THE PRIVATE EQUITY PERFORMANCE PUZZLE

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Abstract

This paper presents conclusive evidence on the returns to US buyout funds, and resolves a puzzle in the existing literature. It uses a new dataset constructed by the authors that is both of high quality and is far more comprehensive than available hitherto. For almost all vintage years from 1980 to 2008, buyouts outperformed the S&P 500 by a margin of some 500-800 bps per annum. We show that the negative or neutral buyout returns reported in existing published studies were an artefact of their underlying data.

We also report new evidence on the cross-sectional determinants of returns and liquidity. While returns are inversely correlated to capital raising, it appears to be the macro-economic environment that is driving both performance and fund liquidity. There is strong evidence that larger funds significantly outperform smaller funds, but no evidence of a concave relationship between size and returns.

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1. Introduction

Three decades after industry inception, the evidence on the returns by private equity funds is still ambiguous. Influential studies by Kaplan and Schoar (2005) and Phalippou and Gottschalg (2009) find private equity underperforming or, at best, matching public benchmarks. But the database upon which this work is based has now been shown to be unreliable (Stucke (2011)).

In contrast, studies that have sourced data directly from a single limited partner (LP) report outperformance against public equity. For example, Ljungqvist and Richardson find excess returns of 5% to 8% per annum; Robinson and Sensoy arrive at 2.5%.[1] But while the fund data held by LPs is likely to be of high quality, results from single LP studies may be unrepresentative if LPs differ in skill (Lerner, Schoar, and Wongsunwai (2007)). In independent and contemporaneous work, Harris, Jenkinson and Kaplan (2013) confirm the excess return of Robinson and Sensoy, using cash flow data from Burgiss. Because Burgiss is a relatively new database. the returns of most of their funds still rely on net asset values, and the authors highlight the preliminary nature of their findings.[2]

In this paper we provide conclusive evidence that the returns by U.S. buyout funds have been indeed significantly higher than those of public equity over a period of three decades. We find excess returns to be in the area of 5% to 8% per annum which is in line with the early findings by Ljungqvist and Richardson (2003), but higher than in any other study covering U.S. buyout funds.

[1] Further single LP studies include Gottschalg, Talmor and Vasvari (2010, 2011).

[2] In the first version of their paper, the authors acknowledge that "confirmation of our results must await the emergence of a complete buyout fund dataset."

In a first step, we construct a dataset for U.S. buyout funds that approaches completeness. The dataset contains 1,169 funds with total capital commitments of over $1 trillion. This is about two or more times the coverage achieved in existing studies. Our data captures 85% to 90% of the capital raised by the overall buyout industry since 1980 and, in contrast to existing studies, this proportion is fairly steady over time. This is important given the highly cyclical returns of private equity funds (Gompers and Lerner (2000), *et al.*). In terms of buyout funds of institutional quality,that is, funds that are eligible for institutional investors like pension funds, endowments or insurance companies, our data must cover close to 100% of the entire population. We thus provide what must be conclusive evidence on the returns from U.S. buyout funds.

The primary source of data is Cambridge Associates' (CA) private equity fund database, made available for the first time for this study. CA data has the high quality of LP data, but offers broad coverage and a long history. We augment this data with hand-collected data from a number of other LPs, including Calpers which is one of the world's largest and most diversified investors in private equity.[3] We use this data to resolve the ambiguity in the results of existing studies, and we locate the differences in earlier findings in the interplay between incomplete data and research design We revisit and correct some of the existing findings on the time-series and cross-sectional characteristics of buyout fund returns and subject the results to more rigorous robustness tests than hitherto. We provide

[3] An independent benchmarking against various databases shows that the average U.S. buyout fund in the Calpers portfolio achieves exactly the average industry performance (Morkötter and Stucke (2013)). This result is not surprising, given the highly diversified nature of their portfolio, reflecting the significant amounts of capital Calpers need to invest (about $50bn).

new results on the cross-sectional determinants of returns, and on the liquidity properties of buyout funds. Our main results are as follows.

Overall, U.S. buyout funds have generated weighted-average excess returns over the S&P 500 performance index of 5.8% per annum for the vintage years 1980 to 2008 (measured as of June 2010). Excluding younger funds raised between 2006 and 2008, excess returns average over 8.6% per annum. These are in line with the findings of Ljungqvist and Richardson (2003) and Gottschalg, Talmor and Vasvari (2010, 2011), suggesting that those studies were not simply an artifact of selection bias. The results are robust to the use of public market-adjusted investment multiples to measure performance, rather than annualized return measures. The results are robust to possible accounting bias in the closing net asset values of unrealized investments. The results are robust to using only the sub-sample of effectively liquidated funds (*i.e.*, excluding all funds younger than 10 years plus those with more than 10% in net assets left). The results are not merely a result of the choice of benchmark – leveraging S&P returns and controlling for size and style partly reduces but does not eliminate excess returns. Moreover, buyout funds perform well against other alternatives including hedge funds, real estate and commodities.

These significant excess returns are primarily earned by positive outliers and, in particular, by top-decile funds. The best performing ten percent of all funds contribute roughly half of all excess returns, while the top quartile earns about three-quarters of all excess returns. Overall, around 60% of buyouts funds beat the S&P.

This paper documents a secular downward trend in absolute buyout returns, in line with the decreasing absolute returns by financial markets in general. However, given that

buyout funds primarily use debt at increasingly lower borrowing costs to fund their acquisitions, this trend is interesting in its own right. We do not observe a corresponding trend in excess returns over public equity – these have been fairly stable over the past three decades, though, display some cyclicality.

The presence of cyclicality in absolute private equity returns has been widely observed and, finding a strong inverse relation between capital raised and buyout returns, Gompers and Lerner (2000), amongst others, attribute this pattern to 'money chasing deals'. We similarly observe that buyout funds delivered much higher absolute and relative returns for vintage years in the first half of the 1980s, 1990s, and 2000s (*i.e.*, funds whose investments were not or less affected by a subsequent recession). Studying the time-series characteristics of fund returns, we identify a number of other correlates that exhibit much stronger statistical significance than capital raised, and have a higher explanatory power of the variation in returns. These variables include the overall economic conditions when capital is invested and realized, valuation multiples in the public equity market, as well as the availability of financial leverage. This is an important finding, not only because it suggests that unspent capital may rather be a mediating variable in a wider economic context.

In the cross-section, we find a statistically and economically significant positive relationship between the size of a buyout fund and its returns in univariate regressions, controlling for inter-vintage year variation. This has not been reported hitherto. Categorising funds into size quartiles per full decade, Harris et al. (2013) do not find such a relationship. Kaplan and Schoar (2005) find a significant, concave, relationship between fund size and returns for venture capital funds, but not for buyout funds. Robinson and

Sensoy (2012) find a size-return relationship only when adding further variables including a fund's sequence number. At the sample mean, we find that larger funds outperform smaller funds by an average of 0.6% per annum as fund size doubles. Limiting the sample to vintage years that were less affected by a subsequent economic downturn, the size/return relationship becomes statistically, and economically, highly significant, with an extra 1.3% return as fund size doubles[4]. In contrast to previous studies, we find no evidence of concavity at all in the relationship between fund size and return.

With respect to fund liquidity, we find that buyout funds employ capital for much shorter periods than their nominal lifetime might suggest. On average, U.S. buyout funds return invested capital to LPs within three years and the overall duration of capital employed averages five years. This period has significantly decreased over time with the maximum fraction of effectively drawn down capital decreasing to just over 50% of total fund commitments. Larger funds have a, statistically significant, faster recovery rate of invested capital, as do funds raised in the first half of each decade. The availability of financial leverage and market conditions, both when funds are invested and investments are realized, are significant determinants of the speed at which capital is called from LPs and invested capital is recovered, as well as the overall duration of capital employed. This is the first paper to analyze these fund characteristics.

[4] However, this observation may suggest a different risk profile between large and small buyout funds, perhaps resulting from the different size of portfolio companies or different levels of financial leverage employed.

The paper is organized as follows. Section 2 estimates the universe of U.S. buyout funds, describes our dataset and outlines the methodology. Section 3 presents the net returns of U.S. buyout funds for their LPs, both in absolute terms and relative to different benchmarks, and subjects the results to a variety of robustness tests. Section 4 explains the findings of previous studies, that use different datasets and study different sub-periods. Section 5 examines the time-series and cross-sectional characteristics of buyout funds, and provides evidence on the influence of fund size, market conditions, and the availability of financial leverage on fund performance and fund liquidity. The final section concludes.

Abkürzungen konsistenz checken

Confirm additional benchmarks via CFs, not estimates

Present tense and emphasize importance of each finding

2. Data and methodology

2.1. The universe of buyout funds

Identifying the universe of private equity funds is not straightforward. Thomson VentureXpert (TVE) and Preqin both publish records of historic fundraising activity that have become the standard reference for the population of buyout funds. These two datasets differ in coverage. While the TVE universe is comprehensive in the 1980s and 1990s, but less so in the 2000s, Preqin's coverage increases from the mid-1990s. Both datasets show

differences in classification at the margin between buyout, growth and mezzanine funds, and in the definition of a 'main fund'[5].

Merging the TVE and Preqin universes, using a conservative rule that retains all U.S. funds categorized as 'buyout' in at least one of the two databases, gives a total of capital raised of $1,138bn with about 1,750 funds for vintage years 1980 to 2008.[6] A third database, LP Source from Dow Jones, focuses exclusively on funds active in the market. LP Source contains around 1,500 main funds, with capital raised of $1,231bn over the same period. Since LP Source has a constantly high coverage throughout the past three decades, and an even higher amount of capital raised, we further use LP Source as a proxy for the buyout fund universe. However, we observe that all three datasets contain many funds that are not of 'institutional quality', that is, institutional investors like pension funds, endowments, or insurance companies would not be allowed to invest in those funds.

2.2. Sample data and coverage

Our base sample comprises all U.S. buyout funds from Cambridge Associates' (CA) private equity performance database. CA was formed in the 1970s and became the world's leading private equity advisory firm with over 900 LP clients. It maintains a cash flow and NAV database for over 4,000 private equity funds, most of which are administrated on behalf of their LP clients in its role as a data custodian and running customized accounts.

[5] For example, TVE lists a large number of side funds and sub-funds.

[6] In case of differences in the size, we count the larger value. If the vintage year does not match, we take the earlier year.

Most recently, CA has been appointed by the Institutional Limited Partners Association (ILPA) to create the industry's official future benchmarks for LPs.

CA data has the quality of limited partner data, but offers broad coverage and a long history. We obtain 556 U.S. buyout funds from CA for the vintage years 1986 to 2008 with combined capital commitments of about $668bn, and data updated to the second quarter of 2010. For each fund we have quarterly numbers on capital contributions and capital distributions between the fund and its LPs, and net-to-LP net asset values.

However, no single data source has yet approached completeness with respect to the universe of buyout funds[7]. As a result, even studies that use broad coverage databases sourced from data aggregators may be vulnerable to the accusation of selection bias (see Harris, Jenkinson and Stucke (2012)). To increase coverage, we hand collect data on a further 613 U.S. buyout funds with capital commitments of $356bn.[8] The main sources are California's Public Employees Retirement System, also one of the oldest fund of funds managers in the U.S.. The remaining data comes from a heterogeneous group of public and private LPs from the U.S., the U.K., Germany and Switzerland.[9]

Our final sample comprises 1,169 U.S. buyout funds, which is upwards of twice the number of funds in any existing research dataset (see Table 1, Panel A). It contains total capital commitments of $1,024bn, which represents 90% of the combined TVE/Preqin universe and around 85% of the LP Source universe by value (see Table 1, Panel B).

[7] For example, for vintage years 1980 to 2005, Cambridge Associates has cash flow data for 431 funds, State Street for 419 funds, Burgiss for 399 funds, and Preqin for 290 funds.

[8] The average fund size of our 613 additional funds is smaller than in the CA dataset. This is, because CA already covers the very vast majority of large and mega funds in the market.

[9] As part of the non-disclosure agreements, these investors require full anonymity.

Importantly, this coverage is fairly evenly distributed back to 1980. If we take only funds of institutional quality into consideration, excluding the hundreds of small first-time funds in both universes, our coverage must approach 100% of the investable population.[10]

Figure 1 compares the median internal rates of return (IRRs) of the sample with different other data sources. Our IRRs are fully in line with those of other sources, and even at the lower end between 1986 and 1990. A comparison of the number of funds in Table 1 with the results in Figure 1 suggests that median IRRs of other data sources get closer to our IRRs, the larger is the number of funds in their respective vintage years. Given that those other sources may contain some of the 10-15% of all buyout funds not captured by us, this provides further reassurance on the representativeness of our data.[11]

2.3. Measurement of returns

Private equity funds are closed-end with a nominal life of ten years, usually extensible until remaining investments are liquidated. LPs commit to subscribe capital that the fund manager (GP) then calls to meet investment needs during the first five to six years or for management fees. Capital returns to LPs may start as early as the third year, as first

[10] Note that the CA database contains only funds of institutional quality. Also, all of our additional LPs are sophisticated investors with strict investment policies; for example ;, they do not invest with fund managers that have existed for less than five years and.

[11] The apparently higher performance of CA, compared to the TVE benchmark, has been attributed by some commentators to success bias (Stucke (2011)). For example, Harris et al. (2013) suggest that 'CA may have a bias towards GPs who are raising new funds and, therefore, may have performed well.' To investigate the possibility of a success bias in the CA data, and since CA's data will form the future benchmark for investors in this asset class, Figure 2 plots the weighted-average and median IRRs and TVPIs for the CA sample and the final sample since the mid-1990s. The CA data shows no indication of a bias.

investments are exited or recapitalized, and continue until the fund is fully liquidated. In a typical profile, invested capital peaks at around year five as capital distributions start to exceed final calls, trending to zero as investments are realized or written-off. Consequently, the return from a fund is known with certainty only when the fund is fully liquidated. Interim measures of fund performance combine cash flows to investors with a net asset value (NAV), which is the accounting valuation of the remaining assets in the fund and represents the terminal cash flow in interim returns. The ratio of residual value to paid-in capital (RVPI) relates the current NAV to the paid-in capital to date. The total value to paid-in capital ratio (TVPI) or 'money multiple' is the ratio of current NAV plus distributed capital to paid-in capital.

We calculate all performance measures by vintage year, for certain sub-periods, and the whole observation period. All weighted-average and mean values are calculated on a pooled cash flow basis for each vintage year, while median values come from individual fund figures. For any period of vintage years we aggregate individual vintage year results by weighting them with their underlying amount of invested capital (capital-weighted) or by the number of underlying funds per vintage year (equally-weighted). We benchmark against the total (gross) returns of various public equity indices using the public market equivalent (PME) approach introduced by Kaplan and Schoar (2005).[12]

The PME approach separately discounts all capital distributions from a private equity fund, and all capital contributions into the fund, using the returns of the public equity

[12] Public market benchmarking has been done by some LPs since the early 1980s. It was first formalized by Long and Nickels (1995). In their model, the LP invests or divests the same amounts in a public equity index on the dates when a private equity fund calls or distributes capital to arrive at a residual value in the index.

index since fund inception, then calculates the ratio of the present values. The PME multiple is a fund's money multiple with both numerator and denominator discounted using the benchmark return. While the PME multiple is a factor that indicates the magnitude by which the absolute returns from a private equity fund have exceeded those from public equity over the fund's lifetime, it gives no information about the rate at which the excess return has accrued. Given the cross-sectional volatility in the duration of employed capital and the systematic downward trend in duration over time (Section 5.3), the PME multiple also has its limitations when comparing performance results across vintage years over a long sample period.

Therefore, we also report the PME IRR, which is formally derived by Griffiths (2009) and Gredil et al. (2013). The net cash flows of the fund are again discounted using the benchmark returns and we then calculate the IRR over this stream of capitalized cash flows with respect to their individual dates. The PME IRR measures the annual rate of excess return between a private equity fund and a benchmark. As it explicitly accounts for the timing of investments and divestments, it provides a better comparison of the relative returns to investors over time. By construction, the PME IRR and the PME multiple are highly correlated with a coefficient of 0.825.[13]

[13] In unreported regressions, we find that a unit change in fund IRR translates into a change in PME IRR of 0.888, on average, at the sample mean. As the standard error is negligible, about 94% of the variation in PME IRRs can be explained by the IRR. Adding the TVPI into the equation does not alter this result – with a coefficient of -0.011 a fund's money multiple is economically insignificant. With respect to the PME multiple, a change in the TVPI corresponds to a change in the PME multiple of 0.571. Adding the IRR as a second variable (coefficient of 1.036) increases the explanatory power from 80.0% to 86.5%.

3. Fund performance

This section reports the net returns generated by U.S. buyout funds for their investors from 1980 to 2008. We present absolute fund returns, and PME returns relative to the S&P 500. To examine the influence of NAVs, we re-estimate returns on the assumption that residual assets are sold at observed secondary market discounts, as well as using the most conservative approach of studying only effectively liquidated funds. Finally, we investigate the sensitivity of returns to the choice of public benchmark, and to financial leverage.

3.1. Absolute and PME returns

Table 2 presents the absolute returns of the 1,169 U.S. buyout funds in our sample. Over all vintage years, U.S. buyout funds achieve a weighted-average IRR of 8.6% and a mean IRR of 10.2%. Excluding young funds from 2006 to 2008, average IRRs are in the region of 12% to 15% and average TVPIs are above 1.6. For the whole sample, top-quartile funds achieve IRRs of at least 17.5%. For funds prior to 2006, the top-quartile IRR is about 20% and the top-quartile TVPI is above two.

The cyclical nature of private equity returns (Gompers and Lerner (2000), Kaplan and Schoar (2005), *et al.*) is evident in Table 2. IRRs of around 25% achieved in the first half of the 1980s became the unofficial target of the industry. IRRs fell sharply in the second half of the 1980s due to many overleveraged companies and a weak economy in the early 1990s. Funds from the first half of the 1990s that exited their investments into the rising economy towards 2000 again show IRRs of around 25%. Later-1990s vintage years

delivered weaker returns with single-digit IRRs. The 2000s follow the same pattern, though these fund returns increasingly reflect unrealized investments.

In addition to the cyclical nature, we find a strong downward trend of absolute returns as shown in Figure 3, Chart A. Weighted-average IRRs were 16.5% in the 1980s, 11.4% in the 1990s and 7.2% in the 2000s. While this trend is in line with the decreasing returns by financial markets in general, and the risk-free rate in particular, the development is interesting given the increasingly lower borrowing costs that buyout funds, who primarily fund their acquisitions with debt, have appreciated.

Table 3 reports PME returns. U.S. buyout funds beat the S&P 500 in almost every vintage year since 1980.[14] Overall, the weighted-average PME IRR is 5.8% per annum, which is substantially higher than the 'approximately equal' performance in Kaplan and Schoar (2005), and the -3.0% in Phalippou and Gottschalg (2009). If we exclude younger funds from 2006 to 2008, excess returns rise to 8.6%. These are economically significant values. Notably, our numbers are higher than the 2.5% to 3% estimated by Robinson and Sensoy (2012, RS), or the 'at least' 3% estimated by Harris et al. (2013, HJK). Whereas to the secular downward trend observed in absolute returns, we do not find a trend in excess returns, as shown in Figure 3, Chart B – these have been fairly stable over the past three decades, though, display some cyclicality as well.

Results for PME multiples are qualitatively similar to PME IRRs. Over all 29 vintage years, the PME multiple is 1.23 for the weighted-average and 1.22 for the mean fund. Excluding funds from 2006 to 2008, PME multiples increase to 1.35, 1.30 and 1.23,

[14] The negative spread in 1987 is due to one outlier that accounted for roughly 40% of capital raised in that year.

respectively. Compared to the PME multiples by RS and HJK, we find again a positive difference, though, less pronounced than for the annualized excess returns. For the overlapping sample period between all three samples, 1984 to 2005, we find a PME of 1.26 (versus 1.24 for HJK, and 1.20 for RS). For the 15-year period leading up to 2005, we find a PME of 1.33 (versus 1.30 for HJK, and 1.21 for RS). This suggests that their calculation of annualized excess returns may understate true values or possible sample issues may be present (we revisit time series of PME multiples in Section 4).

For most vintage years average excess returns are above the median, often significantly, indicating that excess returns are largely driven by positive outliers. Figure 4 shows a concentration analysis of excess returns across our sample. Almost half of the excess returns are delivered by the best performing 10% of funds only. Top-quartile funds combine about three-quarters of all excess returns. In total, 63% of all funds beat the S&P.

As at mid-2010, the measured performance of funds from the 2000s still partly relies on net asset values. Unreported estimates suggest that funds from 2000 and 2001 would remain strong outperformers even if their residual values of 42 to 50% of invested capital were entirely valueless. Funds from 2002 to 2005 need to realize, respectively, 30%, 20%, 55% and 75% of their residual values to continue beating the S&P.

3.2. Evidence based on liquidated funds

The return metrics reported above treat NAVs as a final cash flow in mid-2010. As the outcome and integrity of NAVs, reported by the fund managers themselves, is highly uncertain (Ljungqvist and Richardson (2003)), we now focus on the sub-set of liquidated

funds only.[15] Setting the cut-off after the vintage year 2000, and defining a fund as (effectively) liquidated if its residual value is less than 10% of invested capital, we sample 410 liquidated funds out of 584 funds.

The left panel of Table 4 reports the PME returns of these funds based only on their realized cash flows. For the whole period 1980 to 2000, liquidated funds achieve a weighted-average PME IRR of 3.8% and a mean PME IRR of 4.5% per annum. In total, 55% of the liquidated funds beat the S&P. As for the full sample, the positive spread is largely driven by outliers. Inclusion of the inevitably small NAVs does not materially alter the results, as shown in the bottom row of the table – the weighted-average PME IRR increases to 4.1% and the mean PME IRR is 4.7% per annum.

Nonetheless, a focus on liquidated funds only risks downwardly biasing estimated performance, as it is primarily the more successful and larger funds from the later-1990s that still have an RVPI above 10%. This is also the reason why the mean PME IRR exceeds the weighted-average in the liquidated sample. Consequently, PME IRRs based on the cash flows of these 410 liquidated funds should be seen as a very conservative lower bound.

As an alternative methodology we convert final NAVs into quasi cash distributions, applying discounts observed in successful auction bids in the secondary market for LP interests. Assuming a sale at a 12.6% discount in mid-2010,[16] investors in U.S. buyout funds from 1980 to 2000 would have gained a PME IRR of 5.9% relative to the S&P (right

[15] Although Jenkinson, Sousa and Stucke (2012) find that buyout fund managers generally value their funds conservatively, 2010 and 2011 have been characterized by industry-wide fundraising efforts including significant portfolio mark-ups.

[16] Cogent Partners and UBS, the two most active intermediaries in the secondary market, independently report average discounts to buyout fund NAVs of 12.0% and 12.6%, respectively, for mid-2010.

panel). The average fund would have delivered excess returns of 5.4%. Adding funds until 2005, the PME IRR rises to 7.5% for the weighted-average and 6.2% for the mean fund.[17] These numbers are significantly higher than those reported in previous research.

3.3. The effect of benchmark

For comparability with other studies, we use the S&P 500 to benchmark private equity returns. The choice of the S&P in the literature is partly pragmatic – there is no secondary market with very frequent and transparent pricing, and returns cannot be reliably estimated until a fund is finally liquidated, so that conventional estimation of a factor pricing model is infeasible. Also, LPs typically use the S&P 500 to benchmark, as they view investment in private equity as an alternative to their public equity programs. Nonetheless, the constituents of the S&P 500 bear limited resemblance to the portfolio companies of buyout funds, in terms of size, liquidity or leverage. For example, the minimum size threshold of the S&P 500, which is $5bn at current prices, exceeds the transaction size of the vast majority of leveraged buyouts observed thus far.

In recent work, Korteweg and Nagel (2013), and Sorensen and Jagannathan (2013) argue that there is no need to adjust PMEs for benchmark or leverage due to the realized nature of fund cash flows. Nonetheless, we examine the impact of other benchmarks on excess returns. Rather than an asset pricing exercise, this analysis should therefore be seen as illustrative. To capture the different performance of value stocks and growth stocks, we repeat the analysis above using the S&P 500 Value index as the benchmark. To capture a

[17] We do not include funds from 2006 to 2008 in this exercise, as they are too young to be priced via a general secondary market discount, as their large undrawn commitments require individual valuations.

possible size effect, we compare against the S&P Small-Cap 600 index.[18] To proxy the effect of leverage on the benchmark we follow the practice of earlier studies (Robinson and Sensoy (2012)), and amplify the benchmark return by increments to, in our case, a maximum of 2.00x.

Table 5 reports results for the S&P 500, the S&P 500 Value Stocks, and the S&P Small-Cap 600 for a regular investment in the benchmark, and for amplified returns by increments of 0.25x. Benchmarking against the value version of the S&P 500 has little impact on excess returns, reducing the PME IRR from 8.6% to 8.0%. Using the S&P Small-Cap 600 index as a benchmark materially reduces excess returns for the period from 1995 to 2004, and hence reduces them overall to a PME IRR of 4.7%. The bottom row presents true vintage year averages that are not weighted by capital or the number of funds. The observed size effect disappears. While the leverage simulation adds some complexity to the interpretation, the results suggest that U.S. buyout performance is rather robust to the use of amplified public returns. Only if the most levered version of the S&P Small-Cap index is used as a benchmark the weighted-average excess return of the U.S. buyout funds are significantly reduced.

In unreported work we also benchmark against the HFRI All Hedge Funds index, the FTSE U.S. Real Estate index, and the S&P GS Commodity Index to proxy other

[18] The S&P Small-Cap 600 index contains 600 publicly-listed U.S. companies with an equity value of $200m to $1,000m. Using other small-cap indices, such as the Russell Microcap, the Dow Jones U.S. Small-Cap and the MSCI U.S. Small-Cap gives essentially the same results. The Russell Microcap index contains 2,000 U.S. stocks with capitalizations from $50m to $2,500m. The Dow Jones U.S. Small-Cap index contains 1,750 U.S. stocks with capitalizations up to $4,500m, half of which below $600m. The MSCI U.S. Small-Cap index contains 1,750 U.S. stocks with capitalizations from $300m to $2,800m.

alternative asset classes. These comparisons can also be taken as illustrative only. Ex-post, and over the period under review, U.S. buyout funds generated excess returns over these alternatives in almost all cases.

4. Comparison with other studies

In this section, we reconcile our results to those in the existing literature and show that measured performance is very sensitive to sample distribution, to data quality and to research design.[19]

4.1. Results based on TVE data

The Thomson VentureXpert (TVE) database is broad in coverage and has a long history so has been the natural destination for researchers wanting representativeness. Research that use fund cash flow data sourced from TVE report negative or at best neutral performance against public benchmarks. Kaplan and Schoar (2005, KS) conclude that, on average, overall net returns of the asset class are approximately equal to the S&P 500, while U.S. buyout returns are slightly below those of the S&P. Phalippou and Gottschalg (2009, PG) report a substantial underperformance of 3% per year with respect to the S&P 500. However, Stucke (2013) documents errors in the TVE data, sufficient to generate a significant bias in measured performance.

[19] In unreported work we also compare our PME multiples with published performance metrics from State Street, Preqin, and the current TVE dataset. In each case their reported performance reliably approximates ours in periods where their coverage is relatively complete.

Table 6 presents RVPI ratios of TVE, CA, Preqin, and a group of public reporting institutions (PRI) for U.S. buyout funds as of December 2009. While RVPIs by CA, Preqin and PRI all follow the expected profile following their 10th anniversary and are very similar to each other, RVPIs from TVE are significantly higher.[20] Stucke (2013) shows that the reason for these implausibly high residual values are a large number of funds in the TVE database that stopped being updated during their active lifetime, so that significant capital distributions are missing in the TVE data, while NAVs are carried forward at their last value.

Kaplan and Schoar and Phalippou and Gottschalg are impacted by these incomplete fund data in different ways. KS compare the performance of U.S. buyout and venture capital funds from 1980 to 1995 to the S&P 500, using TVE data at December 2001. KS seek to sample funds that are no longer active and use two criteria to establish this: the fund has been officially liquidated, or the fund had no more cash flow activity for at least the last 6 quarters. The second criterion allows all funds with incomplete data into the sample, while complete records of mature funds with minor cash flow activity are excluded. As an example, the KS sample at December 2001 includes a large number of funds from vintage years 1992 to 1995, though, in practice, it would be rare for a private equity fund to have zero cash flow activity between its 5th to 8th anniversary, or to be even liquidated that early.

PG merge TVE's U.S. and European buyout and venture capital funds with 1980 to 1993 vintage years into a single sample, using data at December 2003. Unlike KS, PG

[20] Half of the funds from the 1980s still carry positive RVPIs 20 to 30 years after inception, the average of which is almost 40%. Similarly, half of the funds from 1990 to 1996 have RVPIs above 10%, the average of which is almost 60%.

actively discuss the high proportion of funds with constant residual values and no cash flow activity. Using the same '6 quarters of inactivity' filter, PG find that as many as 50% of the funds in their working sample have unusually high residual values that average to 43% of invested capital.[21] Rather than the non-updating explanation for the truncated data, the authors interpret constant NAVs as evidence of valueless 'living dead investments', and write all NAVs off to zero.

Figure 5, Chart A, compares our PME multiples with the results of Kaplan and Schoar (2005), which start in 1983. Although Kaplan and Schoar's PME multiples are systematically lower from 1984 to 1995 for the reasons outlined, the time series show some co-movement. In 1983, 1984 and 1986 their results are also positive, then similarly drop below one in 1987 and 1988, followed by an upward trend. From 1991 to 1995, PME multiples of Kaplan and Schoar are systematically below one, while our corresponding figures are above one. Nonetheless, a certain level of co-movement is present.

4.2. Results based on single-limited partner data

Ljungqvist and Richardson (2003, LR) use a sample of private equity funds that come from one of the largest institutional investors in private equity in the U.S. Their sample of 73 mature funds consists of 54 buyout funds and 19 venture capital funds with vintage years from 1981 to 1993, and cash flow records up to September 30, 2002. LR report average

[21] PG write that 462 of their 852 sample funds, which are between 10 and 24 years old, still carry positive residual values that total as much as 43% of the amount they invested, and that most of these funds have not shown any sign of life for a long time. We find evidence that the number of incomplete funds records from 1980 to 1993 in the TVE database has decreased since 2003, and as of 2010 about 25% of the incomplete funds from that period are left (see Table 9, Panel A).

IRR spreads between the private equity funds and their corresponding index investments of 5.7 to 7.5%, which is high compared to other studies and compared to our results for that period. However, the IRR spreads of LR's approach are not directly comparable.

To benchmark, the authors invest into the S&P 500 according to the funds' actual (or average) drawdown schedules. Rather than matching the funds' actual distribution schedules, the authors assume a single, full distribution from the S&P 500 at the end of year 10 at the index's actual value or the index's average value during year 10. Since measured IRR is sensitive to the timing of distributions, a single distribution of the index investments at the end of year 10 is likely to result in a higher IRR spread, since, as LR document, the average private equity fund in their sample has already delivered one third of all cash distributions by shortly after its 6th anniversary and another third by its 9th anniversary. Using the authors' reported vintage year IRRs and TVPIs, we reestimate the performance of their sample funds to have an average PME IRR of about 3.2%. This number is close to our result for the same period which is 3.3%.[22] It seems therefore unlikely that LR's sample is subject to selection bias.

Robinson and Sensoy (2011, RS) use a mixed sample of U.S. and international buyout and venture capital funds with data provided by a large, single LP. For their group of liquidated buyout funds, the authors find annual excess returns of about 2.5% over the S&P 500. Their results are shown in Chart B. In vintage years when there are relatively more funds in the RS sample (1985, 1988 to 1990, 1992, 1994 to 1998) their PME multiples are consistent

[22] We use the number of funds per vintage year in LR's sample to weight our estimated PME IRRs.

with ours, but in some years (1986, 1991, 1993) their PME multiples are quite different. From 1995 to 1998, RS's PME multiples are consistently higher than ours, which may reflect the presence of better-performing European buyout funds in their sample.

However, post-1998, the RS PME multiples are much lower than ours, which is particularly notable for 2000 and 2001 when the overlap between both samples must be significant. To form their sample of liquidated funds, RS use the same rule as KS – they keep only 'funds that were either officially liquidated as of 6/30/2010, or had no cash flow activity for the last six quarters'. This rule generates a surprisingly large number of funds with recent vintage years. For vintage years from 1998 to 2005, Panel B of Table 7 compares the number of U.S. & international buyout funds in RS's full sample, as well as the number and fraction of funds that were either liquidated or had no more cash flow activity for the last 6 quarters in their 'liquidated' sample, with corresponding figures for our sample of U.S. buyout funds. The fractions of funds that match this rule are significantly different. This is particularly notable for funds with vintage years 1998 to 2001, for which the overlap between RS's and our own data must be large. One possible explanation might be that there are truncated records in RS's data, too, that generate pseudo-liquidation similar to that observed in KS and PG.

4.3. Results based on other databases

In Chart C we compare our PME multiples with independent and contemporaneous work by Harris, Jenkinson, and Kaplan (2013, HJK). HJK calculate PME values for a sample of U.S. buyout (and venture capital) funds from the Burgiss Group. For buyout funds, the

authors reach a conclusion similar to RS, estimating an annual excess return of 'at least' 3.0%. However, the Burgiss dataset is relatively young, with a strong trend towards funds raised in recent vintage years whose returns have been increasingly affected by the financial crisis and, necessarily, rely on NAVs.

As in the case of RS, the results of HJK are more volatile than ours from 1984 to 1994, with PME multiples being closer in vintage years with comparably more funds in their sample (1989, 1991 and 1993), and vice versa. In 1987 and 1988, HJK find positive PME multiples; while their sample seems also not to contain the major outlier fund of 1987 (see capital figures in Table 2 of their study), the positive PME multiple in 1988 is in contrast to both, RS and us. From 1995 to 2000 their PME multiples are close to ours. Note that, on a true like-to-like comparison, these PME multiples should be a bit lower, as their calculations include NAVs as of December 2010, which were higher than in June 2010 (the final quarter of our funds).[23] An explanation for this difference might be that the sample of buyout funds from the Burgiss Group subsumes growth capital and generalist funds, both of which have delivered lower returns than buyout funds in the past.

5. Cross-sectional analysis

In this section we examine the cross-section of U.S. buyout funds. We analyze the influence of fund size on returns, and the influence of conditions in financial markets and in

[23] Jenkinson, Sousa and Stucke (2012) find economically and statistically significant mark-ups in the final quarter of a calendar year when fund accounts are typically audited.

the wider economy when capital was invested and when investments were realized. Finally, we examine the cash flow and liquidity properties of our sample funds.

5.1. The effect of fund size

In a world where skilled managers attract larger funds, there may be a systematic relationship between the size of a fund and its achieved performance. Past studies have found ambiguous results. Kaplan and Schoar (2005) find a positive, concave relationship between fund size and performance in their full sample, but not for their sub-sample of U.S. buyout funds only. Robinson and Sensoy (2011) find significance and concavity for their sample of U.S. and international buyout funds, but only after including sequence numbers. Harris et al. (2013) do not find a size effect for U.S. buyout funds based on their analysis that groups funds into size quartiles per full decade. Given the constant growth in fund sizes since industry inception, clustering observations over a full decade implies that large funds from earlier in a decade fall into the mid-size category overall.[24] We test for such a relationship, using as dependent variables a fund's absolute IRR and its PME IRR. We use three measures of fund size as explanatory variables: the natural logarithm of the amount of invested capital, the fund's percentile rank within its single vintage year, and the fund's percentile rank within three adjacent vintage years. We use the square of the log of fund size to test for concavity, and vintage year dummies to control for inter-year variation in returns.

[24] In fact, Harris et al. (2013) find weak significance of outperformance in the second and third size quartile.

Table 8 presents our findings. Panel A shows a systematic positive relationship between the IRR of a fund and its size that is statistically significant at the 5% level. Coefficients are similar for the one and three-year rank and suggest that, at the sample mean, a one decile increase in relative size is associated with an average 0.4% increase in IRR. A fund two times larger in size delivers an additional 0.6% in IRR, on average. For the PME IRR we find a similar positive relationship that is significant at the 5% level, suggesting that larger funds have also generated higher returns relative to public equity. Coefficients are similar to those of the absolute IRR – the average change in the mean PME IRR is about 0.4% for a one decile change in rank, and 0.5% if fund size doubles. When measuring the PME IRR relative to the S&P 600, coefficients are almost the same.[25] The size effect is qualitatively similar, when we use TVPIs or PME multiples as the dependent variable. In contrast to both, Kaplan and Schoar, and Robinson and Sensoy, we find no evidence for a concave relationship between fund size and performance. This is an important update as the existence of concavity has been one of the most often referenced findings.[26]

[25] Both observations are intuitively plausible: the overall timing of drawdowns and distributions for funds from the same vintage year are similar, since both are much determined by general market conditions and macro-economic factors. The main difference between funds is the magnitude of distributions to paid-in capital, depending on the success of their investments. Thus, an adjustment by a single market factor, such as the growth of a public equity index affects funds of the same vintage year in the same way. And in case of a linear relationship between two market factors, for example, two equity indices the impact will be equivalent, resulting in similar coefficients in the cross-section.

[26] It should be noted that this effect may be a result of their individual sample characteristics.

In Panel B we examine whether the systematically higher performance of larger funds is more pronounced in certain years or periods. As larger private equity funds have regularly been able to borrow higher levels of debt for their larger transactions, it could be that large funds from those vintage years have performed better, whose investments were less affected by a subsequent U.S. recession. That is, the fund was fully invested and portfolio companies had time to deleverage before they were subject to an economic downturn. With respect to the U.S. recession starting in 1991, we set the cut-off following the year 1985. With respect to the 2001 downturn, we similarly choose 1995, and with respect to the 2009 downturn we stop in 2005.[27]

When focusing only on these three sub-periods, we find that IRRs and PME IRRs have a highly significant relationship with our three size measures. Coefficients are again similar for both sets of regressions. In the cross-section, an increase in the size rank by one decile is associated with a 0.7% to 0.8% higher mean IRR and PME IRR, on average. As fund size doubles, the average change in the mean IRR and PME IRR is 1.3%. These are economically significant values.

Panel C shows regressions for the complementary vintage years 1986 to 1989 and 1996 to 2000. Coefficients of our three size measures are now negative in all cases, suggesting that larger funds tended to perform worse in these years. However, none of the size measures is economically or statistically significant. Critical for the overall historic

[27] One might argue that funds of 2005 invested too close to the recession in 2009. However, unlike in the later-1980s and 90s, new developments were substantially benefitting equity investors: senior debt for large LBOs in the U.S. was often 'covenant-lite' in 2005-07, *i.e.*, did not contain financial maintenance covenants such as decreasing debt to EBITDA ratios. Furthermore, recent years saw unprecedented levels of discounted debt buybacks from an established secondary market, which were even treated tax neutral by the government.

success of larger buyout funds will be the final outcome of the large funds being closed in 2006 and 2007. Although few of the associated 'mega buyouts' have since failed, many of the deals were consummated at historically high entry multiples.

5.2. Market conditions and performance

Previous studies have found an inverse relationship between capital flows into private equity and the corresponding returns. For example, Kaplan and Schoar (2005) argue that cyclical underperformance is a result of capital flowing to underperforming funds and to new funds in boom periods. Gompers and Lerner (2000) talk about the 'money chasing deals' feature of private equity returns.

While such a relationship makes intuitive sense, the relationship of private equity performance cycles, as shown in Figure 3, with the general business cycle, as well as cycles in public equity and debt capital markets, suggests that wider economic factors could have a significant impact, too. We therefore broaden the perspective to also include more general economic measures and study their impact on U.S. buyout returns. Explanatory variables include:

- The level of uncalled capital by U.S. buyout funds when investments were made; for each quarter we sum the uncalled capital for all funds that are still in their investment period, scaled to the total amount of funds in the market, and normalize this figure by the average U.S. stock market capitalization during that quarter;
- The level of financial leverage employed in the average buyout at any quarter;
- EV/EBITDA multiples of the S&P 500 at the date of entry and exit;

- The economic conditions in the U.S. at entry and exit, proxied by the level of unemployment.

For each fund with vintage years from 1980 to 2005, we calculate the weighted-average of these variables at the time capital was invested (for EV/EBITDA multiples our data starts in 1983). Similarly, we calculate the weighted-average EBITDA multiple and level of unemployment when investments were realized and capital was returned to LPs. Table 9 presents our results.

The IRR of a fund shows a highly significant negative relationship with the level of undrawn capital (see Panel A). This finding is consistent with previous studies. Results are robust within sub-periods – they still hold if a part or all of the 1980s or the 2000s are excluded. Moreover, since we focus only on funds from 1980 to 2005, this relationship is not driven by the large capital inflows into the industry between 2006 and 2008. In the cross-section, an increase in unspent capital by 10 percentage points is associated with an average decline in IRR by 186 bps. However, the direction of causality is not immediately obvious: do increased amounts of unspent capital drive valuations or do rising (public) equity markets and valuations attract more capital into private equity?

As conjectured, EV/EBITDA multiples and general economic conditions at entry are also related to fund returns, the former with higher statistical significance than unspent equity. At the sample mean, an increase in the entry multiples by one unit of EBITDA is associated with a lower IRR of 4.1%. A decrease in economy-wide unemployment by one percentage point is associated with an IRR that is lower by 4.8%, and vice versa. Adding the valuation multiples or economic conditions when investments were realized suggests

that market characteristics at exit are also highly significant in both statistical and economic terms, and reduce the significance of unspent equity in the regression.

For EV/EBITDA multiples at both entry and exit we find that the average change in a fund's mean IRR is, ceteris paribus, -4.6% for the entry multiple and 4.1% for the exit multiple. In unreported regressions, we find similar results for EV/Revenue multiples, EV/EBIT multiples, price-to-earnings and price-to-book ratios in the market. Given that we are measuring returns after fund management fees and carried interest, this effect is likely to be even higher at the individual portfolio company level.

For any 5 percentage points of additional debt in the capital structure of leveraged buyouts, the mean IRR of a fund increases by 3.3%, on average. All variables are significant at the 1% level. Results for economic conditions at entry and exit are similarly significant. At the sample mean, capital invested at worse economic conditions results in an IRR that is higher by an average of 616 bps for any additional percentage point of unemployment. Better economic conditions at exit are associated with a higher IRR of 5.7%, on average. With respect to the PME IRR EV/EBITDA multiples at entry and exit, as well as the state of the economy continue to have a highly significant impact on excess returns over public equity in both statistical and economic terms (see Panel B).

5.3. Cash flow and liquidity properties

One of the major concerns of institutional investors is the illiquid nature of private equity, with LPs being locked into a fund for over 10 years. Although, recent years have seen some growth in the secondary market for LP interests, such transactions are complex, require

several months of preparation, and often involve a material discount to NAV. In the following, we show that the deferred nature of capital calls over five to six years, as well as distributions of capital that start in early years, result in a less illiquid character of U.S. buyout funds than widely assumed.

Table 10, Panel A, describes the cash flow and liquidity characteristics of the funds in our sample with respect to the time until invested capital is recovered, the duration of capital employed, and the maximum fraction of capital called at any time. Funds with vintage years from 1980 to 2000 took an average of 3.0 years to return the nominal amount of drawn down capital to investors.[28] In line with the higher returns of funds raised in the first half of each decade, those funds also return capital 10% to 40% faster than funds from the second half of each decade. While the median fund required 3.5 years to return its capital, it is not possible to calculate the slowest returning quartile for vintage years from the late 1990s, since more than 25% of those funds have a money multiple below one.

Deferred capital calls and early distributions result in a duration of capital that is far less than the nominal 10 to 13 years life of a fund. On average, capital is employed by a fund for 4.9 years. The duration of invested capital has decreased significantly since the early 1980s, perhaps reflecting the increased focus of fund managers on returning invested capital quickly. This behavior may stem from the industry-wide adoption of a preferred rate of returns, or hurdle rate, of typically 8 percent in the early 1990s, which led GPs to become much more focused on maximizing IRRs.

[28] With respect to the time to recovery of capital employed and the duration of capital employed, we use our sample of liquidated funds as we do not want NAVs impacting our results. For the maximum fraction of capital called it is sufficient if a fund's distributions have exceeded the amount of uncalled capital towards the end of its investment period to arrive at the maximum value, hence, we include funds up to 2004.

A further effect of deferred capital calls and early distributions is that the maximum capital effectively called by a fund is usually less than 100%. This fraction has also substantially decreased over the 25-year period. While the maximum fraction of called capital is 77.7% for the median fund between 1980 and 2004, the pooled averages of 55.5% and 58.0% are above the third quartiles in many years. The reason is a diversification effect of cash flows that already takes places for funds within the same vintage year.

Panel B presents regression results between the three liquidity measures and the size of a buyout fund, the level of financial leverage at entry, and market conditions at entry and exit. For all three liquidity measures we find a highly significant relationship with the market multiples at the time capital was invested and investments were realized by a fund. At the sample mean, a change in the entry multiple by one unit is associated with an average change of 4 months for both the time until invested capital is recovered and of the duration of capital employed; the maximum fraction of drawn down capital changes by an average of 3.1%. A change in the exit multiple by one unit is associated with an average change in the mean time until invested capital is recovered by 15%, and a change in the mean duration by 8%, while the maximum fraction of drawn down capital changes by 3.6%. These relationships are intuitively plausible. Capital invested at lower multiples is likely to be returned faster, as the probability of an exit at a higher market multiple in subsequent years increases. Similarly, investments realized in a high multiple environment return larger amounts of capital back to LPs, as shown in the previous regressions.

The size of a buyout fund is significantly negatively related to the time until invested capital is recovered and to the maximum fraction of capital called by a fund. This

relationship suggests that larger buyout funds take relatively longer to draw down committed capital, but are also comparably faster at returning invested capital to LPs. The level of financial leverage at entry is positively related to the maximum fraction of capital called. A possible explanation is that capital tends to be drawn down faster from LPs, when debt capital markets are liquid, but also that the number of portfolio companies that do not return invested capital due to financial distress increases.

6. Conclusions

Private equity firms are highly selective in their acquisitions and seek to cherry pick targets that have significant value creation potential. They tend to focus on industries within their area of expertise. They do extensive due diligence and arrive with a clear strategic plan that they execute urgently, motivating senior management with a large stick and a large carrot. They recoup invested equity as quickly as possible and use financial leverage to amplify the return on equity. Given the intensity of this process, it would be truly surprising if private equity investors did not generate positive gross returns.

The conclusions of Kaplan and Schoar (2005) and Phalippou and Gottschalg (2009) related to the net returns to investors. Their results were not necessarily surprising in a world where rent-seeking fund managers fully appropriate the excess returns through fees and carried interest, leaving net returns to investors that are no better than a random drawing from the S&P. This is consistent with the evidence for mutual funds (Berk and Green, 2004) and for hedge funds (Fung, Hsieh, Naik, and Ramadorai, 2008). However, the findings of Kaplan and Schoar, and Phalippou and Gottschalg, sat uncomfortably alongside

the results from single-LP studies and were at odds with the observation that capital allocations to private equity have grown tremendously since 1980.

We show that U.S. buyout funds have generated significant excess returns over public equity for (almost) every vintage year since 1980. We believe that the results reported in this paper are now definitive for U.S. buyout funds. However, there are two large, open questions.

The first is the outturn of the funds raised since the mid-2000s in the lead up to the recession. A reliable judgment on this needs data that will take years to emerge. Vintage year 2006 to 2008 funds account for roughly half of the capital ever raised by the industry, so history's judgment on the performance of the whole asset class will rely heavily on the ultimate performance of these funds.

The second is the question of benchmark. Since the principal focus of this paper was the measurement of returns, we mainly adopted the S&P 500 as a benchmark, consistent with the existing literature. But hard conclusions about whether or not the U.S. buyout industry has created true alpha for its investors requires further research on the appropriate benchmark beyond our sensitivity analysis for size and leverage. Finally, appropriate adjustments for operational risk will be necessary to draw a definitive conclusion on the risk-adjusted performance of U.S. buyout funds.

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Appendix A: Illustration of the PME approach

Table 1 - Coverage of the sample

Panel A compares sample sizes from different data sources and past studies. Panel B compares the amount of capital raised by the funds in our full sample with the Dow Jones LP Source universe.

Panel A: Comparison of sample sizes from different sources.

Vintage Year	Higson & Stucke	Kaplan & Schoar	Robinson & Sensoy*	Burgiss (Harris et al.)	Cambridge Associates	State Street	Preqin	TVE
1980	6	-	-	-	-		2	2
1981	2	-	-	-	-		-	1
1982	4	-	-	-	-		-	1
1983	8	6	-	-	-		-	5
1984	10	6	3	2	-	17	2	7
1985	8	12	5	1	-		3	7
1986	18	16	1	5	7		3	10
1987	24	22	9	7	7		4	25
1988	23	21	14	7	12		5	17
1989	26	22	15	8	13		4	24
1990	16	14	7	2	2	4	7	9
1991	11	6	2	4	7	7	1	5
1992	21	17	4	5	8	8	8	15
1993	23	11	6	11	8	10	12	21
1994	42	6	22	13	21	22	13	26
1995	36	7	24	17	17	16	9	23
1996	36	-	36	9	24	15	17	23
1997	56	-	30	30	31	30	16	40
1998	72	-	54	38	37	33	28	53
1999	58	-	37	28	35	30	21	38
2000	84	-	60	39	52	38	31	47
2001	47	-	22	26	20	42	12	27
2002	37	-	6	21	19	21	16	16
2003	34	-	7	13	23	25	15	13
2004	62	-	2	46	36	43	22	18
2005	92	-	2	57	52	58	39	24
2006	108	-	-	67	43	63	34	27
2007	107	-	-	74	44	69	37	27
2008	98	-	-	68	38	67	30	14
	1,169	166	368	598	556	618	391	565

* The sample of Robinson and Sensoy includes both U.S. and non-U.S. Buyout funds.

Table 1 (continued)

Panel B: Coverage of the Dow Jones universe by our sample.

Vintage Years	Dow Jones Universe Size (Bns)	Sigma & Evolve Sample % of Size
1980-84	4.4	84.8
1985-89	14.4	78.8
1990-94	53.4	87.3
1995-99	182.0	83.4
2000-04	243.0	84.0
2005-09	454.0	83.1
1980-09	1,350.7	83.1

Source: Cambridge Associates and own LP sample data, Kaplan and Schoar (2005), Robinson and Sensoy (2011), Harris et al. (2012), State Street, Preqin, Thomson VentureXpert, Dow Jones LP Source.

Table 2 - Absolute performance

This table shows IRRs (in %) and TVPIs for our sample of U.S. buyout funds. Weighted-average (Wtd) and mean (Avg) values are calculated on a pooled cash flow basis per vintage year. The median (Med) and top quartile (Top-Q) thresholds are calculated based on individual numbers. For periods of vintage years we weight by invested capital or the number of funds.

Source: Cambridge Associates and own LP sample data, own calculations.

Table 3 - Relative performance

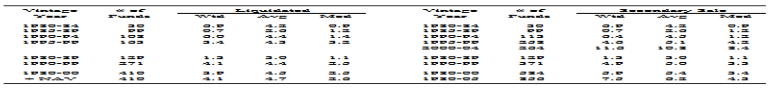
This table shows PME IRRs (in %) and PME multiples relative to the S&P 500 performance index. Weighted-average (Wtd) and mean (Avg) values are calculated on a pooled cash flow basis per vintage year. Median (Med) values are calculated based on individual numbers. For periods of vintage years we weight by invested capital or the number of funds. '> S&P' shows the number and fraction of funds that generate returns in excess of the S&P 500.

Vintage Year	# of Funds	PME IRR			PME Multiple			> S&P	
		Wtd	Avg	Med	Wtd	Avg	Med	#	%
1980	6	12.1	7.5	5.4	1.88	1.54	1.29	3	50
1981	2	14.1	10.5	8.0	2.02	1.71	1.73	1	50
1982	4	16.3	4.1	5.7	1.67	1.20	1.22	2	50
1983	8	2.3	5.1	-1.9	1.10	1.22	0.91	3	38
1984	10	5.8	0.4	-2.8	1.38	1.02	0.85	5	50
1985	8	9.6	6.2	5.0	1.35	1.25	1.25	5	63
1986	18	4.8	6.0	2.4	1.28	1.33	1.17	10	56
1987	24	-2.5	0.5	0.6	0.89	1.03	1.01	12	50
1988	23	-1.2	-0.7	-3.2	0.95	0.97	0.84	7	30
1989	26	5.0	4.1	3.6	1.25	1.19	1.12	15	58
1990	16	2.2	2.2	0.8	1.09	1.09	1.04	9	56
1991	11	10.5	11.2	9.5	1.41	1.44	1.39	10	91
1992	21	6.1	3.9	2.3	1.27	1.17	1.11	12	57
1993	23	3.4	6.0	1.6	1.14	1.23	1.06	13	57
1994	42	8.9	3.2	-1.4	1.43	1.14	0.93	19	45
1995	36	5.6	6.0	3.5	1.26	1.28	1.19	23	64
1996	36	0.1	0.7	-0.5	1.00	1.04	0.98	17	47
1997	56	6.7	4.7	3.0	1.37	1.23	1.16	33	59
1998	72	3.9	7.1	6.6	1.20	1.38	1.28	52	72
1999	58	6.1	6.1	6.8	1.28	1.30	1.40	41	71
2000	84	11.2	11.6	8.5	1.48	1.52	1.41	72	86
2001	47	14.1	12.5	12.4	1.55	1.50	1.44	38	81
2002	37	14.3	11.5	11.6	1.55	1.43	1.42	32	86
2003	34	17.3	17.5	12.5	1.59	1.71	1.48	29	85
2004	62	11.9	10.3	8.9	1.41	1.35	1.33	48	77
2005	92	8.9	6.7	6.5	1.28	1.19	1.16	68	74
2006	108	2.8	1.8	0.3	1.07	1.04	1.01	58	54
2007	107	-0.1	2.2	2.0	1.00	1.04	1.03	62	58
2008	98	-4.0	-7.4	-10.0	0.96	0.92	0.90	33	34
1980-89	129	1.3	3.0	1.1	1.08	1.16	1.05	63	49
1990-99	371	5.1	5.1	3.5	1.25	1.24	1.17	229	62
2000-08	669	6.3	5.3	3.8	1.24	1.22	1.17	440	66
1980-99	500	4.5	4.5	2.9	1.22	1.22	1.14	292	58
1980-05	856	8.6	7.1	5.5	1.35	1.30	1.23	579	68
1980-08	1169	5.8	5.0	3.4	1.23	1.22	1.16	732	63

Source: Cambridge Associates and own LP sample data, S&P Index Service, TF Datastream, own calculations.

Table 4 - Relative performance based on cash flows

This table shows PME IRRs (in %) relative to the S&P 500 performance index. The left panel shows the subset of effectively liquidated funds prior to 2001 (RVPI < 0.1). The right panel converts residual values into cash flow by applying an observed secondary market discount. Weighted-average (Wtd) and mean (Avg) values are calculated on a pooled cash flow basis per vintage year. Median (Med) values are calculated based on individual numbers. For periods of vintage years we weight by invested capital or the number of funds.



Source: Cambridge Associates and own LP sample data, S&P Index Service, TF Datastream, UBS, own calculations.

Table 5 - Alternative benchmarks

This table shows the results of a public market equivalent analysis between our funds from 1980-2005 and the performance of the S&P 500 index, the S&P 500 Value stocks index, and the S&P Small-Cap 600 index. For each index we benchmark against its regular performance (1.00), as well as realized quarterly returns from a leveraged investment in each index (amplification of quarterly returns from 1.25 to 2.00). Periods of vintage years are weighted by invested capital per vintage year. The bottom row of each panel shows an unweighted average over all vintage years.

Source: Cambridge Associates and own LP sample data, S&P Index Service, TF Datastream, own calculations.

Table 6 - Vintage years RVPIs from different data sources

This table presents residual value to paid-in capital ratios for U.S. buyout funds as of December 2009 for Thomson VentureXpert (TVE), Preqin, Cambridge Associates (CA), and major public reporting institutions (PRI). Public reporting institutions include CalPERS, Washington State Board and University of California.

Vintage Year	Sample Size				RVPI (Avg)				RVPI (Wtd-avg)			
	TVE	Preqin	CA	PRI	TVE	Preqin	CA	PRI	TVE	Preqin	CA	PRI
1980-83	9	7	n/a	2	**.03**	.00	n/a	.00	**.01**	.00	n/a	.00
1984	7	6	n/a	1	**.18**	.00	n/a	.00	**.05**	.00	n/a	.00
1985	7	3	n/a	4	**.17**	.00	n/a	.00	**.02**	.00	n/a	.00
1986	10	5	7	1	**.33**	.00	.00	.00	**.26**	.00	.00	.00
1987	25	6	7	2	**.17**	.00	.00	.01	**.18**	.00	.00	.01
1988	17	8	12	–	**.11**	.00	.00	–	**.11**	.00	.00	–
1989	24	10	13	1	**.29**	.00	.01	.00	**.13**	.00	.00	.00
1990	9	10	2	1	**.27**	.00	.00	.01	**.16**	.00	.00	.01
1991	5	7	7	3	**.68**	.00	.00	.00	**.38**	.00	.01	.00
1992	15	11	8	2	**.22**	.00	.00	.00	**.30**	.00	.00	.00
1993	21	16	8	6	**.25**	.01	.03	.02	**.29**	.01	.04	.01
1994	26	21	21	11	**.27**	.03	.03	.02	**.37**	.06	.04	.03
1995	23	20	17	12	**.21**	.02	.04	.02	**.12**	.03	.06	.03
1996	23	21	24	10	**.44**	.05	.05	.05	**.32**	.07	.07	.05
1997	40	28	31	13	**.32**	.11	.09	.08	**.43**	.12	.11	.12
1998	53	46	37	15	**.37**	.16	.16	.16	**.31**	.13	.16	.17
1999	38	34	35	20	**.66**	.27	.26	.26	**.61**	.25	.24	.23
Total	352	259	229	104								

Source: Stucke (2011).

Table 7 - The sample of buyout funds in previous studies

Panel A shows the number of U.S. (and European) buyout funds in the TVE sample as reported by Kaplan and Schoar (2005) for Dec. 2001, Gottschalg et al. (2003) for June 2003, and TVE as of June 2010. Panel B compares the number of U.S. & international buyout funds in Robinson and Sensoy's (2011) full sample, and the number and fraction of their funds that were either liquidated or had no cash flow activity since 2009, to corresponding figures from our sample.

Panel A: Number of buyout funds in different TVE samples.

	Kaplan and Schoar (2005) TVE data as of Dec. 2001	Gottschalg et al. (2003) TVE data as of June 2003	TVE data as of June 2010
U.S. Buyout Funds, 1980-93	197	161	148
E.U. Buyout Funds, 1980-93	-	121	88

Panel B: Liquidated sample of Robinson and Sensoy (2011).

Vintage Year	Robinson and Sensoy U.S. & International Buyout Funds			Higson and Stucke U.S. Buyout Funds		
	Full Sample (U.S. in brackets)	Liquidated or no CF for 6Q	Fraction of all	Full Sample	Liquidated or no CF for 6Q	Fraction of all
1998	78 (59)	54	69%	72	18	25%
1999	69 (59)	37	54%	58	9	16%
2000	83 (68)	60	72%	84	11	13%
2001	33 (26)	22	67%	47	1	2%
2002	7 (5)	6	86%	37	2	5%
2003	8 (8)	7	88%	34	2	6%
2004	4 (3)	2	50%	62	1	2%
2005	2 (2)	2	100%	92	2	2%

Source: Gottschalg et al. (2003), Kaplan and Schoar (2005), Robinson and Sensoy (2011), Thomson VentureXpert, Cambridge Associates and own LP sample data, own calculations.

Table 8 - Fund size and performance

This table shows regression results between the absolute IRR and the PME IRR relative to the S&P 500, and three different size variables. 1-year rank is a fund's percentile position within its vintage year. 3-year rank is a fund's percentile position within 3 adjacent vintage years. Ln (size) is the natural logarithm of a fund's size. Panel A shows the results for all funds from 1980-2005. Panel B and C group these funds into different, complementary sub-periods. Standard errors are in brackets and robust to heteroskedasticity. ***, **, * indicate that coefficients are statistically significantly different from zero at the 1%, 5%, and 10% levels, respectively.

Panel A: Regressions results for all funds from 1980-2005.

	IRR				PME IRR			
One-year Rank	3.657***				3.458***			
	[1.850]				[1.275]			
Three-year Rank		3.909***				3.740***		
		[1.877]				[1.589]		
Ln (size)			0.851***	1.360			0.780***	1.014
			[0.442]	[1.491]			[0.272]	[1.227]
Ln (size)*				-0.039				-0.033
				[0.133]				[0.110]
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.143	0.144	0.143	0.143	0.055	0.055	0.057	0.057
No. of obs.	856	856	856	856	856	856	856	856

Panel B: Regression results for vintage years 1980-1985, 1990-1995, and 2001-2005.

	IRR				PME IRR			
One-year Rank	6.934***				7.447***			
	[2.660]				[2.261]			
Three-year Rank		7.522***				8.091***		
		[2.891]				[2.350]		
Ln (size)			1.915***	2.885			1.935***	3.256
			[0.671]	[1.999]			[0.548]	[1.576]
Ln (size)*				-0.094				-0.021
				[0.188]				[0.151]
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.138	0.139	0.140	0.141	0.094	0.094	0.095	0.095
No. of obs.	459	459	459	459	459	459	459	459

Table 8 (continued)

Panel C: Regression results for vintage years 1986-1989 and 1996-2000.

	IRR				PME IRR			
One-year Rank	-0.394 [2.325]				-1.373 [2.105]			
Three-year Rank		-0.090 [2.385]				-1.052 [2.089]		
Ln (size)			-0.367 [0.550]	-1.034 [2.172]			-0.421 [0.480]	-0.737 [1.859]
Ln (size)²				0.072 [0.183]				0.039 [0.161]
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.068	0.068	0.068	0.069	0.071	0.071	0.072	0.072
No. of obs.	297	297	297	297	297	297	297	297

Source: Cambridge Associates and own LP sample data, S&P Index Service, TF Datastream, own calculations.

Table 9 - Market conditions and performance

This table shows regression results for the absolute IRR (Panel A) and the PME IRR (Panel B) for all funds from 1980-2005. Uncalled capital measures the amount of undrawn capital by all U.S. buyout funds that are still in their investment period, normalized by the U.S. stock market capitalization. Leverage measures the fraction of debt that went into the average buyout. EV/EBITDA at Entry and Exit measure S&P 500 multiples. Economy at Entry and Exit measure the economic situation, proxied by the level of U.S. unemployment. Standard errors are in brackets and robust to heteroskedasticity. ***, **, * indicate that coefficients are statistically significantly different from zero at the 1%, 5%, and 10% levels, respectively.

Panel A: Regressions results for the IRR.

Panel B: Regression results for the PME IRR.

Source: Cambridge Associates and own LP sample data, S&P Index Service, S&P LCD, Reuters LPC, Compustat, Global Financial Data, U.S. Bureau of Labor Statistics, own calculations.

Table 10 - Market conditions and liquidity properties

This table shows three measures for liquidity properties of U.S. buyout funds and their distribution over time (Panel A), as well as relationship to market conditions and fund size (Panel B).

Panel A: Distribution of different liquidity measures.

Vintage	# of	Time to Recovery of Capital Employed					DPI < 1		Duration of Capital Employed					# of	Maximum Fraction of Capital Called				
Year	Funds	Cap	Eql	Q3	Med	Q1	#	%	Cap	Eql	Q3	Med	Q1	Funds	Cap	Eql	Q3	Med	Q1
1980	6	2.9	3.0	3.4	3.8	4.2	-	-	8.8	9.0	6.2	7.1	10.1	6	91.5	90.6	91.4	95.6	99.3
1981	2	3.9	3.8	4.2	4.6	5.0	-	-	5.4	5.5	5.4	5.6	5.8	2	94.4	94.9	95.8	96.0	96.3
1982	4	2.3	2.6	2.5	4.3	6.0	-	-	4.4	5.3	4.1	5.2	6.5	4	89.7	78.5	84.8	95.1	100.0
1983	8	2.0	1.8	2.1	2.6	3.6	-	-	6.1	5.1	4.2	4.4	6.7	8	67.6	60.5	70.5	93.5	97.2
1984	10	3.0	2.8	3.0	4.9	7.1	-	-	7.7	6.7	5.7	7.4	8.7	10	89.4	68.4	80.2	99.9	100.0
1985	8	1.2	1.7	1.7	2.8	4.0	-	-	5.2	5.1	3.2	5.3	6.6	8	54.9	62.7	62.2	92.8	97.8
1986	18	3.1	3.1	3.0	3.9	4.7	-	-	7.5	6.4	5.2	6.0	7.5	18	61.2	64.7	70.2	79.0	97.3
1987	24	3.5	4.0	3.1	4.1	5.5	1	4	6.9	6.8	4.5	6.3	7.0	24	53.7	66.5	69.5	86.8	97.7
1988	23	2.8	3.3	3.1	3.6	4.3	1	4	5.0	5.1	4.3	5.4	5.6	23	59.8	71.1	70.8	81.7	96.3
1989	26	2.7	2.8	2.7	3.2	4.0	3	12	5.5	5.1	4.2	4.3	5.4	26	59.9	70.8	75.6	83.0	98.9
1990	16	2.9	2.4	2.0	2.9	4.6	-	-	4.8	4.9	3.5	4.5	6.0	16	59.3	56.4	62.5	81.5	90.0
1991	11	1.9	1.8	1.2	2.2	3.2	-	-	4.3	4.0	2.8	3.7	4.7	11	49.7	59.6	63.0	67.0	81.0
1992	21	2.2	2.3	2.1	2.6	4.0	4	19	4.7	4.7	3.3	4.4	5.1	21	61.3	61.4	55.5	78.4	90.8
1993	22	1.8	1.5	2.0	2.6	3.4	2	9	4.3	4.0	3.4	3.8	4.7	23	44.6	53.7	61.3	73.0	87.5
1994	38	1.9	1.6	1.7	2.9	4.5	6	16	4.5	4.1	3.4	4.0	5.4	42	39.5	44.5	61.9	75.1	91.4
1995	30	1.7	1.9	2.0	2.8	5.9	5	17	4.0	4.0	3.4	4.4	5.3	36	52.0	52.0	61.1	76.9	95.3
1996	31	3.4	3.2	3.1	4.8	n/a	8	26	4.6	4.7	3.8	4.8	5.8	36	66.0	65.9	71.2	80.5	92.1
1997	41	3.6	2.7	3.2	4.6	n/a	13	32	5.0	4.3	4.1	4.8	5.9	56	58.3	52.6	69.4	82.7	91.1
1998	39	4.3	3.8	3.3	4.4	n/a	12	31	4.7	4.8	4.1	4.4	5.2	72	71.1	67.5	74.7	84.0	91.5
1999	22	3.6	4.1	3.8	4.7	n/a	10	45	4.3	4.6	3.9	4.8	5.5	58	64.6	68.3	71.2	81.7	92.3
2000	10	2.4	1.8	1.8	3.2	4.6	1	10	4.1	3.8	4.0	4.3	4.6	84	50.4	49.5	57.5	67.0	78.6
2001														47	44.5	47.0	53.4	68.3	78.6
2002														37	46.5	48.9	57.0	66.8	75.9
2003														34	41.3	51.7	60.1	70.1	81.4
2004														62	59.4	56.3	70.5	81.3	90.3
1980-84	30	2.7	3.0	2.5	3.6	5.1	-	-	6.9	6.5	4.4	6.2	8.0	30	83.9	73.9	86.5	96.0	100.0
1985-89	99	3.0	3.1	2.9	3.5	4.6	5	5	6.2	5.8	4.3	5.4	6.3	99	57.8	68.1	71.3	82.6	97.9
1990-94	108	2.1	1.9	1.7	2.7	3.8	12	11	4.5	4.3	3.4	4.0	5.2	113	47.7	52.7	60.5	75.0	90.0
1995-99	163	3.5	3.3	2.9	4.4	n/a	48	29	4.5	4.5	3.9	4.6	5.5	258	64.6	62.1	70.9	81.7	92.3
2000-04														264	49.5	50.9	59.5	70.1	82.6
1980-00/04	410	3.0	2.9	2.4	3.5	5.2	66	16	4.9	4.9	3.8	4.7	5.8	764	55.5	58.0	64.9	77.7	91.2

Table 10 (continued)

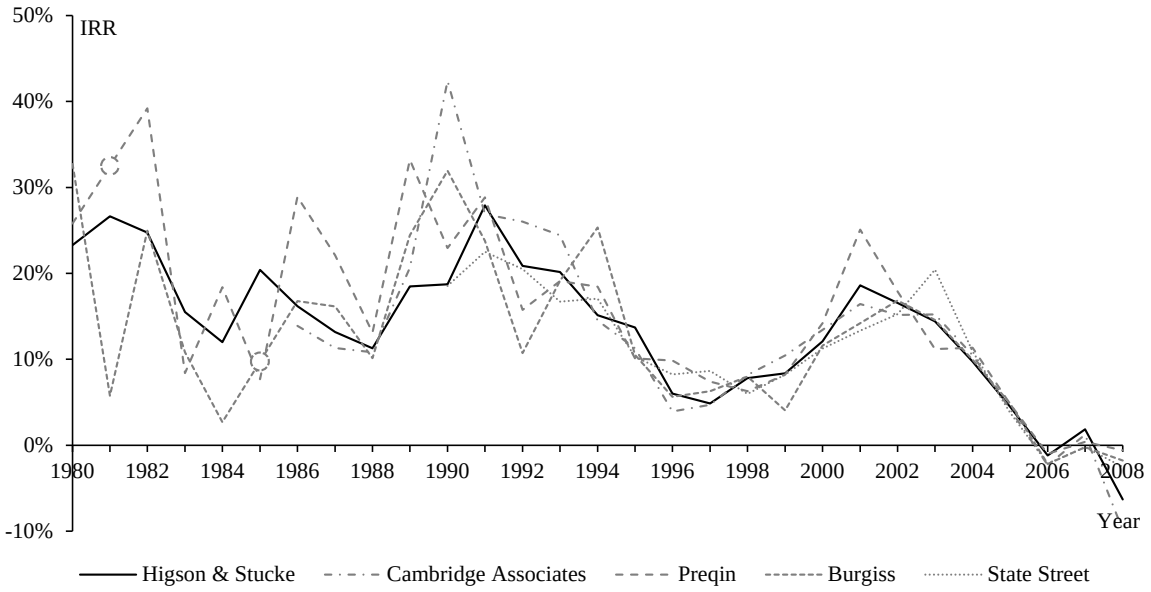
Panel B: Regression.

	Capital Recovery	Duration	Capital Called
Ln (size)	-0.161**	-0.019	-0.036***
	[0.074]	[0.068]	[0.005]
EV/EBITDA at Entry	0.316***	0.302***	0.031***
	[0.100]	[0.100]	[0.008]
Leverage at Entry	1.747	-0.687	1.210***
	[4.301]	[4.049]	[0.363]
EV/EBITDA at Exit	-0.436***	-0.392***	-0.036***
	[0.100]	[0.097]	[0.008]
Year F.E.	Yes	Yes	Yes
R-squared	0.278	0.267	0.219
No. of obs.	332	398	752

Source: Cambridge Associates and own LP sample data, S&P Index Service, S&P LCD, Reuters LPC, Compustat, Global Financial Data, U.S. Bureau of Labor Statistics, own calculations.

Figure 1 - Median IRRs from different sources

This figure shows median IRR values for U.S. buyout funds of the CA sample and our final sample, as well as the Preqin, Burgiss and State Street databases. The circles for Burgiss in 1985 and Preqin in 1981 indicate vintage years without funds in the respective database; we interpolate their lines in these two years.



Source: Cambridge Associates and own LP sample data, Preqin, Burgiss, and State Street sample data, own calculations and illustration.

Figure 2 - Performance of the Cambridge sample and the final sample

This figure compares weighted-average and median IRR (Chart A) and TVPI (Chart B) values of U.S. buyout funds from the Cambridge Associates sample and our final sample from 1994 to 2008.

Chart A: Weighted-average and Median IRRs.

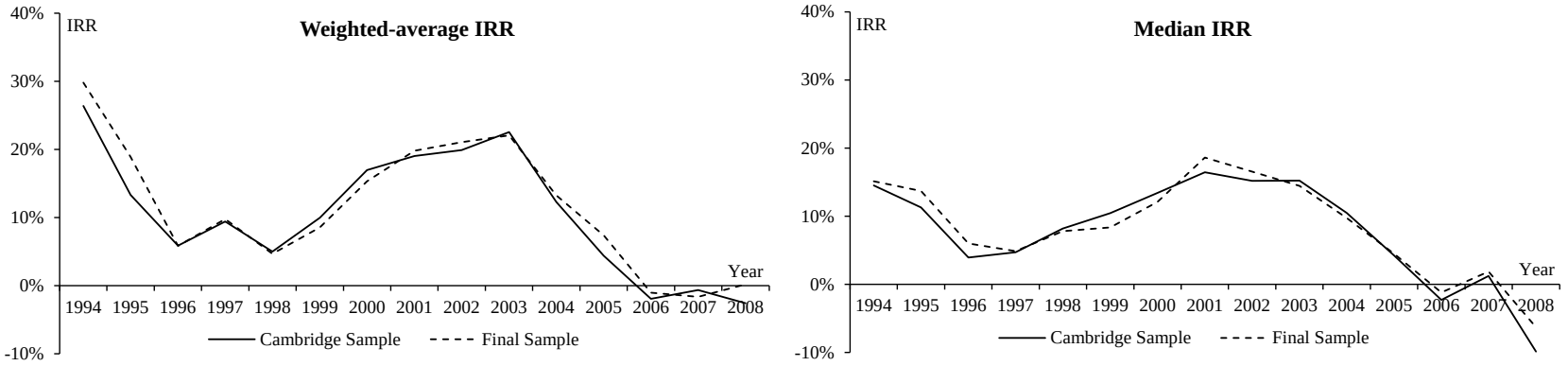
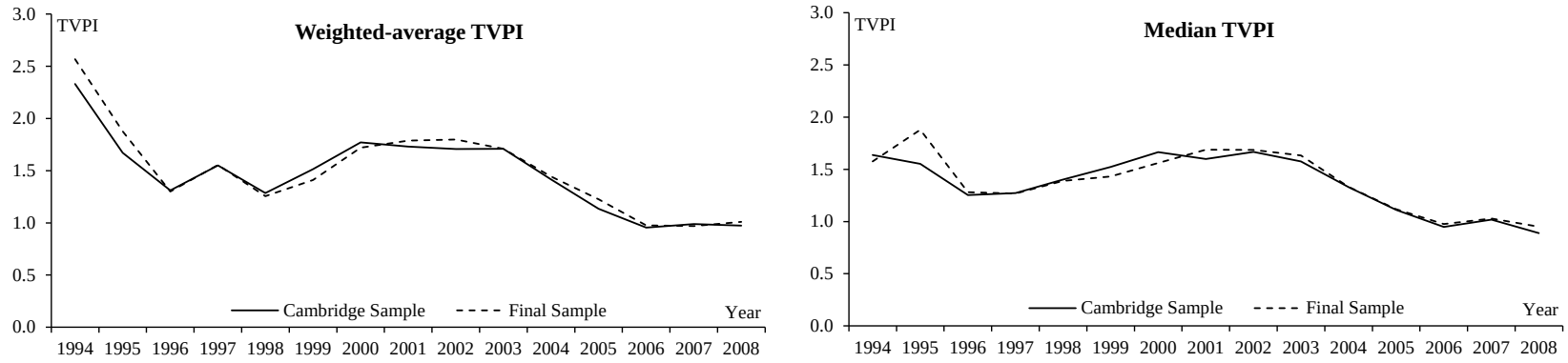


Chart B: Weighted-average and Median TVPIs.



Source: Cambridge Associates and own LP sample data, own calculations and illustrations.

Figure 3 - Return waves since 1980s

Chart A shows weighted-average IRRs and TVPIs, and Chart B shows weighted-average PME IRRs and PME multiples for the U.S. buyout funds in our final sample. To partially adjust for overlapping investment periods and to smooth we calculate rolling +/- 1 vintage year values.

Chart A: IRRs and TVPIs.

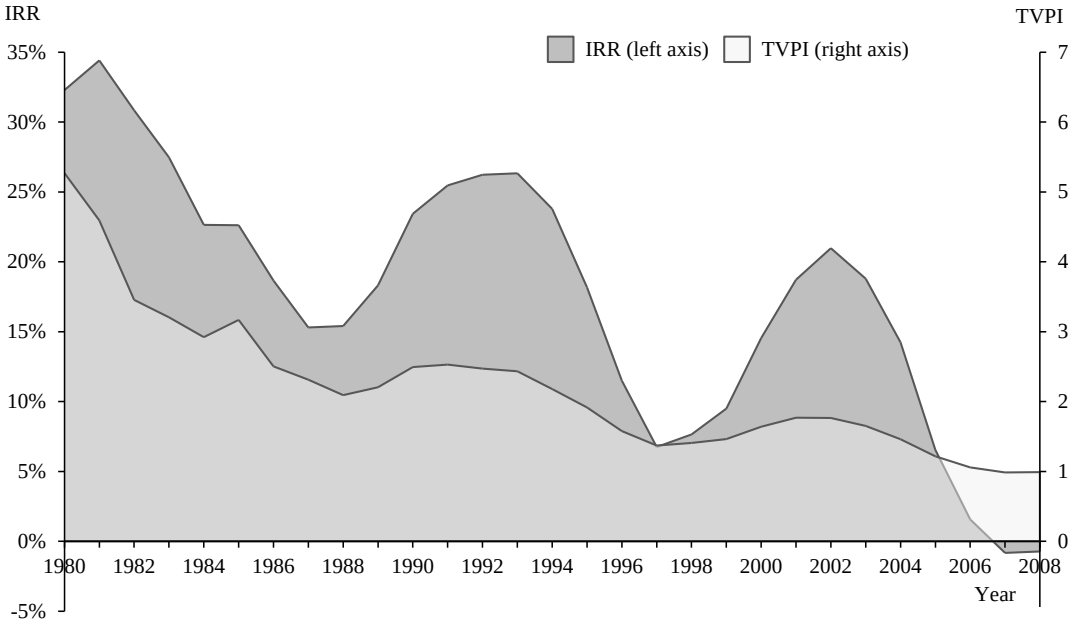
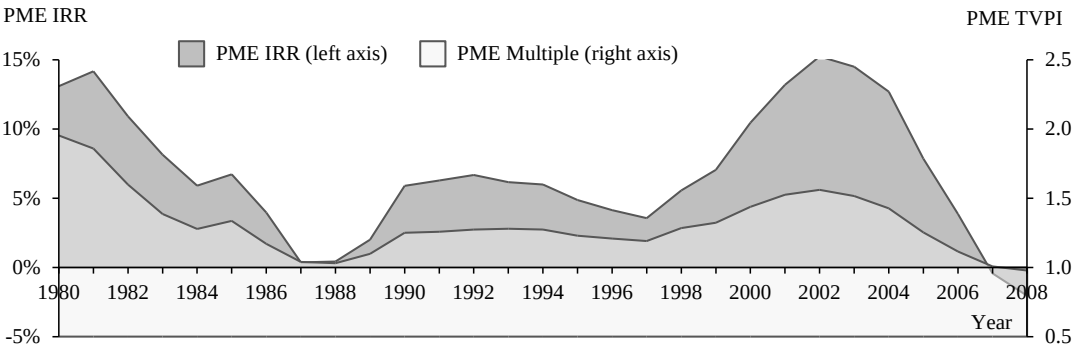


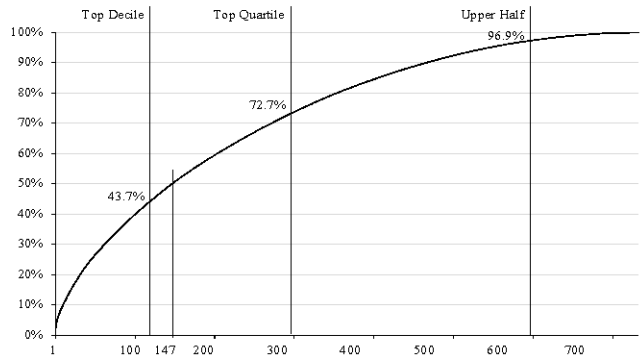
Chart B: PME IRRs and PME Multiples.



Source: Cambridge Associates and own LP sample data, S&P Index Service, own calculations and illustration.

Figure 4 - Concentration of excess returns

This figure shows the (relative) cumulative distribution of excess returns over the S&P 500, ordered by the number of U.S. buyout funds in our sample.



Source: Cambridge Associates and own LP sample data, S&P Index Service, own calculations and illustration.

Figure 5 - Comparison of our PME multiples

This figure compares our PME multiples with those from other studies, based on the total returns of the S&P 500 index.

Chart A: Kaplan and Schoar (2005)

Chart B: Robinson and Sensoy (2011)

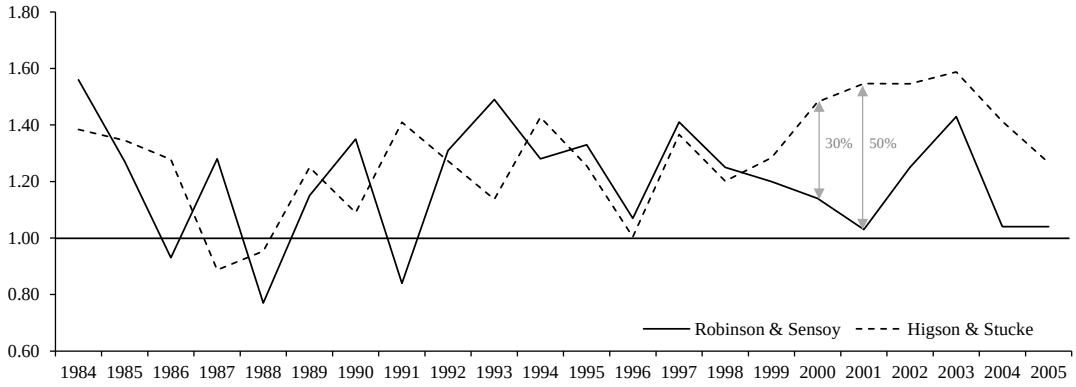
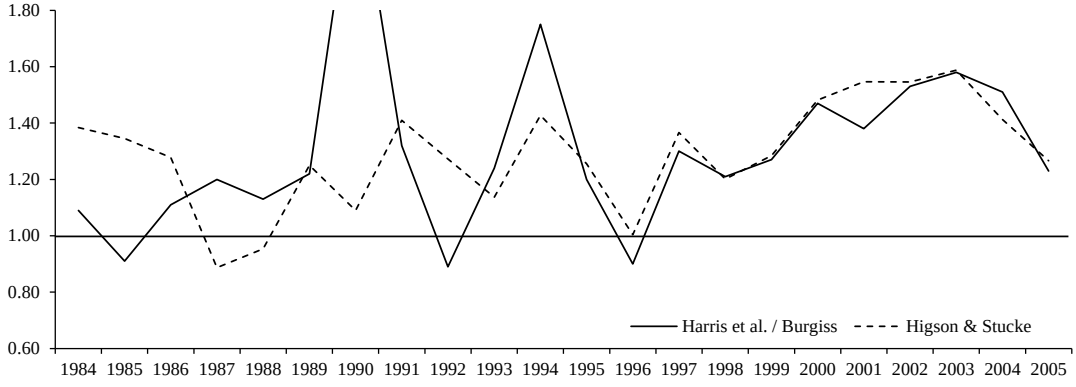


Chart C: Harris et al. (2012) / Burgiss



Source: Cambridge Associates and own LP sample data, Kaplan and Schoar (2005), Robinson and Sensoy (2011), Harris et al. (2012), S&P Index Service, own calculations and illustration.