Evaluating Private Equity Returns from the Investor Perspective - are Limited Partners Getting Carried Away?

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ABSTRACT

In this study, we evaluate the performance of close to 900 buyout and venture capital funds from 1979 to 2008. Returns are measured using traditional performance measures, the internal rate of return and the investment multiple, as well as four different Public Market Equivalent measures, which compares private equity fund returns to the returns of corresponding investments in a publicly traded index. Limiting the sample to funds from the 1990's and the 2000's, we find that buyout funds have consistently outperformed the S&P 500, whereas venture capital funds have shown more volatile returns, outperforming in the 1990's and underperforming in the 2000's. We also observe a negative relationship between venture capital and buyout fund returns, implying possible diversification benefits for investors who seek less volatile returns, but at the cost of a lower alpha. Further, our findings suggest that there is a concave relationship between fund sequence and returns, controlling for size and year-fixed effects. Our results also show that the choice of benchmark is an important aspect for an investor to consider, as well as whether or not to hedge fund cash flows, as both decisions will have large effects on relative and absolute returns, respectively. Finally, we invent a method for measuring whether general partners have been successful in timing the market. For each fund, we create two hypothetical portfolios, one with a fund mimicking strategy and the other with a naive investment approach. We find that the simulated returns from the naive investment approach are superior to those achieved from the mimicking strategy overall, implying that the general partners in our data have not been successful in timing the market.

Keywords: Private Equity, Performance, PME, Public Markets, Limited Partner, Direct Alpha

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EVEN THOUGH PRIVATE EQUITY has been subject to a large amount of public discontent during recent years, the industry is growing like never before.[1] This may come as no surprise in today's low-interest environment, in which investors are increasingly directing capital towards riskier assets in the hunt for yield. Yet, the industry continues to lack transparency and its performance is still a matter of debate.

In this paper, we study the performance of nearly 900 buyout and venture capital funds started between 1979 and 2008. The data, which was gathered from Preqin, provides us with high quality fund cash flows, net of fees, until 2011. To measure returns, we use the Public Market Equivalent (PME) approach, which compares private equity to public equity returns. The method allows us to capture the opportunity cost of capital from investing in private equity, an aspect that the most commonly used return metrics, the internal rate of return (IRR) and Total Value to Paid-In (TVPI), lack to account for. We also compare and highlight the differences between the IRR, the TVPI and the PME. While our approach is similar to that of Harris, Jenkinson, and Kaplan (2015), we make use of a different data set and apply a different PME metric to measure returns. In addition to that, we review and compare several PME metrics and measure what effect investor location and hedging has on private equity returns. We also investigate portfolio diversification effects and invent a method for evaluating whether portfolio managers have been successful in market timing. This allows us to compare results in addition to extend previous research.

We start off by evaluating fund performance the industry way, using the IRR and the investment multiple TVPI. Buyout funds from 1979 to 2008 generated an average and median IRR of 11.0% and 9.7%, respectively. Meanwhile, venture capital funds from the corresponding period delivered an average IRR of 9.5% and a median of 1.9%. All returns are net of fees. The larger dispersion between average and median returns for venture capital funds also shows in the TVPI multiples. The average (median) multiple equals 1.5x (1.3x) for buyout funds and 1.7x (1.1x) for venture capital funds. Whether the average or median return is more relevant from an investor perspective is arguable and depends on the fund picking skills and status of the investor. If all investors can choose freely among funds, one should focus on observing the average return. However, if there are some investors with the ability to pick better performing funds, yet these funds are inaccessible to the typical investor, the

[1] As of June, 2016, the private equity assets under management peaked at $2.5 trillion (Preqin, 2017).

median return is the appropriate measure.

Also, we find that the IRRs were at their highest point in the 1980's for both buyout and venture capital funds, according to median values. Examining the average values we observe that venture capital have performed better in the 1990's, highlighting the importance of caution when measuring returns.

Next, we compare four different PME measures, namely the Index Comparison Method (ICM), PME+, KS-PME and Direct Alpha. The first two metrics calculate performance similarly by comparing the IRR of investing in a private equity portfolio to the IRR of investing in a hypothetical benchmark portfolio. Meanwhile, the KS-PME and Direct Alpha are calculated directly on compounded cash flows. The two generate an adjusted alpha and an adjusted multiple, similar to the IRR and the TVPI. Having evaluated the four metrics, we conclude that while they generate similar results overall, the Direct Alpha method, as presented by Gredil, Griffiths, and Stucke (2014), is the most intuitive one for our purpose of measuring fund returns.

In line with Harris et al. (2015), we conclude that buyout funds have consistently outperformed the public market. This should be expected, as investors demand an illiquidity premium for investing in private equity. We find an average excess return, a Direct Alpha, of 6.9% compared to the S&P 500 benchmark, or 7.2% according to the median, for funds from 1979 to 2008. Those returns are statistically significant above zero and somewhat larger than the average of 3.1% and median of 2.4% for buyout funds from the period 1984 to 2010, found by Harris et al. (2015). For the venture capital sample, we find an average excess return of 3.6% and a median of -0.8%. The results are similar to what was found by Harris et al. (2015). However, they are not statistically significant above zero.

Moreover, we find evidence for a potential negative correlation between buyout and venture capital performance in a given year. To further investigate this discovery, we limit the sample period to 1992 to 2008 and create hypothetical portfolios based on different return assumptions, which invest equal stakes in buyout and venture capital funds. We find an obvious diversification benefit in terms of more stable returns.

Further, we evaluate fund performance by fund sequence number and find a significant concave relationship between the two. The result is contradicting to the positive correlation found by Kaplan and Schoar (2005). Meanwhile, our findings of a concave relationship between size and KS-PME returns echo the findings of Kaplan and Schoar.

Next, we divide returns into quartiles to evaluate the dispersion in perfor-

mance of funds started in a given year. For the buyout sample, we find that buyout funds more often than not have generated positive Direct Alphas, as investing even in a third quartile performing fund would have generated positive abnormal returns on average, compared to the S&P 500. Venture capital fund returns are more disperse, as only the two top quartiles would have provided returns superior to investing in the S&P 500. Also, the difference between the top and the bottom performing funds is much more pronounced for venture capital funds.

Examining fund returns by geographic investment focus, again using the S&P 500 as benchmark, we find that European focused buyout funds have outperformed the US focused counterparts, with yearly abnormal returns of 8.7% versus 6.6% on average, for funds started between 1992 and 2008. However, in more recent years, US funds have been performing better on average. In the venture capital sample, we observe that funds focused in the US have consistently outperformed funds invested in Europe, with Direct Alphas of 4.3% versus -2.5% on average. However, these findings are not statistically significant. Our results are similar to those of Harris et al. (2015). We also find that funds invested in the rest of the world (RoW) have been the worst performing on average, both in the buyout and venture capital sample. None of these findings are statistically significant, presumably due to the small sample size.

Furthermore, we find that the investor's choice of benchmark will largely impact the performance results. We compare fund returns to the S&P 500 and the Euro STOXX 600 benchmarks and find that funds, both European and US focused, would have generated stronger abnormal returns if compared to the Euro STOXX 600.

Having concluded so, we analyze the impact of exchange rate differences for an investor when investing abroad. We assume that an investor can perfectly hedge the fund currency at no cost, and we use the S&P 500 as benchmark for US investors and Euro STOXX 600 for European investors. From the perspective of a European investor investing in a US dollar denominated fund, we find that hedging all cash flows to Euro would have generated close to one percentage point better returns per year than if the investment would have been completely unhedged. Meanwhile, the US investor would have been better off by not hedging any cash flows to Euro when investing in a Euro denominated fund, by 1.7 percentage points annually, on average. Clearly, currency fluctuations will affect private equity fund returns and investors should consider whether to hedge or not before committing to a fund denominated in a different currency.

Another aspect that many researchers and investors take into consideration when choosing between different investment products is risk. Thus, we investigate whether different levels of systematic risk, specifically higher systematic risk, affect relative fund performance. We test different beta values in relation to the S&P 500 and evaluate the effect it has on Direct Alpha. In contrast to popular belief, we find that assuming an inherently higher beta within private equity increases the Direct Alpha on average. The results from this study lead us to the conclusion that higher betas and hence higher risk within private equity, does not explain the relative overperformance of private equity vis-à-vis public equity on average. Our results are in line with the findings of Harris et al. (2015).

Finally, we examine whether the general partners of the funds in our data set have been successful in market timing, by investing when market valuations are low. To do so, we invent a method that generates two hypothetical portfolios, one with a mimicking strategy and one with a naive investment approach, for each fund in our data set. Both portfolios invest the same amount of capital, the sum of all contributions, in the S&P 500. While the mimicking strategy assumes that each time the fund makes a contribution, the corresponding amount is invested in the index, the naive investment approach assumes that all contributions are invested in three or five equal pieces at randomized dates during a three to five year period. We find that the naive investment approach would have generated better returns, indicating that the general partners of the funds in our data set have not been able to time the market.

To conclude, private equity investors have earned a premium relative to investing in the public market, on average. This should be intuitive, because of the illiquid nature of private equity investing and the fact that investors bear a commitment risk because of the uncertainty related to the timing of cash flows. Investing in buyout funds in the past decades would have generated positive and steady relative returns, while venture capital returns would have been more volatile, but with the possibility to earn substantially larger returns. While most of the funds from 1980's and 1990's have been fully realized, the funds from the 2000's in our data set have yet to return large amounts of capital to its investors. What true effect the financial crisis will have on those funds and their relative performance to public benchmarks is yet unknown and will most likely be a subject to future investigations. Also, we touch upon two interesting areas in this paper that we believe could be evaluated further. First, the possible diversification effects of investing in both venture capital

and buyout funds and how to optimize such a portfolio. Second, if and how to hedge the foreign exchange risk of investing in a foreign currency fund.

I. Background on Private Equity

In simple terms, private equity is capital invested in private companies. Investing may occur in firms that are already private, or in public companies with the intention of taking the firm off the market. Once a firm is acquired, the injected capital may be used for developing new products and technologies, making acquisitions, boosting the firm's financial strength, improving the working capital or to buy out other shareholders (Söderblom, 2011).

The industry is usually divided into two sub-industries; buyout and venture capital. In buyout transactions, companies are acquired with relatively small fractions of equity and large fractions of debt. The buyout firms typically take majority stakes in existing or mature companies. Venture capital firms on the other hand mostly invest in young and immature firms where the growth potential is large. In contrast to buyout firms, venture capital firms usually obtain minority stakes in the target firms. Venture capital firms are also more equity focused, as younger companies with uncertain revenues cannot handle as much debt. While there are distinct differences between the two, both type of investors are active owners, providing relevant knowledge and business networks to the target firms, in addition to capital (Kaplan and Strömberg, 2009; Söderblom, 2011).

The fund manager, generally referred to as the general partner (GP), raises capital through private equity funds. These funds are set up as limited partnerships, where GPs are responsible for managing the funds whereas the investors, or limited partners (LP), provide the main part of the capital. The LPs generally consist of large institutional investors, such as pension funds, insurance companies and endowments, as well as wealthy individuals. In order to align interests, GPs tend to invest a small fraction into the fund as well.

Private equity funds typically have a fixed life-time of approximately ten years. During the first five years, the main focus is investing the committed capital. During the next five to eight years, capital is returned to investors. When a fund draws capital for an investment, the LP is said to make a contribution. The process of returning capital to investors on the other hand is called a distribution. When most of the capital is invested, fundraising for a new fund generally takes place (Metrick and Yasuda, 2010).

For their services, GPs charge LPs with an annual management fee, based

on committed capital at first, and once investments are realized, the fee is based on the employed capital. In addition to the management fee, the GP is compensated by what is called carried interest (carry), assuming that the fund performs well. GPs may also charge additional fees, such as transaction fees and monitoring fees. Nonetheless, the carry tends to be the larger part of the GP compensation and is calculated as the share of any profits above a fund's hurdle rate, a predetermined yearly yield. Thus, the GP cannot collect any carry until all LPs have been compensated with the promised hurdle rate. However, when the fund has reached the hurdle rate, GPs have a catch-up percentage to even out the return distribution (Metrick and Yasuda, 2010; Söderblom, 2011). From the perspective of an LP, the return of a fund will depend on the value created, net of the fees charged by the GP.

According to Robinson and Sensoy (2013), buyout funds charge an average (median) management fee of 1.78% (2.00%). The corresponding fee for venture capital funds is 2.24% (2.50%). Meanwhile, the share of the carry equals 20% of all profits above the hurdle rate for almost all private equity funds. In their sample of 837 funds, 10% of the venture capital funds and 1% of the buyout funds charged a higher carry. The average rate amounted to 20.44% for venture capital GPs and 19.96% for buyout fund GPs.

II. Related Literature

A. Performance Metrics

The most commonly used metrics for measuring private equity performance are the IRR and the TVPI multiple, generally referred to as investment multiple. In short, the IRR is the discount rate that sets the net present value of a stream of cash flows equal to zero. In other words, it is the annual yield of an investment's underlying cash flows. Meanwhile, the TVPI measures the value created by a fund by dividing the estimated value of the fund's remaining assets and all the distributions made to date, by the total amount of committed capital from the fund's investors. Both metrics are calculated net of the fees charged by the GP. All formulas for the performance metrics in this section, as well as numerical examples, can be found in Appendix A.

While the metrics are comprehensible, they do come with some major drawbacks. First of all, the IRR is sensitive to the timing of cash flows, which makes it easy to manipulate. Since the metric is commonly used as a selling point for attracting investors, GPs have become increasingly innovative in finding ways to boost the IRR of their funds. For instance, a fund can use

bridge loans to finance investments initially, which will postpone the date of invested equity, hence increasing the IRR. This will come at the cost of a lower investment multiple, since interest paid on the bridge loan will lower the cash available for subsequent distributions. It may also be favorable to sell a profitable investment early if a GP wants to show strong results in the process of raising a new fund. Again, this may lead to a higher IRR at the cost of a lower TVPI.

Secondly, the IRR assumes that all interim cash flows can be reinvested at the same rate, which naturally is too restrictive. This is especially problematic for investments with high IRRs, since there will not frequently appear investment opportunities generating as strong returns as that first investment, in which one can invest the interim cash flows.

Thirdly, since institutional investors are increasingly reallocating capital towards the alternative asset class, including private equity, and away from the public equity market, this involves an obvious cost of capital which the IRR and TVPI fail to account for. Luckily, the PME method was created to solve this issue by comparing private equity returns to public equity returns.

The PME model was initially introduced by Long and Nickels (1996) as the Index Comparison Model (ICM). In the ICM, the performance of the private equity fund of focus is compared to the performance of a benchmark portfolio that combines the cash flows of the private equity fund with the returns of a public benchmark. Specifically, each time the fund makes a contribution, the corresponding amount is invested in the benchmark. Similarly, when the fund makes a distribution, the corresponding amount is sold off from the benchmark portfolio. Hence, the fund and the benchmark portfolio will have identical cash flow streams. Worth noting is that all cash flows are net of fees. What makes the returns differ between the private equity fund and the benchmark portfolio is the net asset value (NAV), which in the benchmark portfolio is a fictive value calculated as the difference between the sum of the future value of all contributions and the sum of the future value of all distributions, compounded with benchmark returns. In determining whether the private equity fund has outperformed the benchmark, the IRR of the net cash flows from the fund is compared to the IRR of the benchmark portfolio. The difference, or the delta, shows the average yearly abnormal return.

While being an intuitive metric, Gredil et al. (2014) point out a clear caveat with the ICM, namely that the hypothetical benchmark portfolio typically does not liquidate as the private equity fund does. If a fund strongly outperforms (underperforms) the reference portfolio, the NAV carries a large

long (short) position in the benchmark, which may lead to skewed results. The ICM should thus be used with caution.

PME+, as made public by Rouvinez (2003) and Capital Dynamics, was designed to solve the issue of large negative NAVs as appears in the ICM by introducing a scaling factor to the model. In PME+, all distributions in the benchmark portfolio are multiplied by this scaling factor, in order for the NAV of the benchmark portfolio to equal the NAV of the private equity fund. Similar to the ICM method, PME+ compares the IRR of the private equity fund to the IRR of investing the corresponding amount in the index. Nevertheless, the PME+ also comes with drawbacks as the method is sensitive to early distributions and not applicable to younger funds where distributions have yet to take place. Another caveat with the method is that it does not generate an investable benchmark portfolio, since the scaling factor is implemented after distributions have taken place.

Kaplan and Schoar (2005) develop an additional measure, referred to as KS-PME by Gredil et al. (2014). In contrast to previously mentioned models, the KS-PME results in a multiple demonstrating how much wealthier an LP is by investing in the private equity fund of focus contra the public stock market index. The calculation of the multiple is similar to that of the TVPI, the difference being that all cash flows are in future values, compounded with the benchmark return. If the multiple exceeds unity, an LP is wealthier by investing in the private equity fund than in the index, and if the output multiple is less than one, the investor is poorer. As the KS-PME is more advanced than the two previously discussed heuristic counterparts, it will generate more reliable results. Unfortunately, the model is not without flaws, as it gives no information about the per-period rate at which the wealth created from the private equity fund has developed compared to index. In other words, the model does not provide us with an alpha.

The Direct Alpha method was initiated by Gredil et al. (2014) to solve the issue of the KS-PME. The model makes use of the KS-PME cash flows, but instead of finding a multiple it calculates the IRR of the indexed future value of cash flows to find a yearly abnormal return rate.

Common for all PME measures is the required inputs, namely a fund's contributions and distributions net of fees, the fund's reported NAV at the end of the period and the index values of the chosen benchmark (S&P 500 is often used as it is seen as an appropriate market proxy). While the PME metrics solve the most important issue of the IRR, in our opinion, by incorporating the opportunity cost of capital, they fail to solve all issues. The PME metrics

we have discussed (except for the KS-PME multiple which is more similar to the TVPI than the IRR) are also sensitive to the timing of cash flows and assume that each cash flow can be reinvested at the same rate.

Furthermore, while the contributions, distributions and index values are absolute, the NAV is estimated and reported by the GP. Therefore, the accuracy of the performance output for non-liquidated funds from the PME models will hinge upon how correctly the NAV has been estimated.[2] According to most recent research, NAVs of active funds tend to be underestimated. Jenkinson, Sousa, and Stucke (2013) state that the value of a fund's investments tend to underestimate future distributions by 35% on average. Brown, Gredil, and Kaplan (2013) also find support for understated NAVs, especially for top-performing funds. In both papers, the authors find that while some funds do overstate their NAVs to increase the IRR, this usually happens during the fundraising process for new funds. Brown and Yasuda (2016) conclude that the risk of GPs overstating NAVs is solely applicable to the low-performing GPs, as top-performing GPs do not need to artificially boost numbers to raise new funds. Brown et al. (2013) note that the lower-performing funds appear to be unsuccessful in their venture of manipulating returns to raise follow-up funds, as LPs tend to see through these measures. In addition, younger funds have yet to make contributions and distributions. Looking at historical private equity performance, fund returns tend increase as funds mature in accordance to the well-known J-curve.

Furthermore the PME models give no credit to fund managers who are able to time cash flows efficiently. If a fund invests when the market valuations are low, this will not be recognized properly in the performance results as the size of the contribution is market-adjusted via a benchmark. Later on in this paper, we invent a method aiming to clarify if the GPs in our data set have been successful in timing the market.

Finally, the PME models implicitly assume that the risk of private equity funds equals the risk of the market. However, much of prior research suggests that private equity funds are associated with a higher risk than the market, especially true for venture capital funds. This is easy to adjust for in the PME models however, by altering the assumption about the beta value.

[2] As of year-end 2008, the Financial Accounting Standard Board requires that private equity funds report the fair value of their assets on a quarterly basis. Thereby, funds must continuously update the fair value of their assets. This has probably led to more accurate valuations of the NAV since 2008. Previously, funds could value assets to their costs until an explicit change in the value. Exact fair values is naturally impossible to obtain for such illiquid assets, however.

B. Previous Findings

In their study of private equity returns, Kaplan and Schoar (2005) find that US funds generate approximately the same returns as the S&P 500 on average. The authors use a data set of funds from the 1980's and 1990's. While buyout funds performed somewhat poorer than the benchmark, venture capital funds outperformed the index using a value weighted approach. The authors also investigate persistence in returns between funds from the same partnership and find conclusive evidence for it. Furthermore, they find that size affects returns in a concave relation. In other words, larger funds generate better returns up until a certain point when they become too large.

Harris, Jenkinson, and Kaplan (2014) evaluate nearly 1,400 venture capital and buyout funds from 1984 to 2008 and find that buyout funds have in fact outperformed the S&P 500 consistently, by more than 3% annually. Meanwhile, the authors find that venture capital funds outperformed S&P 500 in the 1990's but not in the 2000's.

In a follow up study, Harris et al. (2015) make use of an extended data set, including 1,800 North American buyout and venture capital funds as well as 300 European focused buyout funds, with vintage years from 1984 to 2010. They find that the performance of buyout funds with vintage years before 2006 have exceeded benchmark for all years but one, by about 3 to 4% per year. Buyout funds with vintage years post 2005 have returns closely equal to index. In addition, they observe that the performance of venture capital funds in relation to the public market has been much more volatile. Once again, they conclude that funds with vintages in the 1990's outperformed while those in the 2000's underperformed. However, they find that the returns of venture capital funds with more recent vintage years have started to rebound. Furthermore, they observe that there is a large difference between buyout and venture capital funds when it comes to performance of funds started in a specific year. The dispersion in performance is much wider for venture capital funds than for buyout funds. Comparing results between European and North American focused funds, the authors find that European focused funds from 1994 to 1999 have shown a stronger performance, while North American funds from 2000 and forward have performed better on average.

III. Data

The data used for this study is gathered from Preqin, one of the most prominent data providers for the alternative asset industry. The majority of Preqin's

data is obtained by fund LPs through Freedom of Information Act (FOIA) requests, mainly in the US, but also in the UK. The FOIA requires that public pension plans report information about the funds they invest in. Data is also provided directly by the GPs of the funds, thereby confirming a full spectrum of fund performance.

The data set includes observations from a total of 2,100 funds, covering the period 1979 to 2011. For each fund, we are provided with transaction amounts in US dollar (contributions and distributions) net of fees by date, as well as a fund's NAV reported at some date subsequent to the fund's latest transaction. In addition, the data set provides information regarding fund type, vintage year, fund size, geographic focus and in what stage the fund is (whether it is liquidated, closed, or in the process of raising capital).

Our focus, in line with most previous research, is studying the performance of buyout and venture capital funds. Therefore, funds with other investment focuses, such as mezzanine or growth funds, or funds specialized in a certain segment within buyout or venture capital are removed from the data set. Furthermore, funds with missing size values and funds that have not yet made any distributions are dropped, leaving us with a total of 847 funds. Funds are divided into one of the three geographic focuses US, Europe or the RoW, including observations from Asia, the Middle East and South America.

Naturally, we have to consider potential biases in our data. Because the data set is gathered from FOIA requests, we can be certain about a high level of confidence in the data accuracy, at least for the buyout funds since public pension plans invest in nearly all of the larger buyout funds that are available to them. The data may however be subject to a backfill bias, a version of the survivorship bias, which occurs when fund performance of past results are reported into a database. Investors are most likely to backfill the results of earlier sequences to those funds that they are currently invested in. Thereby, private equity managers with low performing first time funds, which have not been successful in raising a follow on fund, are less likely to be in the data set. Meanwhile, GPs with a number of successful funds are more likely to be in the data set as there is a high probability that one or several investors who report to Preqin are currently invested in funds from such GPs.

Yet, Harris et al. (2015) who make use of a data set from Burgiss conclude that performance results are both qualitatively and quantitatively similar to those in Preqin, Pitchbook and in Cambridge Associates. Pitchbook, just like Preqin, collects data from FOIA requests while the other two data providers do not. As there is such a consistency between the performance results of the

different data sets, it seems highly unlikely that our results are biased.

Worth noting is that our sample of venture capital funds is rather limited, which may harm the power of the results from those funds. There can also be missing top tier venture capital funds, as many of the top-performing funds do not want to report their returns, and thus have decided not to accept public LPs. On the other hand, top venture capital funds are rationed, and it is thus hard for the typical LP to get the chance to invest in them. Therefore, including them could potentially give misleading, stronger results, than what would be expected for the typical LP.

IV. Descriptive Statistics

The 847 funds in our data set represent a total of $1 trillion in committed capital or $1.2 trillion in 2008, adjusted with the US inflation rate. This translates into $1.2 billion on average per fund. Compared to previous studies making use of fund data from Burgiss, such as that of Harris et al. (2015), the average fund size is considerably larger in our data set. Meanwhile, commitment sizes differ substantially whether the fund has a buyout or venture capital focus. Buyout funds in our sample have capital commitments of $1.7 billion on average, while venture capital funds have $329 million in capital commitments on average.

In Table I, we show the fraction of funds that are first time, second time, third time, and of higher sequences. Unfortunately, our data set does not mark the sequence number of each fund, so the first fund by date from a specific sponsor in our data does not necessarily need to be the first fund issued by that sponsor. However, we assume that this is the case for the purpose of this analysis. Distributions are shown for the main sample and for buyout and venture capital subsamples separately.

Table I

Distribution of Fund Sequences

This table shows the fraction of fund sequences in our data set, for the entire sample and for buyout and venture capital funds separately. The sample covers funds issued between 1979 and 2008. First Time Funds represents the fraction of funds by a specific GP, which has not before issued any funds. Second and Third Time Funds are similarly the fraction of funds that are issued second and third in line by a specific GP. Higher Sequences captures the funds that are fourth in line or higher. The last row of the table shows the number of fund observations for each sample.

	All Funds	Buyout	Venture
First Time Funds	0.50	0.49	0.52
Second Time Funds	0.24	0.25	0.23
Third Time Funds	0.12	0.12	0.12
Higher Sequence	0.14	0.14	0.13
Sample	847	537	310

Evidently, there is a large exposure towards first time funds; 50% of the main sample, or 49% of the buyout funds and 52% of venture capital funds. Meanwhile, about a quarter of all funds are second in sequence and somewhat more than one tenth of all funds are third time funds. As presented by Kaplan and Schoar (2005), first time funds generally perform worse than higher sequence number funds. Meanwhile, Brown and Yasuda (2016) find that GPs with strong interim performance are much more likely to raise a follow-up fund, of larger size than the previous. The last row of the table shows the number of observations within the three samples. Out of the 847 funds, a majority, or 537 are buyout funds while 310 are venture capital funds.

In Table II, we divide the funds by geographic investment focus and by the decades in which the funds were started. Funds are focused in one of the following three regions: US (81%), Europe (14%) or RoW, including observations from Asia, the Middle East and South America (5%). The large overexposure towards US funds may be explained by Preqin's data collection method. As main part of the data is collected from US investors, this leads to an overexposure towards US funds. While LPs may look abroad when investing in larger funds, they tend to invest locally when it comes to small and medium sized funds. In the first column of each regional division, we show the number of fund observations and in the second column, we show the average fund size measured in millions of US dollar.

Table II

Distribution of Geographic Investment Focuses

This table shows how the funds in our data set are distributed between investing in the US, Europe and in the rest of the world. The sample covers funds issued between 1979 and 2008. For each geographic investment area, we show the number of funds and the average fund size in millions of US dollars. The distribution is shown for the buyout and the venture capital subsamples separately and split by the decade in which the funds were issued. Missing values are denoted with "-".

	Buyout					
	US		Europe		RoW	
Vintage	#	Size	#	Size	#	Size
80's	17	545	1	631	0	-
90's	145	741	26	1,140	8	357
00's	246	2,000	71	3,263	23	1,377
Sample	408	1,492	98	2,673	31	1,114

	Venture					
	US		Europe		ROW	
Vintage	#	Size	#	Size	#	Size
80's	19	110	0	-	0	-
90's	107	201	6	283	4	112
00's	151	468	16	248	7	215
Sample	277	340	22	258	11	177

Clearly, both the number of observations and the average fund size increase with time. Also, worth noting is the limited amount of non-US fund observation from the 1980's. Therefore, we cannot make any cross-region comparisons for that decade.

Taking a closer look at the buyout sample, we observe that the average fund size is considerably larger for funds with a European focus ($2.7 billion) than those with a US focus ($1.5 billion). This comes as no surprise, as again, Preqin collects main part of the data from US investors, and the typical investor only tends to invest in the largest funds when they look abroad. The funds with a RoW focus have an average capital commitment of $1.1 billion, which is not so far from the average US fund size.

For the venture capital subsample, US focused funds are clearly the largest, $340 million on average, followed by European focused with capital commitments of $258 million on average. Venture capital funds with a RoW focus are nearly half the US size, $177 million on average.

V. Performance Findings

A. IRR and TVPI Fund Performance

We start off by reporting fund performance the industry way. In Table III, average and median IRRs and TVPI multiples are shown by vintage year for buyout and venture capital funds separately. The table also shows the realization percentage rate of the funds for each vintage year, calculated as the fraction of a fund's distributions made to date in relation to the sum of the fund's reported NAV and fund's the distributions made to date.

Whether one should study median or average value in evaluating private equity performance is debatable. As highlighted by Harris et al. (2014), the average value is the proper measure when investors are able to choose freely among funds, thereby being able to diversify their portfolios. The median is more relevant if LPs are able to identify which funds will outperform, yet these funds are not available for the typical LP to invest in. In their study from 2016, Cavagnaro, Sensoy, Wang, and Weisbach find that one standard deviation increase in skill increases LP returns by 3%. Assuming that there are better performing sponsors who only accept investors which they have long going relations with, which we believe to be a reasonable assumption, this would imply that the median is the appropriate measure. However, we will continue to report both average and median returns when possible. As research suggests that persistence in private equity fund returns from a given sponsor exist, we do not want to rule out fund picking as a possible way for LPs to generate alpha. We also want to observe the magnitude of dispersion in returns for buyout and venture capital returns, respectively.

According to the IRRs presented in Table III, it appears as if buyout funds have outperformed venture capital funds overall. Buyout funds from 1979 to 2008 have generated an average IRR of 11.0%, while the venture capital funds delivered a corresponding return of 9.5%. Median IRRs are 9.7% and 1.9%, respectively. Evidently, there is a larger dispersion between average and median returns for venture capital funds.

The TVPI multiples tell a different story. While the median multiple confirms that buyout funds have been the better performers overall, the average multiples show opposite results. On average, buyout (venture capital) funds have returned 1.5x (1.7x) times the capital invested, or 1.3x (1.1x) times according to the median. Once again, the dispersion is substantially larger between the average and median return for the venture capital subsample.

Table III

Fund IRR and TVPI Performance

This table shows the average and median IRRs and TVPIs, investment multiples, for the buyout and the venture capital subsamples separately, split by vintage year. The sample covers funds issued between 1979 and 2008. The table also shows the realization percentage rate of the funds for each vintage year, calculated as the fraction of a fund's distributions made to date, in relation to the sum of the fund's reported NAV and the fund's distributions made to date. All returns are calculated on US dollar denominated cash flows. Missing values are denoted with "-". Negative values are shown in parentheses.

	Buyout						Venture					
			IRR (%)		TVPI (x)				IRR (%)		TVPI (x)	
Vintage	# of Obs.	Realized (%)	Average	Median	Average	Median	# of Obs.	Realized (%)	Average	Median	Average	Median
1979	0	-	-	-	-	-	1	100.0	17.1	17.1	2.2	2.2
1980	2	100.0	22.9	22.9	7.0	7.0	0	-	-	-	-	-
1981	0	-	-	-	-	-	0	-	-	-	-	-
1982	0	-	-	-	-	-	1	100.0	8.0	8.0	1.7	1.7
1983	0	-	-	-	-	-	1	100.0	11.3	11.3	2.2	2.2
1984	2	100.0	19.2	19.2	3.1	3.1	3	100.0	10.6	11.4	1.9	2.0
1985	1	100.0	14.9	14.9	2.7	2.7	2	100.0	17.2	17.2	2.7	2.7
1986	0	-	-	-	-	-	1	100.0	4.5	4.5	1.3	1.3
1987	5	99.9	19.4	19.0	3.7	3.2	4	99.3	13.3	10.9	2.3	2.0
1988	3	100.0	11.1	10.4	1.7	1.5	3	100.0	19.4	23.5	2.5	2.3
1989	5	100.0	25.9	30.0	2.7	2.6	3	100.0	18.2	9.9	2.7	1.6
1990	6	99.3	15.2	11.7	1.8	1.8	4	99.8	18.2	17.4	2.4	2.2
1991	3	100.0	26.5	22.8	3.0	2.7	2	100.0	17.8	17.8	2.0	2.0
1992	7	99.8	16.5	21.4	1.7	1.7	6	99.9	33.5	31.6	3.9	3.1
1993	11	99.9	20.9	18.2	2.4	2.2	9	100.0	34.5	24.2	3.6	3.1
1994	16	98.7	22.6	19.0	2.0	2.0	9	92.8	30.0	31.9	5.8	2.7
1995	15	98.7	11.3	9.7	1.5	1.3	14	99.4	38.5	16.7	3.3	1.7
1996	23	95.2	4.8	6.4	1.3	1.3	9	96.9	28.7	13.4	3.5	1.6
1997	28	90.1	7.3	5.9	1.4	1.3	21	93.3	30.8	8.0	1.9	1.3
1998	39	91.3	4.8	6.3	1.4	1.4	21	82.6	28.9	(5.8)	2.0	0.8
1999	31	77.4	5.5	8.9	1.4	1.5	22	68.9	(10.1)	(9.3)	0.6	0.7
2000	39	72.6	15.2	14.5	1.7	1.7	49	52.9	(2.8)	0.3	0.9	1.0
2001	23	81.9	28.2	23.3	2.1	1.9	30	48.6	(1.9)	0.1	1.0	1.0
2002	26	65.0	18.1	18.3	1.6	1.8	13	49.0	(0.4)	1.2	1.1	1.0
2003	26	49.4	21.3	14.5	2.0	1.5	13	31.4	(0.1)	0.3	1.1	1.0
2004	34	42.8	14.7	13.3	1.5	1.5	11	22.0	1.8	3.5	1.1	1.2
2005	58	27.0	7.1	8.2	1.2	1.3	17	17.0	(0.9)	(1.8)	1.0	1.0
2006	53	13.8	2.0	1.6	1.1	1.0	22	12.2	(1.6)	0.3	1.0	1.0
2007	57	10.7	6.9	7.0	1.2	1.1	15	6.8	10.2	4.6	1.3	1.1
2008	24	7.8	6.8	(2.1)	1.1	1.0	4	7.7	6.4	(0.6)	1.1	1.0
80's	*18*	*100.0*	*19.9*	*18.4*	*3.4*	*2.5*	*19*	*99.8*	*14.4*	*11.4*	*2.3*	*2.2*
90's	*179*	*91.7*	*9.6*	*9.0*	*1.6*	*1.5*	*117*	*88.9*	*23.2*	*6.1*	*2.5*	*1.3*
00's	*340*	*36.0*	*11.3*	*9.5*	*1.4*	*1.3*	*174*	*34.7*	*(0.3)*	*0.5*	*1.0*	*1.0*
Sample	537	56.7	11.0	9.7	1.5	1.3	310	59.1	9.5	1.9	1.7	1.1

Taking a closer look at the buyout subsample, we find that funds generated exceptionally strong IRRs in the 1980's, of close to 20%, examining both average and median figures. In the following two decades, buyout funds generated substantially lower IRRs of around 10%, with somewhat weaker returns in the 1990's than in the 2000's. The TVPI multiples also show strong returns in the 1980's, a 3.4x multiple on average and a median multiple of 2.5x. Meanwhile, the 1990's vintages generated somewhat superior returns compared to the 2000's vintages, according to the money multiples. Such a contradicting pattern between IRR and TVPI can be explained by capital being distributed quicker to investors in the 2000's, hence boosting the IRR at the cost of the TVPI multiple.

Venture capital performance appears much more volatile. The average IRR shifts from 14.4% in the 1980's to 23.2% in the 1990's and down to -0.3% in the 2000's. Respective median IRRs are 11.4%, 6.1% and 0.5%. Evidently, there is a large dispersion between venture capital returns both between and within vintage decades, especially true during the 1990's. Examining year 1995 for instance, we find that the average IRR of 38.5% is more than twice as large as the median of 16.7%. According to the average TVPI figures, the 1990's was the best performing vintage decade, while the median figures tell us that the 1980's funds were the best performers.

What is worth noting is that while nearly all funds from the 1980's and 1990's are fully realized, funds issued in 2000's have only returned close 40% of the value to the investors. Thus, we cannot be certain about the return accuracy of funds started in the 2000's, as those returns are dependent on the assumptions made about their NAVs. An underestimated (overestimated) NAV leads to larger (smaller) realized returns.

While the IRR and TVPI measures are indeed comprehensible and simple to calculate, they fail to incorporate the opportunity cost of capital. We also note that the two metrics make us draw contradicting conclusions about performance, speaking for the fact that an LP should not consider only one metric when evaluating fund returns.

B. PME Fund Performance

In this section, we extend our analysis by comparing private equity returns to the performance of the S&P 500 Composite, which is supposed to reflect the general market performance. The S&P 500 is a market-weighted index consisting of the 500 most widely held, not the largest, listed American companies. As several PME approaches have been developed in past years, we aim

to investigate how much the results from each method differ from the others. The purpose of the analysis is to investigate whether investors could choose freely among the methods when evaluating returns, or if there is one method that seems superior. All PME models implicitly assume that the systematic risk of the funds is equal to that of the market. In later sub-sections, we will alter this assumption.

In Table IV, we report fund performance using the four different PME measures ICM, PME+, KS-PME and Direct Alpha. We show average relative returns for each method in the first row, median performances in the second row and standard deviations in the third row for each measure. While the first three columns report equal weighted returns, the following three report value weighted ones. In the equal weighted approach, each fund receives the same weight while in the value weighted approach, the largest funds are given a larger weight. We note that the equal weighted returns are stronger than the value weighted returns, overall. This is line with the findings of Kaplan and Schoar (2005), who observe a concave relationship between fund performance and size. In other words, larger funds perform better up until a certain point when they become too large, and then returns tend to decrease. We find similar results when regressing returns on size, controlling for year-fixed effects and sequence, shown in Table XX in Appendix B.

Table IV

Relative Fund Performance with Several PME Approaches

This table shows the relative performance of the funds in our data set using the ICM, PME+, KS-PME and the Direct Alpha PME methods. We report figures for the main sample and for the buyout and venture capital subsamples separately. The S&P 500 Composite index is used as benchmark. The table shows relative returns using an equal weighted approach in the first three columns, where all funds are given the same weight, and a value weighted approach where larger funds earn a larger weight, in the following three columns. The first row of each PME measure shows the average abnormal return, the second row shows the median abnormal return and the standard deviation of the abnormal returns in the third row. All returns are calculated on US dollar denominated cash flows. The sample covers funds issued between 1979 and 2008. Negative values are shown in parentheses.

	Equal Weighted			Value Weighted		
	Total	Buyout	Venture	Total	Buyout	Venture
ΔICM	1.7%	4.4%	(3.0)%	3.1%	3.7%	(1.7)%
	1.6%	4.4%	(0.5)%	3.5%	3.9%	(0.3)%
	12.4%	12.0%	11.5%	12.4%	12.5%	10.2%
ΔPME+	4.6%	4.5%	4.8%	3.6%	3.7%	2.7%
	4.1%	7.4%	(0.8)%	3.7%	4.5%	(0.8)%
	52.8%	58.3%	41.7%	43.6%	44.7%	32.0%
KS-PME	1.30x	1.33x	1.25x	1.24x	1.24x	1.12x
	1.15x	1.25x	0.96x	1.11x	1.14x	0.96x
	1.14x	0.68x	1.65x	0.60x	0.47x	1.25x
Direct Alpha	5.7%	6.9%	3.6%	4.8%	5.1%	1.9%
	3.9%	7.2%	(0.8)%	3.8%	4.6%	(0.8)%
	24.9%	15.0%	36.0%	16.4%	14.5%	27.9%

From an investor point of view, the equal weighted approach might make the most sense since an investor can diversify the exposure towards funds of different sizes. However, investors may still be overexposed to larger funds if the absolute investment size is larger in bigger funds.

Observing the buyout sample, we find that both the average and median funds have outperformed the market using all of the four PME methods. However, returns generated by venture capital funds appears weaker. While the median fund has underperformed the market according to all four methods, all except the ICM show an overperformance on average. Furthermore, the standard deviations are larger for buyout than venture capital funds using the ICM and PME+ approaches, while smaller according to the KS-PME and Direct Alpha methods. Thus, even though it appears as if buyout funds are the better performers, the top (and the bottom) performing funds may still be venture capital funds.

According to the equal weighted ICM approach, buyout funds have outperformed the S&P 500 with 4.4% per year, examining both the average and median return. Meanwhile, venture capital funds have shown an underperformance compared to benchmark, with an alpha of -3.0% on average, or 0.5% according to the median, per year. Value weighted observations show superior results for the venture capital subsample, while the reverse holds for buyout funds. Even so, buyout funds continue to show outperformance while venture capital returns maintain below benchmark. Worth noting is that 31% of all benchmark portfolios have generated negative NAVs.

Using the PME+ method, buyout fund performance does not change considerably from the ICM approach. Meanwhile, venture capital relative performance turns positive and increases to 4.8% on average using the equal weighted approach and to 2.7% using the value weighted approach. Worth noting is that standard deviations are considerably larger using the PME+ approach, telling us that these performance figures are more volatile than those of the ICM.

The KS-PME method make us draw similar conclusions about performance above or below benchmark as the PME+ does. The average (median) multiple equals 1.33x (1.25x) for buyout funds and 1.25x (0.96x) for venture capital funds, according to the equal weighted approach. Value weighted multiples show somewhat weaker relative performance.

Finally, according to the Direct Alpha approach, buyout funds have generated an average excess return of 6.9% and a median of 7.2%. For the venture capital funds, the average yearly return is 3.6% above benchmark, while the median relative return is -0.8%, again according to the equal weighted ap-

proach. Studying the value weighted numbers, the returns once again tend to decrease, but the pattern stays the same.

C. Performance Correlations

Clearly, the PME measures produce different results, and at times contradicting ones. To further investigate how much the output from the measures differ from the others, we demonstrate their correlations together with the IRR and TVPI in Table V.

We find that the IRR, the TVPI, the KS-PME and the Direct Alpha correlate strongly to each other, all correlations being above 0.75. The correlations that we find between the IRR, TVPI and KS-PME are also similar to the findings of Kaplan and Schoar (2005). The highest correlations are found between the IRRs and the Direct Alphas (0.97), and the results of the two investment multiples, TVPI and KS-PME (0.92). These observations are not surprising as the two pairs calculate returns in similar manners (using either nominal or future values of cash flows).

Table V
Correlation Between Fund Performance Measures

This table shows the correlation between the IRR, TVPI, ΔICM, ΔPME+, KS-PME and Direct Alpha returns for all the 847 funds in our data set. The measured returns are in absolute numbers. All returns are calculated on US dollar denominated cash flows. The sample covers funds issued between 1979 and 2008.

	IRR	TVPI	Δ ICM	Δ PME+	KS-PME	Direct Alpha
IRR	1.00					
TVPI	0.76	1.00				
ΔICM	0.40	0.20	1.00			
ΔPME+	0.57	0.41	0.32	1.00		
KS-PME	0.86	0.92	0.36	0.49	1.00	
Direct Alpha	0.97	0.70	0.51	0.58	0.87	1.00

The ICM and the PME+ methods show weaker correlations to their counterparts. However, these correlations are measured in absolute returns, which may not be the most accurate measure of correlation since the PME+ and ICM are heuristic in nature, calculating the difference between two IRRs, while the other metrics use more advanced methods to generate one output figure directly. Thus, we look at how the different methods rank fund performance. For each return metric, we rank the performance output for all of the 847 funds from 1 to 847 (highest to lowest) in order to measure the correlation between how the different metrics rank the funds performance-wise. Results are shown in Table VI.

Table VI

Correlation Between Ranked Fund Performance Measures

This table shows the correlation between the IRR, TVPI, ΔICM, ΔPME+, KS-PME and Direct Alpha returns for all the 847 funds in our data set. Correlations are based on rankings of the measured returns from each fund, where the fund with the highest return is ranked as number one and the fund with the lowest return earn a value of 847, for each of the six metrics. All returns are calculated on US dollar denominated cash flows. The sample covers funds issued between 1979 and 2008.

	IRR	TVPI	Δ ICM	Δ PME+	KS-PME	Direct Alpha
IRR	1.00					
TVPI	0.96	1.00				
Δ ICM	0.73	0.69	1.00			
Δ PME+	0.91	0.86	0.83	1.00		
KS-PME	0.89	0.90	0.83	0.95	1.00	
Direct Alpha	0.91	0.86	0.86	0.98	0.97	1.00

Now, we observe that the correlations of the two heuristic approaches relative to the other methods increase substantially. For example, the correlation between ΔPME+ and Direct Alpha moves from 0.58 to 0.98. Meanwhile, the correlation between ΔICM and KS-PME increases from 0.36 to 0.83.

In addition, the correlations between IRR and Direct Alpha, and TVPI and KS-PME decreases, from 0.97 to 0.91 and from 0.92 to 0.90, respectively. Clearly, there is a difference between how the fund returns are ranked. From an investor perspective, this may not be a substantial difference, but considering that these results are on a large number of observations, the differences can be huge on a fund to fund basis. Also, as the ICM method generates negative NAVs in 31% of all funds, this skews the numbers and make the calculations more imprecise. Meanwhile, we do not trust the PME+ completely, because of the large standard deviations it generates. As the KS-PME only shows the overall wealth produced by a fund, while the Direct Alpha method generates a per-period rate of return, we find the latter one is the most intuitive and will from here on use that measure when evaluating returns.

D. Fund Performance over Time

In this sub-section, we examine fund performance over time. We report both average and median (equal weighted) Direct Alphas for the buyout and venture capital subsamples by vintage year in Table VII. We also include a column showing the index value of the S&P 500 observed the last date of each year, to get an understanding of how the index has developed. As there are rather few observations in the first years of our data set, we have restricted the sample to cover the period 1992 to 2008 from here on.

Table VII

Relative Performance over Time

This table shows the average and median relative performance, measured by the Direct Alpha, for the buyout and the venture capital subsamples separately, split by vintage year. The S&P 500 Composite index is used as benchmark. The table also shows the closing value of the S&P 500 Composite on the last observable date of each year. All returns are calculated on US dollar denominated cash flows. The sample was limited to cover funds issued between 1992 and 2008. Missing values are denoted with "-". Negative values are shown in parentheses.

		Buyout (%)		Venture (%)	
Vintage	S&P 500	Average	Median	Average	Median
1992	435.7	(0.5)	5.4	14.1	11.5
1993	466.5	4.9	2.3	13.8	8.6
1994	459.3	6.1	6.0	12.5	9.7
1995	615.9	1.3	(1.0)	19.0	0.4
1996	740.7	(0.0)	(1.8)	16.8	6.3
1997	970.4	6.4	6.5	19.7	1.6
1998	1,229.2	5.7	5.8	23.7	(4.3)
1999	1,469.3	5.5	8.7	(10.1)	(9.6)
2000	1,320.3	12.0	12.3	(4.0)	(1.2)
2001	1,148.1	21.3	18.8	(4.3)	(3.0)
2002	879.8	13.2	14.6	(3.0)	(1.8)
2003	1,111.9	17.4	12.6	0.5	1.6
2004	1,211.9	13.5	12.4	0.3	4.3
2005	1,248.3	7.8	7.8	(0.9)	(0.6)
2006	1,418.3	2.3	3.1	(4.3)	(2.2)
2007	1,468.4	2.6	3.2	5.4	1.9
2008	903.3	(5.1)	(6.7)	(3.8)	(9.0)
1992-99	-	*4.4*	*3.9*	*12.9*	*(1.2)*
2000-08	-	*8.3*	*8.2*	*(2.3)*	*(1.0)*
1992-08	-	7.0	7.3	3.6	(1.2)

Table VII shows that the buyout funds have consistently managed to outperform the S&P 500, with 7.0% per year on average. The return is statistically significant above zero. The median buyout fund generated a yearly return of 7.3% above benchmark. These results are superior to those found by Harris et al. (2015), who observe an average Direct Alpha of 3.1% and a median of 2.4% for buyout funds from the period 1984 to 2010.

Examining the returns by vintage year, the buyout funds have outperformed index during all but three of the seventeen years, measured in terms of both average and median returns. Funds in the 2000's have performed better relative to the market than funds in the 1990's, 8.3% versus 4.4% on average during the respective periods. Interestingly, when comparing the IRRs for the buyout funds during the 1990's and the 2000's as we did in Table III, it appears as if funds performed equally well during the two periods, making this an exceptional example for why one should compare fund returns to market returns and not look at fund returns alone.

Studying the venture capital returns, we find that the average fund outperformed the S&P 500 with an annualized excess return of 3.6%. This figure is not statistically significant above zero. The median fund performed worse than

benchmark, by -1.2% per year on average during the period. During seven of the thirteen years, the average venture capital fund showed negative abnormal returns, or eight if we study median returns. In contrast to the buyout funds, the 1990's seems to be the decade in which venture funds performed the best, with an average Direct Alpha of 12.9%. The median return for the 1990's tells a different story, showing a return of -1.2%, below the benchmark. During the 2000's, venture capital show negative average and median abnormal returns. Also interesting is the large dispersion between average and median returns in the venture capital subsample, especially in the 1990's.

As previously discussed, the funds from the 2000's are yet to be liquidated and the relative performance will depend on how the funds proceed to realize returns. During the financial crisis, the S&P 500 index dropped by a large extent, from a value of 1,468 at year end 2007 to 903 in year end 2008. In theory, a decrease in the benchmark should lead to an increase in the relative performance of the private equity fund, assuming that the market value of a fund's investment does not drop accordingly. Thus the unrealized alphas of the 2000's are subject to change and should be treated as no more than indications of what the realized Direct Alphas will be, until funds are realized.

What strikes us as interesting is that the returns of buyout and venture capital does not seem to correlate in a given year. Examining the returns of funds started in 1999 to 2002 we observe that the venture capital funds have shown negative relative returns in connection to the crash of the Internet bubble, while buyout funds started in those years generated strong relative returns. This could potentially suggest that an investor could increase portfolio diversification by investing in both fund types.

In Table VIII we aim to research the effect of portfolio diversification on relative returns in more depth. We create three different portfolios per vintage year, where each portfolio is 50% invested in buyout and 50% in venture capital. Returns are compared to the S&P 500 benchmark. In a given vintage year, the return of Portfolio I is calculated as the average of the average returns from the two fund types in that year. Portfolio II takes the average of the median returns from each fund type in a given year, while Portfolio III is an equal investment in venture capital and buyout funds assuming their respective value weighted returns, in a given year.

Table VIII

Relative Performance and Diversification Benefits

This table shows the relative performance, measured by the Direct Alpha, for three hypothetical portfolios set up each vintage year. Each portfolio is assumed to invest equally large stakes in the buyout and venture capital funds issued in each year. In a given year, Portfolio I calculates the relative return as the average of the average returns of the buyout and venture capital funds issued in that year. Similarly, the relative return of Portfolio II in a given year is calculated as the average of the median returns of the buyout and venture capital funds issued in that year. Finally, Portfolio III calculates the relative return as the average of the value weighted return of the buyout and the venture capital funds issued in a given year. The S&P 500 Composite index is used as benchmark. The table also shows the closing value of the S&P 500 Composite on the last observable date of each year. All returns are calculated on US dollar denominated cash flows. The sample was limited to cover funds issued between 1992 and 2008. Missing values are denoted with "-". Negative values are shown in parentheses.

		Direct Alpha (%)		
Vintage	S&P 500	Portfolio I	Portfolio II	Portfolio III
1992	435.7	6.8	8.4	7.1
1993	466.5	9.4	5.4	3.8
1994	459.3	9.3	7.8	6.3
1995	615.9	10.2	(0.3)	4.4
1996	740.7	8.4	2.2	0.7
1997	970.4	13.0	4.0	6.5
1998	1229.2	14.7	0.8	3.7
1999	1469.3	(2.3)	(0.5)	1.4
2000	1320.3	4.0	5.6	4.0
2001	1148.1	8.5	7.9	7.5
2002	879.8	5.1	6.4	8.8
2003	1111.9	8.9	7.1	9.6
2004	1211.9	6.9	8.3	6.7
2005	1248.3	3.5	3.6	3.9
2006	1418.3	(1.0)	0.5	(0.0)
2007	1468.4	4.0	2.5	(0.5)
2008	903.3	(4.4)	(7.9)	(2.0)
1992-99	-	*8.6*	*1.9*	8.9
2000-08	-	*3.0*	*3.6*	1.9
1992-08	-	5.3	3.1	*3.5*

We observe obvious diversification benefits for inventors seeking stable returns on a year to year basis. Comparing Table VIII to Table VII, all three portfolios show positive Direct Alphas for the whole sample period, as well as for the two sub-periods. The number of times a vintage year shows a negative return decrease, as well as the magnitude of the negative returns. Meanwhile, the positive returns also decrease. Portfolio I generates a yearly abnormal return of 5.3% for the entire sample-period, Portfolio II a yearly excess return of 3.1%, while Portfolio III would have outperformed the index by 3.5% per year. While the returns are not as strong as the average buyout return, they are steadier over time. Thus, for LPs that have constant and increasing liabilities such as pension funds and public institutions, there are clear benefits of diversification. However, this is an area in need of further research.

In evaluating fund returns, we proceed by investigating whether funds managed by proven GPs have been able to generate stronger returns than funds from newcomers. One would expect that as a GP becomes more experienced, their funds should deliver better returns. Such a positive relationship

between performance and fund sequence was found by Kaplan and Schoar (2005). When regressing returns from 1992 to 2008 funds on sequence, controlling for size and fixed-year effects, we find a statistically significant concave relationship, indicating a contradicting finding to that of Kaplan and Schoar (2005). Worth noting is that we are not certain of the sequence numbers of the funds in our data set, so we cannot be sure that this finding is correct. Results from the regression is shown in Table XX, found in Appendix B.

To gain a deeper understanding of the distribution of returns, we divide the Direct Alphas into quartiles by vintage year, illustrated in Table IX. This is a common practice in evaluating private equity performance, as it gives a clear picture of the dispersion in returns. In their study, Kaplan and Schoar (2005) also found that funds from the top performing GPs tend to consistently outperform funds of lower performing GPs over time. Therefore, this is a convenient metric to look at for an investor when to select which funds to invest in. Once again, the sample is divided into buyout and venture capital funds and by vintage year. The best performing funds are found in the first quartile and the worst in the fourth.

Table IX
Relative Performance by Quartiles

This table shows the relative performance, measured by the Direct Alpha, split into quartiles in each vintage year, for the buyout and the venture capital subsamples separately. The best performing funds appear in the first quartile, while the worst performing funds appear in the fourth quartile in a given year. The S&P 500 Composite index is used as benchmark. All returns are calculated on US dollar denominated cash flows. The sample was limited to cover funds issued between 1992 and 2008. Negative values are shown in parentheses.

	Buyout (%)				Venture (%)			
Vintage	1st	2nd	3rd	4th	1st	2nd	3rd	4th
1992	32.5	13.2	(16.4)	(39.2)	39.8	16.7	6.3	(9.1)
1993	16.8	4.3	0.8	(3.6)	40.2	12.1	(0.2)	(10.3)
1994	21.7	10.9	0.6	(8.7)	47.5	11.0	(8.8)	(17.4)
1995	16.9	4.4	(3.9)	(13.3)	78.1	7.7	(3.0)	(15.1)
1996	12.1	4.0	(4.2)	(12.7)	70.4	6.6	(2.0)	(34.4)
1997	21.2	9.2	2.0	(6.9)	69.9	14.1	(2.8)	(12.5)
1998	21.9	9.9	3.0	(12.1)	101.5	3.0	(8.7)	(16.4)
1999	17.7	10.6	4.3	(10.7)	0.7	(5.7)	(12.0)	(23.9)
2000	22.6	15.0	8.4	1.7	6.0	0.7	(6.1)	(17.2)
2001	43.9	25.3	12.4	2.0	7.8	(0.4)	(5.6)	(18.6)
2002	27.3	17.7	9.7	(2.0)	7.0	1.1	(8.3)	(15.2)
2003	43.9	15.0	10.0	(0.7)	12.4	3.4	(0.4)	(17.5)
2004	30.4	14.9	10.0	(1.3)	10.6	6.1	(4.5)	(12.6)
2005	22.3	9.9	5.5	(6.4)	14.2	0.3	(5.3)	(16.6)
2006	13.3	6.2	0.5	(11.7)	7.2	(0.3)	(6.0)	(17.8)
2007	20.8	6.4	(1.5)	(16.7)	32.9	2.8	(2.9)	(13.4)
2008	21.7	0.5	(14.4)	(28.1)	18.2	(2.9)	(15.1)	(15.5)
1992-99	*20.1*	*8.3*	*(1.7)*	*(13.4)*	*56.0*	*8.2*	*(3.9)*	*(17.4)*
2000-08	*27.4*	*12.3*	*4.5*	*(7.0)*	*12.9*	*1.2*	*(6.0)*	*(16.0)*
1992-08	23.9	10.4	1.6	(10.0)	33.2	4.5	(5.0)	(16.7)

As one would expect, we find a substantially larger dispersion between the performance of the top versus the bottom quartile funds in the venture capital subsample compared to buyout subsample. For buyout funds, the average Direct Alpha of the top quartile equals 23.9% while the bottom quartile generates an average of -10.0% relative to benchmark, examining funds from the entire time period. For venture capital funds, the top performing fund on average generates a yearly return of 33.2% above benchmark, while the bottom generates a return of -16.7% relative to index on an annual basis. Observing buyout fund quartile returns, even the third quartile of funds generates positive returns, while for venture capital funds, an LP must invest in one of the two top quartiles to earn a positive Direct Alpha. These results are in line with those of Harris et al. (2015), who also found that only the bottom quartile buyout fund underperformed the index, while the two bottom quartiles venture capital funds underperformed the index, on average.

We also observe that the first quartile Direct Alphas of buyout funds have been rather steady, averaging 20.1% and 27.4% respectively, for the periods 1992 to 1999 and 2000 to 2008. Between the two subset periods, we also note that the Direct Alphas in the third and fourth quartile have improved, from -13.4% to -7.0%. One explanation for this finding could be that buyout funds have diminished their risk-taking in general, but it could also indicate favorable market conditions.

Looking at the corresponding quartiles for venture capital funds, we observe a large decline in performance between the first and second quartile, from 33.2% to 4.5%, on average. Also, returns in the first quartile decreased drastically in the 2000's when the Internet bubble burst, from 56.0% to 12.9%.

What must be kept in mind is that none of the 2000's funds have been liquidated, and as we know, returns in private equity tend to move according to the J-curve. Also, for newer venture capital funds it may be difficult to estimate the value of investments, so GPs might underestimate the NAV when a fund is young, which could explain why the first quartile is substantially lower in the 2000's. Venture capital funds also tend to have rather stale NAVs, as they often value firms at cost or by the last seed round. Buyout funds on the other hand mostly value their investments at market value by using multiples or a discounted cash flow analysis. The risk-reward aspect is of course relevant when comparing buyout and venture capital returns, as venture capital inherently is riskier. We discuss the risk-reward aspect later in this paper while adjusting beta values relative to index.

Examining the quartiles of fund returns for the two subsamples, it appears evident that fund picking skills are more crucial for LPs investing in venture capital. Meanwhile, it is debatable whether fund picking skills exists or not. Nevertheless, as funds from best performing venture capital firms tend to be oversubscribed, it is important for investors to nurture a strong long-term relationship with those GPs. Of course, this also implies that LPs might sometimes have it in their best interest to invest in newly started funds to obtain a relationship with a GP, even though the GP is unproven.

E. Fund Performance by Geographic Focus

While the majority of the funds in our data are focused in the US, approximately one fifth of them are focused in Europe or the RoW. Hence, we find it interesting to examine whether funds invested in a specific area has performed better or worse compared to the counterparts. In Table X, we show the average Direct Alphas split by geographic investment focus and vintage year for buyout and venture capital funds separately. We use the S&P 500 as benchmark for all geographic focuses in this section.

Table X

Relative Performance by Geographic Fund Focus

This table shows the average, equal weighted, relative performance, measured by the Direct Alpha, by the geographic investment focuses US, Europe and RoW, for the buyout and the venture capital subsamples separately, split by vintage year. The S&P 500 Composite index is used as benchmark. All returns are calculated on US dollar denominated cash flows. The sample was limited to cover funds issued between 1992 and 2008. Missing values are denoted with "-". Negative values are shown in parentheses.

	Buyout (%)			Venture (%)		
Vintage	US	Europe	RoW	US	Europe	RoW
1992	(0.5)	-	-	14.1	-	-
1993	4.9	-	-	16.9	-	(11.2)
1994	3.5	24.6	-	12.5	-	-
1995	2.2	0.8	(8.1)	20.1	5.5	-
1996	(1.9)	5.9	4.8	18.2	6.1	-
1997	4.3	20.6	(19.8)	17.1	30.1	58.1
1998	5.8	11.4	(15.5)	27.2	(8.4)	(10.5)
1999	3.2	12.3	20.7	(10.1)	-	(8.6)
2000	11.8	14.1	-	(3.2)	(13.8)	2.4
2001	23.1	16.5	27.1	(3.9)	(5.9)	-
2002	10.4	20.6	-	(3.4)	(0.7)	-
2003	16.9	19.0	-	0.4	0.8	-
2004	13.7	16.8	1.8	0.3	-	-
2005	7.3	6.9	12.7	(0.9)	4.9	(6.8)
2006	3.1	(3.5)	12.4	(3.4)	-	(24.6)
2007	2.9	(1.3)	10.5	8.5	(1.4)	(0.8)
2008	(5.4)	(8.9)	0.3	(4.1)	-	(2.9)
1992-99	*3.2*	*13.0*	*(3.0)*	*13.3*	*8.3*	*7.0*
2000-08	*8.5*	*7.2*	*9.6*	*(1.9)*	*(5.2)*	*(4.9)*
1992-08	6.6	8.7	6.3	4.3	(2.5)	(0.6)

Examining the buyout funds first, we observe that funds within all geographic focus areas have outperformed the market on average, speaking for consistency in returns regardless of geographic investment focus. It appears as if European focused funds are the best performers, averaging an excess annual return of 8.7%. US and RoW funds have generated similar yields, 6.6% and 6.3% respectively. US and Europe fund alphas are statistically above zero, while there are too few RoW observations to draw any statistical conclusions about RoW returns. Looking deeper into the numbers, we find that while the US and RoW focused funds have shown better performance in recent years, the performance of European focused funds has substantially decreased. Between 2006 and 2008, returns have been below benchmark for the European funds, on average. One reason for the weakening performance may be explained by that private equity investing within Europe was a rather unexplored area in the 1990's, leading to many ample opportunities as the industry boomed.

Our findings are similar to those of Harris et al. (2015), who find that European focused funds outperformed US focused funds from 1994 to 1999 and that US focused funds outperformed European focused funds from 2000 to 2010. However, they quantify the performance using the KS-PME measure, and not the Direct Alpha so we cannot provide a more detailed comparison.

The observed Direct Alphas of the venture capital subsample show that only US funds have managed to outperform index on average. During the period 1992 to 2008, US funds have performed 4.3% better than benchmark per year, while European and RoW focused funds produced Direct Alphas of -2.5% and -0.6%, on average. However, none of these alphas are significantly above zero and the number of observations are few for the European and RoW focused funds. Interestingly, funds within all geographic investment focuses outperformed the S&P 500 on average in the 1990's, and to a large extent. The reverse holds for the 2000's funds. As we have previously mentioned, we find the burst of the Internet bubble to be a reason for this pattern. Also, US focused funds are the ones that have shown the strongest performance during both sub-periods.

F. Fund Performance from Different Investor Perspectives

Up until now, we have assumed that the S&P 500 is the relevant benchmark for an investor when comparing returns. However, which benchmark is the most relevant depends on many factors, such as the geographic base of the investor and the riskiness of the fund. For example, if an LP invests in a US focused fund, the relevant benchmark might be the S&P 500, since the

portfolio companies are more exposed to the US market. However, if the alternative to investing in the US focused fund is a European index, then that could be the comparable benchmark for the LP. Also, as funds take on different levels of risk, one could control for this by comparing buyout returns to a less risky benchmark and venture capital returns to a riskier benchmark, for instance. The risk can be captured by adjusting the beta value as well, which we will do in a later analysis. Thus, we will focus on the benchmark aspect alone right now.

In Table XI, we illustrate how fund returns differ as we assume different benchmarks. Since we have few RoW observations, we focus on US and European focused funds only. For simplistic reasons, we assume that investors are either American or European. Therefore, it makes sense to include a European benchmark and we use the Euro STOXX 600, which is denominated in Euro and comprises of 600 firms from seventeen different European countries.

Table XI

Relative Performance by Benchmark Assumptions

This table shows the average, equal weighted, relative performance, measured by the Direct Alpha, using the S&P 500 Composite and Euro STOXX 600 as benchmarks, for US and European focused funds separately, split by vintage year. The table also shows the closing value of the S&P 500 Composite and the Euro STOXX 600 on the last observable date of each year. All returns are calculated on US dollar denominated cash flows. The sample was limited to cover funds issued between 1992 and 2008. Missing values are denoted with "-". Negative values are shown in parentheses.

	Benchmarks		US Funds (%)		EU Funds (%)	
Vintage	S&P 500	STOXX	S&P 500	STOXX	S&P 500	STOXX
1992	436	102	6.2	8.0	-	-
1993	466	138	10.0	11.4	-	-
1994	459	125	7.0	7.2	24.6	24.8
1995	616	142	11.5	10.8	2.4	1.7
1996	741	171	4.5	4.2	6.0	5.7
1997	970	236	10.3	10.3	22.2	22.6
1998	1,229	279	14.1	14.3	9.0	9.6
1999	1,469	379	(3.0)	(2.0)	12.3	14.0
2000	1,320	360	3.5	4.3	0.1	0.5
2001	1,148	299	6.2	6.4	7.1	6.5
2002	880	202	5.3	5.2	15.8	13.9
2003	1,112	229	11.0	10.4	14.5	13.6
2004	1,212	251	9.7	11.4	16.8	16.0
2005	1,248	310	5.0	8.3	6.7	10.4
2006	1,418	365	0.9	5.8	(3.5)	0.9
2007	1,468	365	4.1	8.9	(1.3)	2.9
2008	903	198	(5.2)	(0.5)	(8.9)	(5.1)
1992-99	-	-	*7.5*	*7.9*	*12.4*	*12.9*
2000-08	-	-	*4.5*	*6.8*	*4.9*	*6.6*
1992-08	-	-	5.7	7.2	6.8	8.2

The first two columns show the index closing values of each benchmark during the last observable date of each year. The next two columns show returns of US focused funds, first compared to the S&P 500 and second com-

pared to Euro STOXX 600. The final two columns show returns of European funds, compared to S&P 500 and Euro STOXX 600. All returns are calculated on US dollar denominated cash flows, as that is how they appear in our data set.

We find that there is a large difference between the Direct Alphas for both US and European focused funds depending on what benchmark is applied. If we choose to compare returns to the S&P 500, US funds have generated an average return of 5.7% above benchmark while European focused funds have performed 6.8% above, on an annual basis. Using Euro STOXX 600 as benchmark, US funds have shown an annual excess return of 7.2% and European focused funds have performed even better, by 8.2% above benchmark annually. Also evident is that there is a larger difference of returns compared to benchmarks in more recent years. Clearly, choosing benchmark will have a large effect on the relative performance outcome. While the absolute returns are the same, it implies that an investor needs to make careful considerations regarding what benchmark to apply when evaluating relative fund returns.

Furthermore, an investor choosing to invest capital in a fund overseas is likely to be exposed to foreign exchange risk. LPs can choose to hedge either the fund currency, or the portfolio companies' currencies. We aim to investigate what effect hedging has on the relative returns in a simplified exercise. Since we do not know the holdings the funds in our data, we focus on fund currency hedging for this analysis. As investors are uncertain about the timing of each cash flow, we assume that the exchange rate is equal to the forward exchange rate in this simplified exercise. That allows us to not make any explicit assumptions about the timing of the hedging. We assume that all cash flows can be perfectly hedged and that there are no transaction costs related. Once again, we compare US and European focused funds and we use the S&P 500 and Euro STOXX 600 as benchmarks. We show average Direct Alphas per vintage year, from the perspective of a US investor and a European investor. For the US investor, we compare returns to the S&P 500 Composite and for the European investor, returns are compared against the Euro Stoxx 600. The cash flows of the European focused funds are assumed to be in Euro, even though they appear in US dollars in our data set. Results are presented in Table XII. In the first column of each sub-section, we show the average returns from investing directly in a "domestic" fund, a US denominated fund for a US investor or a Euro denominated fund for a European investor. The next two columns show average returns from investing overseas. From the perspective of the US investor, the second column shows the unhedged average

returns of investing in a European focused fund denominated in Euro. The third column shows the hedged returns of investing in the Euro denominated fund, assuming that all cash flows are converted into the local currency of the investor.[3]

Table XII

Relative Performance with and without Hedging

This table shows the average, equal weighted, relative performance, measured by the Direct Alpha, from the perspective of a US and a European investor, split by vintage year and the funds' investment focuses; the US and Europe (EU). From the US investor perspective, returns are benchmarked against the S&P 500 Composite and for the European investor; returns are benchmarked against the Euro STOXX 600. As investors are uncertain about the timing of each cash flow, we assume that the exchange rate is equal to the forward exchange rate in this simplified exercise. That allows us to not make any explicit assumptions about the timing of the hedging. For the US investor, the local currency is assumed to be the US dollar and for the European investor, the Euro is assumed to be the local currency. According to the table, a US (European) investor has three alternatives 1) investing in a domestic fund denominated in the US dollars (Euro), 2) investing in a European (US) focused fund without hedging the Euro (US dollar) denominated cash flows, or 3) investing in a European (US) focused fund without while hedging the Euro (US dollar) denominated cash flows. Hence, the cash flows of the European focused funds are assumed to be in Euro, in contrast to previous tables where all returns are calculated on US dollar denominated cash flows. The sample was limited to cover funds issued between 1992 and 2008. Missing values are denoted with "-". Negative values are shown in parentheses.

	US Investor - S&P 500 (%)			EU Investor - STOXX 600 (%)		
Vintage	US funds (USD)	EU funds (Unhedged)	EU funds (Hedged)	EU funds (EUR)	US funds (Unhedged)	US funds (Hedged)
1992	6.2	-	-	-	8.0	6.0
1993	10.0	-	-	-	11.4	9.2
1994	7.0	19.5	24.6	19.8	7.2	4.5
1995	11.5	(0.2)	2.4	(0.6)	10.8	7.8
1996	4.5	3.7	6.0	3.7	4.2	3.3
1997	10.3	22.0	22.2	22.6	10.3	10.7
1998	14.1	10.4	9.0	11.1	14.3	15.9
1999	(3.0)	18.5	12.3	20.3	(2.0)	2.2
2000	3.5	5.6	0.1	5.9	4.3	8.8
2001	6.2	12.1	7.1	11.2	6.4	10.9
2002	5.3	19.7	15.8	17.5	5.2	8.2
2003	11.0	16.0	14.5	15.0	10.4	12.7
2004	9.7	18.6	16.8	17.7	11.4	13.7
2005	5.0	8.2	6.7	11.9	8.3	9.4
2006	0.9	(3.5)	(3.5)	0.9	5.8	5.7
2007	4.1	(1.7)	(1.3)	2.4	8.9	9.1
2008	(5.2)	(6.4)	(8.9)	(2.7)	(0.5)	0.6
1992-99	*7.5*	*13.1*	*12.4*	*13.8*	*7.9*	*8.1*
2000-08	*4.5*	*7.0*	*4.9*	*8.6*	*6.8*	*9.0*
1992-08	5.7	8.5	6.8	9.9	7.2	8.1

Since the Direct Alpha is an annual measure, the effect of the currency changes is of a large magnitude considering the compounding effect. During this time period, investing in European focused funds would in hindsight always have been the better choice on average, as both hedged and unhedged Direct Alphas are higher for US investors in European focused funds. For European LPs the opposite is true; investing in US focused funds would have generate poorer returns. From the US investor perspective, investing in a European focused fund while not hedging the cash flows would have generated

[3]We use a weighted European exchange rate on the European currencies called EURSTP in order to convert the cash flows.

stronger abnormal returns on average, 8.5% compared to 6.8%. Meanwhile, the European LP investing in a US dollar denominated fund would have been better off hedging cash flows to Euro, producing a yearly abnormal return of 8.1% compared to the unhedged return of 7.2%, on average. To conclude, the importance of considering hedging when investing in foreign focused private equity is highlighted by the large spread in returns. Hedging strategies is something any sensible LP should consider so as to mitigate, or increase, risk. Ignoring to hedge foreign exchange rate risk could be seen as currency speculation, as currency rates are volatile and uncertain.

G. Risk of Private Equity Investing

As we have previously discussed, the Direct Alpha method implicitly assumes that private equity returns are equally risky as the returns of the market. Yet, there are many studies investigating how private equity correlates with the market. The research of Sörensen and Jagannathan (2015) indicate that under certain conditions, the systematic risk does not need to be taken into consideration when evaluating returns of private equity funds. They argue, logically, that discounting cash flows with realized market returns implicitly captures the systematic risk. Meanwhile, Jegadeesh, Kräussl, and Pollet (2015) find a beta of 1.0 for fund of funds, looking at public market data. Axelson, Strömberg, and Sörensen (2013) find betas of 2.2-2.4 for buyout funds gross of fees. If fees are taken into consideration the betas should be somewhat lower. Those values differ substantially from the findings of Driessen, Lin, and Phalippou (2012) who observe a market beta of 1.3 for buyout funds, but these are net of fees. For venture capital funds, the authors find a beta of 2.7, also net of fees. Further, Ljungqvist and Richardson (2003) report betas of 1.04-1.13 for buyout funds. The wide dispersion in estimated betas largely depends on the approach taken to research them. Nonetheless, it is an important consideration for investors, as alphas naturally depend on the chosen beta value.

In Table XIII, we show how relative returns differ as we assume different levels of risk, captured by the beta. Returns are compared against the S&P 500. This analysis is similar to that of Harris et al. (2015), but we test different levels of systematic risk for venture capital funds compared to buyout funds. We find this more relevant, as research suggest that the systematic risk is considerably larger for venture capital funds than for buyout funds. Keeping this in mind, we test beta values of 1.5 and 2.0 for buyout funds and 2.5 and 4.0 for venture funds. We compare those to the Direct Alphas with beta values of 1.0 in Table VII.

Table XIII

Relative Performance by Risk Assumptions

This table shows the average, equal weighted, relative performance, measured by the Direct Alpha, assuming different levels of systematic risk, beta values, for the buyout and the venture capital subsamples separately, split by vintage year. For the buyout funds, we test beta values of 1.0, 1.5 and 2.0 and for the venture capital funds; we test beta values of 1.0, 2.5 and 4.0. The S&P 500 Composite index is used as benchmark. All returns are calculated on US dollar denominated cash flows. The sample was limited to cover funds issued between 1992 and 2008. Negative values are shown in parentheses.

	Buyout (%)			Venture (%)		
Vintage	Beta 1.0	Beta 1.5	Beta 2.0	Beta 1.0	Beta 2.5	Beta 4.0
1992	(0.5)	(7.2)	(12.8)	14.1	(5.0)	(13.8)
1993	4.9	(0.6)	(4.6)	13.8	(4.3)	(9.0)
1994	6.1	0.7	(1.5)	12.5	(1.0)	(2.0)
1995	1.3	(1.4)	(2.8)	19.0	4.1	3.8
1996	(0.0)	(0.8)	(0.5)	16.8	11.2	18.5
1997	6.4	7.5	9.9	19.7	15.6	26.4
1998	5.7	7.8	11.0	23.7	26.7	44.3
1999	5.5	7.1	9.9	(10.1)	(2.7)	16.6
2000	12.0	11.9	12.8	(4.0)	1.8	19.1
2001	21.3	19.4	18.8	(4.3)	0.1	16.0
2002	13.2	12.6	13.4	(3.0)	1.2	16.0
2003	17.4	17.6	19.3	0.5	12.0	40.1
2004	13.5	15.4	19.0	0.3	9.9	36.9
2005	7.8	10.8	15.7	(0.9)	11.3	40.6
2006	2.3	5.2	9.9	(4.3)	0.7	13.1
2007	2.6	1.8	1.6	5.4	6.7	13.7
2008	(5.1)	(9.9)	(14.4)	(3.8)	(10.3)	(11.5)
1992-99	*4.4*	*3.8*	*4.7*	*12.9*	*8.2*	*17.0*
2000-08	*8.3*	*8.8*	*10.6*	(2.3)	3.7	21.2
1992-08	7.0	7.1	8.6	3.6	5.5	19.6

We observe average Direct Alphas of 7.0%, 7.1% and 8.6% for buyout funds, assuming beta values of 1.0, 1.5 and 2.0, respectively, during the period 1992 to 2008. Our previous conclusion that buyout funds have outperformed the market on average during both sub-periods does not change as we change the beta value.

Venture capital funds are more affected by different betas, which is natural as we test higher beta values. We observe average Direct Alphas of 3.6%, 5.5% and 19.6% for beta values of 1.0, 2.5 and 4.0, respectively. Studying the sub-periods, we observe that the average negative Direct Alpha in 2000 to 2008 turns positive when we test for higher betas. This is probably due to the decrease in the index during the time period, being magnified by a higher beta.

We draw the conclusion that higher betas and hence higher risk within private equity does not explain the relative overperformance compared to public equity, on average. Our conclusion echoes the research of (Harris et al., 2015).

H. Market Timing

As previously mentioned, a caveat with the PME models is that they fail distinguish whether a fund's returns is partly attributable to market timing. Thus, we invent a method for hypothetically testing the market timing in terms of the funds' investments.

For each fund observation, we create two hypothetical portfolios that invests the sum of the fund's contributions in the S&P 500. The first portfolio uses a mimicking strategy and the second uses a naive investment approach. In the mimicking strategy, we use the denominator of the KS-PME multiple, assuming that each time a fund draws down capital, the corresponding amount is invested in the benchmark. In the naive investment approach, we assume that the sum of all contributions by a fund is invested in three or five equally large parts at three or five different dates, respectively. The first investment of the naive investment approach is randomized to some date of the year in which the fund made its first contribution. The following two to four dates are randomized to dates between one and 365 days following the prior date. Therefore, the contributions can be invested during a minimum period of three or five days and a maximum period of three or five years, in theory. The holding period differs for each fund and is determined by the last date that we can observe a cash flow for that fund in the data set. If a fund has managed to time the market, the multiple should exceed one. Results are presented in Table XIV.

$$Market\ Timing\ Multiple = \frac{\sum_{i=1}^{n} FV(Contributions)}{\sum_{j=1}^{m} r_j(\sum_{i=1}^{n} Contributions)/m}$$

$$r_j = \frac{\text{Index value at the date of the last observed fund cash flow}}{\text{Index value at each investment date}}, \quad \text{for } j = 1, 2, ..., m$$

Where n is the actual number of contributions a fund has made to date and where m is the number of investments in the naive investment approach, which can take the value of three or five.

Table XIV

Market Timing Multiple

In this table, we show the results of a method that we have invented for measuring whether funds in our data set have been successful in timing the market. To do so, we create a multiple comparing the returns of two hypothetical portfolios for each fund, one with a mimicking strategy and one using a naive investment approach. In the mimicking strategy, we use the denominator of the KS-PME multiple, assuming that each time a fund draws down capital, the corresponding amount is invested in the benchmark. In the naive investment approach, we assume that the sum of all contributions by a fund is invested in three or five equally large parts at three or five different dates, respectively. The first investment of the naive investment approach is randomized to some date of the year in which the fund made its first contribution. The following two to four dates are randomized to dates between one and 365 days following the prior date. Therefore, the contributions can be invested during a minimum period of three or five days and a maximum period of three or five years, in theory. The holding period differs for each fund and is determined by the last date that we can observe a cash flow for that fund in the data set. If a fund has managed to time the market, the multiple should exceed one. The S&P 500 Composite index is used as benchmark. All returns are calculated on US dollar denominated cash flows. The sample was limited to cover funds issued between 1992 and 2008.

	3 Equal Investments (x)			5 Equal Investments (x)		
Vintage	Total	Buyout	Venture	Total	Buyout	Venture
1992	0.86	0.85	0.88	0.89	0.88	0.91
1993	0.80	0.80	0.81	0.85	0.85	0.85
1994	0.70	0.71	0.70	0.77	0.78	0.77
1995	0.76	0.73	0.79	0.84	0.81	0.88
1996	0.79	0.81	0.74	0.88	0.91	0.83
1997	0.83	0.82	0.84	0.91	0.89	0.92
1998	0.95	0.97	0.91	1.00	1.01	0.97
1999	1.11	1.13	1.07	1.06	1.08	1.02
2000	1.11	1.12	1.10	1.01	1.03	1.00
2001	0.97	0.99	0.96	0.94	0.96	0.92
2002	0.87	0.87	0.86	0.91	0.91	0.91
2003	0.90	0.91	0.89	0.94	0.95	0.93
2004	0.95	0.95	0.95	0.99	0.98	0.99
2005	1.00	1.00	1.00	1.04	1.03	1.05
2006	1.09	1.08	1.13	1.04	1.02	1.10
2007	1.10	1.11	1.09	1.00	1.00	0.98
2008	0.93	0.92	0.97	0.93	0.93	0.94
1992-99	*0.88*	*0.89*	*0.87*	*0.93*	*0.94*	*0.92*
2000-08	*1.02*	*1.02*	*1.02*	*0.99*	*1.00*	*0.99*
Sample	0.97	0.97	0.96	0.97	0.97	0.96

Regardless of whether investments have been made during a maximum of three year or five year period, results show that LPs would have been better off investing their capital commitments in a random walk than according to the private equity funds' timing, on average. The average multiple for funds from 1992 to 2008 equals 0.97x for buyout funds and 0.96x for venture capital funds, regardless of the number of investments in the naive investment portfolio. However, funds issued close to the Internet bubble crash around year 2000 and close to the financial crisis around 2008 have managed to perform better than the naive approach. This is not very surprising as those were periods when there were large drops in the S&P 500. Worth mentioning is that this analysis only captures the aspect of market timing, hence one could argue that it is quite spectacular that private equity funds have managed to outperform the benchmark to such a large extent anyhow.

One may also argue that private equity firms have not been aiming to time the market as they efficiently can change between investing equity and debt. When the market outlook is positive and the stock indices are at all-time highs, using debt is often cheap, and as private equity funds are flexible with their debt and equity mix, this might be something they are able to take advantage of. Kaplan and Strömberg (2009) argue that mispricing of debt often leads to buyout waves. As a consequence, buyout funds expect to pay larger premiums for the target firms, as they take advantage of the cheaper debt. We support this view as GPs need to invest the capital commitments to receive the management fee and carry, implying that they do not have time to wait until market conditions improve; assuming that they do in fact have the ability to time the market. By utilizing the market mispricing they can instead continuously invest, and do not to need care about market timing.

VI. Conclusion

In evaluating fund returns, we use a high quality data set from Preqin, studying close to 900 buyout and venture capital funds issued between 1979 and 2008. While the industry norm is to evaluate returns using either the IRR or the TVPI multiple, these metrics do not capture the aspect of opportunity cost of capital such as investing in a publicly traded index. Instead, we use the Public Market Equivalent, the PME, to study fund returns, a method that compares private to public equity returns.

As there are several PME approaches for an investor to choose from, we investigate four different measures to find out whether they generate similar returns or if there is one method which is more appropriate to use. Studying the correlation and ranking of private equity funds from these approaches, we confirm that the Direct Alpha method is the most intuitive one for measuring relative returns.

Comparing private equity performance to the returns of S&P 500, private equity funds are shown in a positive light. We find that buyout funds on average outperform the public benchmark. On the other hand, venture capital fund returns are more volatile, as funds from 1992 to 1999 has outperformed the S&P 500, on average, while 2000 to 2008 vintage funds underperformed. If an LP is able to pick the top quartile funds, by pure luck or skill, venture capital funds are the ones delivering the highest returns. Meanwhile, assuming investors do not hold fund picking skills, buyout funds is clearly a better choice when studying average returns.

Nonetheless, there might be diversification benefits from investing in both venture capital and buyout funds. We observe a negative correlation between venture capital and buyout fund returns, and also show, by creating three types of investment portfolios split into two equally large investments in venture capital and buyout funds, the positive benefit of investing in both fund types to decrease portfolio volatility.

Further, we find that buyout funds have started to distribute capital quicker between the 1990's to 2000's to LPs, which has boosted the IRR at the cost of the TVPI multiple. This increasingly reinforce the importance for LPs to compare returns using more measures than the IRR.

We also find that LPs investing in foreign funds should spend more time on considering whether to hedge the foreign exchange risk or not. The lost return due to such choices can be of a large magnitude and thereby affect returns. Also, an investor should spend some time on evaluating which public index is of most relevance, as this choice may have a large effect on the relative performance.

In addition, we conclude that fund managers have been insufficient in timing the market in terms of investments. Whether this stems from inability or if there is another underlying reason such as a need to invest even though the market is hot is uncertain, but we expect that the latter is a more reasonable explanation.

Finally, we find that fund size has a concave relationship to returns. Interestingly, we also find a concave relationship between fund sequence and returns, in contrast to the findings of Kaplan and Schoar (2005)

For future research, we have detected two areas worth exploring further. First, extended research of correlation between venture capital and buyout funds is warranted, as it is an interesting area for LPs who could decrease the overall risk and stabilizing returns over time by investing in both types of funds simultaneously. Second, an additional perspective that we bring up in this paper and believe to be important is the foreign exchange risk and how to hedge an investment portfolio. An LP can either hedge the exchange rate on a fund basis or portfolio company basis, but there is also the issue of if an investor should hedge, and how much.

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Appendix A. Performance Formulas

Below we present the the four input variables required for calculating private equity fund returns using the IRR, the TVPI and the four PME methods ICM, PME+, KS-PME and Direct Alpha.

Contributions to a private equity fund is defined as

$$\{c_0, c_1 ... c_N\} \tag{A1}$$

Distributions to a private equity fund is defined as

$$\{d_0, d_1 ... d_N\} \tag{A2}$$

The residual value of a private equity fund, the NAV, is defined as

$$NAV_{PEfund} \tag{A3}$$

The reference benchmark used is defined as

$$\{s_0, s_1 ... s_N\} \tag{A4}$$

The future value of contributions at time n is

$$FV(Contributions) = \{c_0 * \frac{s_n}{s_0}, c_1 * \frac{s_n}{s_1}, ..., c_n\} \tag{A5}$$

The future value of distributions at time n is

$$FV(Distributions) = \{d_0 * \frac{s_n}{s_0}, d_1 * \frac{s_n}{s_1}, ..., d_n\} \tag{A6}$$

Appendix A. IRR & TVPI

The internal rate of return is calculated as

$$\sum_{i=1}^{k} \frac{(Contributions, Distributions, NAV)}{(1 + IRR)^t} = 0 \tag{A7}$$

Where t is the number of time periods.
The IRR of the fund is calculated on all the cash flows of the fund and the NAV (seen as a Distribution).

The Total Value to Paid-in multiple is calculated as

$$TVPI = \frac{\sum Distributions}{\sum Contributions} \tag{A8}$$

Table XV
IRR & TVPI Numerical Example

This table shows a numerical example for calculating the IRR and the TVPI of a hypothetical private equity fund. While the IRR is calculated on Net CF, representing net cash flows and the respective final NAV of the private equity fund, the TVPI multiple is calculated on the contributions and distributions.

	IRR & TVPI			
Date	Contribution	Distribution	NAV_{PEfund}	Net CF
31-Dec-2000	100	0		(100)
31-Dec-2001	0	0		0
31-Dec-2002	100	100		0
31-Dec-2003	100	0		(100)
31-Dec-2004	0	150		150
31-Dec-2005	0	0		0
31-Dec-2006	0	50		50
31-Dec-2007	0	150		150
31-Dec-2008	0	0		0
31-Dec-2009	0	0	100	100
Fund IRR	19%			
Fund TVPI	1.83x			

Appendix B. ICM

The output from the ICM is the difference between the IRR of the private equity fund and the IRR of the hypothetical reference portfolio invested in the benchmark. If the delta is positive, the fund has outperformed the public market and vice versa if the delta is negative.

$$\Delta IRR = IRR_{PEfund} - IRR_{ICM} \tag{A9}$$

The IRR of the reference portfolio is calculated on all the cash flows of the portfolio and the NAV:

$$IRR_{ICM} = IRR\left(Contributions, Distributions, NAV_{ICM}\right) \tag{A10}$$

While the cash flows of the reference portfolio are identical to those of the private equity fund's, the NAV differs. The NAV of the reference portfolio is calculated as the sum of the future value of contributions less the sum of the future value of distributions (which are compounded by the return of the benchmark):

$$NAV_{ICM} = \Sigma\, FV(Contributions) - \Sigma\, FV(Distributions) \tag{A11}$$

Table XVI
ICM Numerical Example

This table shows a numerical example for calculating the ICM delta of a hypothetical private equity fund. The Fund IRR, as calculated in Table XV, is compared to the ICM IRR calculated on Net CF, which in this case is the net cash flows plus the NAV of the fictive ICM portfolio.

		ICM			
Date	S&P500	Contribution	Distribution	NAV ICM	Net CF
31-Dec-2000	1,320	100	0	100	(100)
31-Dec-2001	1,148	0	0	87	0
31-Dec-2002	880	100	100	67	0
31-Dec-2003	1,112	100	0	184	(100)
31-Dec-2004	1,212	0	150	51	150
31-Dec-2005	1,248	0	0	52	0
31-Dec-2006	1,418	0	50	9	50
31-Dec-2007	1,468	0	150	(140)	150
31-Dec-2008	903	0	0	(86)	0
31-Dec-2009	1,115	0	0	(106)	(106)
Fund IRR	19%				
ICM IRR	7%				
Delta IRR	11%				

Appendix C. PME+

Similar to the ICM, the PME+ compares the difference between the IRR of the fund of interest, and a reference benchmark portfolio:

$$\Delta IRR = IRR_{PEfund} - IRR_{PME+} \tag{A12}$$

The IRR of the benchmark portfolio once again depends on the cash flows of the benchmark portfolio and the NAV. In the PME+ approach however, the NAV is identical to the one of the private equity fund. What differs from the IRR calculation of the private equity fund is instead that all distributions are scaled by a factor, called s:

$$IRR_{PME+} = IRR\,(Contibutions, Distributions, NAV_{PEfund}) \tag{A13}$$

The scaling factor is calculated as:

$$s = \frac{\Sigma\, FV(Contributions) - NAV_{PEfund}}{\Sigma\, FV(Distributions)} \tag{A14}$$

Table XVII

PME+ Numerical Example

This table shows a numerical example for calculating the PME+ delta of a hypothetical private equity fund. The Fund IRR, as calculated in Table XV, is compared to the PME+ IRR calculated on Net CF, which in this case is the net cash flows (where distributions are multiplied by the scaling factor), plus the respective final NAV of the private equity fund.

		PME+			
Date	S&P500	Contribution	s x Distribution	NAV PME+	Net CF
31-Dec-2000	1,320	100	0	100	(100)
31-Dec-2001	1,148	0	0	88	0
31-Dec-2002	880	100	51	116	(49)
31-Dec-2003	1,112	100	0	246	(100)
31-Dec-2004	1,212	0	77	192	77
31-Dec-2005	1,248	0	0	198	0
31-Dec-2006	1,418	0	26	199	26
31-Dec-2007	1,468	0	77	131	77
31-Dec-2008	903	0	0	79	0
31-Dec-2009	1,115	0	0	100	100

Fund IRR	19%
Scaling factor	0.51
PME+ IRR	2%
Delta IRR	17%

Appendix D. KS-PME

The KS-PME calculation is similar to that of the TVPI, the only difference being that all contributions and distributions are compounded by the return of the public benchmark. Thus, the KS-PME is calculated as the sum of future value of all contributions made to date and the NAV of the fund, divided by the sum of the future value of all distributions made to date:

$$KS - PME = \frac{\Sigma\, FV(Distribution) + NAV_{PEfund}}{\Sigma\, FV(Contribution)} \tag{A15}$$

Table XVIII
KS-PME Numerical Example

This table shows a numerical example for calculating the KS-PME of a hypothetical private equity fund. The KS-PME multiple is calculated on the future value of contributions and distributions.

		KS-PME			
Date	S&P500	FV(Contribution)	FV(Distribution)	NAV PE	Net CF
31-Dec-2000	1,320	84	0		(84)
31-Dec-2001	1,148	0	0		0
31-Dec-2002	880	127	127		0
31-Dec-2003	1,112	100	0		(100)
31-Dec-2004	1,212	0	138		138
31-Dec-2005	1,248	0	0		0
31-Dec-2006	1,418	0	39		39
31-Dec-2007	1,468	0	114		114
31-Dec-2008	903	0	0		0
31-Dec-2009	1,115	0	0	100	100

Fund TVPI	1.83x
KS-PME	1.66x

Appendix E. Direct Alpha

Direct Alpha, which is closely linked to the KS-PME, generates a yearly abnormal return by taking the IRR of the future value of all contributions and distributions and the NAV of the fund:

$$DirectAlpha = IRR\left(FV(Contributions),\ FV(Distributions),\ NAV_{PEfund}\right) \tag{A16}$$

Table XIX
Direct Alpha Numerical Example

This table shows a numerical example for calculating the Direct Alpha of a hypothetical private equity fund. The Direct Alpha is calculated as an IRR on Net CF, representing future value of all cash flows and the respective final NAV of the private equity fund.

		Direct Alpha			
Date	S&P500	FV(Contribution)	FV(Distribution)	NAV PE	Net CF
31-Dec-2000	1,320	84	0		(84)
31-Dec-2001	1,148	0	0		0
31-Dec-2002	880	127	127		0
31-Dec-2003	1,112	100	0		(100)
31-Dec-2004	1,212	0	138		138
31-Dec-2005	1,248	0	0		0
31-Dec-2006	1,418	0	39		39
31-Dec-2007	1,468	0	114		114
31-Dec-2008	903	0	0		0
31-Dec-2009	1,115	0	0	100	100

Fund IRR	19%
Direct Alpha	18%

Appendix B. Size and Sequence Regression

Table XX
KS-PME Regression

This table shows the regression where KS-PME is the dependent variable, controlling for size of the fund and fund sequence, raised to the power of one and two. We raise sequence and size by the power of two to check if the variables have a convex or concave relationship to KS-PME. The variables are in logarithmic form. We also use a venture capital fund dummy variable which is equal to one if the fund is a venture capital fund. We control for year-fixed effects. The first row for each variable is the correlation coefficient, the second row is the t-value, the third row is the confidence interval. The data set used includes all funds between 1979 to 2008.

VARIABLES	(1) (LN) KS-PME
(LN) KS-PME	
(LN) Size	0.432*** (3.254) 0.160 - 0.703
(LN) Size^2	-0.0303*** (-3.236) -0.0495 - -0.0111
(LN) Sequence^2	-0.258** (-2.544) -0.466 - -0.0503
(LN) Sequence	0.340** (2.675) 0.0795 - 0.600
VC Dummy	-0.220** (-2.188) -0.426 - -0.0140
Constant	-1.303** (-2.755) -2.271 - -0.334
Observations	847
Number of Vintage groups	29
R-squared	0.072

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1