect								-1.96***	0.01	-0.01	0.32	0.03
								(0.065)	(0.274)	(0.311)	(0.274)	(0.224)
Main Effect ×:												
ln(P/D)								1.04***	-1.09***	-0.52*	0.03	0.78***
								(0.016)	(0.351)	(0.265)	(0.275)	(0.262)
ln(TED)								1.46***	-0.29**	-0.05	0.01	0.02
								(0.053)	(0.146)	(0.143)	(0.122)	(0.171)
ln(% Uncalled)								0.44***	0.05	0.10**	0.17***	-0.22***
								(0.020)	(0.046)	(0.042)	(0.042)	(0.055)
Fund Age Fixed Effects	Yes	Yes	No	Yes	No	Yes	No	No	No	No	No	No
Time Fixed Effects	Yes	No	No	No	No	No	No	No	No	No	No	No
Observations	13,063	13,060	13,060	13,043	13,043	13,043	13,043	13,043	13,043	13,043	13,043	13,043
Pseudo R-squared	0.0679	0.0277	0.00341	0.0362	0.0362	0.0373	0.0182	0.110	0.0420	0.0392	0.0218	0.0198

Table 10: Buyout Distributions and Macroeconomic Conditions

This table presents estimates of the relation between capital distributions and macroeconomic conditions for buyout funds. 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 at the end of the preceding calendar quarter. ln(TED) is the natural logarithm of the TED spread at the end of the preceding calendar quarter. % Uncalled is the percentage of committed capital that has not been called by the end of the previous calendar quarter. Crisis is a dummy for calendar quarters between 2007 Q3 and 2009 Q1 (inclusive). The dependent variable is the natural logarithm of one plus the amount of the distributed capital expressed as a percentage of committed capital. Columns (1)-(7) group all VC funds together. Columns (8)-(12) split the sample according to different criteria, and report the main effect associated with that criterion along with the interactions of that criterion with the Crisis dummy, ln(P/D), ln(TED), and ln(% Uncalled). Prior Dist. is a dummy for whether the fund had distributed capital prior to that quarter. Low PME is a dummy for whether the performance of the fund up to the previous quarter placed in the lowest tercile of all VC funds. First fund is a dummy for the first fund sequence number. Small and large are dummies for whether the fund is in the smallest (respectively, largest) tercile of the size distribution. All models are estimated by Tobit. 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.

								Main Effect=				
								Prior Dist.	Low PME	First Fund	Small	Large
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ln(P/D)		0.29**	0.35*	0.29*	0.34*	0.26	0.40*	0.08***	0.40**	0.47**	0.30	0.62***
		(0.145)	(0.199)	(0.157)	(0.200)	(0.159)	(0.212)	(0.009)	(0.188)	(0.184)	(0.242)	(0.203)
ln(TED)				0.34***	-0.01	0.32***	0.09	-0.14***	0.39***	0.30***	0.06	0.20*
				(0.098)	(0.135)	(0.101)	(0.126)	(0.032)	(0.112)	(0.111)	(0.140)	(0.108)
ln(% Uncalled)						-0.13***	-0.26***	-0.19***	-0.15***	-0.17***	-0.31***	-0.22***
						(0.020)	(0.025)	(0.011)	(0.022)	(0.021)	(0.028)	(0.028)
Crisis		-2.30	-4.47***	-4.07***	-5.44***	-4.35***	-5.63***	-3.74***	-4.52***	-4.15***	-6.03***	-5.59***
		(1.574)	(1.481)	(1.494)	(1.733)	(1.510)	(1.757)	(0.047)	(1.566)	(1.523)	(1.768)	(1.767)
Crisis×:												
ln(P/D)		0.49	1.02***	0.84**	1.26***	0.88**	1.17***	0.87***	0.88**	0.82**	1.23***	1.20***
		(0.402)	(0.382)	(0.388)	(0.450)	(0.389)	(0.448)	(0.012)	(0.400)	(0.398)	(0.449)	(0.449)
ln(TED)				-0.02	0.21	-0.01	0.10	-0.04	-0.05	-0.00	0.08	0.07
				(0.180)	(0.223)	(0.179)	(0.215)	(0.029)	(0.180)	(0.182)	(0.212)	(0.212)
ln(% Uncalled)						0.11***	0.19***	0.06***	0.11***	0.13***	0.21***	0.22***
						(0.034)	(0.035)	(0.014)	(0.034)	(0.034)	(0.035)	(0.034)
Main Effect								11.20***	1.19*	1.71***	-1.21*	4.16***
								(0.039)	(0.661)	(0.619)	(0.649)	(0.646)
Crisis×Main Effect								-0.58***	0.34*	-0.09	0.32*	-0.62***
								(0.047)	(0.195)	(0.243)	(0.190)	(0.138)
Main Effect ×:												
ln(P/D)								0.16***	-0.50***	-0.51***	0.08	-0.81***
								(0.009)	(0.159)	(0.153)	(0.150)	(0.149)
ln(TED)								0.50***	-0.04	0.11	0.21**	-0.20**
								(0.032)	(0.091)	(0.081)	(0.088)	(0.093)
ln(% Uncalled)								0.10***	0.10***	0.11***	0.13***	-0.15***
								(0.011)	(0.022)	(0.026)	(0.026)	(0.024)
Fund Age Fixed Effects	Yes	Yes	No	Yes	No	Yes	No	No	No	No	No	No
Time Fixed Effects	Yes	No	No	No	No	No	No	No	No	No	No	No
Observations	21,789	21,786	21,786	21,775	21,775	21,775	21,775	21,775	21,775	21,775	21,775	21,775
Pseudo R-squared	0.0541	0.0396	0.00226	0.0413	0.0413	0.0429	0.0143	0.0969	0.0483	0.0446	0.0234	0.0227