
Article:
Buchner, A, Mohamed, A orcid.org/0000-0002-2974-9467 and Schwienbacher, A (2016) Does risk explain persistence in private equity performance? Journal of Corporate Finance, 39. pp. 18-35. ISSN 0929-1199

https://doi.org/10.1016/j.jcorpfin.2016.05.003

Does Risk Explain Persistence in Private Equity Performance?*

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This version: May 13, 2016

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Abstract

In this paper, we investigate whether fund-specific risk helps explain performance persistence in private equity funds, using detailed deal-level cash flow information at both the fund and deal levels. We further extend existing findings to international evidence on buyout and venture capital (VC) by testing the impact of various risk measures. We find that risk is an important driver of performance persistence and helps explain such persistence. We also find persistence in risk in private equity, in particular persistence in downside volatility for both buyout and VC funds. Finally, we document that fund performance is more strongly affected by fund managers able to minimize downside losses than selecting outperforming portfolio companies. This effect is strongest for buyout but, to a weaker extent, also holds for VC. Our results are further robust to controlling for legal factors at the country level.

Keywords: private equity; performance; venture capital; buyout; risk; persistence

JEL Classifications: G24; G23

1. INTRODUCTION

Since Kaplan and Schoar's (2005) seminal article on fund performance persistence in US private equity (PE), several follow-up studies have investigated drivers of this persistence. For example, Harris, Jenkinson, Kaplan and Stucke (2014) find that performance persistence has largely disappeared in the buyout but not venture capital (VC) segment. In contrast, Korteweg and Sorensen (2014) find greater long-term persistence in buyout than in VC due to larger differences in skills among buyout fund managers. Cumming Dai, Hass and Schweizer (2012) even document performance persistence in the hedge fund industry, and that the level of persistence is affected by regulation. The question whether there is persistence in fund performance is important because it implies that some fund managers consistently outperform their peers over a longer period and, thus, that past performance is a good predictor of future performance.

This study contributes to this debate by examining whether fund-level risk can explain the observed persistence in performance of funds. Performance persistence might simply occur because fund managers consistently take on more risk than other fund managers, leading to persistence in risk. Fund managers who take high levels of risk would have persistently higher returns than their counterparts. Previous studies have not investigated this issue because of a lack of accurate deal-level data. However, Kaplan and Schoar (2005) recognized that risk might help explain persistence, but they could not investigate it further beyond examining potential differences across subsamples of fund asset classes to capture differences in risk between funds. Fund-level cash flows are indeed not appropriate for measuring risk, because there is a

strong cash flow pattern over time in the 10-year life cycle of private equity funds. This pattern occurs because cash flows are lower at the beginning and increase significantly toward the end. In contrast, we make use of deal-level cash flows, which allow us to calculate the volatility of the internal rates of return (IRRs) of the different deals to measure risk at the fund level. This approach helps us investigate the following research questions: do differences in risk explain the fund performance persistence puzzle in private equity? Moreover, in addition to performance persistence, can we observe persistence in risk over follow-up funds? More generally, is fund performance driven by managers able to consistently "minimize extreme losses" (i.e., downside volatility) or "select outperforming deals" (i.e., generate upside volatility)? Both effects affect performance, but in different ways. We investigate these research questions for VC and buyout funds located both in the United States and internationally.

In this paper, we use detailed deal-level and fund-level cash flow data coming from the Center for Private Equity Research (CEPRES) database. Our international sample covers 18,256 unique investments in portfolio companies done by 769 VC and buyout funds during the 1980–2009 period. Slightly more than half the investments are realized (i.e., divested). Although portfolio companies are anonymized, the database enables linking portfolio companies to funds and funds to management firms. Previous versions of the data have been used by Franzoni, Nowak and Phalippou (2012) for buyout and Cumming, Schmidt, and Walz (2010), Cumming and Walz (2010) and Krohmer, Lauterbach, and Calanog (2009) for VC. In contrast, our sample covers a larger time span and both types of private equity (VC and buyout). Moreover, we make use of information at both the deal and fund levels.

Our primary measure of risk is intra-fund volatility, which represents the standard deviation of IRRs of the different portfolio companies in which a fund has invested over its lifetime. This volatility is essentially a proxy for total investment risk of a fund. Using total risk seems somewhat unconventional given that standard asset pricing theory suggests that only systematic risk is priced in equilibrium. However, in contrast to this conventional view, the article from Ewens, Jones and Rhodes-Kropf (2013) provides evidence that idiosyncratic risk is also a priced factor for private equity fund investments. Ewens, Jones and Rhodes-Kropf (2013) develop a theoretical model to analyze the role of idiosyncratic risk for the pricing of private equity investments. Their model predicts a positive relationship between the investment returns of funds and the ex-post idiosyncratic risk of the funds' returns. Empirically, they find a strong correlation between realized total risk and fund returns. Based on this previous empirical evidence, it seems reasonable to use total risk as the appropriate measure of investment risk for private equity funds in this paper.

We further consider upward and downward intra-fund volatility to examine the impact of upside and downside risk on fund performance. This extension is motivated by the fact that private equity investments typically involve highly skewed investment returns that deviate substantially from a normal distribution. In this case, downside volatility is a more plausible measure of risk than variance because investors worry about under-performance rather than over-performance, as Markowitz (1991) suggests. Consistent with existing studies, we use the Public Market Equivalent (PME) ratio as our main measure of fund performance. PME uses a market index of similar risk to scale a fund's market value and thus is a risk-adjusted performance measure (i.e., adjusted for systematic risk but not total risk). Recent research by

Sorensen and Jagannathan (2015) and Korteweg and Nagel (2015) shows that the PME is a risk-adjusted performance measure that can be derived under the assumption that investors have logarithmic utility functions. As a risk-adjusted measure of performance the PME should not be correlated with any measure of systematic or total fund risk. However, if PME is highly correlated with our measures of total risk (below, we will show that this is the case), then it is reasonable to include further controls for risk when using the PME to assess performance persistence. Our results, however, also hold for IRR, which is a measure of absolute returns. In other words, we examine the impact of total risk on fund performance, which is an appropriate measure for studying persistence in performance and risk.

We find that total fund risk is an important driver of performance in the US, even for risk-adjusted performance. We find no persistence in non-US funds. Total risk explains away the previously documented performance persistence for the US, especially for buyout funds. For US VC funds, performance persistence remains, while total fund risk is also a significant driver. Next, we find strong persistence in risk, consistent with the view that performance persistence goes hand in hand with persistence in risk. This finding offers an alternative and complementary explanation for performance persistence to the traditional one based on expertise. This relationship is again strongest for US funds. When evaluating downside and upside risk separately, we find that the impact of downside risk persistence is strongest for both buyout and VC funds, since upside volatility is generally not persistent after controlling for fund size.

Prompted by these findings, we next investigate whether fund performance is driven by a strategy of "minimizing extreme losses" or "generating outperforming ventures", an issue that is particularly important for VC. Indeed, fund managers may generate high performance for two

reasons: either because they are able to minimize total losses, notably by selecting targets that do not appear too risky, or because they are able to select the most promising firms in the industry and thereby ensure that at least one investment generates a very high return. In the first case, performance is high because downside risk is minimized; in the second case, performance is high because the fund has a "star" included in its portfolio (leading to higher upward volatility). Our analysis indicates that managing downside risk has the greatest impact on fund performance. Consistent with our intuition, this finding is strongest for buyout funds, for which target companies are more mature and typically require corporate restructuring. For VC funds, the impact of upside risk is more important than for buyout funds, because VC investments are prone to more upside gains owing to the highly innovative and high-growth-oriented firms in which VC funds invest.

Finally, we extend our analysis by examining the impact of legal conditions and fund-level (managerial style) characteristics. Following extant literature (including La Porta, Lopez-de-Silanes, Shleifer and Vishny, 1998, Cumming and Knill, 2012, Cao, Cumming, Qian and Wang, 2015, Cumming and Dai, 2010, Cumming, Dai, Hass, and Schweizer, 2012, and Cumming, Siegel and Wright, 2007), we find no evidence that our results are driven by these additional factors. In fact, we find no evidence that the broad measures of "law & finance" traditionally used in the literature affect persistence.

Our study contributes to the literature on fund performance in private equity.[1] To the best of our knowledge, the only study that directly links fund performance to deal-level

[1] A different research question often addressed in this literature is whether private equity yields a premium over public equity (Kaplan and Schoar, 2005; Phalippou and Gottschalg, 2009; Harris, Jenkinson and Kaplan, 2014). This requires cash flows net of fees. We have cash flows gross of fees, so we do not address this question here.

characteristics is that by Braun, Jenkinson and Stoff (2013). However, they are unable to relate portfolio companies to specific funds so that they construct "synthetic funds" by bundling a series of sequential investments. In contrast with their approach, we are able to allocate every portfolio company investment to a specific fund, for which we also have detailed fund information. Thus, we have extensive information on management firms, funds and portfolio companies and can relate each company to a fund and each fund to a management firm. This allows us to construct precise measures of risk and extend our understanding using new information. Franzoni, Nowak and Phalippou (2012) examine a driver of abnormal returns (the "alpha") in private equity and find that it is explained by its liquidity risk premium. This result suggests that risk specific to private equity helps explain differences in returns between private and public equity. However, these authors do not examine persistence over time.

Marquez, Nanda and Yavuz (2014) offer a theoretical contribution into this literature by developing a model to explain why performance persistence is in equilibrium. They argue that top-performing fund managers may voluntarily limit fund size and fees to generate more value in the selected portfolio companies than other fund managers. As a result, funds of top-performing managers become over-subscribed but also show persistence in performance.

The remainder of the paper is structured as follows: the next section describes the data, defines our risk measures used and presents our sample. Section 3 analyzes drivers of fund performance and the impact of risk on performance persistence. We further examine persistence in risk. Section 4 concludes.

2. DATA DESCRIPTION, RISK MEASURES AND SAMPLE COMPOSITION

2.1. Data Description

We use data from the CEPRES database, which is unique in that it provides detailed information and cash flow data at deal and fund levels; other databases tend to provide data for private equity at either the fund level or the investment level only. CEPRES data are described in detail in Franzoni, Nowak and Phalippou (2012). Several studies have used the database, including Cumming, Schmidt and Walz (2010), Cumming and Walz (2010), Franzoni, Nowak and Phalippou (2012), and Krohmer, Lauterbach and Calanog (2009).

Through its special data collection method (based on the so-called Private Equity Analyzer), CEPRES effectively anonymizes all information related to investments to meet the confidentiality requirements of the VC and PE firms that provide data to CEPRES. This means that third parties are not able to identify individual portfolio companies, funds or management firms. This is crucial and eliminates the incentives for management firms to overstate the results they report to CEPRES. Lack of anonymity in other databases may result in overstating, partial reporting and back-filling of information, amounting to positive self-reporting biases. We have details on 392 buyout funds that invested in 6,702 deals, 3,729 of which are fully realized deals. We also observe 377 VC funds that invested in 11,554 deals, 6,005 of which are fully realized deals. Our sample covers deals made during the period from January 1980 to the end of 2008, for which we have cash flow data until December 2009. All our variables are defined in Appendix Table 1.

Figure 1 depicts the number of buyout and VC funds by vintage year. It shows that our sample is consistent with the general view that only a few VC and buyout funds were set up

during the 1980s and early 1990s compared with later years. Just before the dot.com bubble, the number of VC and buyout funds had almost doubled, as compared with the 1980–1998 period, and continued to increase during the bubble (especially VC funds). During the post-bubble period, the number of funds established again declined significantly, but not as much as the number of funds established in the 1980s and early 1990s. Since the financial crises, only a few new VC and buyout funds have been raised, possibly because of unfavorable exit markets and lack of capital supply from capital-constrained institutional investors.

[Please insert Figure 1 about here]

Table 1 reports for our sample the distribution of VC and buyout deals by investment year from 1980 through 2009. The sample is divided into buyout and VC funds and by US and non-US funds. The table shows that in the early 1980s, the number of deals was lower than that in the 1990s and 2000s. This is true for the buyout and VC deals and for deals done by US and non-US funds. For the US buyout, the number of deals realized was higher in the 1980s and 1990s than those in the 2000s. The pattern is consistent for non-US buyout funds. For the VC funds, there were more realized deals in the 1980s and 1990s than in the 2000s in terms of numbers and proportions, consistent with the need for a longer investment period of several years in VC before an exit is possible. These results are not limited to US VC funds, but also non-US VC funds. Although the number of investments has increased in the 2000s, the rate of realized deals has decreased proportionally as compared with 1980s and 1990s. As Table 1

shows, VC deals are more than twice the number of buyout deals, while for the US subsample, the VC deals are approximately three times the number of buyout deals.

[Please insert Table 1 about here]

2.2. Definition of Risk Measures

To analyze whether differences in risk explain performance persistence, we construct several measures of risk for our sample of private equity funds. The first measure of risk is the *Intra-Fund Volatility of IRRs*. For a fund that has invested in N portfolio companies with returns, as measured by the IRR, given by IRR_1, IRR_2, …, IRR_N, this risk measure is calculated by

$$\sigma = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(IRR_i - IRR)^2},$$

where IRR is the mean rate of return of all the N investments made by the fund. This measure corresponds to the standard deviation of IRRs of individual investments made by the fund. It proxies for the variability or dispersion of the investment returns of a fund around the mean value. Thus, funds that take on high levels of investment risk, on average, display higher levels of intra-fund volatility than funds that take on low levels of risk.

The intra-fund volatility presented previously is only a valid measure of risk a fund takes when returns are adequately captured by a normal distribution. The reason is that the intra-fund volatility does not distinguish between variations below and above the mean. To account for the fact that private equity returns are typically highly skewed, we use two additional measures: intra-fund downside and upside volatility are modified versions of the intra-fund

volatility introduced previously that allow distinguishing between the different degrees of upside and downside variations in returns. The formal definition of *Intra-Fund Downside Volatility of IRRs* is[2]

$$\sigma_D = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(\min(IRR_i - Tar;0)^2} .$$

The formal definition of the *Intra-Fund Upside Volatility of IRRs* is

$$\sigma_U = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(\max(IRR_i - Tar;0)^2} .$$

In both equations, "Tar" denotes the return target. Similar to Ang, Chen and Xing (2006), we use a target return of zero in all the following calculations.

2.3. Summary Statistics of Sample

Table 2 reports the descriptive statistics of different risk measures for the full sample, buyout and VC funds. We also report statistics for two related measures of return distribution: Loss Rate and Intra-Fund Skewness of IRRs. Loss Rate refers to the percentage of investments of a fund that lead to complete loss and thus generate an IRR of –100%.

The mean (median) loss rate of funds is 8.46% (3.85%) for the full sample (all quartiles combined), while for buyout and VC separately, these values are 6.06% (0.00%) and 14.82% (13.04%), respectively. As expected, the probability of total loss is greater for VC than for buyout funds. The intra-fund volatility is high for the full sample of funds with mean (median) of

[2] In order to get an unbiased estimator, the standard deviation given above must be scaled by N-1. In contrast, up- and downside volatilities are typically defined by scaling by the sample size N.

101.22% (58.18%), while the value for buyout is 92.20% (57.99%) and for VC is 123.1% (69.76%). As indicated by the next two measures, the high intra-fund volatility is driven by the upside rather than the downside volatility. This observation is true for the buyout and VC funds. For example, the intra-fund downside volatility is 27.50% for the full sample compared with 97.21% for the intra-fund upside volatility. For the buyout, the downside volatility is 22.38% compared with 94.00% for the upside volatility. Similarly, for the VC, the downside volatility is 40.21% and the upside is 111.15%. The funds are positively skewed, especially for the VC funds, with a skewness of 1.62, compared with 0.89 for the buyout and 1.12 for the full sample.

Table 2 also shows how the risk measures differ between the first and fourth quartile funds. Fund quartiles are calculated by sorting data based on the IRRs of funds. The mean loss rate is high for the first quartile and slightly lower for the fourth quartile. The mean of intra-fund volatility for the first quartile is lower than the fourth quartile and consistent for the full sample, buyout and VC funds. We observe the same for the upside volatility, while for the downside volatility, the mean is high for the first quartile and low for the fourth quartile. In other words, funds with a low performance show, on average, a higher downside risk. In terms of skewness, the intra-funds IRR are highly positively skewed in the fourth quartile and less positively skewed in the first quartile. This is consistent for the full sample, buyout and VC funds. These statistics indicate that high fund performance is mainly driven by a few deals. The excessive skewness of the intra-fund IRRs justifies our choice of using robust regressions in our multivariate analysis.

[Please insert Table 2 about here]

3. ANALYSIS

3.1. Performance of VC and Buyout Investments

We measure the performance of VC and buyout investments using IRR and investment multiple and Public Market Equivalent (PME). These measures of performance are widely used in the literature (see Harris, Jenkinson, Kaplan and Stucke, 2014; Harris, Jenkinson and Kaplan, 2014). Our measure of IRR is gross of fees, which include carried interest. We use all realized deals of a fund to estimate the IRR using cash flow from initial investments to the exit. The investment multiple compares the sum of all investments in portfolios companies with the sum of all cash outflows and the residual value of the investments. On the other hand, The PME can be viewed as a market-adjusted multiple of invested capital. Table 3 shows the mean and median IRR, multiple and PME in each investment year, based on deal-level data. The table further reports averages for the 1980s, 1990s and 2000s. The results are reported separately for buyout and VC deals. The table shows significant variations in the IRR, multiple and PME for buyout deals across investment years. For all years, the average IRR is 19.8% and multiple and PME are 2.644 and 1.842 respectively. Buyout deals before the financial crisis seem to have negative IRR, and low multiple and PME on average. The average IRR was low in the 1980s but significantly higher in the 1990s and 2000s. However, for the multiple the mean is quantitatively similar across all the investment years (mean multiple for 1980–2008 is 2.644). The PME has been higher in the 2000s as compared to the periods between 1980s and 1990s.

[Please insert Table 3 about here]

For the VC investments, the performance patterns are different from the buyout segment. The average IRR across all investment years is 23.6%, multiple is 2.703 and PME is 1.942. VC deals had exceptionally high IRRs of more than 70% on average during 1998 and 1999. This could be due to the dot.com bubble during that period. Over the same period, buyout funds generated an average IRR of 5.2% in 1998 and –5.6% in 1999. The average IRR was low in the 1980s, rather high in the 1990s, and again negative in the 2000s. Furthermore, the average investment multiple and PME are lower in the 2000s than in the 1980s and 1990s.

Table 3 shows the IRRs and multiples for US and non-US funds, and Table 4 reports statistics of IRRs and investment multiples for deals carried out by US based funds only. We again separate the sample by fund type. For buyout deals, the average IRR in the 1980s was 16.9% compared with 26.2% in the 1990s and 14.4% in the 2000s. The corresponding median IRR was 20.3%, 23.0% and 19.7%, respectively. The fact that the median IRRs are higher than the means suggests that the IRRs are skewed to the left. The returns during the Internet bubble are negative, but after the bubble, the returns are positive. In addition, the multiples were high in the 1980s and 1990s but low in the 2000s. For VC deals, the average IRR is 24.3%, while in the 1990s, it was approximately 57.5% compared with –23.6%. During the dot.com bubble in 1999, VC deals significantly outperformed the buyout deals in absolute terms. However, post-2000 the VC returns have been low and have persisted until the end of 2009. The fact that VC returns have been low on average is consistent with Harris, Jenkinson and Kaplan (2014) findings. Taken together, our results show that IRRs for the buyout segment are higher than those for VC after

2000, while in the 1990s, the IRRs of VC deals were higher than those of buyout deals. This evidence is consistent in the US and non-US subsamples.

[Please insert Table 4 about here]

Table 5 shows summary statistics in terms of fund sequence number included in our sample. Panel A shows statistics for the sample that also includes first funds. Panel B shows the same statistics but with follow-up funds only; i.e., only the sample of funds that are included in our analysis of performance and risk persistence. Measured by fund sequence number, the table indicates that our sample includes a large range of follow-up funds, some of which are managed by PE firms that have already raised a large number of other funds before. Comparing the sample size between the two panels (392 in Panel A versus 288 in Panel B), we can see that even in Panel A, the average PE firm is quite experienced, since we lose a rather limited number of observations when restricting the sample of follow-up funds. Panel B indicates that the average fund in our restricted sample is almost the 6th (exact mean is 5.85) fund of the PE firm (with median of 4th). Also, 59.19% of the funds in Panel B have a fund sequence number higher than three.

[Please insert Table 5 about here]

3.2. Performance Persistence

In this section, we examine whether there is persistence in fund performance. The first step enables us to confirm existing findings. In the second step, we investigate whether fund risk explains the relationship between previous and current fund performance (i.e., performance persistence).

We examine the performance persistence using PME.[3] We measure PME using the approach adopted by Kaplan and Schoar (2005) and Harris, Jenkinson, Kaplan and Stucke (2014), which compares an investment in a private equity fund with an equivalent investment in the relevant public stock market index. The PME can be viewed as a market-adjusted multiple of invested capital. For example, a PME of 1.5 indicates that at the end of the fund's life, investors ended up with 50% more than they would have obtained if they had invested in the public market. We use the S&P 500 Index to proxy for the public market for US funds and main national indices for all non-US funds. In accordance with the literature, we examine performance persistence for buyout and VC separately.

Table 6 shows our multivariate results for buyout funds, based on different subsamples: all buyout funds (Panel A), US buyout funds (Panel B) and non-US buyout funds (Panel C). Model 1a (Panel A) shows persistence in PME over time, and it is statistically significant at the 5% level. When we control for fund size (Model 2a), persistence in PME remains significant, though at the 10% level. Given that fund volatility may influence PME, in Models 3a and 4a we examine whether performance persistence remains significant after controlling for intra-fund volatility, our measure of risk. Thus, these two regressions directly test our prediction on performance persistence. As expected, persistence in PME is largely explained by fund volatility. In Model 4a,

[3] Using IRR yields similar results. Results are available on request.

we split the intra-fund volatility into upside and downside volatility. We find that performance persistence is explained away by both upside and downside volatilities. The PME is positively related to the upside volatility and negatively related to the downside volatility. The different sign of coefficients is consistent with the definition of upside and downside volatility used in our analysis. Performance persistence is therefore related to both fund upside and downside volatility.

[Please insert Table 6 about here]

To investigate whether PME persistence is specific to the US (and thus connects our analysis with existing studies that focus on the US), we examine performance persistence for US funds only (Table 6, Panel B). The results show that PME is persistent for US funds (Model 1b); this finding holds even when we control for fund size (Model 2b). Nonetheless, performance persistence is explained away by the intra-fund volatility, as shown in Models 3b. Model 4b shows that the persistence in PME is again explained away by both upside and downside volatility. Finally, Panel C shows the results for non-US funds. The results from Models 1c to 4c show no persistence in the PME in general, but the impact of volatility and the split between upside and down side volatilities are important determinants of the PME. The effects of upside and downside volatilities on PME are again statistically significant.

We next investigate performance persistence for VC funds. Typically, VC deals are smaller than buyout deals, and it is possible that the persistence in PME is restricted to buyout investments. In addition, VC investment opportunities are likely to be more time varying

because opportunities arise from technological changes. Thus, expertise may not be as long-lived as for buyouts, making performance persistence less likely. Table 7 replicates Table 6 but for VC funds. Panel A shows results for all VC funds, Panel B for US VC funds and Panel C for non-US VC funds. Similar to buyout funds, the results show that PME is persistent among VC funds even after we control for fund size (Models 1a and 2a). Furthermore, intra-fund volatility (Model 3a) and upside or downside volatilities (Model 4a) are related to performance but do not explain away performance persistence. This finding contrasts with the case of buyout funds in Table 6. The results of Panel A show that performance is persistent among the VC funds. Panels B and C indicate that PME is persistent for US VC funds, but not for VC funds located elsewhere. A reason for this might be the lack of development of VC markets outside the US, so expertise, an important ingredient of performance persistence (Korteweg and Sorensen, 2014), is lower. Moreover, intra-fund volatility explains away only a small fraction of performance persistence. The results remain qualitatively the same when we separate the intra-fund volatility into upside and downside volatilities. Thus, PME performance is persistent for VC funds in the US. We find no evidence of PME performance persistence for non-US VC funds, though the PME is influenced positively by the upside volatility and negatively by the downside volatility in both subsamples. Overall, the results show that PME performance is persistent for the VC funds especially the US VC, in contrast with the buyout funds, for which the performance persistence is explained away by the upside and downside fund volatilities.

[Please insert Table 7 about here]

3.3. Risk Persistence

The findings in Section 3.2 raise follow-up questions about persistence in risk itself. In other words, if risk helps explain performance and affects the impact of performance persistence, it is likely that funds exhibit persistence in risk over time. We expect this to hold especially for US funds, for which performance persistence is strongest. To examine this prediction empirically, we estimate the same regressions as for performance persistence but now use our risk measure. Thus, we regress intra-fund volatility (standard deviation of IRRs) on the lag of intra-fund volatility using the same set of control variables and fixed effects as for performance persistence.

Table 8 reports the results on risk persistence. Panel A shows the results for buyout funds, and Panel B shows the results for VC funds. For buyout funds (Panel A), we find that risk is persistent. This result is statistically significant at all conventional levels, even after we control for fund size (Model 2). In economic terms, we find that an increase of one standard deviation in intra-fund volatility of a VC fund increases volatility of the next VC fund by 34.2 percentage units; and 17.7 percentage units for buyout funds. When separating the sample by US and non-US buyout funds, we find that the risk is persistent for US buyout funds (Models 3 and 4) but not for non-US funds. The lack of significant findings for non-US funds is consistent with the lack of findings of performance persistence for non-US funds. For VC funds (Panel B), we find similar results to buyout, as we observe risk persistence, but it is mostly driven by US funds. For non-US VC funds, we find no risk persistence after controlling for fund size (Model 6). Therefore, fund size captures the effect of the previous fund's risk. Larger funds also appear to have lower risk than smaller funds.

Overall, our results show that risk is persistent in buyout and VC funds. Nonetheless, the persistence in risk is limited to US funds, while non-US funds show persistence only for the VC funds, which is explained away by fund size. These results suggest that performance persistence in VC or buyout funds, as documented in the literature, is due to risk persistence.

[Please insert Table 8 about here]

As mentioned previously, risk persistence could be due to upside or downside volatility, or both. Thus, in Tables 9 and 10 we examine risk persistence in upside and downside intra-fund volatility separately. In both tables, Panel A shows the results for buyout funds and Panel B for VC funds. We further separate samples by US and non-US funds. Model 1 of Panel A shows that downside volatility is persistent for buyout funds after we control for fund size. However, for the US buyout funds, we do not find evidence of downside volatility, while for non-US funds, the downside volatility is persistent even after we control for fund size (Models 5 and 6). In Panel B, we investigate risk persistence for VC funds. Models 1 and 2 show risk persistence in VC funds for the full sample. In terms of economic significance, we find that an increase of one standard deviation in downside volatility of a VC fund increases downside volatility of the next VC fund by 8.8 percentage units; and 6.4 percentage units for buyout funds. However, US funds exhibit higher persistence in the VC funds than non-US funds (Models 3 and 4 as compared with Models 5 and 6). This difference is consistent with the view that the risk appetite for the US funds is different between VC and buyout. It is also true that VC funds take on more risk than buyout funds because of their deals, which are typically riskier than buyout investments. Moreover, the

difference between US and non-US buyout funds suggests that the US market is more competitive, which may explain the lack of persistence in the first place. Indeed, in a more competitive market, managers with loss-making funds may not be able to stay in the market in the first place, so persistence is not observed.

[Please insert Table 9 about here]

We also examine whether the risk persistence is due to upside volatility. Table 10 reports the results. Panel A shows that upside volatility is not persistent in buyout investments. Separating the buyout funds into US and non-US samples, we find that only US funds show persistence in the upside volatility (Models 3 and 4 as compared with Models 5 and 6). For the VC funds (Panel B), we find no persistence in the upside volatility for VC funds in the full sample. However, non-US funds show persistence in the upside volatility (Model 5). In Model 6, we control for fund size, and the results show that risk persistence in the upside volatility is explained away by fund size. Thus, fund size drives persistence in the upside volatility for the non-US VC funds. Overall, these results suggest that there is no persistence in upside risk in any of the subsamples based on asset class (buyout or VC) or geography, with the sole exception of US VC funds. As previously, this result may be because the US VC market is more mature and thus populated by more experienced fund managers who have the skills to select top-performing companies more often over time.

[Please insert Table 10 about here]

Finally, we use the Sharpe and Sortino ratios as measures of risk-adjusted performance to explore further performance persistence. The Sharpe ratio is generally defined as the return earned in excess of the risk-free rate per unit of total risk. In order to calculate the Sharpe ratio of the funds in our sample, we use the fund IRRs and proxy total risk by using the intra-fund volatility. The Sortino ratio differs from the Sharpe ratio in that it divides excess returns by the downside volatility. Hence, we calculate Sortino ratios using our measure of downside volatility. In general, the Sortino ratio is a more reasonable measure of risk-adjusted performance when analyzing assets that have highly skewed returns. In Table 11, we examine the persistence of these two measures for all buyout funds, US funds and non-US funds. Model 1a (Panel A) shows persistence in the Sharpe ratio for all funds even after we control for fund size (Model 2a). Models 3a and 3b in Panel A show no evidence of persistence in risk-adjusted performance using the Sortino ratio. For the US funds (Panel B), we find no evidence of persistence using the Sharpe ratio; however, we find weak evidence (significant at 10%) of persistence using the Sortino ratio. For the non-US funds, we find strong evidence of persistence using the Sharpe ratio but again no evidence using the Sortino ratio (Panel C). The Sharpe ratio exhibits persistence because of the non-US funds, while the US funds do not exhibit any persistence based on the Sharpe or Sortino ratio.

[Please insert Table 11 about here]

Table 12 reports persistence results for the VC funds again using the Sharpe and Sortino ratios. Panel A shows the results for all VC funds, Panel B shows the results for the US funds and Panel C shows the results for non-US funds. Models 1a and 2a in Panel A show the results of the Sharpe ratio, and Models 3a and 4a show the results of the Sortino ratio. For all funds, we find no evidence of persistence using either the Sharpe or Sortino ratio. Panel B shows the results for the US funds and clearly indicates that the Sortino ratio exhibits significant persistence, even after we control for fund size (Models 3b and 4b). Nonetheless, there is no evidence of persistence using the Sharpe ratio. For non-US VC funds, we find weak evidence of persistence using the Sortino ratio but not the Sharpe ratio.

[Please insert Table 12 about here]

3.4. Is Performance Driven by Outperformers or Cost Minimization?

In this section, we investigate which type of risk helps explain outperformance, that is, whether performance is driven by picking outperformers (higher upside volatility) or minimizing losses (lower downside volatility). To do so, we focus on the IRR as a measure of performance. The IRR is the most appropriate measure here because we want to measure absolute returns, not risk-adjusted returns as done with PME.

In Table 13, we first examine the relationship between IRR and risk as measured by intra-fund volatility and then show the results for alternative measures of risk: skewness, downside volatility and upside volatility. These three measures help test for the direction of the distribution and, thus, the particular form of risk. The table presents results for all funds

(separately for buyout and VC), US funds and non-US funds. For the full sample, we find that the IRR is positively related to intra-fund volatility (Model 1 for buyout and Model 4 for VC). The coefficients are significant at the 1% level. In Models 2 and 5, we control for skewness and find that the results on volatility remain.

[Please insert Table 13 about here]

However, these results reveal that intra-fund volatility is not always a good proxy for fund risk. For example, for the US buyout funds, the coefficient on intra-fund volatility turns out to be non-significant. This is most likely because private equity returns tend to deviate significantly from a normal distribution, in which case the volatility does not adequately represent risk. Therefore, we also split the intra-fund volatility into downside and upside volatility in the regressions (see Models 3 and 6). As expected, we find that the IRR is negatively related to downside and positively related to upside volatility. The regression coefficients are highly significant (mostly at the 1% level), regardless of the sample and asset class, with the exception of non-US VC funds. It is worthwhile here to compare the absolute values of the coefficients to separate the effect of out- and underperforming investments on the fund IRR. The results show that in absolute terms, the coefficients for the downside volatility are much larger than the coefficients for the upside volatility. The impact of downside volatility is 7.3 times larger than upside volatility for buyout funds, and 1.5 times larger for VC funds. These differences in coefficients are highly significant, except for the non-US VC funds. That is, fund performance is driven more by fund managers being able to minimize losses than consistently

choosing outperforming investments. This finding holds for both the buyout and the VC funds. However, in line with expectations, selecting outperforming deals typically has a stronger effect on the performance of VC funds than for buyout funds, as indicated by the larger coefficients on the upside volatility for all funds and US VC funds only.

3.5. Impact of Legal Factors and Fund Management Characteristics

In this section, we consider alternative factors that might affect performance and risk persistence. First, we examine the impact of legal factors. Cumming, Dai, Hass, and Schweizer (2012) show that legal conditions affect performance persistence in the hedge fund industry. Similar effects may occur in private equity. Better investor and creditor protection may increase performance of investors and thereby also private equity funds. Further, Cumming and Knill (2012) show that country's disclosure index, judicial efficiency and anti-director rights have positive impact on VC performance. A recent study by Cao, Cumming, Qian and Wang (2015) find that strong creditor rights influence LBO investments. Since legal conditions influence performance, they could also impact performance persistence. In order to examine the impact of legal conditions, we use a number of country characteristics similar to the previous studies and that we match with the country of the PE fund. First, we collect information of the legal origin of the fund's country. We construct a dummy variable to capture English legal origin. Second, we use more precise measures of investor and creditor rights commonly used in the "law and finance" literature (following La Porta, Lopez-de-Silanes, Shleifer and Vishny, 1998), including in the studies cited above. These are the Anti-director Rights, Creditor Rights, Public Enforcement Index, Efficiency of the Judiciary, Disclosure Requirements Index, and Burden of

Proof. All these variables are defined in Table 14 and taken from La Porta, Lopez-de-Silanes, Shleifer and Vishny (1998) and La Porta, Lopez-de-Silanes and Shleifer (2006).

[Please insert Table 14 about here]

Our results show that country characteristics do not fully explain performance persistence in buyout investments as shown in Panel A of Table 14 (Models 1 to 4). None of the variables is statistically significant at the commonly used 5% level, while the result on performance persistence (the variable PME_{t-1}) still holds. In Models 5 to 8, we further include risk measures (upside and downside volatility) as additional control variables. The results indicate that risk continues to explain performance persistence in buyout funds and not legal conditions. Panel B shows results of the same specifications but for the subsample of VC funds. We conclude similarly. Therefore, our conclusions on the impact of risk on performance persistence are robust to the inclusion of controls for legal conditions in the country of the fund.

Second, we examine whether performance and risk persistence is driven by managerial style and other fund-specific characteristics (see Cumming, Siegel and Wright, 2007, for an overview of the literature on factors affecting the risk profile of funds). Cumming and Dai (2010) show that the propensity to syndicate, to stage, and to sit on boards, and the distance between investee and investor are critical factors to explain VC investments. Cumming and Dai (2011) further document that fund size affects performance and risk of private equity funds. Cao, Cumming, Qian and Wang (2015) find that whether investors are domestic or international further affects the risk profile of the buyout investments, since they may have different levels of

interest in taking risk. All these characteristics could influence the risk profile of VC or buyout funds and thereby performance and risk persistence. It may further control for changes in the composition of the managerial team over time, since such changes may also lead to changes in managerial styles. It is also documented in the literature that experienced PE firms tend to invest more in early stage rounds than less experienced ones. This investment behavior reflects their willingness to take more risk and hence might impact performance and risk persistence. To control for the impact of these different factors on persistence, we use different fund-level measures of PE firm experience, the propensity to do cross-border deals, to sit on boards, to syndicate and to stage investments. The results are provided in Table 15, where these additional variables are also defined.[4]

[Please insert Table 15 about here]

Models 1 to 3 of Table 15 show the results for the subsample of buyout funds, while Models 4 to 6 for the subsample of VC funds. Again, we find that fund risk dominates in explaining performance persistence. In contrast, firm characteristics have no significant impact on risk persistence of buyout (Models 1 to 3 and VC (Models 4 to 6) funds. These results indicate robustness of our previous conclusions on the importance of fund risk in explaining persistence.

[4] In Table 14, we use the fund's sequence number (i.e., whether the considered fund is the first, second, ... fund managed by the PE firm) as proxy of PE firm experience. However, we obtain qualitatively similar results for two other measures of experience: the age of the PE firm (i.e., the vintage year of the last fund-raising minus the year in which the PE firm was founded), and the total number of portfolio companies of the PE firm (based on entire history in our sample).

3.6. Additional Tests

We performed several robustness checks and additional tests that are not reported in any table. Our main finding on persistence in risk is also confirmed when treating Loss Rate (as defined in Section 2.3) as a measure of fund risk. Fund managers who have achieved a low loss rate in one fund will also largely have a lower loss rate in the next fund.

Other tests performed pertain to the question whether the relationship we find is due to other underlying relationships for which we did not control. For example, the relationship may be due to the strong specialization in private equity, especially in VC, in specific stages of development. That is, the consistently high loss rate across funds of a same manager could be due to this manager raising only early-stage funds, which tend to be riskier that other funds. However, adding dummies for stage focus of funds to the specification does not eliminate our result on risk persistence, nor does adding dummies for industry and regional focus of funds. These extra robustness checks confirm that risk persistence also holds within usual risk classifications (e.g., stage of development, geography, industry) of private equity funds. In this case, the underlying rationale for the persistence in risk could be due to the strong specialization need among fund managers.

Further, we examine the possible impact of differences in industries (such as high-tech versus non-high-tech), differences in vintage years and the effect of outliers. To examine the effect of industries on performance persistence, we include a dummy variable that equals one if the fund's industry focus is high-tech and 0 otherwise. Our definition of hi-tech industries is similar to Cumming and Dai (2010).[5] Our results are robust to the inclusion of this additional

[5] These industries include health care, life science, high-tech and information technology sectors.

control variable and high-tech industries do not explain the performance persistence in PE. Next, we consider the effects of different vintage years by examining the post-1999 subsample only. Our choice of using the post-1999 period is motivated by study of Harris, Jenkinson, Kaplan and Stucke (2014), who takes a similar approach. They find only weak evidence of performance persistence post-2000 for buyout investments, while persistence for VC funds remain the same between pre- and post-2000. Our results for the VC funds are consistent with their findings. However, for the buyout investments, we find performance persistence also post-1999. Possibly this difference is because our sample includes both US and non-US funds, while their sample only considers US funds. Overall, our subsample analysis indicates our conclusions hold across a long time period for buyout and VC funds. Further, we winsorize the returns at the 1% and 5% levels to test the effect of outliers. We find that our results are robust controlling for the outliers.

Finally, we examine the possible impact of survivorship bias. Indeed, our sample is restricted to PE firms that have raised multiple funds, since persistence can only be tested for subsequent funds. Other PE firms may have failed to do so (most likely due to poor performance) and hence our results might be subject to survivorship bias. To address this concern, we use a two-stage Heckman estimation model for buyout and VC funds separately. In the first stage, we estimate the probability of raising a subsequent fund. In the second stage, we then estimate the performance persistence based on our restricted sample as done so far but include the Inverse Mills' Ratio as additional control variable. We find no evidence that survivorship bias impacts our analysis of risk and performance persistence.

4. CONCLUSION

This study examines the impact of fund-level risk on performance persistence as well as risk persistence in private equity. Consistent with Kaplan and Schoar (2005), we find that returns are persistent for VC and buyout funds for US funds. We further extend the analysis by providing evidence for non-US funds, for which persistence tends to be weaker. Our study extends the results of Kaplan and Schoar and related studies, by showing that risk as measured by the standard deviation of IRR is persistent for VC and buyout funds regardless of whether these funds are based in the US or outside the US. We interpret these results of performance persistence in private equity to be due largely to persistence in risk. In other words, private equity funds tend to invest persistently in deals with similar risk-return levels, which in turn leads to persistence in both risk and return.

We believe our conclusions can be extended to other types of financial intermediaries, in particular to hedge funds for which Cumming, Dai, Hass, and Schweizer (2012) has also documented performance persistence. These authors have shown that regulation may affect the extent of performance persistence, while our study indicates that such persistence may also be related to persistence in risk. Unlike other studies, our data allow us to directly control for fund risk. Since the economic arguments proposed in our study are not specific to private equity, fund risk is likely to be a driver of persistence also in other fund industries where performance persistence can be observed.

Our analysis has some limitations, which also offer opportunities for future research if additional information becomes available. For instance, the managerial team of a PE

management firm may change over time. Such changes in the composition of the managerial team may affect performance persistence if the latter is attributed to specific, non-transferable expertise of managers. Tracking changes in the composition of managerial teams may offer further insights into what drives performance and risk persistence. Similarly, persistence may be stronger in certain industries for which specific expertise may be more important than in other industries. Along similar vein, persistence may be lost if investments are made in other industries, which may happen when investment opportunities shift to new industries over time. Finally, performance and risk persistence may evolve over time, notably during bubble years in which risks and returns may be distorted. We leave these insights for future research.

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Figure 1: VC and buyout funds by vintage year

This figure shows the number of buyout and VC funds in our sample by vintage year from 1980 to 2008.

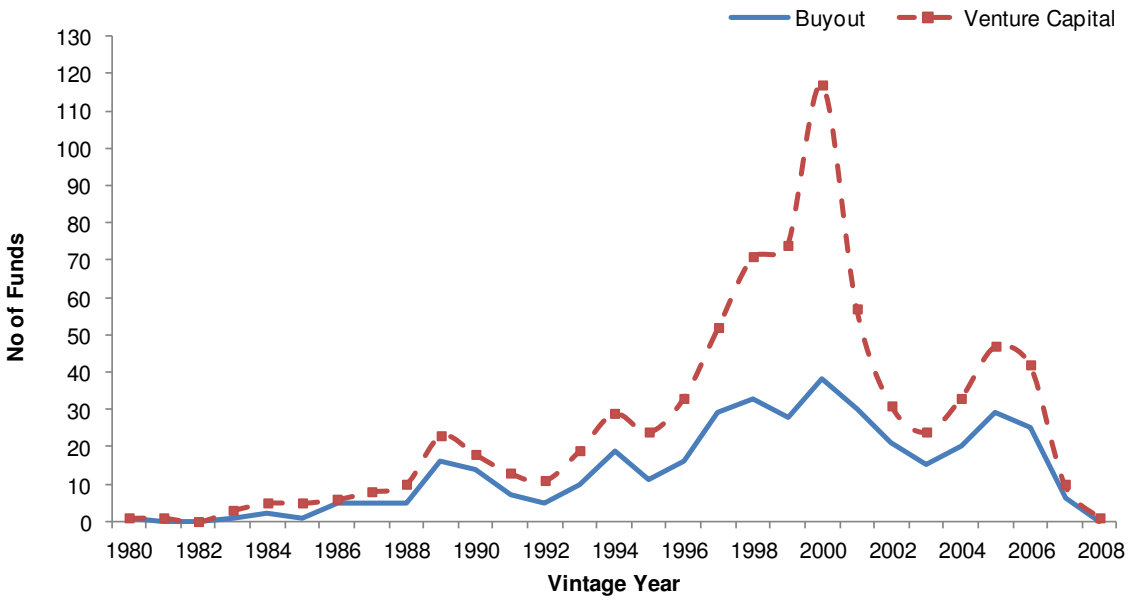

Table 1: **Sample distribution of VC and buyout investments**

This table shows the distribution of VC and buyout investments by investment year. The buyout and VC deals are divided into deals made by US and non-US funds. The table also indicates the number of these deals that are realized (i.e., exited). At the end, the table shows the total number of deals as well as the subsample of deals in the 1980s, 1990s and 2000s, respectively.

	Buyout investments					VC investments				
	Full sample	US		Non-US		Full sample	US		Non-US	
Investment year		All deals	Realized Deals	All deals	Realized deals		All deals	Realized deals	All Deals	Realized deals
1980	1	0	0	1	1	0	0	0	0	0
1981	5	0	0	5	5	8	8	7	0	0
1982	2	0	0	2	1	18	18	14	0	0
1983	5	1	1	4	4	19	19	16	0	0
1984	10	8	6	2	1	32	32	27	0	0
1985	17	12	9	5	5	48	48	47	0	0
1986	25	22	16	3	3	70	64	59	6	5
1987	56	28	23	28	24	73	51	44	22	19
1988	72	48	44	24	24	97	83	76	14	14
1989	97	73	72	24	24	130	122	118	8	7
1990	173	94	90	79	73	125	97	94	28	25
1991	178	85	83	93	89	143	95	79	48	43
1992	177	91	86	86	82	153	126	123	27	24
1993	182	106	101	76	70	219	154	142	65	60
1994	294	141	131	153	135	256	187	168	69	56
1995	271	113	97	158	141	314	236	212	78	64
1996	326	136	117	190	161	475	332	289	143	95
1997	400	144	111	256	208	584	440	354	144	92
1998	447	172	112	275	169	804	616	471	188	128
1999	539	192	117	347	218	1241	951	648	290	192
2000	702	249	132	453	244	1817	1253	715	564	292
2001	344	97	55	247	126	925	652	288	273	119
2002	366	113	46	253	132	680	514	177	166	46
2003	341	132	45	209	87	693	548	176	145	40
2004	385	155	36	230	53	773	603	138	170	41
2005	432	166	38	266	44	640	455	63	185	38
2006	438	156	7	282	25	614	467	35	147	6
2007	320	119	1	201	3	399	310	12	89	3
2008	91	38	1	53	0	178	152	2	26	1
2009	6	0	0	6	0	26	3	0	23	1
Total	**6702**	**2691**	**1577**	**4011**	**2152**	**11554**	**8636**	**4594**	**2918**	**1411**
1980s	290	192	171	98	92	495	445	408	50	45
1990s	2987	1274	1045	1713	1346	4314	3234	2580	1080	779
2000s	3425	1225	361	2200	714	6745	4957	1606	1788	587

Table 2: Summary statistics of different risk measures of funds

This table shows the mean and median values for Loss Rate, Intra-Fund Volatility of IRRs, Intra-Fund Downside and Upside Volatility of IRRs and Intra-Fund Skewness of IRRs, based on deal-level cash flow data. The table shows the statistics for the full sample, buyout and VC deals and for all quartiles, first quartile and fourth quartile, respectively.

		All quartiles			**First quartiles**			**Fourth quartiles**		
		Full sample	Buyout	VC	Full sample	Buyout	VC	Full sample	Buyout	VC
Loss Rate										
	Mean	8.46%	6.06%	14.82%	11.97%	8.57%	16.61%	9.04%	4.59%	16.33%
	Median	3.85%	0.00%	13.04%	7.02%	0.00%	14.73%	4.55%	0.00%	15.00%
Intra-Fund Volatility of IRRs										
	Mean	101.22%	92.20%	123.10%	60.94%	46.32%	78.46%	174.62%	144.47%	214.23%
	Median	58.18%	57.99%	69.76%	44.82%	42.29%	50.42%	107.81%	82.13%	150.58%
Intra-Fund Downside Volatility of IRRs										
	Mean	27.50%	22.38%	40.21%	35.72%	29.17%	44.01%	25.66%	14.79%	41.04%
	Median	27.96%	23.21%	43.25%	39.12%	31.99%	47.66%	25.87%	3.39%	44.95%
Intra-Fund Upside Volatility of IRRs										
	Mean	97.21%	94.00%	111.15%	43.59%	30.33%	57.58%	186.69%	167.17%	213.48%
	Median	50.18%	56.10%	55.49%	19.22%	17.38%	21.47%	114.28%	96.67%	145.98%
Intra-Fund Skewness of IRRs										
	Mean	1.12	0.89	1.62	0.59	0.48	1.07	1.75	0.96	1.95
	Median	0.94	0.82	1.49	0.13	0.08	0.39	1.71	1.20	2.44

Table 3: Summary statistics on deal-level performance

This table shows the mean and median IRR, investment multiple and PME based on the full sample of fully realized deals. The table shows IRR investment multiple and PME statistics by investment year and by buyout and VC subsamples. IRR, multiples and PME are gross of fees and carried interest payments.

Investment year	Buyout							VC						
		IRR		Multiple		PME			IRR		Multiple		PME	
	No. deals	Mean	Median	Mean	Median	Mean	Median	No. Deals	Mean	Median	Mean	Median	Mean	Median
1980	1	0.044	0.044	1.384	1.384	0.380	0.380	—	—	—	—	—	—	—
1981	5	0.194	0.092	7.474	1.958	2.422	0.670	7	-0.167	-0.545	1.510	0.135	0.933	0.070
1982	1	-0.212	-0.212	0.171	0.171	0.040	0.040	14	0.262	0.256	8.497	3.414	3.284	1.320
1983	5	0.152	0.056	2.358	1.558	1.132	0.490	16	-0.346	-0.640	3.365	0.049	1.479	0.025
1984	7	0.794	0.471	9.303	9.506	4.359	3.330	27	0.042	-0.030	3.334	0.782	1.545	0.180
1985	14	0.248	0.304	4.487	2.797	2.181	1.400	47	-0.161	0.016	2.402	1.166	0.990	0.580
1986	19	0.303	0.250	3.142	2.839	1.953	1.820	64	0.061	0.091	3.332	1.700	1.762	0.795
1987	47	0.029	0.066	2.741	1.413	1.711	0.660	63	0.003	0.073	2.465	1.272	1.487	0.800
1988	68	0.045	0.104	2.169	1.723	1.178	0.800	90	-0.067	0.004	3.279	1.022	1.659	0.570
1989	96	0.001	0.144	2.410	1.620	1.442	1.070	125	0.130	0.099	3.016	1.682	1.767	0.790
1990	163	0.197	0.171	2.946	2.000	1.727	1.060	119	0.093	0.101	2.609	1.655	1.552	0.930
1991	172	0.349	0.343	3.313	2.551	1.993	1.515	122	0.055	0.124	2.631	1.432	1.505	0.855
1992	168	0.369	0.268	3.138	2.133	1.867	1.445	147	0.273	0.130	4.174	1.652	2.489	0.920
1993	171	0.563	0.424	5.048	3.025	2.716	1.780	202	0.209	0.108	3.542	1.597	1.876	0.770
1994	266	0.320	0.300	3.128	2.338	1.474	1.130	224	0.225	0.101	4.122	1.404	2.094	0.680
1995	238	0.300	0.237	2.741	1.866	1.467	0.980	276	0.385	0.214	3.922	1.650	2.068	0.880
1996	278	0.208	0.163	2.825	1.694	1.540	1.020	384	0.387	0.108	4.436	1.391	2.527	0.845
1997	319	0.159	0.185	2.577	1.785	1.815	1.260	446	0.359	0.040	4.122	1.128	2.901	0.820
1998	281	0.052	0.123	2.128	1.608	1.857	1.330	599	1.166	-0.026	5.115	0.946	4.217	0.750
1999	335	-0.056	0.056	1.624	1.252	1.783	1.230	840	0.714	-0.451	2.092	0.205	2.117	0.225
2000	376	-0.138	-0.005	1.549	0.990	1.818	1.075	1007	-0.384	-0.611	0.646	0.067	0.688	0.080
2001	181	0.123	0.223	2.265	1.907	2.121	1.770	407	-0.368	-0.448	1.043	0.170	0.923	0.130
2002	178	0.358	0.393	3.189	2.390	2.317	1.795	223	0.105	-0.299	1.627	0.440	1.301	0.340
2003	132	0.565	0.569	3.020	2.731	2.241	2.005	216	0.015	-0.122	2.018	0.759	1.501	0.570
2004	89	0.512	0.590	2.680	2.633	2.174	2.110	179	0.202	-0.045	2.220	0.927	1.864	0.730
2005	82	0.447	0.551	2.141	1.808	1.879	1.475	101	0.010	-0.131	1.283	0.762	1.127	0.660
2006	32	0.564	0.677	2.032	2.025	1.803	1.835	41	0.263	-0.941	1.387	0.004	1.268	0.000
2007	4	-0.714	-0.999	0.310	0.023	0.535	0.025	15	0.929	-0.962	1.213	0.059	1.220	0.060
2008	1	-1.000	-1.000	0.000	0.000	0.000	0.000	3	-0.639	-1.000	0.347	0.000	0.377	0.000
Total	3729	0.198	0.205	2.644	1.874	1.842	1.310	6004	0.236	-0.137	2.703	0.574	1.942	0.440
1980s	263	0.079	0.135	2.836	1.732	1.579	0.930	453	0.011	0.063	3.150	1.284	1.636	0.660
1990s	2391	0.214	0.199	2.791	1.892	1.786	1.210	3359	0.555	0.003	3.671	1.015	2.597	0.690
2000s	1075	0.191	0.246	2.269	1.867	2.031	1.660	2193	-0.206	-0.518	1.129	0.144	1.004	0.150

Table 4: Summary statistics on deal-level performance for the US subsample

This table shows the mean and median IRR, investment multiple and PME based on the US sample of fully realized deals. The table shows IRR, investment multiple and PME statistics by investment year and by buyout and VC subsamples. IRR, multiples and PME are gross of fees and carried interest payments.

Investment year	US buyout							US VC						
		IRR		Multiple		PME			IRR		Multiple		PME	
	No. deals	Mean	Median	Mean	Median	Mean	Median	No. Deals	Mean	Median	Mean	Median	Mean	Median
1981	—	—	—	—	—	—	—	7	-0.167	-0.545	1.510	0.135	0.933	0.070
1982	—	—	—	—	—	—	—	14	0.262	0.256	8.497	3.414	3.284	1.320
1983	1	0.381	0.381	3.635	3.635	1.680	1.680	16	-0.346	-0.640	3.365	0.049	1.479	0.025
1984	6	0.922	0.660	10.654	12.275	5.013	3.740	27	0.042	-0.030	3.334	0.782	1.545	0.180
1985	9	0.648	0.536	6.386	2.976	3.131	2.070	47	-0.161	0.016	2.402	1.166	0.990	0.580
1986	16	0.323	0.354	3.449	2.994	2.112	1.920	59	0.067	0.092	3.469	1.710	1.829	0.860
1987	23	0.213	0.110	3.572	1.530	2.164	0.790	44	-0.031	0.049	2.576	1.242	1.586	0.625
1988	44	0.087	0.150	2.336	2.011	1.232	0.900	76	-0.072	0.004	3.550	1.019	1.817	0.620
1989	72	0.046	0.161	2.702	2.102	1.616	1.135	118	0.131	0.098	3.073	1.679	1.793	0.805
1990	90	0.385	0.309	3.610	2.095	2.147	1.290	94	0.140	0.175	2.777	1.820	1.650	1.090
1991	83	0.501	0.483	3.931	2.899	2.475	2.110	79	0.042	0.124	2.793	1.432	1.606	0.840
1992	86	0.378	0.286	2.820	2.133	1.759	1.505	123	0.154	0.109	4.014	1.651	2.263	0.850
1993	101	0.669	0.439	6.199	3.917	3.300	1.990	142	0.221	0.136	3.552	1.613	1.939	0.775
1994	131	0.318	0.326	3.411	2.569	1.612	1.160	168	0.223	0.102	3.613	1.463	1.828	0.650
1995	97	0.341	0.211	2.854	1.701	1.444	0.930	212	0.437	0.217	4.224	1.650	2.241	0.880
1996	117	0.194	0.117	2.689	1.639	1.447	0.980	289	0.486	0.120	4.928	1.725	2.829	0.980
1997	111	0.117	0.188	2.890	1.865	2.044	1.340	354	0.308	0.000	4.302	1.000	3.041	0.770
1998	112	0.037	0.124	1.941	1.715	1.688	1.495	471	1.234	-0.063	5.525	0.776	4.562	0.720
1999	117	-0.141	0.004	1.355	1.027	1.415	0.980	648	0.703	-0.501	1.950	0.164	1.961	0.185
2000	132	-0.221	-0.124	1.118	0.586	1.336	0.530	715	-0.425	-0.616	0.648	0.067	0.701	0.080
2001	55	0.056	0.216	1.984	1.753	1.814	1.610	288	-0.381	-0.513	1.070	0.108	0.946	0.115
2002	46	0.488	0.498	4.182	2.826	2.920	1.920	177	0.077	-0.274	1.785	0.540	1.413	0.470
2003	45	0.536	0.547	2.599	2.438	1.986	1.840	176	-0.037	-0.255	1.574	0.621	1.195	0.485
2004	36	0.556	0.590	2.700	2.382	2.238	1.945	138	0.206	-0.023	2.167	0.947	1.803	0.740
2005	38	0.277	0.386	1.827	1.273	1.546	1.155	63	0.006	-0.540	1.309	0.200	1.153	0.180
2006	7	0.396	0.311	1.724	1.552	1.509	1.420	35	0.231	-1.000	1.207	0.000	1.113	0.000
2007	1	-1.000	-1.000	0.000	0.000	0.000	0.000	12	0.042	-0.976	0.885	0.045	0.885	0.045
2008	1	-1.000	-1.000	0.000	0.000	0.000	0.000	2	-0.458	-0.458	0.521	0.521	0.565	0.565
Total	1577	0.225	0.224	2.891	1.932	1.870	1.310	4594	0.243	-0.159	2.815	0.523	2.009	0.410
1980s	171	0.169	0.203	3.273	2.193	1.837	1.210	408	0.008	0.060	3.276	1.266	1.695	0.630
1990s	1045	0.262	0.230	3.115	2.067	1.900	1.300	2580	0.575	0.000	3.797	1.000	2.687	0.630
2000s	361	0.144	0.197	2.063	1.492	1.800	1.350	1606	-0.231	-0.540	1.121	0.132	1.000	0.130

Table 5: **Descriptive statistics for funds**

This table shows descriptive statistics for the sample of VC and buyout funds based on fund sequence number. Panel A reports statistics for the full sample of funds and Panel B reports statistics for the sub-sample of funds with a predecessor fund (i.e., those included in our analysis of performance and risk persistence). *Fund Sequence Number* indicates whether the fund is the first, second, third, and larger than third fund of the PE management firm. Statistics provided are mean, median, standard deviation (Std), minimum (Min) and maximum (Max) of the sequence numbers of the sample funds.

	Buyout			Venture Capital		
	All funds	US funds	Non-US funds	All funds	US funds	Non-US funds
Panel A: Full Sample of Funds						
Percentage of Funds by Fund Sequence						
First Funds	23.47%	22.00%	24.38%	21.49%	20.51%	24.04%
Second Funds	17.86%	15.33%	19.42%	21.22%	19.05%	26.92%
Third Funds	14.29%	14.00%	14.46%	17.24%	15.38%	22.12%
Later (> Third) Funds	44.39%	48.67%	41.74%	40.05%	45.05%	26.92%
Statistics on Fund Sequence Numbers						
Mean	4.71	5.79	4.05	4.06	4.34	3.33
Median	3	3	3	3	3	2
Std	5.46	7.01	4.10	4.41	4.73	3.36
Min	1	1	1	1	1	1
Max	40	40	32	45	45	27
No. Obs.	392	150	242	377	273	104
Panel B: Sub-Sample of Funds with a Predecessor Fund						
Percentage of Funds by Fund Sequence						
Second Funds	23.53%	20.95%	25.15%	24.69%	23.28%	29.63%
Third Funds	17.28%	17.15%	17.36%	20.16%	19.05%	24.07%
Later (> Third) Funds	59.19%	61.90%	57.49%	55.15%	57.67%	46.30%
Statistics on Fund Sequence Numbers						
Mean	5.85	6.97	5.16	5.07	5.21	4.59
Median	4	4	4	4	4	3
Std	5.60	7.00	4.38	4.78	4.97	4.05
Min	2	2	2	2	2	2
Max	33	33	32	45	45	27
No. Obs.	288	110	178	248	192	56

Table 6: Performance persistence in buyout funds

This table shows performance persistence for buyout funds based on the sample of all funds, US funds and non-US funds. The dependent variable is the logarithm of PME of the current fund (at time t). All the variables are defined in Appendix Table 1. *Diff. Coeff.* gives the difference (in absolute terms) of the coefficients for *Upside Vol* and *Downside Vol.*, while *t-Value Diff.* reports the value of the corresponding t-test. We include dummies for vintage year of current fund and previous fund in all our regressions. ***,**,* are significant level at 1%, 5% and 10%, respectively.

	Panel A: All buyout funds				**Panel B: US buyout funds**				**Panel C: Non-US buyout funds**			
	Models				***Models***				***Models***			
	1a	***2a***	***3a***	***4a***	***1b***	***2b***	***3b***	***4b***	***1c***	***2c***	***3c***	***4c***
PME $_{t-1}$	0.113**	0.101*	0.095*	0.074	0.171**	0.181**	0.105	0.109	0.087	0.085	0.098	0.004
	(2.08)	(1.85)	(1.77)	(1.47)	(2.18)	(2.27)	(1.43)	(1.59)	(1.15)	(1.11)	(1.40)	(0.06)
Fund Size		-0.031				0.009				-0.008		
		(-1.58)				(0.27)				(-0.29)		
Intra-F Vol			0.054***				0.073**				0.070***	
			(2.76)				(2.11)				(3.03)	
Upside Vol				0.085***				0.116***				0.071***
				(4.81)				(3.78)				(3.28)
Downside Vol				-0.649***				-0.586***				-0.744***
				(-4.59)				(-3.45)				(-3.79)
No. Obs.	287	286	285	287	110	109	109	110	178	178	176	176
Adj. R-sq	0.038	0.049	0.092	0.199	0.487	0.458	0.593	0.677	0.260	0.230	0.215	0.177
Diff. Coeff.				0.564***				0.470***				0.673***
t-Value Diff.				(3.95)				(2.72)				(3.41)

Table 7: Performance persistence in VC funds

This table shows performance persistence for VC funds based on the sample of all funds, US funds and non-US funds. The dependent variable is the logarithm of PME of the current fund (at time t). All the variables are defined in Appendix Table 1. *Diff. Coeff.* gives the difference (in absolute terms) of the coefficients for *Upside Vol* and *Downside Vol.*, while *t-Value Diff.* reports the value of the corresponding t-test. We include dummies for vintage year of current fund and previous fund in all our regressions. ***,**,* are significant level at 1%, 5% and 10%, respectively.

	Panel A: All VC funds				**Panel B: US VC funds**				**Panel C: Non-US VC funds**			
	Models				***Models***				***Models***			
	1a	***2a***	***3a***	***4a***	***1b***	***2b***	***3b***	***4b***	***1c***	***2c***	***3c***	***4c***
PME $_{t-1}$	0.205***	0.214***	0.134**	0.124**	0.183***	0.189***	0.147**	0.137**	0.131	0.143	0.081	0.095
	(3.79)	(3.96)	(2.50)	(2.51)	(2.81)	(2.87)	(2.33)	(2.19)	(1.47)	(1.55)	(0.88)	(1.09)
Fund Size		0.031				0.022				-0.029		
		(0.96)				(0.52)				(-0.53)		
Intra-F Vol			0.088***				0.071***				0.273***	
			(3.76)				(2.78)				(3.56)	
Upside Vol				0.178***				0.082***				0.264***
				(8.61)				(3.43)				(3.93)
Downside Vol				-0.682***				-0.635***				-0.722*
				(-3.78)				(-2.88)				(-1.84)
No. Obs.	246	248	247	247	191	191	190	191	55	54	56	54
Adj. R-sq	0.389	0.388	0.417	0.553	0.426	0.416	0.460	0.486	0.430	0.420	0.460	0.480
Diff. Coeff.				0.504***				0.553**				0.458
t-Value Diff.				(2.77)				(2.49)				(1.15)

Table 8: Persistence in risk

This table shows risk persistence using intra-fund volatility estimated by deal-level data. Panel A shows the volatility persistence using buyout funds, and Panel B shows the persistence using VC funds. The dependent variable *Intra-F Vol* is the standard deviation of deal-level IRRs of the current fund (at time t), as defined in Section 2.2. All the variables are defined in Appendix Table 1. We include dummies for vintage year of current fund and previous fund in our regressions. ***,**,* are significant level at 1%, 5% and 10%, respectively.

	All funds		**US funds**		**Non-US funds**	
Panel A: Buyout funds	*Models*					
	1	***2***	***3***	***4***	***5***	***6***
Intra-F Vol $_{t-1}$	0.157***	0.155***	0.249***	0.244***	0.079	0.078
	(3.43)	(3.36)	(5.07)	(4.58)	(1.12)	(1.08)
Fund Size		0.012		0.058*		0.012
		(0.48)		(1.67)		(0.28)
No. Obs.	279	279	106	107	173	171
Adj. R-sq	0.280	0.269	0.785	0.754	0.209	0.205
Panel B: VC funds						
Intra-F Vol $_{t-1}$	0.214***	0.218***	0.202***	0.160**	0.209***	0.005
	(3.40)	(3.45)	(2.76)	(2.24)	(3.3)	(0.01)
Fund Size		0.075		0.102*		-0.309***
		(1.64)		(1.76)		(-3.70)
No. Obs.	241	241	186	184	54	51
Adj. R-sq	0.434	0.441	0.668	0.500	0.827	0.810

Table 9: Persistence in downside risk

This table shows downside risk persistence using downside fund volatility estimated using deal data. Panel A shows the persistence using buyout funds, and Panel B shows the persistence using VC funds. The dependent variable *Downside Vol* is the downside volatility based on deal-level IRRs of the current fund (at time t), as defined in Section 2.2. All the variables are defined in Appendix Table 1. We include dummies for vintage year of current fund and previous fund in our regressions. ***,**,* are significant level at 1%, 5% and 10%, respectively.

	All funds		**US funds**		**Non-US funds**	
Panel A: Buyout funds	*Models*					
	1	***2***	***3***	***4***	***5***	***6***
Downside Vol $_{t-1}$	0.367***	0.372***	0.077	0.101	0.433***	0.442***
	(5.95)	(5.99)	(0.67)	(0.89)	(5.76)	(5.89)
Fund Size		-0.003		-0.012		-0.017
		(-0.30)		(-0.61)		(-1.61)
No. Obs.	288	288	110	110	178	178
Adj. R-sq	0.330	0.328	0.391	0.400	0.322	0.337
Panel B: VC funds						
Downside Vol $_{t-1}$	0.596***	0.592***	0.607***	0.603***	0.145	0.878***
	(8.03)	(7.99)	(7.97)	(7.78)	(0.48)	(13.09)
Fund Size		0.012		0.002		0.002
		(1.12)		(0.18)		(0.30)
No. Obs.	247	248	192	192	55	54
Adj. R-sq	0.518	0.532	0.656	0.649	0.445	0.974

Table 10: Persistence in upside risk

This table shows upside risk persistence using upside fund volatility estimated using deal data. Panel A shows the persistence using buyout funds, and Panel B shows the persistence using VC funds. The dependent variable *Upside Vol* is the upside volatility based on deal-level IRRs of the current fund (at time t), as defined in Section 2.2. All the variables are defined in Appendix Table 1. We include dummies for vintage year of current fund and previous fund in our regressions. ***,**,* are significant level at 1%, 5% and 10%, respectively.

	All funds		**US funds**		**Non-US funds**	
Panel A: Buyout funds			*Models*			
	1	***2***	***3***	***4***	***5***	***6***
Upside Vol $_{t-1}$	-0.006	-0.006	0.053	0.066**	-0.020	-0.019
	(-0.38)	(-0.38)	(1.57)	(2.14)	(-1.00)	(-0.96)
Fund Size		0.003		-0.069**		0.015
		(0.21)		(-2.35)		(0.69)
No. Obs.	286	288	109	109	178	176
Adj. R-sq	0.161	0.166	0.452	0.566	0.233	0.225
Panel B: VC funds						
Upside Vol $_{t-1}$	0.020	0.021	0.013	0.010	0.067***	-0.014
	(1.10)	(1.18)	(0.64)	(0.53)	(9.11)	(-0.55)
Fund Size		0.074*		0.090**		-0.211***
		(2.47)		(2.25)		(-5.56)
No. Obs.	247	248	189	192	54	50
Adj. R-sq	0.625	0.635	0.678	0.714	0.951	0.961

Table 11: Persistence in buyout funds using Sharpe and Sortino ratios

This table shows persistence in buyout funds using Sharpe and Sortino ratios. The table shows the results for all buyout funds, US funds and non-US funds. The dependent variable is the Sharpe ratio in Models 1 and 2 and the Sortino ratio in Models 3 and 4. All the variables are defined in Appendix Table 1. We include dummies for vintage year of current fund and previous fund in our regressions. ***,**,* are significant level at 1%, 5% and 10%, respectively.

	Panel A: All buyout funds				**Panel B: US buyout funds**				**Panel C: Non-US buyout funds**			
	Models				***Models***				***Models***			
	1a	***2a***	***3a***	***4a***	***1b***	***2b***	***3b***	***4b***	***1c***	***2c***	***3c***	***4c***
Sharpe Ratio $_{t-1}$	0.127**	0.139**			0.055	0.055			0.216**	0.226***		
	(2.21)	(2.44)			(1.08)	(1.06)			(2.60)	(2.70)		
Fund Size		-0.029		0.049		0.001		0.067		-0.021		-0.007
		(-1.44)		(1.19)		(0.04)		(1.06)		(-0.77)		(-0.07)
Sortino Ratio $_{t-1}$			0.002	0.002			0.021	0.025*			-0.009	-0.008
			(1.52)	(1.63)			(1.53)	(1.85)			(-0.02)	(-0.02)
No. Obs.	279	280	201	202	107	107	82	83	172	171	116	117
Adj. R-sq	0.103	0.119	0.851	0.853	0.714	0.708	0.926	0.929	0.174	0.148	0.807	0.835

Table 12: Persistence in VC funds using Sharpe and Sortino ratios

This table shows persistence in VC funds using Sharpe and Sortino ratios. The table shows the results for all VC funds, US funds and non-US funds. The dependent variable is the Sharpe ratio in Models 1 and 2 and the Sortino ratio in Models 3 and 4. All the variables are defined in Appendix Table 1. We include dummies for vintage year of current fund and previous fund in our regressions. ***,**,* are significant level at 1%, 5% and 10%, respectively.

	Panel A: All VC funds				**Panel B: US VC funds**				**Panel C: Non-US VC funds**			
	Models				***Models***				***Models***			
	1a	***2a***	***3a***	***4a***	***1b***	***2b***	***3b***	***4b***	***1c***	***2c***	***3c***	***4c***
Sharpe Ratio $_{t-1}$	0.076	0.078			0.024	0.014			0.206	0.218		
	(1.19)	(1.22)			(0.47)	(0.27)			(1.44)	(1.53)		
Fund Size		0.007		0.003		0.003		0.019		0.037		-0.015
		(0.34)		(0.06)		(0.14)		(0.35)		(0.72)		(-0.16)
Sortino Ratio $_{t-1}$			0.007	0.007			-0.058***	-0.058***			0.118*	0.113*
			(0.70)	(0.67)			(-6.47)	(-6.42)			(1.87)	(1.75)
No. Obs.	242	241	225	224	188	187	176	175	53	54	45	44
Adj. R-sq	0.468	0.411	0.663	0.640	0.568	0.548	0.766	0.764	0.300	0.315	0.574	0.549

Table 13: Impact of upside and downside risk on IRR

This table shows the relationship among IRR, intra-fund volatility, skewness, downside volatility and upside volatility. The table shows the results for all funds, US funds and non-US funds. The dependent variable is the IRR of funds. All the variables are defined in Appendix Table 1. *Diff. Coeff.* gives the difference (in absolute terms) of the coefficients for *Upside Vol* and *Downside Vol.*, and *t-Value Diff.* reports the value of the corresponding t-test. We include dummies for vintage year of current fund and previous fund in our regressions. ***,**,* are significant level at 1%, 5% and 10%, respectively.

	All funds						***US funds***						***Non-US funds***					
	Models						***Models***						***Models***					
	1	*2*	*3*	*1*	*2*	*3*	*1*	*2*	*3*	*1*	*2*	*3*	*1*	*2*	*3*	*1*	*2*	*3*
	BO	BO	BO	VC	VC	VC	BO	BO	BO	VC	VC	VC	BO	BO	BO	VC	VC	VC
Intra-F Vol	0.034***	0.026**		0.151***	0.157***		0.020	0.030		0.145***	0.152***		0.038***	0.022*		0.018	-0.009	
	(3.72)	(2.42)		(8.95)	(7.46)		(1.19)	(1.58)		(6.12)	(15.16)		(3.31)	(1.68)		(1.10)	(-0.40)	
Skewness		0.013			-0.005			-0.007			-0.004			0.031**			0.045**	
		(1.54)			(-0.64)			(-0.61)			(-0.45)			(2.54			(2.48)	
Downside Vol			-0.359***			-0.227***			-0.268***			-0.360***			-0.343***			-0.165
			(-6.05)			(-3.23)			(-2.93)			(-4.55)			(-4.79)			(-1.12)
Upside Vol			0.049***			0.149***			0.0335**			0.150***			0.264***			0.022
			(5.86)			(10.75)			(2.17)			(9.01)			(8.57)			(1.37)
No. Obs.	389	383	392	376	370	375	148	147	149	272	269	273	241	236	242	102	100	100
Adj. R-sq	0.279	0.274	0.380	0.659	0.654	0.682	0.485	0.477	0.512	0.706	0.708	0.772	0.263	0.279	0.809	0.436	0.392	0.422
Diff. Coeff.			0.310***			0.078			0.235**			0.210***			0.079			0.143
t-Value Diff.			(5.17)			(1.09)			(2.53)			(2.59)			(1.01)			(0.97)

Table 14: Impact of legal conditions

This table shows the impact of the fund's country characteristics on performance and risk persistence. Panel A shows the results of the performance persistence for buyout funds (measured by *PME*), Panel B for VC funds (measured by *PME*) and Panel C shows the results of risk persistence for both buyout and VC funds (measured by *Intra-F Vol*$_t$). All the variables are defined in Appendix Table 1. We include dummies for vintage year of current fund and previous fund in our regressions. ***,**,* are significant level at 1%, 5% and 10%, respectively.

Panel A: Buyout funds	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	Dep.Var. = PME				**Dep.Var. = PME**			
PME $_{t-1}$	0.117**	0.117**	0.113**	0.114**	0.080	0.083	0.081	0.077
Upside Vol					0.072***	0.071***	0.072***	0.082***
Downside Vol					-0.639***	-0.649***	-0.628***	-0.617***
Anti-director Rights	0.018	-0.042	-0.012	-0.006	-0.003	-0.0640*	-0.045	-0.029
English Legal Origin	-0.132				-0.070			
Creditor Rights	-0.006				-0.006			
Public Enforcement Index		-0.038				0.120		
Efficiency of the Judiciary		0.032	0.040*	0.035		0.033	0.035	0.037*
Disclosure Requirements Index			-0.281				-0.025	
Burden of Proof				-0.248*				-0.108
No. Obs.	286	286	286	286	286	286	286	286
Adj. R-sq	0.072	0.050	0.055	0.070	0.326	0.326	0.327	0.351

Table 14 continues

Panel B: VC funds								
PME_{t-1}	0.190***	0.183***	0.179***	0.179***	0.127**	0.097*	0.108**	0.109**
Upside Vol					0.179***	0.178***	0.173***	0.172***
Downside Vol					-0.719***	-0.698***	-0.721***	-0.700***
Anti-director Rights	0.069	0.085	-0.084	-0.062	-0.008	0.110	0.033	-0.009
English Legal Origin	-0.185				0.131			
Creditor Rights	-0.044				0.011			
Public Enforcement Index		-0.257				-0.536		
Efficiency of the Judiciary		0.014	0.022	0.002		0.001	0.041	0.028
Disclosure Requirements Index			0.871				-0.158	
Burden of Proof				0.432				0.098
No. Obs.	247	247	247	247	247	247	247	247
Adj. R-sq	0.417	0.407	0.403	0.403	0.548	0.570	0.551	0.547

Table 14 continues

Panel C: Buyout and VC funds	***Buyout funds***				***VC funds***			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
	Dep. Var. = Intra-F Vol				**Dep. Var. = Intra-F Vol**			
Intra-F Vol $_{t-1}$	0.149***	0.151***	0.149***	0.145***	0.211***	0.169***	0.154**	0.173***
Anti-director Rights	-0.071	-0.062	-0.080	-0.054	-0.023	-0.097	-0.191	-0.094
English Legal Origin	0.139				0.202			
Creditor Rights	-0.035				-0.074			
Public Enforcement Index		0.387				0.299		
Efficiency of the Judiciary		-0.011	-0.027	-0.017		0.376***	0.359***	0.342***
Disclosure Requirements Index			0.564				1.055	
Burden of Proof				0.251				0.243
No. Obs.	279	279	279	279	242	242	242	242
Adj. R-sq	0.270	0.269	0.270	0.267	0.440	0.508	0.514	0.508

Table 15: Impact of fund-level characteristics

This table shows the impact of fund characteristics on performance and risk persistence for buyout and VC investments. All the variables are defined in Appendix Table 1. We include dummies for vintage year of current fund and previous fund in our regressions. ***,**,* are significant level at 1%, 5% and 10%, respectively.

	Buyout funds			**VC funds**		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Dep.Var. = PME		Dep. Var. = Intr-F Vol	Dep.Var. = PME		Dep. Var. = Intra-F Vol
PME $_{t-1}$	0.093*	0.052		0.165***	0.090*	
Intra-F Vol $_{t-1}$			0.161***			0.218***
Upside Vol		0.088***			0.194***	
Downside Vol		-0.647***			-0.674***	
Fund Size	-0.036*	-0.039*	0.005	0.015	-0.029	0.078
PE Experience	0.004	0.004	0.009	0.008	0.012*	-0.003
Propensity to Invest Cross-Border	0.129*	0.062	0.032	-0.033	0.014	-0.182
Propensity to Sit on Boards	0.138*	0.161*	0.104	-0.107	-0.110	0.032
Propensity to Syndicate	0.039	-0.007	0.134	0.151*	0.151*	0.026
Propensity to Stage				-0.171*	-0.252*	-0.049
No. Obs.	**287**	**287**	**279**	**247**	**247**	**241**
Adj. R-sq	0.065	0.250	0.297	0.417	0.603	0.430

Appendix Table 1: Variable Definitions

Variable	Definition
IRR	Internal rate of return (IRR) of a fund (or portfolio company) investment calculated using information of the investment cash flows.
Multiple	Total-Value-to-Paid-In (TVPI) multiple of a fund (or portfolio company) investment.
PME	Public Market Equivalent of a fund investment. We calculate PME using the approach proposed by Kaplan and Schoar (2005). The S&P 500 Index is used to proxy for the public market for US funds and main national indices are used for all non-US funds.
Fund Size	Fund Size is measured as the natural logarithm of the fund's total invested capital in US dollars.
Intra-F Vol	Intra-fund volatility measures the standard deviation of IRRs of the individual portfolio company investments made by a fund. It proxies for the total risk of a fund (see also the formal definition in Section 2.2).
Downside Vol	Downside volatility measures the downside standard deviation of IRRs of individual portfolio company investments made by a fund. It proxies for the downside risk of a fund (see also the formal definition in Section 2.2).
Upside Vol	Upside volatility measures the upside standard deviation of IRRs of individual portfolio company investments made by a fund. It proxies for the upside potential of a fund (see also the formal definition in Section 2.2).
Sharpe Ratio	Sharpe ratio measures the return earned by a fund in excess of the risk-free rate per unit of total risk. In order to calculate the Sharpe ratios of the sample funds, we use fund IRRs and proxy total risk by using the intra-fund volatilities.
Sortino Ratio	The Sortino ratio measures the return earned by a fund in excess of the risk-free rate per unit of downside risk. In order to calculate the Sortino ratios of the sample funds, we use fund IRRs and proxy downside risk by using the downside volatilities.
Skewness	Measures the skewness of IRRs of the individual portfolio company investments made by a fund.
PE Experience	The fund's sequence number of the management firm.
Propensity to Invest Cross-Border	The fraction of the portfolio company investments of a fund that are cross-border deals.
Propensity to Sit on Boards	The fraction of the done deals in which the fund held a board seat relative to the fund's total number of deals.
Propensity to Syndicate	The fraction of the done deals that are syndicated relative to the fund's total number of deals.
Propensity to Stage	The average number of rounds a given PE fund invests in portfolio companies (based on all investments made).
Anti-director Rights	An index taking a value from 0 for less rights to 5 for more rights offered to shareholders of a publicly listed company in

	the country of the fund. (Source: La Porta, Lopez-de-Silanes and Shleifer, 2006)
English Legal Origin	A dummy variable taking a value of 1 if the fund is located in a country that has a common law legal origin and 0 otherwise. (Source: La Porta, Lopez-de-Silanes and Shleifer, 2006)
Creditor Rights	An index aggregating creditors' rights in the country of the fund and takes a value from 0 (weak creditors rights) to 4 (strong creditors' right). (Source: La Porta, Lopez-de-Silanes, Shleifer and Vishny, 1998)
Public Enforcement Index	An index taking a value from 0 (less) to 1 (more) that represents the level of public enforcement of securities laws in the country of the fund. It is calculated as the arithmetic average of supervisor, investigative, orders and criminals. (Source: La Porta, Lopez-de-Silanes and Shleifer, 2006)
Efficiency of the Judiciary	An index ranging from 0 (less) to 10 (more) indicating how efficient the legal system is in the country of the fund. (Source: La Porta, Lopez-de-Silanes and Shleifer, 2006)
Disclosure Requirements Index	An index ranging from 0 (less) to 1 (more) and measures the extent of disclosure requirements in a prospectus in the country of the fund. (Source: La Porta, Lopez-de-Silanes and Shleifer, 2006)
Burden of Proof	An index ranging from 0 (less) to 1 (more) and measures how difficult it is for a shareholder to recover damages from a company in the country of the fund. (Source: La Porta, Lopez-de-Silanes and Shleifer, 2006)