The private equity return gap*

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Abstract

Investors in private equity funds do not control the timing of their cash flows to and from the fund. The internal rate of return (IRR), the most popular measure of returns for private equity investors, is affected by cash flow timing, while the cash-on-cash multiple is not. Any gap between a fund's reported IRR and the return implied by the cash-on-cash multiple arises from exogenous shocks to cash flows and/or the timing choices of the fund's general partner (GP). In a sample of 3,915 private equity funds, we find that return gaps average over half of the magnitude of reported IRRs, are larger than expected, and persist across a GP's funds. High return gaps are negatively related to the GP's future performance, but facilitate future fundraising, especially among certain investor types (funds of funds, insurance companies, and private pension funds) and among relatively unsuccessful investors.

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1 Introduction

Private equity is a fast-growing asset class that, at over $3 trillion under management, is set to exceed hedge funds.[1] One potential driver of the rapid rise of private equity is the attractive returns that private equity managers (general partners, or GPs) provide to investors (limited partners, or LPs). An increasingly sophisticated academic literature examines the size and risk profile of these returns, typically focusing on internal rates of return (IRRs).[2] This literature generally takes the timing of cash flows to LPs as given, often comparing private equity returns to those of other asset classes over the same periods of time. The cash flow profiles of private equity investments differ greatly from those of mutual funds or hedge funds, where capital is committed and withdrawn at the investors' discretion.[3]

These comparisons do not consider the fact that LPs have very little control over cash flow timing, which in turn affects the IRR. Capital calls of unpredictable size must be paid by LPs on short notice, lest the LP be subject to a lawsuit, punitive interest rates or loss of stake. This forces LPs who wish to minimize the odds of this occurrence to hold low-risk, low-yielding assets in anticipation of capital calls.[4] In contrast to bonds or publicly traded shares that issue sticky dividends, capital (or IPO shares) of unpredictable amounts is returned to LPs throughout the fund's life at the discretion of the GP. Finally, given that some distributions occur before calls, funds often never have the entire "committed amount" invested at any given time during the fund's life.

[1] `https://www.ft.com/content/715fda20-d6ff-11e8-a854-33d6f82e62f8?desktop=true&segmentId=d8d3e364-5197-20eb-17cf-2437841d178a`

[2] Kaplan and Schoar (2005); Phalippou and Gottschalg (2009); Harris, Jenkinson, and Kaplan (2014); Sorensen, Wang, and Yang (2014); Ang, Chen, Goetzmann, and Phalippou (2018)

[3] Note that this is not simply illiquidity, as the LP is unable to pay a fee or give advance notice in order to change the timing of cash flows.

[4] Zeisberger, Prahl, and White (2018) (page 245) describe how some GPs use credit facilities in order to ensure that LPs receive a maximum of one capital call per quarter.

Is this distinction important? If the private equity fund's life were a marathon, private equity managers could choose to run a stretch of the race. Their pace would be compared to that of other private equity managers who ran different stretches of the same race, and to that of index funds and hedge funds who ran the marathon from beginning to end. Being able to choose the timing and length of the measurement period quite possibly increases a runner's performance, even when compared to other runners over the same periods of time.

In this study, we investigate the IRRs reported by private equity funds, and the extent to which they differ from the returns implied by cash-on-cash multiples,[5] or "multiple-implied returns," which are unaffected by cash flow timing. Whereas IRRs assume non-invested, committed cash earns the same return as funds invested within the fund, multiple-implied returns assume that committed cash earns zero return while it is outside the fund. Thus, multiple-implied returns represent a lower bound on the true returns to investing in a private equity fund, assuming there is no distressed sale of riskier assets in order to meet capital calls, however. We seek to understand the causes and correlates of the difference between the IRR and the multiple-implied return, which we call the "return gap,"[6] as well as its effects on LP investment behavior.

While private equity funds report cash-on-cash multiples, IRR is the headline measure of return, and is used by data providers to rank funds relative to peer funds of the same vintage. Recent research documents that the reported IRRs of past funds affect a GP's ability

[5]By cash-on-cash multiple, we mean the ratio of all cash distributed to a fund's investors during the fund's life to all cash contributed into the fund by the investors during the fund's life. See, for example, Lopez-de-Silanes, Phalippou, and Gottschalg (2015) and Phalippou, Rauh, and Umber (2018)

[6]Kacperczyk, Sialm, and Zheng (2007) compute a return gap for mutual funds by comparing the return reported by the fund to the return earned by the fund's beginning-of-quarter holdings. Our measures are similar in name only. While their measure, which takes the reported return as the true return to investors, is positively related to a fund manager's skill in managing intra-quarter trades, our measure uses the multiple-implied return as a lower bound for the true return on investors' capital during the fund's lifetime. We posit that the sign of our measure's relation to the GP's ability to create value for investors depends on whether the gap is an indication of talent of of resources wasted on obfuscation.

to fundraise[7], as well as carried interest, which comprises a large part of GP compensation. Whether the GP can collect carried interest at all is often based on whether the fund's IRR surpasses a pre-set hurdle rate. Moreover, after this hurdle rate is achieved, the GP sometimes receives all further fund profits until it has "caught up" with the returns to the fund's LP investors, and typically holds 20% of all distributed profits, which makes achieving the hurdle rate for the IRR potentially very lucrative.[8]

Although some fluctuation in the fund's cash flows is due to exogenous economic forces, several GP choices can lead to differences in IRR for a given cash-on-cash multiple. High early cash distributions can lead to large IRRs due to the assumption that these intermediate cash flows to LPs are reinvested at the same rate throughout the life of the fund. This characteristic of IRR provides an incentive for GPs to terminate good investments early and/or to pay large early dividends. A fund could also use subscription line financing, which entails borrowing money for its investments and thus delaying capital calls from LPs. If the borrowing rate is below the intended IRR of the fund, this will increase the fund's reported IRR, but decrease the fund's cash-on-cash multiple due to the interest paid. Subscription line financing costs are low because these loans are backed by LP commitments, and LPs are contractually obligated to meet capital calls on short notice, or suffer very large penalties (e.g., lawsuit, loss of stake). Appendix A presents a base case set of cash flows typical to a private equity fund that spans 10 years, and the effect on IRR of a hypothetical subscription line financing arrangement.

To the extent that some GPs manage headline IRRs more than others, the difference between a fund's IRR and its multiple-implied return could persist across the GPs' funds

[7]Chung, Sensoy, Stern, and Weisbach (2010) and Hochberg, Ljungqvist, and Vissing-Jørgensen (2014)

[8]General partner compensation often follows the industry standard of 2/20, in other words two percent management fee on all invested capital and 20 percent carried interest of the total return, typically after a hurdle rate is reached. Gompers and Lerner (1999) discuss compensation in the private equity industry.

and reflect that GP's style and skill. For example, skill at employing capital throughout the life of the fund would make the gap persistently lower; common use of subscription-line financing or a policy of early exits would make the gap consistently higher. We seek to determine whether the gap is simply a measure of sophistication and a marker for GP talent in generating returns for investors over the entirety of the fund's life, or whether it represents resources wasted on IRR boosting strategies.

First, we ask whether reported IRRs differ from IRRs that result from simulated, random cash flows. By simulating cash flows that assume uniform distribution of contributions in the first half of fund life and distributions in the second half, we find that reported IRRs for liquidated funds are higher than what one would expect. [9] Second, using the multiple-implied return as a benchmark measure of the return to private equity investors that is difficult to manipulate, we examine whether the return gap is persistent for a given GP and thus reflective of the general partner's investment style. We find strong evidence of persistence in the return gap from the current fund to the subsequent fund, for the same GP.

Third, we decompose IRR into the multiple-implied return and the return gap and ask which, if any, of these components are informative about future returns of the same GP. We find that only multiple-implied returns, and not return gaps, are positively related to the multiple-implied returns of GPs' future funds. Moreover, return gaps are negatively related to future multiple-implied returns for many fund types and vintages. These results suggest that some resources are wasted on generating high IRRs.

Last, we investigate which components of the IRR, the multiple-implied return or the

[9] Metrick and Yasuda (2010) describe how GPs typically invest in new companies only in the first five years, with some follow-on investments as well as divestitures made in the final five years of a private equity fund's life.

return gap, are related to future fundraising. At the GP level, we find that current funds' return gaps are positively associated with the size of follow-on funds. At the LP level, we investigate reinvestment behavior in response to the return gaps of current funds. When we regress an indicator variable for whether the investor reinvests with the same GP in a subsequent fund on the current fund's return gap, we find positive and significant coefficients for multiple investor categories, and no significant negative coefficients. This suggests that return gaps influence investor decision-making. To better understand these results, we follow Cavagnaro, Sensoy, Wang, and Weisbach (2018), who point out that investor type is not a strong determinant of performance. We use their measure of skill to classify investors, and find that the relatively less successful investors weight the return gap more heavily in their decision to reinvest in the GP's subsequent fund.

Taken together, our results suggest that the limitations of the IRR as a measure of private equity returns are not fully understood by investors.

2 Private equity and IRR background

Private equity funds purchase the equity or sometimes the debt of private firms. The private equity firm, or general partner, often manages one or more private equity funds. At the outset of a fund's life, the GP fundraises to obtain commitments from limited partner investors that can in turn be invested in portfolio companies. A Limited Partner Agreement (LPA) outlines the LP's monetary commitment as well as GP compensation. As investment opportunities arise, the general partner calls invested capital from limited partners. As the fund matures and divests of its portfolio companies, the fund returns capital and profit, less a general partner management fee and carried interest, to the LPs. It is unusual for a private equity

fund to hold onto cash following such divestitures. The LPA typically calls for return of capital and profit over a ten-year fund life but fund-life extensions are possible. It is common for GPs to begin fundraising for the next fund early in the previous fund's life (Brown, Gredil and Kaplan, forthcoming).

Private equity funds and their limited partner investors generally favor the internal rate of return as a metric for returns. Much research has focused on the returns to investors of private equity funds, but these returns have been difficult to evaluate. Kaplan and Schoar (2005) and Phalippou and Gottschalg (2009) find that, after fees, private equity funds substantially underperform public markets, but Harris, Jenkinson, and Kaplan (2014) find that private equity funds outperform public markets by 3% per year, after correcting errors in the raw data. Sorensen, Wang, and Yang (2014) argue that this outperformance is inadequate to compensate investors for the substantially greater risk, leverage, and illiquidity associated with private equity investments. Ang, Chen, Goetzmann, and Phalippou (2018) find that LPs may at best break even compared to investing in small, illiquid stocks, raising questions about why investors have greatly increased their allocations to this asset class.

Interim reported IRRs rely on the assumption that fund-reported net asset values (NAVs) are equal to the market values of these assets. General partners have historically had considerable leeway in reporting interim asset values to their investors. This has attracted the attention of both researchers and the SEC. [10] Conservatively underreporting NAVs, especially early values, generally boosts IRR [See Phalippou (2011)].

[10]Cochrane (2005), Korteweg and Sorensen (2010) and Jenkinson, Sousa, and Stucke (2013) find that portfolio companies' asset values tend to be higher in fundraising periods. Barber and Yasuda (2017) further find that funds time their portfolio companies' strongest exits to coincide with fundraising. Brown, Gredil, and Kaplan (2017) argue that NAV inflation is practiced by unsuccessful GPs, but that LPs see through this behavior. Easton, Larocque, and Stevens (2018) find that private equity NAVs more accurately represent ex post future cash flows following the establishment of ASC 820 (formerly known as SFAS 157), *Fair Value Measurements* by the Financial Accounting Standards Board (FASB) in 2008.

We seek to compare the reported IRR to the rate of return earned by an investor who must leave capital in the fund from inception to the end of the fund's life. LPs effectively face these conditions because their committed capital must be sent on short notice once called by the GP and, although it may be returned early, the date of return is ex-ante unknown. Therefore, we conjecture that the capital is unlikely to earn a comparable return during the fund's life outside of its use by the fund.[11] In the extreme case, if no return is earned on the capital outside of the private equity fund, the cash-on-cash multiple offers a better gauge of the return actually earned by investors over the fund's life. We can calculate the return implied by the fund multiple for the duration of the life of the fund:

$$Multiple\_Return = (Multiple)^{1/T} - 1, \tag{1}$$

where T is the life of the fund and *Multiple* is the fund's reported cash-on-cash multiple. For instance, a multiple of 2 would signify a 100% return over the life of the fund, which is a 7.2% annual return over a ten-year fund's life. We then compute the difference between the reported IRR and this rate of return.

$$Gap = IRR - Multiple\_Return \tag{2}$$

A gap between reported IRR and the rate of return implied by the fund's cash-on-cash multiple will naturally arise due to the existence of intermediate cash flows that effectively shorten the investment horizon. This will tend to make reported IRRs higher than multiple-implied returns when the multiple is greater than one, and lower when the multiple is less

[11] Some investors compute a modified IRR, or MIRR, taking into account the returns they think they can earn on the capital while it is not in the fund. The riskier the alternative investment vehicles, however, the more likely it is that LPs may not be able to make capital calls and suffer financial consequences.

than one.[12]

Kaplan and Schoar (2005) develop the PME, or public market equivalent, as a measure of the return to private equity investments relative to public equities. Simply put, the PME compares an investment in a private equity fund to an investment in the S&P 500. While the PME overcomes some of the difficulties of assuming that distributed funds can be reinvested at a similar return to that earned by the private equity fund, it does not account for the fact that the GP chooses the timing of the cash flows, and that the LP must find a home for the intermediate cash flows of the fund.

3 Data

We obtain private equity fund data from Preqin's Performance, Fund Summary, Cash Flow, and Investor modules. We focus on both the reported IRR and the multiple-implied return for the entire life of the fund; thus our primary analysis retains funds that report both the IRR and cash-on-cash multiple for the life of the fund. If a fund is not yet liquidated, we require that it is at least three years old as of 2017. Our sample comprises 6,914 funds of 2,139 private equity firms, of which 2,086 are liquidated. For some tests, we require fund cash flow data, and thus use a sub-sample of 3,317 funds, of which 661 are liquidated.

Figure 1 shows the number of funds in the sample by vintage year. The median vintage year of the funds is 2004, with a range of 1980-2014. Summary statistics for the 6,429 funds from 1,893 private equity firms appear in Panel A of Table 2. Closed fund size (*FundValue*) averages \$673.3M with a median of \$270M. Reported average (median) IRR (*IRR*) is 12.7% (10.9%), and cash-on-cash multiple (*Multiple*) is 1.61 (1.45). These compare with the median

[12]Thus, we expect a negative gap when IRR is negative. Results in the paper are stronger when we remove funds with negative IRRs.

IRR of 13% described in Harris, Jenkinson, and Kaplan (2014) and with the median cash-on-cash multiple of 1.65 reported by Phalippou, Rauh, and Umber (2018), both for sample periods with earlier start dates.

Computing the return gap requires an assumption about fund life, which we do not have for all funds in the sample. To estimate an expected fund life by fund type, we use liquidated funds from Prequin's Cash Flow module and compute the actual fund lives of liquidated funds. We define fund life as the length of time it takes for investors to receive 95% of the fund's total distributions. This is a conservative choice because using the date of the last distribution as the end of the fund's life would tend to make the multiple-implied return smaller, and the gap larger. We take the median fund life by fund type and use this in the calculation of the return gap for liquidated funds. This produces a reasonable expected fund life for investors ex ante. For funds that have not yet liquidated, we use the actual time since the vintage year as the fund's life.[13]

Panel A of Table 2 also presents summary statistics on the return gap (*Gap*), winsorized at the 1% level to mitigate the effect of outliers. The gap averages 8.23%, more than half of the average IRR, and the median return gap is 5.98%. These gaps are large. Figure 2 presents reported IRRs and return gaps by vintage year, and Panel B of Table 2 examines IRR and return gap by type of fund. The largest gaps appear for buyout, secondaries, and turnaround funds; we find the smallest median gaps for direct lending, expansion/late stage, infrastructure, and mezzanine. Panel C of Table 2 present summary statistics by investor. Foundation and corporate investors seem to invest in funds with the lowest gaps, while superannuation schemes and wealth managers seem to invest in funds with the highest gaps.

[13]For each of our regression tests, we separately show results for liquidated funds as it is possible that results vary for liquidated funds, where we can observe the fund's IRR over the life of the fund, and for non-liquidated funds, where we observe and use the final reported IRR for the fund.

Cash contributed later in the life of the fund and cash distributed earlier in the life of the fund increase the fund's IRR. In order to confirm that return gaps truly reflect a shortening of the investment period and contribute to an increased IRR, we test the association between a fund's return gap and the relative timing of its cash flows. To conduct this analysis, we compute a measure of the timing of capital calls and of capital distributions and relate these to the return gap for the liquidated funds. For every year in the life of each fund, we separately calculate the percentage of total cash contributions and percentage of total cash distributions attributable to that fund year. Specifically, we divide the cash contributions (distributions) per fund year by the total cash contributions (distributions) realized from inception to liquidation. These fund-year percentages provide a fund-specific distribution of cash contributions and distributions throughout the life of the fund. We then calculate a measure of cash inflow deferral (related to contributions) and a measure of cash outflow acceleration (related to distributions) by applying a weight to each fund-year percentage. For contributions, we weight the fund-year percentage by the fraction of the year in the fund's life divided by the total fund life, thus weighting later cash inflows more. We sum these over the life of the fund to arrive at *ContSkew*, the measure of cash inflow deferral. For distributions, we exactly reverse the weights over the life of the fund and multiply each fund-year percentage by the fraction of the fund life minus the fund-year plus one divided by the total fund life, thus weighting earlier cash outflows more. We sum these over the life of the fund to arrive at the measure of cash outflow acceleration, *DistSkew*. Equations 3 and 4 contain more detail:

$$ContSkew = \sum_{t=1}^{T} \left[\frac{Cont_t}{\sum_{t=1}^{T} Cont_t} \cdot \frac{t}{T} \right] \tag{3}$$

$$DistSkew = \sum_{t=1}^{T} \left[\frac{Dist_t}{\sum_{t=1}^{T} Dist_t} \cdot \frac{(T-t)+1}{T} \right] \tag{4}$$

In addition, for each fund, we also explore a third measure of cash flow timing, *AveSkew*, the average of cash inflow deferral (*ContSkew*) and cash outflow acceleration (*DistSkew*). Table 3 regresses return gap on these measures of cash flow skew and confirms that they are positively related to the return gap, as expected. Not surprisingly, the coefficient on *ContSkew*, our measure of cash inflow deferral, is statistically significant for the overall sample and for four of the eight subsamples. The coefficient on *DistSkew*, our measure of cash outflow acceleration, is highly statistically significant for the full sample, as well as all eight subsamples. Moreover, in most cases, the coefficients on *DistSkew* are larger than *ContSkew*. Thus, while our results suggest later capital calls and earlier distributions are associated with a higher return gap, earlier distributions appear to be more strongly associated with return gaps.

4 How do empirical gaps compare to a simulated setting?

A natural gap between reported IRR and the rate of return implied by the fund's cash-on-cash multiple arises due to the existence of intermediate cash flows that effectively shorten the investment horizon. This gap could be due to exogenous cash flow shocks or to investment decisions by GPs that maximize LPs' wealth. To the extent that we would expect different optimal investment and liquidation times for each holding of each fund, we would expect cash flows to be fairly random across investment and liquidation periods of the fund. In

turn, we would expect the average return gap to be close to an average return gap computed using these random cash flows. To investigate this possibility, we simulate cash flows for each fund by using the fund's cash-on-cash multiple and simulating cash flows that achieve that multiple. For each fund type (e.g., buyout or turnaround, and etc.), we estimate the median life over all funds of that type using the cash flow data. We estimate the life as the time it takes in years for LPs to receive 95% of the cash flows from the fund. For the simulation, we assume that all LP investments occur in uniformly distributed amounts in the first half of the fund life and add up to the total contribution amount. We further assume that all distributions to LPs occur in the last half of fund life, again in random dollar amounts that add up to total distributions. For odd fund lives, we assume a zero payout in the middle year. To be clear, in the simulation we do not assume a distribution of cash flows based on the distributions we observe in our dataset as we wish to simulate what a fund's IRR and return gap would look like without any management of cash flow timing.

Figure 3 presents a lowess plot of these results, broken down among small funds (less than \$100M) in Figure 3a, medium funds (\$100-499M) in Figure 3b, and large funds (\$500M+) in Figure 3c.[14] Note that expected gaps are negative for negative IRRs because shortening the horizon over which negative returns are realized makes the IRR more negative. Also, the horizontal axis is shorter in Figure 3c because cash-on-cash multiples for these large funds are smaller in the data. Figure 3 shows that for all fund sizes, reported IRRs are close to simulated IRRs for low multiple-implied returns, and that the two quantities begin to diverge for positive multiple-implied returns. For all three fund size categories, the divergence seems largest for multiple-implied returns of roughly 20% per year. For each category, a t-test of the difference between simulated and true return gaps finds that actual return

[14]See Tetlock (2007) for details of lowess estimation.

gaps are significantly larger than simulated return gaps. This suggests that cash calls are occurring later on average than randomly during the first half of the fund's life, and/or that distributions are occurring earlier than randomly in the last half of the fund's life.

5 Are return gaps persistent across a private equity firm's funds?

If return gaps are due to the random timing of the cash flows from the fund's portfolio companies, we do not expect them to persist in subsequent funds of a given GP. Table 4 examines whether return gaps from past funds of the private equity firm are related to return gaps for subsequent funds of the same private equity firm, by estimating the following equation for each fund i:

$$Gap_i = \alpha_0 + \alpha_1 lag3Gap_i + \alpha_2 lag3Multiple\_Return_i + \alpha_3 logFundValue_i + \ldots + \epsilon_i \quad (5)$$

Lagged values indicate the values from the lagged fund from the same GP that was raised at least three years prior to the current fund. Thus, this analysis is restricted to funds that have a predecessor fund that is at least 3 years older. We include fund vintage and fund type fixed effects, where fund types appear in Table 2 Panel B. Standard errors are double-clustered by vintage year and by private equity firm. In addition to the lagged fund IRR decomposed into the gap, *lag3Gap*, and the multiple-implied return, *lag3Multiple_Return*, we also control for the log of fund size, *logFundValue*.

Table 4, Panel A shows that gaps are highly persistent, especially for funds with positive

IRRs, suggesting that the distribution of cash flows along the fund's life are related to the private equity firm's management style. Results are stronger if we only require one year's difference, no doubt because the data set is larger.

Panel B of Table 4 decomposes the sample by size of fund, by fund type, and by the location of the GP. This panel shows that Gaps are persistent for small and medium funds (less than \$100M and between \$100M and \$500M), venture and other funds, and US funds. Panel C further shows that the persistence is economically stronger for pre-2005 vintage funds, though it is statistically stronger for the later vintages, and that it is strongest for liquidated funds. Since the gap is expected to build over time over the life of the fund, this result is expected. This finding of persistence is not necessarily due to a deliberate attempt to inflate IRRs, but this persistent investment style may be informative about future funds' performance. We thus turn to an assessment of private equity firms' future fund performance.

6 Is a private equity fund's return gap informative about the performance of the GP's future funds?

We next examine whether return gaps are related to future fund performance. If high return gaps are an indication that GPs are skilled in affecting LP perceptions about their returns, this ability might be correlated with the ability to generate actual high multiple-implied returns for investors as well. On the other hand, if a GP expends energy and uses costly methods to inflate IRR, this may be at the expense of the fund's cash-on-cash multiple.

Table 5 presents regressions of the fund's multiple-implied return on the earlier fund's

return gap and control variables, as in the following equation:

$$Multiple\_Return_i = \alpha_0 + \alpha_1 lag3Gap_i + \alpha_2 lag3Multiple\_Return_i + \alpha_4 logFundValue_i + \ldots + \epsilon_i$$

This table shows that, after controlling for lagged multiple-implied return and other controls, for many fund categories there is a negative relation between the return gap of one fund and the multiple-implied returns of the subsequent fund of the private equity firm, suggesting that the gap may be an indicator of value destruction to inflate performance. The results are economically significant. In column 3 of Panel A, the coefficient of -0.0477 on Lag3Gap suggests that, for every one standard deviation (0.116) increase in the earlier fund's return gap, the current fund enjoys an 0.55% lower multiple-implied return. In contrast, the multiple-implied return is a strong predictor of the next fund's performance, with a coefficient that is roughly 5 times as large. Panels B and C show that this result is fairly consistent across subsets of the data.

7 Are return gaps related to future fundraising?

Finally, we examine whether private equity return gaps impact future fundraising. We consider both the ability of the GP to raise larger funds in the future and LP investor behavior around fundraising events.

Beginning with the GP's ability to fundraise in the future, Table 6 estimates the following equation:

$$Chsize_i = \alpha_0 + \alpha_1 lag3Gap_i + +\alpha_2 lag3Multiple\_Return_i \alpha_3 logFundValue_i + \ldots + \epsilon_i \quad (6)$$

The dependent variable is the percentage change in size of the current fund from the lagged fund that was raised at least three years prior. Recall that we require a three year time period for the LP to be able to observe performance of the prior fund. This variable is winsorized at the 1% level to mitigate the effect of outliers, and funds smaller than $10M are omitted. Of course, this analysis in Table 6 is conditional on the presence of a follow-on fund. The regression also includes 42 vintage and 24 fund type fixed effects, and standard errors are clustered by vintage year and by private equity firm.

In column 1, we find that the return gap of the earlier fund is positively associated with the size of the private equity firm's follow-on fund. In Column 2, we find that the multiple-implied return of the earlier fund is also positively associated with the size of the next fund raised by the same private equity firm. However, it is important to consider the effect of both components of IRR, and the following columns of Panel A include both multiple-implied return and the return gap. We find no consistent relation between past multiple-implied return and the size of the private equity firm's follow-on fund, but we do find a positive relation between the return gap of the earlier fund and the increase in size of the subsequent fund. It appears that investors are focusing on the portion of the IRR that is most difficult for them to realize. For example, in column (3) of Panel A, a return gap that is 1 percentage point larger in the earlier fund is associated with a subsequent fund that is more than 3% larger. Panels B and C show that these results are strongest for large funds and for buyout funds.

We note that our results do not directly compare to those of Brown, Gredil, and Kaplan (2017), who find that GPs inflate interim NAVs during fundraising periods. This temporary NAV inflation of active funds may or may not affect the final IRR that is reported for the fund. Moreover, Phalippou (2011) shows that a consistent policy of NAV inflation may

decrease IRRs.

Based on the evidence that return gaps are associated with the ability of a GP to raise larger funds in the future, we next consider the behavior of various types of investors as defined by Preqin's Investors module. Preqin categorizes private equity LP investors across categories including endowments, public pension plans, and more. We are able to download investor data for 4,432 funds. We estimate the following equation across each of the largest investor categories:

$$Reinvest_{i,j} = \alpha_0 + \alpha_1 Gap_i + \alpha_2 Multiple\_Return_i + \alpha_3 logFundValue_i + \ldots + \epsilon_i \qquad (7)$$

In this analysis, the dependent variable is an indicator variable for whether a given investor j in private equity fund i invests in a subsequent fund with the same GP. The median investor reinvests with the same GP 25% of the time during our sample period. We restrict the sample to funds for which the GP goes on to raise a subsequent fund, and we require prior funds to be at least three years younger than current funds in order for LPs to be able to observe performance.

Results for the six largest categories of investor appear in Table 7, Panel A. In this table, we observe that many of the coefficients on the return gap of the fund are significantly positive, and none are significantly negative. In particular, insurance companies, funds of funds and foundations appear to be more likely to reinvest if the current fund's gap is higher, controlling for the multiple-implied return, fund size, and a host of fixed effects. For example, given a gap that is 1 percentage point higher, a private pension fund appears 0.24% more likely to invest in the GP's next fund.

Cavagnaro, Sensoy, Wang, and Weisbach (2018) create a measure of investor skill that

is simply the proportion of the investor's funds that beat the median IRR for that fund category and vintage. They argue that investor type alone is not a good indicator of skill, i.e. that there are skilled investors of all investor types. Using Preqin's fund categories and vintages (for example, large buyout funds of vintage 1995), we create similar measures of skill which compare the investor's performance to the median category IRR in our sample and the median category Multiple in our sample. The first skill category, "High IRR," includes investors who invest in at least four funds in our sample, and whose average indicator variable for beating the median IRR in that category and vintage is greater than 0.5. "Low IRR" investors invest in at least four funds during the sample period and have an average indicator variable for beating the median category and vintage IRR that is less than 0.5. Similarly, we categorize investors on whether they tend to beat the median fund multiple. The model we estimate is the same as in Equation 7 except that the model is run by skill category instead of by investor type. We again include *Gap* and *Multiple_Return* for the most recent fund of the GP that is at least three years older than the fund under consideration. Results appear in Table 7, Panel B. This panel shows that less skilled investors put significant weight on the return gap, while more skilled investors put less weight on the return gap, when deciding when to invest.

8 Conclusion

This study examines the difference between a fund's reported IRR and the annual rate of return implied by the fund's cash-on-cash multiple, which is not affected by several biases of the IRR calculation. This return gap is persistent across successive funds of the same private equity firm, suggesting that it is in part due to private equity firms' choices in the

timing of cash flows. We find a negative relation between lagged return gap and follow-on fund multiple-implied returns, however, suggesting that IRR inflation, intentional or not, is negatively related to GP skill in producing returns for investors. We further find that return gaps are positively related to the increase in size of the subsequent fund raised by the private equity firm. Moreover, certain investor types (including insurance companies, private pension funds, and funds of funds) and relatively less successful investors appear more likely to reinvest with high return-gap fund managers. By investigating the timing of cash flows throughout a fund's life and its relation to reported IRR, we document a limitation of the IRR as a measure of private equity fund returns.

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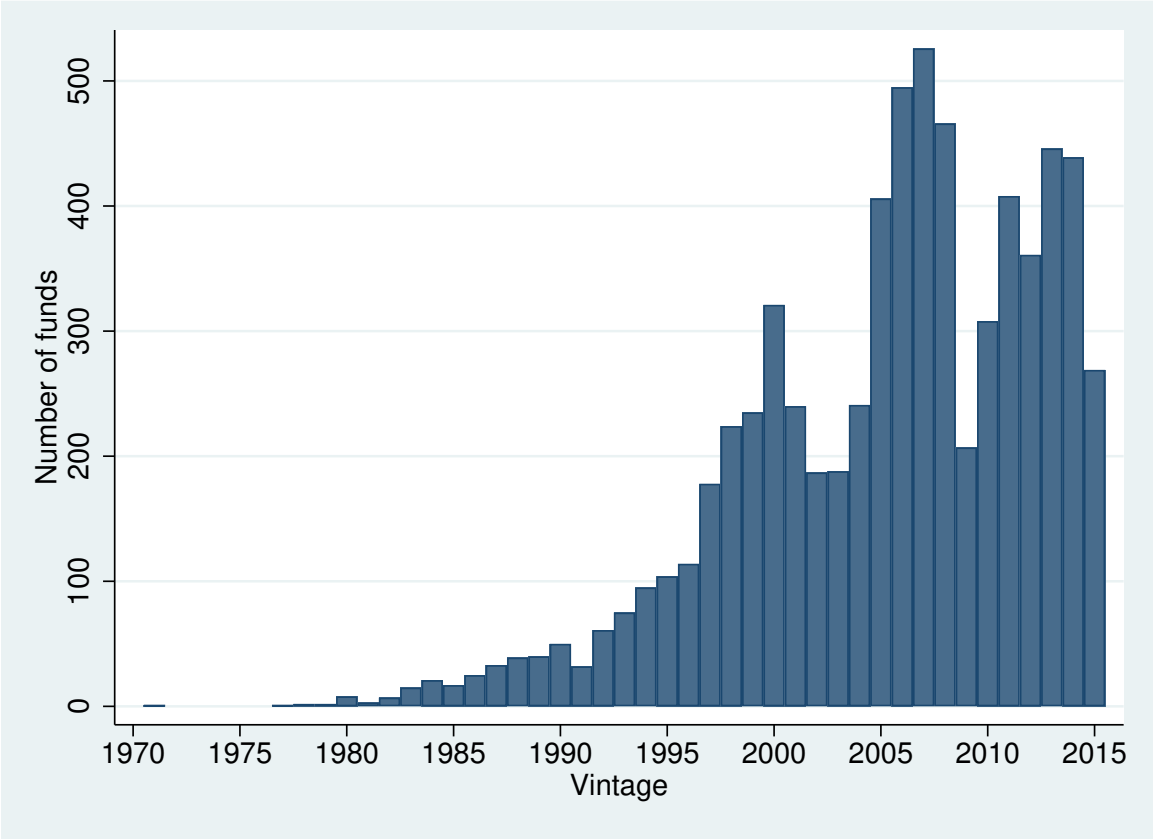
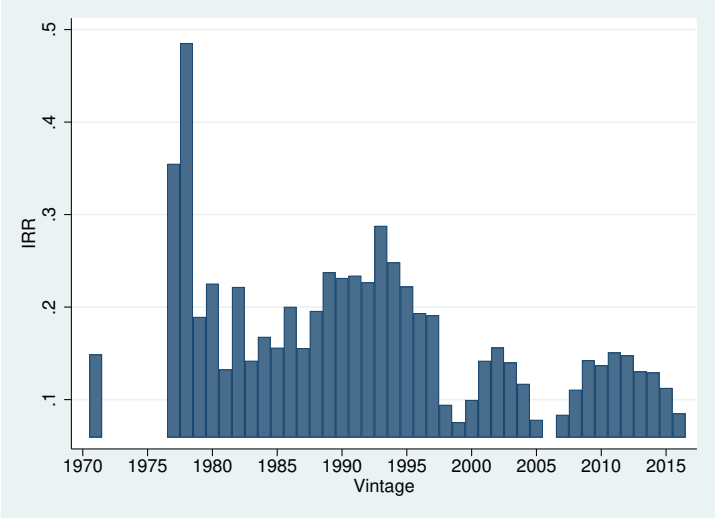
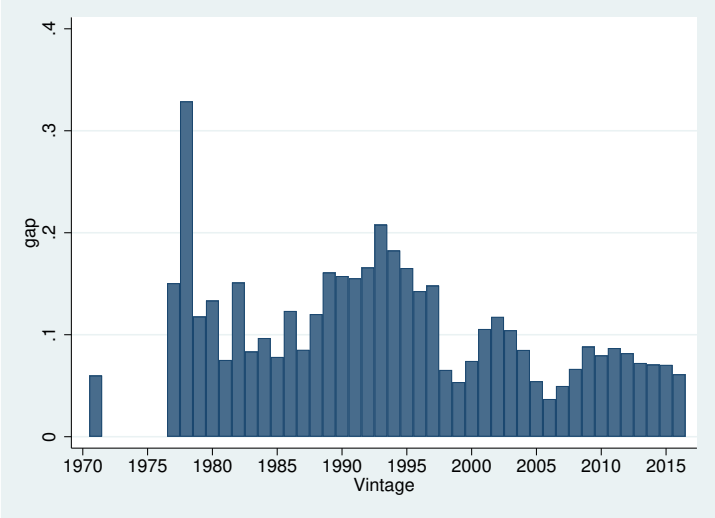


Figure 1: Number of funds by vintage year.

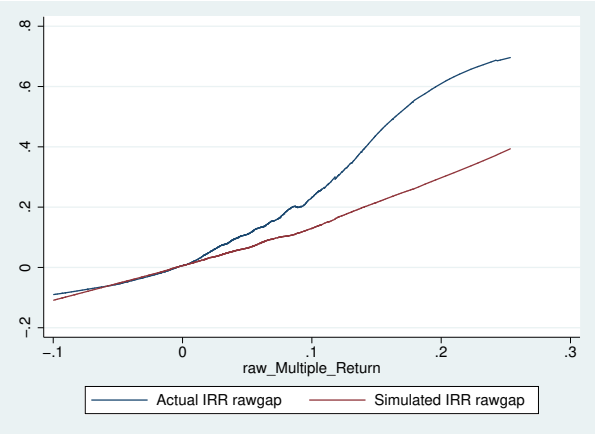


(a) Reported IRR

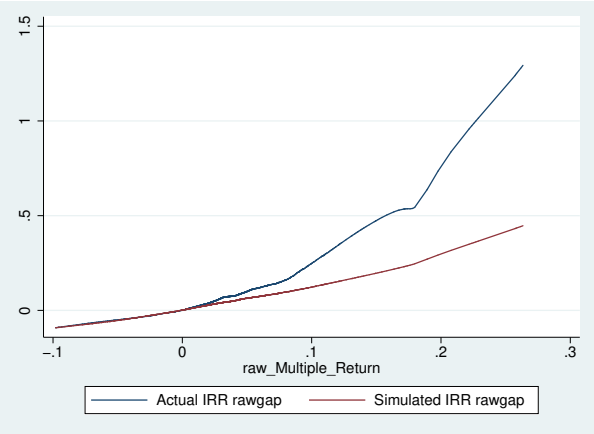


(b) IRR Gap

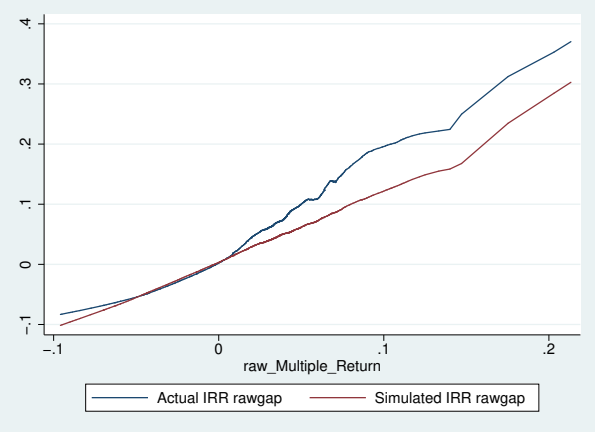
Figure 2: Reported fund IRR and IRR gap by vintage year.



(a) Small Funds



(b) Medium Funds



(c) Large Funds

Figure 3: Simulated and actual IRR gaps. Simulated gaps are obtained by using the fund's multiple and simulating cash flows that achieve that multiple, where all LP investments occur in the first half and all payouts to LPs occur in the last half of the fund's life. Results are appear for small funds (less than \$100M), medium funds (\$100-499M), and large funds (\$500M+). The horizontal axis is shorter in Figure 3c because cash-on-cash multiples for these large funds are smaller in the data.

Table 1: Variable definitions

Variable	Description	Source
AveSkew	The average of cash inflow deferral, ContSkew, and cash outflow acceleration, DistSkew.	Preqin cash flow data
ContSkew	Using LP fund contribution amounts and dates, we weight the fund-year percentage of contributions by the fraction of the year in the fund's life divided by the fund life, thus weighting later cash inflows more. We sum these over the life of the fund. See equation 3.	Preqin cash flow data
DistSkew	Using LP fund distribution amounts and dates, we multiply each fund-year percentage of distributions by the fraction of fund life minus the fund-year plus one divided by the fund life, thus weighting earlier cash flows more. We sum these over the life of the fund to arrive at this measure of cash outflow acceleration. See equation 4.	Preqin cash flow data
FundValue	Fund closed value in millions.	Preqin
IRR	The fund's reported internal rate of return, winsorized at the 1% level.	Preqin
Multiple	The fund's reported multiple.	Preqin
Topquartile	An indicator variable for whether the fund is top quartile in its vintage and type, based on IRR.	Preqin return data
Gap	The difference between a fund's reported IRR and the rate of return implied by the fund's multiple as in equation 2. This variable is winsorized at the 1% level.	Preqin
lag1-	A lagged measure for a fund with a vintage at least 1 year older than the current fund. This variable is winsorized at the 1% level.	Preqin
lag3-	A lagged measure for a fund with a vintage at least 3 years older than the current fund. This variable is winsorized at the 1% level.	Preqin
Multiple_Return	The rate of return implied by the fund's multiple. This variable is winsorized at the 1% level.	Preqin return data
lagMultiple_Return	The rate of return implied by the multiple of the private equity firm's prior fund that is at least 3 years older than the current fund. This variable is winsorized at the 1% level.	Preqin
Repeat_Investment	Indicator variable for whether the fund investment by the investor is a repeat with the same GP.	Preqin

Table 2: Fund-level summary statistics

This table presents summary statistics for the funds. Variable definitions appear in Table 1. Panel B shows means by fund type.

Panel A

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	mean	sd	p1	p25	p50	p75	p99	N
Multiple	1.608	0.811	0.260	1.170	1.450	1.830	5.590	6,914
IRR	0.127	0.156	-0.259	0.0510	0.109	0.180	0.790	6,914
Multiple_Return	0.0446	0.0524	-0.127	0.0204	0.0431	0.0697	0.214	6,914
Gap	0.0823	0.116	-0.154	0.0233	0.0598	0.110	0.634	6,914
FundValue	673.3	1,369	14	107	270	650	6,808	6,914
Vintage	2,005	6.993	1,985	2,001	2,006	2,011	2,015	6,914

Panel B

Type	IRR	Multiple	Gap	N
Balanced	0.122	1.756	0.084	111
Buyout	0.156	1.773	0.106	1,629
Co-investment	0.150	1.548	0.084	124
Direct Lending	0.087	1.313	0.043	93
Distressed Debt	0.129	1.497	0.080	177
Expansion / Late Stage	0.117	1.647	0.080	120
Fund of Funds	0.103	1.500	0.061	899
Growth	0.128	1.700	0.077	345
Infrastructure	0.114	1.458	0.068	152
Mezzanine	0.099	1.458	0.065	260
Natural Resources	0.136	1.623	0.091	208
Real Estate	0.116	1.424	0.071	1,236
Secondaries	0.168	1.516	0.116	227
Special Situations	0.131	1.590	0.085	72
Turnaround	0.182	1.586	0.136	24
Venture Debt	0.153	1.652	0.106	25
Venture/Early Stage	0.115	1.723	0.079	1,212

Panel C

Type	IRR	Multiple	Gap	N
Bank	0.119	1.662	0.077	183
Corporate Investor	0.100	1.450	0.068	117
Endowment Plan	0.111	1.544	0.070	364
Family Office	0.123	1.662	0.080	85
Foundation	0.110	1.504	0.069	698
Fund of Funds Manager	0.120	1.558	0.082	298
Government Agency	0.092	1.400	0.062	67
Insurance Company	0.128	1.514	0.082	327
Investment Company	0.116	1.518	0.081	142
Private Equity Firm	0.111	1.586	0.075	126
Private Pension Fund	0.112	1.505	0.072	644
Public Pension Fund	0.110	1.440	0.069	467
Sovereign Wealth Fund	0.106	1.462	0.069	24
Superannuation Scheme	0.155	1.627	0.109	47
Wealth Manager	0.128	1.602	0.084	134

Table 3: Measures of cash flow skew and the return gap

This table presents the result of regressions of the return gap on the relative timing of its cash flows for the liquidated private equity funds in our sample that have cash flows, using *Gap* as the dependent variable and *ContSkew* and *DistSkew* as explanatory variables. Variable definitions appear in Table 1. Standard errors are double-clustered by vintage year and by private equity firm.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Full	Small	Medium	Large					
VARIABLES	Sample	Funds	Funds	Funds	Venture	Buyout	Other	Pre 2000	Post 2000
ContSkew	0.367***	0.692	0.351***	0.388***	0.183	0.241*	0.355***	0.585***	0.167**
	(0.00)	(0.25)	(0.01)	(0.00)	(0.52)	(0.08)	(0.00)	(0.00)	(0.02)
DistSkew	0.491***	0.563	0.472***	0.481***	0.570***	0.314**	0.314***	0.595***	0.205**
	(0.00)	(0.13)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)
Observations	658	91	345	222	177	236	245	407	251
R^2	0.311	0.387	0.404	0.423	0.408	0.296	0.398	0.315	0.477
Vintage FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Fund Type FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table 4: Determinants of the gap

This table presents the result of regressions of a fund's return gap (*Gap*) on the return gap for the latest fund that was raised at least one year prior to the current fund by the same general partner, as well as fund size (*logFundValue*). Variable definitions appear in Table 1. Standard errors are double-clustered by vintage year and by private equity firm. There are 24 fund type and 42 vintage year fixed effects.

Panel A

	(1)	(2)	(3)	(4)	(5)	(6)
	Full	Full	Full	IRR	IRR	IRR
VARIABLES	Sample	Sample	Sample	>0	>0	>0
lag3Gap	0.0764**	0.0311	0.0306	0.0999***	0.0854**	0.0893**
	(0.01)	(0.37)	(0.37)	(0.00)	(0.03)	(0.03)
lag3Multiple_Return		0.184**	0.185**		0.0619	0.0519
		(0.01)	(0.01)		(0.36)	(0.44)
logFundValue			0.000375			-0.00319**
			(0.83)			(0.05)
Observations	3,915	3,915	3,915	3,427	3,427	3,427
R^2	0.146	0.148	0.148	0.182	0.183	0.184
Vintage FE	YES	YES	YES	YES	YES	YES
Fund Type FE	YES	YES	YES	YES	YES	YES

Panel B

VARIABLES	(1) Small Funds	(2) Medium Funds	(3) Large Funds	(4) Venture	(5) Buyout	(6) Other	(7) US	(8) Europe	(9) Other
lag3Gap	0.152**	0.101**	0.0180	0.0763**	0.0460	0.0982***	0.0794**	0.0151	0.0349
	(0.02)	(0.03)	(0.38)	(0.03)	(0.25)	(0.01)	(0.04)	(0.80)	(0.37)
logFundValue	0.0127	0.00556	0.00668*	0.0109***	-0.00214	0.000229	0.00101	0.000346	-0.00448
	(0.22)	(0.29)	(0.09)	(0.00)	(0.44)	(0.92)	(0.61)	(0.92)	(0.41)
Observations	567	1,748	1,600	621	991	2,303	2,853	748	314
R^2	0.196	0.199	0.140	0.445	0.181	0.115	0.153	0.244	0.276
Vintage FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Fund Type FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Panel C

VARIABLES	(1) Pre 2005	(2) Post 2005	(3) Closed	(4) Liquidated
lag3Gap	0.0886**	0.0636***	0.0318	0.146***
	(0.04)	(0.00)	(0.18)	(0.00)
logFundValue	-0.00205	0.00174	0.00351**	-0.00670
	(0.40)	(0.36)	(0.01)	(0.12)
Observations	1,118	2,797	3,053	862
R^2	0.186	0.063	0.085	0.197
Vintage FE	YES	YES	YES	YES
Fund Type FE	YES	YES	YES	YES

Table 5: Determinants of the next fund's performance

This table presents the results of regressions of multiple-implied returns *Mutliple_return* on the return gap and the multiple-implied return for the latest fund that was raised at least one year prior to the current fund by the same general partner (*lag3Gap* and *lag3Multiple_Return*), as well as an indicator variable for whether the fund is in the top quartile for its vintage and type, based on IRR (*Topquartile*), and fund size (*logFundValue*). Regressions include vintage year and fund type fixed effects. Variable definitions appear in Table 1. Standard errors are double-clustered by vintage year and by private equity firm. There are 24 fund type and 42 vintage year fixed effects.

Panel A

	(1)	(2)	(3)	(4)
	Full	Full	Full	Full
VARIABLES	Sample	Sample	Sample	Sample
lag3Gap	0.0182*		-0.0477***	-0.0460***
	(0.06)		(0.00)	(0.00)
lag3Multiple_Return		0.185***	0.268***	0.265***
		(0.00)	(0.00)	(0.00)
logFundValue				-0.00140**
				(0.04)
Observations	3,915	3,915	3,915	3,915
R^2	0.132	0.154	0.161	0.162
Vintage FE	YES	YES	YES	YES
Fund Type FE	YES	YES	YES	YES

Panel B

VARIABLES	(1) Small Funds	(2) Medium Funds	(3) Large Funds	(4) Venture	(5) Buyout	(6) Other	(7) US	(8) Europe	(9) Other
lag3Gap	-0.0650**	-0.0347*	-0.0481***	-0.0459**	-0.0139	-0.0463***	-0.0536***	-0.0690***	0.00149
	(0.04)	(0.07)	(0.00)	(0.03)	(0.48)	(0.00)	(0.00)	(0.00)	(0.97)
lag3Multiple_Return	0.494***	0.237***	0.161***	0.298***	0.186***	0.250***	0.259***	0.389***	0.0939
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.45)
logFundValue	0.000538	-0.00289	0.00237	0.00597**	-0.000648	-0.00284***	-0.00120	-0.00185	-0.000843
	(0.91)	(0.28)	(0.32)	(0.03)	(0.63)	(0.00)	(0.15)	(0.26)	(0.64)
Observations	567	1,748	1,600	621	991	2,303	2,853	748	314
R^2	0.251	0.187	0.171	0.355	0.123	0.153	0.177	0.237	0.203
Vintage FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Fund Type FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Panel C

VARIABLES	(1) Pre 2005	(2) Post 2005	(3) Closed	(4) Liquidated
lag3Gap	-0.0226	-0.0382**	-0.0453***	-0.0244
	(0.12)	(0.02)	(0.00)	(0.25)
lag3Multiple_Return	0.166***	0.271***	0.254***	0.239***
	(0.00)	(0.00)	(0.00)	(0.00)
logFundValue	-0.000914	-0.00114	-0.00107	-0.00202
	(0.39)	(0.14)	(0.20)	(0.25)
Observations	1,118	2,797	3,053	862
R^2	0.259	0.141	0.156	0.237
Vintage FE	YES	YES	YES	YES
Fund Type FE	YES	YES	YES	YES

Table 6: The return gap and fundraising

This table presents the results of regressions of the percentage change in size of the current fund from the most recent earlier fund (*chsize*) on the return gap and the multiple-implied return for the latest fund that was raised at least one year prior to the current fund by the same general partner (*lag3Gap* and *lag3Multiple_Return*), as well as an indicator variable for whether the fund is in the top quartile, based on IRR, for its vintage and type (*Topquartile*) and fund size (*logFundValue*).The dependent variable is winsorized at the 1% level. Variable definitions appear in Table 1. Standard errors are double-clustered by vintage year and by private equity firm. There are 24 fund type and 42 vintage year fixed effects.

Panel A

	(1)	(2)	(3)	(4)
	Full	Full	Full	Full
VARIABLES	Sample	Sample	Sample	Sample
lag3Gap	3.096***		2.523***	2.961***
	(0.00)		(0.00)	(0.00)
lag3Multiple_Return		6.763***	2.334	-1.338
		(0.00)	(0.15)	(0.37)
lag3logFundValue				-0.766***
				(0.00)
Observations	3,915	3,915	3,915	3,915
R^2	0.107	0.102	0.108	0.216
Vintage FE	YES	YES	YES	YES
Fund Type FE	YES	YES	YES	YES

Panel B

VARIABLES	(1) Small Funds	(2) Medium Funds	(3) Large Funds	(4) Venture	(5) Buyout	(6) Other	(7) US	(8) Europe	(9) Other
lag3Gap	0.123	1.173***	3.124**	2.181**	4.672***	1.847	2.579***	2.521	7.207***
	(0.79)	(0.01)	(0.02)	(0.04)	(0.00)	(0.15)	(0.00)	(0.10)	(0.00)
lag3Multiple_Return	0.0197	-1.284	-4.005	-2.172	-0.966	-0.221	-1.096	-0.457	-11.05**
	(0.99)	(0.34)	(0.16)	(0.36)	(0.72)	(0.91)	(0.57)	(0.87)	(0.01)
lag3logFundValue	-0.745***	-1.602***	-1.716***	-0.953***	-0.561***	-0.820***	-0.813***	-0.637***	-0.654***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	567	1,748	1,600	621	991	2,303	2,853	748	314
R^2	0.558	0.535	0.378	0.352	0.183	0.237	0.216	0.262	0.412
Vintage FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Fund Type FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Panel C

VARIABLES	(1) Pre 2005	(2) Post 2005	(3) Closed	(4) Liquidated
lag3Gap	2.918***	2.865***	3.016***	2.133**
	(0.00)	(0.01)	(0.00)	(0.01)
lag3Multiple_Return	-2.880	-0.0288	-1.551	0.551
	(0.31)	(0.99)	(0.44)	(0.87)
lag3logFundValue	-0.992***	-0.699***	-0.756***	-0.908***
	(0.00)	(0.00)	(0.00)	(0.00)
Observations	1,118	2,797	3,053	862
R^2	0.241	0.196	0.228	0.267
Vintage FE	YES	YES	YES	YES
Fund Type FE	YES	YES	YES	YES

Table 7: Determinants of repeat investors for large investor categories

This table presents the results of logit regressions of the likelihood that a private equity investor will invest with the PE firm again in the future. The dependent variable, *Reinvest* is an indicator variable for whether a given investor j in private equity fund i invests in a subsequent fund with the same GP. In Panel A, investors are broken down by broad category. In Panel B, investors are divided into whether, throughout our sample, their fund investments have beat the median IRR or Multiple for that category and vintage (High IRR and High Multiple) more than half of the time, or have underperformed more than half the time (Low IRR and Low Multiple). Investors in the sample in Panel B hold at least 4 funds during the sample period. Regressions include vintage year and fund type fixed effects. Variable definitions appear in Table 1. Standard errors are double-clustered by vintage year and by private equity firm. There are 24 fund type and 42 vintage year fixed effects.

Panel A

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Endowment Plan	Foundation	Fund of Funds Manager	Insurance Company	Private Pension Fund	Public Pension Fund
Gap	0.267	0.333**	0.365***	0.391***	0.237**	0.121
	(0.18)	(0.05)	(0.00)	(0.00)	(0.02)	(0.26)
Multiple_Return	-0.127	0.0169	0.518*	0.315	0.181	0.592*
	(0.79)	(0.97)	(0.06)	(0.45)	(0.58)	(0.06)
logFundValue	-0.0631***	-0.0166	0.00376	-0.00149	-0.0116	0.00166
	(0.00)	(0.30)	(0.71)	(0.89)	(0.44)	(0.88)
Observations	3,915	6,439	7,305	4,592	9,727	15,365
R^2	0.092	0.084	0.127	0.059	0.083	0.048
Vintage FE	YES	YES	YES	YES	YES	YES
Fund Type FE	YES	YES	YES	YES	YES	YES

Panel B

VARIABLES	(1) High IRR	(2) Low IRR	(3) High Multiple	(4) Low Multiple
Gap	0.263***	0.279**	0.254***	0.294***
	(0.00)	(0.01)	(0.00)	(0.00)
Multiple_Return	0.154	0.427	0.168	0.239
	(0.54)	(0.11)	(0.54)	(0.30)
logFundValue	-0.00673	-0.0137	-0.00670	-0.00887
	(0.56)	(0.16)	(0.56)	(0.34)
Observations	25,233	19,338	27,985	15,819
R^2	0.096	0.093	0.094	0.103
Vintage FE	YES	YES	YES	YES
Fund Type FE	YES	YES	YES	YES

Appendix

This Appendix shows a base case set of cash flows typical to a private equity fund that spans 10 years. There are capital calls in years 0-2, no cash flows in intermediate years and cash distributions in the later years. The lower half of the table shows a hypothetical case of subscription line financing for the same fund, where the first two capital calls are borrowed until year 2 at an interest rate of 1% per year. The private equity fund has closed size 100, ignoring annual management fees. Baseline cash flows for years 0 through 9 are given in the first line. In the second case with subscription line financing, the cash flows from years 1 and 2 are borrowed until year 3 at the simple interest rate of 1% per year, costing $3 in year 3. Thus, the LP multiple is lower under subscription-line financing, but the reported IRR is higher and the carry earned by the GP is 14.45 compared to 0.

	0	1	2	3	4	5	6	7	8	9
Fund cash flows	-50	-50	0	0	0	0	0	0	75	110
LP cash flows	-50	-50	0	0	0.	0	0	0	75	110
Fund IRR	7.90%									
Fund Multiple	1.85									
Carry to GP	0.00									
LP IRR	7.90%									
LP Multiple	1.85									

	0	1	2	3	4	5	6	7	8	9
Fund cash flows	0	0	-103	0	0	0	0	0	75	110
LP cash flows	0	0	-103	0	0	0	0	0	75	95.6
Fund IRR	9.30%									
Fund Multiple	1.80									
Carry to GP	14.45									
LP IRR	8.00%									
LP Multiple	1.66									