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Managerial Skill and European PERE Fund Performance

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Abstract

Institutional investors often select private equity real estate (PERE) funds based on the belief that some of the managers possess skill. In this paper, we study skill of PERE general partners (GPs) from two perspectives: performance persistence and limited partner (LP) reinvestment. We first risk-adjust fund returns by controlling for fund characteristics and obtain abnormal returns that are driven by managerial skill. We then use pooled OLS and probit regressions on abnormal returns to show that managerial performance persists in our sample, and that skilled managers continue to deliver winning risk-adjusted performance, while for mediocre managers performance does not persist in terms of neither performance correlation nor probability of repeating performance. We also provide evidence that LP reinvestment can serve as a signal of skill, as reinvested funds perform better than non-reinvested ones. This positive effect of reinvestment also applies to the predecessor loser and non-winner funds, suggesting that poor performance does not always indicate the lack of skill, but can be a result of random events.

Keywords Real estate investment · Private equity real estate · Managerial skill · Performance persistence · Reinvestment · Private equity

Introduction

Main investors in private equity real estate (PERE) funds are institutional investors such as pension funds and insurance companies. With money of their beneficiaries at stake, high variability of PERE returns coupled with a low liquidity of PERE investments, makes picking the "right" fund increasingly important. At the same time, fund selection is complicated by the opaqueness of the asset class, which leaves investors with relatively little information about potential investments. In these circumstances

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conventional wisdom among institutional investors is to select funds by those PERE fund management firms (also known as general partners, GPs) whose previous funds were successful. Industry data corroborates this: according to Preqin (2018), 69% of interviewed institutional investors indicated that successful management team track record is the most important factor when selecting a new fund. Apparently, investors believe in performance persistence i.e. that performance of successive funds by the same GP is correlated.

Another piece of information that may be available to institutional investors during a fund-picking process is limited partner (LP) reinvestment. If current fund investors decide to stay with the GP and reinvest their capital in the GP's next fund, the outside investors may use it as a signal of satisfaction with the manager and of high anticipated returns. The importance of LP reinvestments is underlined by the fact that in private equity the information about the quality of different GPs is often inaccessible and restricted to existing investors (Lerner et al. 2007). This way, in the situation of information deficit, LP reinvestment serves as an additional aid in the investor's decision-making process.

Either of these rationales implicitly assumes that GP firms vary in their ability to lead a fund to success. Such intrinsic ability is often referred to as managerial skill and can manifest itself through a number of outlets, for example, by picking the right markets and investments (Diller and Kaserer 2009; Fuerst and Matysiak 2013; Axelson et al. 2009; Anson and Hudson-Wilson 2003; Baum and Farrelly 2009), market timing (Diller and Kaserer 2009; Alcock et al. 2013), negotiation skills, ability to source and execute more complex deals (Baum and Farrelly 2009), successfully deploying leverage (Alcock et al. 2013) and avoiding losses (Bollen and Pool 2009). Despite the limited empirical evidence on managerial skill in PERE, the expectation that managerial skill affects PERE performance is not unreasonable. Information asymmetries inherent to PERE lead to systematic differences in knowledge about investment opportunities, and good deals tend to concentrate in the portfolios of the skilled management teams (Diller and Kaserer 2009). Additionally, better GPs may have proprietary access to particular transactions, thus being able to access better investments (Kaplan and Schoar 2005). These notions are indirectly confirmed by the recent findings of negatively skewed PERE returns, indicating that only few GPs deliver high returns (Fuerst et al. 2014; Delfim and Hoesli 2016). Finally, value-added and opportunity investment styles explicitly rely on skills of the managers for adding value. Overall, PERE serves as a favorable setting for manifestation of differences in skill among GP firms, and it is possible that PERE returns are affected by managerial skill – at least to a certain extent.

Traditional way of analyzing managerial skill in the setting of private equity, mutual and hedge funds has been through performance persistence, as repeating successful performance is believed to be attributed to the existence of skill (Gompers et al. 2010; Acharya et al. 2013; Braun et al. 2017) and allows distinguishing skill from luck (Bollen and Pool 2009). The logic is that if funds of the same firm consistently outperform their peers, this serves as an indication of skill. Performance persistence as an evidence of managerial skill has been documented by e.g. Grinblatt and Titman (1992), Elton et al. (1993), and Elton et al. (1996) for managing firms of mutual funds, Agarwal and Naik (2000) and Kosowski et al. (2007) for hedge fund managing companies, and by Kaplan and Schoar (2005) and Harris et al. (2014b) and Braun

et al. (2017) in non-real estate private equity GPs. In PERE, Hahn et al. (2005), Tomperi (2010) and Aarts and Baum (2016) study performance persistence among successive funds by the same GP, however, they do not explicitly establish the link between managerial skill and performance persistence, but rather analyze performance persistence as an independent phenomenon. Indeed, as they analyze either raw (Tomperi 2010) or normalized (Hahn et al. 2005; Aarts and Baum 2016) returns, the documented persistence can be driven by the funds' risk profiles rather than the skill of the GPs. Existing evidence by Fuerst and Matysiak (2013) and Delfim and Hoesli (2016) shows that fund-specific characteristics such as investment style, vintage and size affect PERE returns, thus indicating that persistence in non-risk-adjusted performance cannot be readily taken as an evidence of managerial skill. Farrelly and Stevenson (2016), on the contrary, find that fund characteristics have little statistically significant effect on fund performance, however, they conjecture that performance is rather driven by exact real estate investment decisions, which, based on the above examples, is also related to the skill of the GP. Focusing on the effect of investment style on performance, Fisher and Hartzell (2016) demonstrate that there is no difference in performance between value-add and core PERE funds, while combined together they outperformed core assets in the ODCE index during the time period of 1980–2003 and under-performed it in the 2004–2008 vintages.

This paper contributes to the understanding of managerial skill of PERE GPs in two respects. First, unlike existing PERE literature, we analyze persistence in realized risk-adjusted returns by successive funds of same GP, and thus capture performance driven by skill. In particular, we use after fee cash flow, valuation and descriptive data of 261 European PERE funds sourced from three major data providers covering vintages from 1997 to 2013 to, first, calculate each fund's realized IRR and, second, to risk-adjust the IRRs on the effect of style, geography, size and vintage, to obtain abnormal returns, which we use for our performance persistence analysis. This approach allows us to capture the persistence borne by skill, rather than persistence in the risk profile of funds by the same GP.[1]

Our evidence suggests that abnormal performance persists between focal and previous, and focal and second previous funds of the same GP, in contrast to Hahn et al. (2005) and Aarts and Baum (2016), who discover persistence only in a short-term. Further, we find that persistence is not uniform among poorly performing and successful funds. In particular, persistence is stronger for pairs where predecessor is a winner compared to persistence found in the overall sample. On the contrary, performance does not persist in the pairs with loser predecessor. We confirm our results using an alternate methodology. Using a probit model, we document that the probability of winning performance is higher for winners than it is for losers, while probability of losing performance is not predicted by the loser predecessor funds. Our results suggest that skilled GPs consistently deliver successful risk-adjusted performance, while for inept GPs performance does not persist.

Puzzled with the lack of persistence in abnormal performance of loser funds, we hypothesize that this result could be driven by the random events outside managers'

[1] Although it would be interesting to disentangle the managerial skill on firm vs. individual level, our data does not enable the identification of the key personnel responsible of managing the fund. In this paper, we use terms 'GP' and 'manager' interchangeably.

powers. PERE funds' assets and local markets they operate in are highly heterogeneous, and hence bear high idiosyncratic risk. If some of the skilled GPs' funds were affected by such random events, abnormal performance could be a noisy indication of skill. In order to capture the underlying skill in such scenarios, we turn to analyze managerial skill from the perspective of LP reinvestment. Fund LPs, as fund insiders, should be able to gather "soft information" about the managers, as opposed to the fund outsiders who have access to only "hard information" such as realized returns (Hochberg et al. 2014). In other words, LPs should be able to perceive managerial skill of their GPs, despite negative effect of random events. Having learnt about skill of their GPs, LPs react rationally by making full use of this information and thus reinvest their capital in the GP's next fund (Berk and Green 2004; Phalippou 2010). We then conjecture that if incumbent LPs decide to reinvest their capital in the GP's follow-on fund, it can serve as an indication of skill observed by the investors.[2]

The second contribution of this paper is extending the analysis of GP skill in PERE to LP reinvestment. Although the idea of associating reinvestment with GP skill is not new, it has mostly appeared in LP performance studies (e.g. Lerner et al. (2007) and Phalippou (2010) for non-real estate private equity). To our knowledge, it has not been used in the context of GP performance. We show that, firstly, reinvested funds overall are more probable to become winners, indicating that reinvested funds are funds by skilled GPs. Secondly, reinvested loser and non-winner funds have a higher probability of winning than non-reinvested ones, confirming our hypothesis that some of the loser fund GPs, too, possess skill. We conclude that reinvestment has a signaling value that can be used in a fund-selection process and is a more robust managerial skill indicator than performance persistence, as it registers skill in spite of the effect of random events.

The remaining of the paper is structured as follows. The next section provides an overview of the existing literature on the topic. Section 3 explains the empirical strategy. Section 4 describes the data used in this study. Sections 5 presents the results of model estimations. Section 6 contains the results of the robustness test. The last section concludes.

Literature

Managerial skill in PERE has received little attention. Alcock et al. (2013) study managerial skill in terms of alpha from a regression analysis of PERE returns. They document that most of the PERE returns can be explained by variation in the underlying market return, and that funds overall are unable to deliver significant positive outperformance on the basis of managerial skill. Another approach to identify managerial skill is via performance persistence. Bond and Mitchell (2010) analyze year-on-year performance of UK open-ended funds included in the Investment Property Databank (IPD). They adjust the returns in excess of three benchmark alternatives: IPD Universe excess total return index, excess returns in the IPD property sectors and

[2] Although it has been shown that not all the LPs are sophisticated in a sense of their capacity to learn about GP skill (Lerner et al. 2007; Cavagnaro et al. 2019), and thus, some reinvested funds could be the funds of unskilled managers, further in the paper we show that in our sample reinvested funds are more likely to perform better than non-reinvested ones in terms of both risk-adjusted and raw returns, signifying that the presumption about the link between LP reinvestment and GP skill holds in our sample.

return on publicly traded securities. Following Carhart's (1997) methodology, they calculate transition probabilities for raw relative performance and for abnormal returns, comparing ten or five-year horizons. They document that managerial performance persists for above- and below-average funds, when comparing ten-year horizons, and that this persistence is more pronounced for abnormal returns than for raw relative performance. Over five-year horizons, the evidence on risk-adjusted performance persistence is mixed and shows sensitivity to the chosen time frame.

To our knowledge there are only three papers that have studied performance persistence between consecutive PERE funds by the same GP. Hahn et al. (2005) were first to analyze IRR-based performance ranks in a sample of 110 opportunistic funds started between 1991 and 2001. They report strong performance persistence between current and previous fund, closely resembling the results of Kaplan and Schoar (2005) in their study of non-real estate private equity performance. However, Hahn et al. (2005) find that fund ranks tend to reverse across a five-year interval, indicating that GPs staying in business after five years will be managing the fund of the opposite performance rank. Tomperi (2010) investigates persistence in IRRs in a global sample of 896 PERE funds raised during 1980–2009 as a part of the wider study on PERE performance. The study documents strong positive performance persistence similar to that found by Hahn et al. (2005). Recently, Aarts and Baum (2016) followed Hahn et al.'s (2005) methodology and studied a global sample of 313 value-added and opportunistic funds raised between 1990 and 2009. They find strong performance persistence between two consecutive funds, however, of a lesser magnitude than that found by Hahn et al. (2005). According to Aarts and Baum (2016), the performance persistence in PERE is short-lived, as there is no statistically significant correlation between focal fund performance and second and third predecessor fund performance.

Evidence on performance persistence from non-real estate private equity is more established. In their seminal study Kaplan and Schoar (2005) study Venture Economics fund performance data over the years 1984–2001 and find substantial persistence in performance at both ends of performance distribution using transition matrices. They also use regression analysis and document persistence between two consecutive funds, as well as between the current fund and the second previous fund. Diller and Kaserer (2009) find performance persistence in a sample of 777 European private equity funds from Tomson Venture Economics covering years 1980–2003. They reject the idea that the persistence is due to the market timing abilities. Phalippou and Gottschalg (2009) corroborate the findings of Kaplan and Schoar and find that performance persistence absorbs the explanatory power of other fund characteristics. Harris et al. (2014b) call into question previous research findings and show that for buyout funds persistence diminishes post-2000, while for venture funds persistence remains strong. They find evidence for significant performance persistence for both venture and buyout pre-2000 funds. Recently Braun et al. (2017) analyzed persistence of deal by deal performance of 269 GPs operating globally over the period 1974 to 2012 and found that persistence diminishes in the periods of increased competition, as well as over the period 2001–2012 which they associate with mature market. Interestingly, this effect is not uniform – top quartile deal persistence almost disappears during high competition periods, persistence in poor performance is of the similar magnitude as during low competition times. Korteweg and Sorensen (2017) differentiate between long-term, investable, and spurious

private equity performance persistence. They find support for the long-term performance persistence, especially for the smaller funds.

To our knowledge, no existing study has focused on LP reinvestment decisions in PERE. Investigating a related topic, Krautz and Fuerst (2015) studied how GP centrality and fund size affect the speed of raising a follow-on fund. They demonstrate that better connected managers are on average quicker in raising capital for their follow-on funds, however, this effect is overtaken by the size of previous fund and the fund manager's total amount of capital under management in the full specification. Existing evidence from non-real estate private equity, e.g. Lerner et al. (2007) and Cavagnaro et al. (2019), suggests that some LPs are able to select private equity partnerships that have the best potential to earn the highest returns, implying that certain investors are good at spotting skillful managers. Berk and Green's (2004) theoretical model assumes that mutual fund investors act rationally on the information about managerial skill and thus pour capital of in the funds of skilled GPs. This results in GPs increasing the fund size and their compensation, to the point where performance persistence disappears. Phalippou (2010) argues that better performing venture capital funds are backed by more sophisticated LPs as an interpretation of Lerner et al.'s (2007) finding of reinvested funds performing better than non-reinvested ones. He demonstrates that performance does not persist for well-performing funds and, similar to Berk and Green (2004), concludes that this is due to skilled LPs who learn about skilled managers and invest in their funds, thus eliminating return predictability due to decreasing return to scale.

Hochberg et al. (2014), however, explicitly focus on the GP skill in their study of performance persistence in venture capital (VC) and argue that current fund LPs collect "soft information" about the GP's skill, while outside investors can only observe "hard information" such as realized returns. Consequently, if incumbent investors do not reinvest in a follow-on fund, outside investors perceive it as a negative signal of managerial skill. In our study we apply the same rationale and consider LP reinvestment in a follow-on fund as an indication of a managerial skill. Consequently, the expectation is that reinvested funds should perform better than non-reinvested ones.

Empirical Strategy

Abnormal Returns

Unlike previous studies on private equity real estate performance persistence that use pre-calculated performance metrics sourced from the data providers, we calculate performance metrics using cash flow and valuation data. To preserve the sample size, we treat valuations of unliquidated funds as final cash flows as in Kaplan and Schoar (2005) and Kiehelä and Falkenbach (2015). Our performance measure is internal rate of return (IRR), as it is most commonly used by investors to evaluate PERE fund performance and by managers to determine performance fees[3] (Farrelly and Stevenson 2016; Van der Spek 2017).

[3] An alternative performance metric used by e.g. Kiehelä and Falkenbach (2015) is public market equivalent (PME), which provides comparison of the fund performance to the performance of the public benchmark. However, PME is likely to incorrectly gauge the performance of the funds from geographies that are weakly represented in European public real estate indices, and thus cannot serve as a reliable performance metric for European PERE funds.

One challenge with analyzing managerial skill through performance persistence is distinguishing the persistence in managerial skill from persistence driven by other factors. Fuerst and Matysiak (2013) and Delfim and Hoesli (2016) show that fund investment style, size, gearing and vintage significantly affect PERE fund returns. Existing PERE performance persistence studies only partially control for the fund characteristics, and it can be expected that persistence documented in these studies is caused by persistence in e.g. investment style or geography. Normalized ranks used by Hahn et al. (2005) and Aarts and Baum (2016) only neutralize the variation between vintages. Tomperi (2010) does not account for the effect of style nor vintage. To isolate returns from the effect of strategy choices, we use IRR-based abnormal return (AR) for our analysis.

Abnormal returns have previously been used to gauge managerial skill in the mutual fund performance persistence studies (e.g. Bers and Madura 2000; Lin and Yung 2004; Prather et al. 2004, Bessler et al. 2018), where AR is typically measured as an outperformance (alpha) of the fund compared to a suitable benchmark return, such as S&P 500, Wilshire REIT Index, MSCI World Stock Index or IPD indices. The nature of these vehicles, such as their infinite lifetime and monthly return observations, allows estimating alpha for each fund in the sample. In our case, as only a single return observation per fund is available, the result is only one alpha for a full sample of funds. Given this constraint, we define our abnormal return as a residual return, which is a common approach to measure abnormal returns in e.g. event studies (e.g. Campbell et al. 2010; Steiner and Heinke 2001):

$$AR_i = \left(IRR_i - r_f\right) - \left(\widehat{IRR_i - r_f}\right), \tag{1}$$

where IRR_i is fund i's observed IRR calculated using after fee cash flow and valuation data, r_f is a risk free rate, and $\widehat{IRR_i - r_f}$ is a linear prediction from fitting model (2) that captures the effect of fund characteristics on return. In our study, for the absence of the comparable performance benchmark, we construct a set of control variables representing fund characteristics potentially affecting fund raw returns and use them to estimate a "benchmark" return. These variables include investment style, geographical focus and fund size. We also control for vintage year fixed effects in order to control for the differences in market conditions affecting fund performance. We do not control for the property type, as this descriptive is missing for Burgiss data, which accounts for 39% of funds in our sample, however, as shown by Farrelly and Stevenson (2016) and Delfim and Hoesli (2016), property-type specialization has no statistically significant relationship with private real estate fund performance. We therefore estimate the following model to obtain a prediction of return driven by fund risk profile:

$$IRR_i - r_f = \beta_0 + \beta_1 GeoFocus_i + \beta_2 Style_i + \log FundSize_i + \delta_t + \varepsilon_i \tag{2}$$

where $GeoFocus_i$ is fund's geographical focus, $Style_i$ is fund's investment style, $logFundSize_i$ is logarithm of fund size, δ_t are vintage year fixed effects and ε_i is an error term. By then defining AR as a part of the return that remains unexplained after controlling for the effect of fund strategy choices (1), we expect to capture return driven by managerial skill.

Estimations

Once we've calculated our measure of managerial skill (AR_i), the study unfolds in four sequential steps. First, we analyze performance persistence in a traditional setting of a pooled OLS regression, using AR as our performance metric, which is an approach that is similar to that used by e.g. Bers and Madura (2000) and Prather et al. (2004) in mutual fund performance studies. This is in contrast to previous studies that employed raw returns or normalized ranks as performance metric. We regress the performance of the focal fund (AR_{mi}) on the predecessor fund performance ($AR_{mi\text{-}1}$), second predecessor fund performance ($AR_{mi\text{-}2}$), third predecessor fund performance ($AR_{mi\text{-}3}$), and average performance of all predecessor funds (AR_{all}). We also repeat Hahn et al.'s (2005) and Aarts and Baum's (2016) methodology and use normalized rank[4] (NR) as a performance metric to ensure that our results are consistent.

Having established the existence of performance persistence in our sample, we turn to analyze whether this persistence is homogeneous, as it can be expected that successful and poor performance do not persist to the same extent. Specifically, we look at the magnitude of correlation between focal and previous fund performance depending on the predecessor fund's performance tercile and quartile. While tercile division represents an intuitive partition of funds into "good" funds at the top, "average" funds in the middle and "bad" funds at the bottom of the probability distribution, and better accommodates smaller samples, measuring and comparing fund performance based on its quartile position within a given vintage is a common private equity industry practice, with top quartile funds marketed by GPs and sought after by potential investors (Harris et al. 2012). In this paper we refer to the funds in the top tercile or quartile as 'winners', while 'losers' locate in the bottom quantile.[5] Thus, the quantile divisions allow us to trace the dependencies between winning and losing funds across vintages. We continue by estimating the following pooled OLS regression model:

$$AR_{mi} = \beta_0 + \beta_1 AR_{mi-1} + \beta_2 Q_{mi-1} + \beta_3 (AR_{mi-1} \times Q_{mi-1}) + \varepsilon_{mi}, \quad (3)$$

where abnormal return (AR_{mi}) of the focal fund i of a given manager m is a dependent variable. On the right-hand side of the equation are predecessor fund's abnormal return ($AR_{mi\text{-}1}$); categorical variable corresponding to the quantile of the predecessor fund ($Q_{mi\text{-}1}$), and their interaction term. ε_{mi} is an error term. Our variable of interest is the average marginal effect of $AR_{mi\text{-}1}$ at each quantile, which is effectively the slope of the predecessor fund's abnormal return at different quantile levels.

Further we address performance persistence from the perspective of its probability. As institutional investors often select funds based on the performance of the GP's previous fund, we test how probable it is that the previous fund performance will repeat. To answer this question, we test how the quantile of the predecessor fund affects the probability of the focal fund winning or losing. We are particularly interested in a probability of persisting winning or losing performance in a pair of consecutive funds. We expect that the probability of winning differs depending on predecessor fund

[4] $NR = (n - r)/(n - 1)$, where n is the total amount of funds with the same vintage year, and r is the rank of the fund within the vintage cohort, based on its absolute performance.

[5] We use the term "quantiles" to refer to both quartiles and terciles at the same time.

quantile, with winning predecessor funds having the highest probability of being followed by a winner. And vice versa, that loser funds have a higher probability of being followed by losers.

We estimate two probit regressions to measure the effect of predecessor fund quantiles on the probability of winning (4) and losing (5) focal performance:

$$\Pr(W_{mi} = 1) = \Phi(\beta_0 + \beta_1 Q_{mi-1}), \tag{4}$$

$$\Pr(L_{mi} = 1) = \Phi(\beta_0 + \beta_1 Q_{mi-1}). \tag{5}$$

In (4) W_{mi} takes a value of one if the focal fund belongs to the top quantile and a value of zero otherwise; $\Pr(W_{mi} = 1)$ refers to the probability of the focal fund becoming a winner; Φ is the cumulative distribution function of the standard normal distribution; and $Q_{mi\text{-}1}$ is a predecessor fund quantile. Eq. (5) is similar, with L_{mi} taking a value of one, if the focal fund is a loser, and a value of zero otherwise; and $\Pr(L_{mi} = 1)$ referring to the probability of the focal fund becoming a loser.

Probit regression allows us to not only estimate the probability of the winning or losing performance, but also quantify the effect of previous fund performance on this probability. The change in probability of the outcome in question when changing from the reference quantile to $Q_{mi\text{-}1}$ is shown by average marginal effects. For the regression (4) we select bottom quantile as a reference category, and for the regression (5) the top quantile. The average predicted probability of $W_{mi} = 1$ or $L_{mi} = 1$ at each level of $Q_{mi\text{-}1}$ is shown by predictive margins.

Finally, we address cases when skill does not manifest itself through performance persistence. Apart from fund-specific characteristics, performance of PERE funds can also be negatively affected by random events. Heterogeneity of fund properties and local property markets result in PERE funds carrying a high idiosyncratic risk.[6] In addition, the effect of such random events can be amplified in PERE funds, which move from investment to management to exit phase in a predetermined schedule. This predefined phase sequence and limited life allow for little maneuver from specific times to invest and liquidate and thus restrict the possibilities of alleviating the negative effect of random events. Besides market-wide phenomena, some of such events affect the funds unsymmetrically, depending on the investment stage and strategy, and thus, would not be captured by time fixed effects. Further, some of these random events could be fund specific, such as loss of key personnel. Although dealing with such occurrences without major consequences for fund performance can be considered as one of the instances of skill, there are cases when overcoming such events can be outside of manager's powers. If so, risk-adjusted performance is still a noisy indication of skill. Assuming fund LPs are able to distinguish skill from random events, we hypothesize that LP continuation with the same manager, i.e. reinvestment of their capital in the manager's next fund, is a signal of managerial skill transmitted by the LPs.

[6] In non-real estate private equity literature, Ewens et al. (2013) find that idiosyncratic risk is priced in VC funds, even net of fees; Robinson and Sensoy (2016) find that variation in fund cash flows is either idiosyncratic or explained by the fund's age.

Consequently, we expect that reinvested funds, i.e. the funds with whose managers investors decided to stay, are funds of GPs who possess managerial skill, and therefore these funds are more likely to become winners, as compared to the funds in which LPs did not reinvest their capital. In that sense we are using reinvestment as a proxy for the unobserved managerial skill recognized by the investors. If true, it can be inferred that LP reinvestment has a signaling value and can be relied upon as one of the factors in a fund-picking process, along with managerial track record. We use data on historical LP investment into PERE funds to analyze whether funds chosen by LPs for reinvestment perform better than their peers, even if the predecessor fund performed poorly.

We first estimate a general probit model with a sole reinvestment dummy to determine the overall effect of reinvestment on winning performance. This way we test whether reinvested funds in general have a higher probability of becoming winners:

$$\Pr(W_{mi} = 1) = \Phi(\beta_0 + \beta_1 reinv_{mi}), \tag{6}$$

where W_{mi} takes a value of one if the focal fund is a winner and zero otherwise; $reinv_{mi}$ is a dummy variable taking a value of one if fund i was invested in by at least one LP, which have previously invested in the fund *i-1* by the same manager m, and zero otherwise.

We continue by evaluating the effect of reinvestment on the performance for different predecessor groups:

$$\Pr(W_{mi} = 1) = \Phi(\beta_0 + \beta_1 reinv_{mi} + \beta_2 Q_{mi-1} + \beta_3 reinv_{mi} \times Q_{mi-1}), \tag{7}$$

where we add a categorical variable of predecessor fund quantile, Q_{mi-1}, and its interaction with the reinvestment dummy to the previous equation.

As investors typically focus on the top quantile funds (Harris et al. 2014b), it is of interest to test our hypothesis on the remaining non-top quantile performers as a group. In particular, we test whether current LP reinvestment can serve as a predictor of winning performance for the previous non-winners:

$$\Pr(W_{mi} = 1) = \Phi(\beta_0 + \beta_1 reinv_{mi} + \beta_2 NW_{mi-1} + \beta_3 reinv_{mi} \times NW_{mi-1}), \tag{8}$$

where NW_{mi-1} is a dummy variable that takes a value of one if previous fund was in any but first quantile, and zero otherwise.

For each of the equations we are interested in the average marginal effect of $reinv_{mi}$, i.e. in the change in probability of winning performance in the presence of reinvestment, as well as in overall probability of winning for reinvested funds.

Data and Descriptive Statistics

Fund Data

Due to the private nature of PERE industry, available PERE data is relatively scarce. In order to compile a comprehensive dataset adequately representing European PERE fund universe, we combine data from three sources: Burgiss,

European Association for Investors in Non-Listed Real Estate Vehicles (INREV) and Preqin. The high quality of Burgiss data has been documented by Harris et al. (2014a) and Harris et al. (2014b). The data is sourced directly from LPs, who use Burgiss systems for record-keeping and performance monitoring, with cross-checks among LPs in the same funds resulting in a high degree of data accuracy. At the same time, both INREV and Preqin data are collected from GPs through voluntary reporting (INREV – via dedicated online platform, Preqin – using Freedom of Information (FOIA) requests), and thus can potentially suffer from self-reporting biases.

Our combined dataset consists of financial data representing fund cash flows and valuations and their timing, and descriptive data, which includes fund style, size, vintage, geographical focus and manager id. All financial data is net of fees. Although all three data sources contain financial data, due to the high quality of Burgiss data, we prefer it over INREV and Preqin data, whenever there is an overlap. The cash flows cover time interval from Q4 1997 to Q1 2016. The funds younger than 12 quarters were removed from the sample due to their immaturity.

Final sample consists of 261 funds covering vintages from 1997 to 2013, together totaling €110 billion in size (Table 1). Most of our sample consists of core funds (99 funds), followed by value-added (95 funds) and opportunistic funds (67 funds). However, opportunistic funds have the highest total size of nearly €42 billion. Most of the funds in our sample are focused on Western Europe (66%), while the fractions of Pan-European, Southern European, Nordic and Central and Eastern Europe-focused funds vary between 6% and 11%. The development of performance metrics can be seen in Table 2. Average AR is by construction zero for virtually all the vintages with relatively low standard deviation. Average funds' IRR is negative for the vintage years 2002, 2004–2007, and is the highest for funds launched in 2000–2001, 2009 and for the younger vintages 2012–2013, with overall mean IRR of around 1%. The low absolute returns might seem surprising at first glance, especially given a significant proportion of non-core funds that are typically expected and advertized to deliver higher returns. This is because most of the funds in our sample suffered from the financial crisis of 2007–08 and subsequent European debt crisis, with value-add and opportunistic funds taking a bigger hit due to the riskier investment strategies employed. The returns in our sample are aligned with previous studies focusing on PERE performance: Kiehelä and Falkenbach (2015) report an average IRR of −1.3% for the sample of European PERE non-core funds covering vintages 1998–2012; Delfim and Hoesli (2016) document an average return of 1.07% for the sample of closed-end non-listed European real estate funds spanning vintages 2001–2014; and Fisher and Hartzell (2016) report a mean IRR of −2.28% for value-add and −1.74% for opportunistic funds for the vintages 2004–2008 in their sample of predominantly North American funds from Burgiss. Interestingly, regardless of the weak absolute returns of European PERE funds, the industry was able to attract capital even in the post-crisis years. According to INREV (2018), the amount of equity raised by European non-listed real estate funds kept steadily increasing in the post-crisis years, indicating a continuous investor interest in the asset class. To account for the differences in the investment environment, we control for vintage fixed effects in our estimations of abnormal returns.

In total, there are 94 fund managers, 48 of which have two or more funds, and 46 have only one fund.[7] Average amount of funds per manager is three among all managers, and 4.1 among those who have more than one fund. We require a lapse of at least six quarters between the launch dates of the two funds for them to be considered as consecutive funds. Given this, we obtain 140 pairs of consecutive funds.

Investor Data

Investor data is provided by Preqin and comprises of investor firms and funds they invested into. There are 3263 unique real estate fund names, including open-ended, closed-ended and debt funds globally, and 2768 unique investor firm names. Time horizon of the investments is unknown. We were able to match 108 out of 261 funds in our sample to the funds in the investor data. We assign a reinvestment dummy variable *reinv* for each focal fund that has been reinvested into by one or more LPs that have previously invested in its predecessor. If none of the LPs in the previous fund has reinvested their capital in the current fund, the dummy *reinv* takes a value of zero. Out of 108 funds, 68 funds have been reinvested into and 40 were not.

Results

Establishing Performance Persistence

Our first evidence of managerial skill via performance persistence is presented in Table 3. Based on regression results presented in Panel A, we find correlation between abnormal returns of focal and previous, focal and second previous and focal and average previous fund performance. The coefficient for the third predecessor fund is, however, not statistically significant. The results for normalized rankings (Panel B) are generally consistent with those for abnormal returns, albeit this time performance persists three funds back, while the coefficient of the average previous performance is not significant. The coefficients are also larger than for abnormal return estimation. Overall, performance persistence in our sample is of smaller magnitude than that found by Hahn et al. (2005) and Aarts and Baum (2016), but it lasts longer, as they do not find statistically significant correlation in performance beyond immediately previous fund.

Effect of Previous fund's Relative Performance on the Magnitude of Performance Persistence

Continuing our analysis, we develop previous regression by adding a categorical variable of previous fund quantile and its interaction with the abnormal performance. By doing so we test whether performance at the different quantiles of predecessor fund persists the same way. Estimation results presented in Table 4 confirm our expectation that performance persistence is not uniform for different types of performers. Such, when looking at terciles, performance persists only for

[7] Although by combining the three data sources we aim to obtain the complete fund sequence for each GP, some funds may still be missing from the sample.

Table 1 Funds Sample Overview

	A. All Funds			B. Core			C. Value-Added			D. Opportunistic		
Vintage	N	Total size (billions €)	Mean size (millions €)	N	Total size (billions €)	Mean size (millions €)	N	Total size (billions €)	Mean Size (millions €)	N	Total size (billions €)	Mean size (millions €)
1997–1999	12	5.9	488	7	1.7	237	3	*	*	2	*	*
2000-2001	13	8.8	675	6	4.6	765	1	*	*	6	4.0	673
2002	12	3.6	298	7	2.9	408	4	*	*	1	*	*
2003	12	4.7	390	8	3.3	411	3	*	*	1	*	*
2004	22	6.5	297	12	3.2	268	8	2.8	348	2	*	*
2005	34	12.8	376	10	2.8	276	13	5.6	427	11	4.5	405
2006	39	14.0	358	16	5.6	348	15	4.4	294	8	4.0	498
2007	37	15.9	430	11	1.5	138	17	8.4	493	9	6.0	666
2008	24	14.6	608	3	*	*	6	2.9	483	15	11.3	753
2009	10	5.2	521	0	*	*	5	2.4	471	5	2.9	571
2010	16	5.4	337	8	1.6	199	7	3.3	472	1	*	*
2011	18	6.2	344	9	3.0	329	7	2.6	372	2	*	*
2012-2013	12	6.4	531	2	*	*	6	3.5	577	4	*	*
1997-2013	261	109.8	421	99	31.7	320	95	37.8	398	67	40.3	602

*For reasons of confidentiality, data is aggregated for vintages with less than five funds and cannot be shown for style-vintage combinations with less than five funds

Table 2 Summary statistics of private equity real estate fund returns by vintage

Vintage	N	AR				IRR			
		mean	sd	min	max	mean	sd	min	max
1997–1999	12	0.00	0.10	−0.17	0.18	0.10	0.10	−0.07	0.29
2000–2001	13	0.00	0.11	−0.11	0.21	0.12	0.11	−0.04	0.34
2002	12	0.00	0.22	−0.60	0.28	−0.02	0.22	−0.61	0.27
2003	12	0.00	0.07	−0.07	0.13	0.04	0.07	−0.04	0.18
2004	22	0.00	0.15	−0.38	0.21	−0.04	0.14	−0.42	0.14
2005	34	0.00	0.12	−0.40	0.28	−0.05	0.13	−0.45	0.23
2006	39	0.00	0.14	−0.49	0.22	−0.07	0.13	−0.55	0.15
2007	37	0.00	0.09	−0.20	0.14	−0.04	0.10	−0.28	0.09
2008	24	0.00	0.09	−0.19	0.20	0.01	0.10	−0.21	0.21
2009	10	0.00	0.04	−0.07	0.06	0.12	0.05	0.05	0.19
2010	16	0.00	0.10	−0.32	0.11	0.08	0.10	−0.25	0.18
2011	18	0.00	0.10	−0.23	0.18	0.10	0.10	−0.15	0.29
2012–2013	12	0.00	0.11	−0.13	0.20	0.13	0.13	−0.01	0.37
Total	261	0.00	0.12	−0.60	0.28	0.01	0.14	−0.61	0.37

This table shows mean, standard deviation, minimum and maximum values of internal rate of return (*IRR*) and abnormal return (*AR*) of funds in a given vintage year. *IRR* is calculated using fund level cash flow and valuation data, *AR* is calculated as a residual return from regressing IRR in excess of risk free rate on a set of control variables reflecting fund's risk profile. For reasons of confidentiality, data is aggregated for vintages with less than five funds

pairs of funds, where predecessor was a top tercile fund (abnormal return coefficient of 0.39). For quartiles, performance persists for top, second and third quartile predecessors, but with a different magnitude (coefficients of 0.48, 1.36 and 2.55 correspondingly).

For both terciles and quartiles, losing predecessor performance does not persist. At the same time, coefficients are significantly larger for all the predecessor quantiles showing positive persistence, when compared to the whole sample coefficients documented in the previous section. This suggests that the coefficient size was previously dampened by the lack of performance persistence for losing funds.

Probability of Repeating Performance

So far we studied persistence in terms of correlation between the performances of the focal and predecessor funds, and found strong correlation in performance of fund pairs with well-performing predecessors. However, positive correlation does not guarantee that the focal fund will be a winner, while this is what interests potential investors the most. In this section we shift the focus to the focal fund winners (losers) and analyze how probable it is for different predecessor funds to be followed by winners (losers). We are most interested in the probability of the repeating winning and losing performance.

Table 3 Performance persistence

Panel A: Dependent variable: AR_{mi}				
AR_{mi-1}	0.126*** (0.044)			
AR_{mi-2}		0.170*** (0.046)		
AR_{mi-3}			0.143 (0.094)	
AR_{all}				0.199** (0.093)
Constant	−0.007 (0.011)	−0.009 (0.011)	−0.001 (0.012)	−0.013 (0.010)
R^2	0.024	0.050	0.027	0.03
N	140	107	79	153
Panel B: Dependent variable: NR_{mi}				
NR_{mi-1}	0.162** (0.079)			
NR_{mi-2}		0.231** (0.095)		
NR_{mi-3}			0.221** (0.100)	
NR_{all}				0.187 (0.116)
Constant	0.414*** (0.041)	0.367*** (0.062)	0.390*** (0.064)	0.380*** (0.063)
R^2	0.032	0.066	0.058	0.023
N	140	107	79	153

In Panel A the dependent variable is fund *i*'s abnormal return, AR_{mi}. AR_{mi-1}, AR_{mi-2} and AR_{mi-3} are the abnormal returns of the predecessor funds *i-1*, *i-2* and *i-3*. AR_{all} is the average abnormal return of all funds of a manager *m* that preceded the fund *i*. In Panel B the dependent variable is focal fund *i*'s normalized rank based on IRR, NR_{mi}. NR_{mi-1}, NR_{mi-2} and NR_{mi-3} are the normalized ranks of the predecessor funds *i-1*, *i-2* and *i-3*. NR_{all} is the average normalized rank of all funds of the manager *m* that preceded the fund *i*. Standard errors are in parentheses and are adjusted for serial correlation and heteroscedasticity. ***, **, * indicates significance at the 1, 5, and 10% levels, respectively

The results of the probit regressions are presented in Table 5.[8] With regard to terciles, the probability of repeating top tercile performance is 37.2% and is 17.5 pp. higher when compared to the probability of a loser fund being followed by the winner standing at 19.7%. For the quartile division, the probability of becoming a winner, if the predecessor fund was a winner, is 28.6%, which is 17.2 pp. higher as compared to the losers. Interestingly, both second tercile and second quartile funds have higher overall probability (42% and 31% correspondingly) to be followed by winners compared to their respective first quantiles. However, this difference between the probabilities is not statistically significant (untabulated).

We now move to the losing performance probability. Although overall predicted probability of focal losing performance is the highest for the loser predecessors (42.6% and 31.8% for bottom tercile and quartile respectively, compared to 30.2% and 20% for top tercile and quartile), it is not statistically significantly different from the winning performers. Consistent with the findings for the winning probability, second tercile and

[8] For this model and further in the paper we do not report probit regression coefficients, as they cannot be interpreted directly. For interpretation of coefficients, marginal effects have to be estimated.

Table 4 Performance persistence depending on predecessor's fund quantile

Dependent variable: *ARmi*		
	(1)	(2)
AR_{mi-1}*1st tercile	0.389** (0.146)	
AR_{mi-1}*2nd tercile	0.581 (0.666)	
AR_{mi-1}*3rd tercile	−0.052 (0.064)	
2nd tercile	0.051 (0.031)	
3rd tercile	−0.016 (0.036)	
AR_{mi-1}*1st quartile		0.481*** (0.178)
AR_{mi-1}*2nd quartile		1.364*** (0.455)
AR_{mi-1}*3rd quartile		2.550** (1.1187)
AR_{mi-1}*4th quartile		0.019 (0.047)
2nd quartile		0.340 (0.041)
3rd quartile		0.104** (0.042)
4th quartile		0.36 (0.036)
Constant	−0.033 (0.027)	−0.056 (0.034)
R^2	0.072	0.113
N	140	140

This table reports average marginal effects from the pooled OLS regression, where focal fund's abnormal return, $AR_{mi,}$ is the dependent variable, and predecessor's fund quantile, Q_{mi-1}, abnormal return, AR_{mi-1} and their interaction are independent variables. Column 1 presents the results on estimation for terciles and column 2 for quartiles. The omitted group for the main effect of the categorical variable is 1st tercile in Column 1 and 1st quartile in column 2, respectively. Standard errors are in parentheses and are adjusted for serial correlation and heteroscedasticity. ***, **, * indicates significance at the 1, 5, and 10% levels, respectively

second quartile predecessor funds have the lowest probability of focal fund being a loser in their respective quantiles based on the overall predicted probability results.[9]

Up to this point our findings indicate that persistence in abnormal returns is limited to well-performing funds. If abnormal returns are driven by GP skill, we can interpret this result as an evidence that performance persists for the skilled GPs, whereas inept firms do not show consistency in the risk-adjusted performance of their funds. This is different from findings reported by Kaplan and Schoar (2005), who document persistence in both successful and poor performance for non-real estate private equity funds.

Effect of Reinvestment on Probability of Top Performance

The general lack of persistence in losing performance in previous sections suggests that some of the poorly performing managers improve their performance from previous to focal fund. However, if performance is driven by managerial skill, such inconsistency

[9] Motivated by this, in an unreported probit regression we estimate an additional average marginal effect of the losing tercile and quartile performance, but this time selecting the second tercile and quartile, respectively, as a reference category. In terms or terciles, the difference in probability of losing performance between bottom and second tercile predecessors is 20pp and is statistically significant at 10%. As for quartiles, the difference in probability is still not statistically significant.

Table 5 Probability of winning or losing performance

	Panel A: probability of winning		Panel B: probability of losing	
Quantile	Average marginal effect	Predictive margin	Average marginal effect	Predictive margin
Terciles				
1st tercile	0.175** (0.088)	0.372	*reference*	0.302
2nd tercile	0.220** (0.088)	0.417	−0.080 (0.107)	0.222
3rd tercile	*reference*	0.197	0.124 (0.099)	0.426
N	140		140	
Log-lik	−83.079		−87.036	
Chi^2	8.64		2.99	
Pseudo R^2	0.038		0.026	
Quartiles				
1st quartile	0.172** (0.086)	0.286	*reference*	0.200
2nd quartile	0.194** (0.097)	0.308	−0.007 (0.107)	0.192
3rd quartile	0.115 (0.079)	0.229	−0.000 (0.109)	0.200
4th quartile	*reference*	0.114	0.118 (0.080)	0.318
N	140		140	
Log-lik	−71.380		−75.278	
Chi^2	7.32		3.34	
Pseudo R^2	0.036		0.015	

This table reports average marginal effects and predictive margins from a probit model $\Pr(W_{mi}=1)=\Phi(\beta_0+\beta_1 Q_{mi-1})$ that estimates the probability of winning focal fund performance (Panel A); and model $\Pr(L_{mi}=1)=\Phi(\beta_0+\beta_1 Q_{mi-1})$ that estimates the probability of losing focal fund performance (Panel B) for each predecessor's tercile and quartile. Average marginal effects at each predecessor quantile represent the difference in probably of winning (losing) performance as compared to the lowest (top) quantile. Predictive margins show overall probability of a winning (losing) focal performance for the predecessor quantile in question. Standard errors are in parentheses and are adjusted for serial correlation and heteroscedasticity. ***, **, * indicates significance at the 1, 5, and 10% levels, respectively

is puzzling. To explain this phenomenon, we hypothesize that for some skillful managers, poor performance could be caused by the random events which are outside their power, and therefore, such performance would not be indicative of their skill. If this is the case, some of the incumbent LPs should be able to recognize latent talent of the GPs, so that their reinvestment would serve as a proxy of GP skill.

Consequently, we expect reinvested loser funds to have a higher probability of success as compared to non-reinvested losers. Additionally, we test the effect reinvestment has on the non-win predecessors as a group, i.e. predecessors belonging to two bottom terciles or three bottom quartiles.

The results of the Eqs. (6), (7) and (8) are presented in Table 6. We find that overall reinvested funds are 24 pp. more probable to become winners than non-reinvested ones, with overall probability of 44%, suggesting that generally reinvestment decisions are likely to be associated with better performance. Assessing the effect of reinvestment depending on the predecessor performance, although the marginal effect is positive for each tercile, it is statistically significant only for the loser funds. For such funds,

reinvestment improves the chance of winning by 24 pp. – from just 6% to 30%. For non-top tercilers as a group, reinvestment is associated with an addition of 26 pp. to the probability of the focal winning performance which equals 40%.

As to quartiles, for the overall sample reinvestment increases fund's probability to become a winner by 28 pp. with overall probability of 35%. As now only funds that have reinvestment data on them are included in the analysis, and sample size is reduced 82 observations, we are unable to estimate average marginal effects for the first and third quartile predecessors due to the lack of observations, and therefore we do not report results for this specification. For the second and fourth quartile predecessors, the effect of reinvestment on the probability of winning performance is not statistically significant, which also can potentially be a result of the insufficient amount of observations per quartile. However, reinvestment improves the chances of winning performance by 20 pp. when three lower quartiles are grouped with a total probability of 28%.

Our results suggest that reinvestment is indicative of winning performance overall, however, when distinguishing between previous winner and loser funds, reinvestment improves chances of winning only for loser and non-winner predecessors. For winning predecessors, the effect of reinvestment is positive but insignificant. In other words, successful funds have high chances to be followed by successful funds regardless of reinvestment, whereas loser funds that get reinvested are much likelier to win than their non-reinvested counterparts. Combined with our previous finding of performance persistence only for winner funds, we interpret our latest findings as follows. When abnormal performance is unaffected by random events, winner funds, which are the funds of skilled GPs, already have a high probability of performing well, and thus the role of reinvestment in driving winning probability is limited[10]; whereas when abnormal performance is negatively affected by factors we cannot control for through risk-adjustment, reinvestment appears to be useful in discerning funds by skillful GPs among losers. These results are in line with our hypothesis that reinvestment serves as an indication of unobserved managerial skill in cases when GPs improve their abnormal performance from fund to fund, and the performance does not persist. Having found a significant effect of reinvestment on loser and non-winner funds, we have confirmed that, first, the lack of loser persistence documented in the previous section was partially due to the random events not controlled for by the risk adjustment, and, second, some of the loser managers indeed possess managerial skill.

Although reinvestment, by construction, has an effect only when managerial skill is unobserved, i.e. in case of poor abnormal performance followed by the successful abnormal performance, it is important to note that in a real-life setting the abnormal performance is unknown to the outside parties. This highlights the importance of sample-wide positive effect of LP reinvestment on the probability of winning, as it entails that LP reinvestment serves as an indication of skill and, consequently, can be used in a fund-selection process.

[10] We also allow for possibility that some of the predecessor's winning performance was caused by the positive random events. In that case, LPs would skip reinvestment, anticipating upcoming poor returns. In an unreported probit regression we estimate the probability of focal losing and non-winning performance for predecessor winners, which were not reinvested. Although, consistent with our main results, lack of reinvestment decreases the probability of focal winning performance in terms of the whole sample, we do not find evidence that non-reinvestment affects the probability of winner funds to be followed by non-winners and losers. This result could potentially be caused by the lack of observations for the non-reinvested funds. Alternative explanations could be that either investors cannot discern good luck from skill, or they just are not concerned with it, as long as the performance is good.

Table 6 Effects of reinvestment on probability of winning performance

	Average marginal effect	Predictive margins	Average marginal effect	Predictive margins	Average marginal effect	Predictive margins
	(1)		(2)		(3)	
Terciles						
$reinv_{mi-1}$	0.241** (0.107)	0.441				
$reinv_{mi-1}$ at 1st tercile			0.162 (0.194)	0.412	0.162 (0.194)	0.412
$reinv_{mi-1}$ at 2nd tercile			0.250 (0.253)	0.583		
$reinv_{mi-1}$ at 3rd tercile			0.242*** (0.091)	0.304		
$reinv_{mi-1}$ at (2nd to 3rd tercile)					0.264** (0.112)	0.400
N	108		82		82	
Log-lik	−66.678		−45.860		−48.334	
Chi^2	4.03		8.62		3.75	
Pseudo R^2	0.048		0.105		0.056	
Quartiles						
$reinv_{mi-1}$	0.278*** (0.071)	0.353				
$reinv_{mi-1}$ at 1st quartile					*n/e*	0.313
$reinv_{mi-1}$ at (2nd to 4th quartile)					0.201** (0.086)	0.278
N	108				78	
Log-lik	−54.804				−38.259	
Chi^2	10.91				5.46	
Pseudo R^2	0.098				0.065	

This table reports average marginal effects and predictive margins from probit regressions, which estimate the probability of focal fund winning performance for various types of predecessor funds. Average marginal effects show the effect of reinvestment, $reinv_{mi}$ on the probability of winning performance for the whole sample of predecessors (1), at each predecessor tercile or quartile (2) or at top and non-top predecessor groups (3). Predictive margins show the overall probability of winning performance for the respective marginal effect. For the first and third quartile the lack of observations does not allow to estimate average marginal effects of reinvestment, consequently, the result for these quartiles is marked "n/e" – not estimable. Standard errors are in parentheses and are adjusted for serial correlation and heteroscedasticity. ***, **, * indicates significance at the 1, 5, and 10% levels, respectively

Another benefit of the LP reinvestment as a fund-selection tool is that it is less sensitive to the effect of random events, unlike raw or abnormal returns.

Robustness

Previously in this paper we have tested the robustness of our results to the alternative definitions of winning and losing performance, as well as verified performance

persistence in terms of normalized ranking. In this section we examine the robustness of our results to the use of an alternative performance metric, raw IRR. It is of interest whether our results hold when the raw non-risk adjusted metric used for analysis. We repeat the four estimation steps conducted for AR and obtain results that are consistent with our primary estimations.

The results for overall sample persistence are presented in Table 7. We find strongly statistically significant persistence between immediately consecutive funds of a similar magnitude as for AR. Persistence between focal and average previous performance is significant at 10% and again similar to our primary result. The coefficients for the second and third predecessor IRRs, are, however, not statistically significant.

The results from estimating the persistence depending on predecessor quantile are presented in Table 8. Insignificant coefficients for $IRR_{mi\text{-}1}$ at each level of both terciles and quartiles indicate that, unlike in our primary results, performance does not persist for specific predecessor performance groups, but, as was shown in the previous estimation, only for the whole sample. The difference from our primary result confirms our expectation that persistence in IRR is rather driven by the persistence in the fund profile by the same manager, while AR performs better at registering the underlying differences in fund performance that are driven by the managerial skill.

Turning to probability of winning and losing performance, the results in Table 9 suggest that funds belonging to first and second tercile or quartile have around 20 pp. higher chance to be followed by winner funds as compared to the respective bottom quantiles. At the same time, there is some indication of persistence in loser performance: bottom quartile funds are 14 pp. likelier to be followed by bottom quartilers, at 10% statistical significance.

Finally, Table 10 documents reinvestment has a significant impact on fund's probability to become a winner in respect of both terciles and quartiles. This result demonstrates that apart from abnormal returns, reinvestment predicts successful performance also in the absolute terms. For terciles, second tercile predecessors and two bottom terciles as a group are statistically significantly affected by reinvestment. For second tercile funds' winning probability is increased by 47 pp. by reinvestment with

Table 7 Performance persistence for the IRR-based sample

Dependent variable: IRR_{mi}				
$IRR_{mi\text{-}1}$	0.136*** (0.050)			
$IRR_{mi\text{-}2}$		0.112 (0.080)		
$IRR_{mi\text{-}3}$			0.136 (0.126)	
IRR_{all}				0.185* (0.098)
Constant	−0.006 (0.013)	−0.007 (0.014)	0.003 (0.015)	−0.013 (0.012)
R^2	0.024	0.018	0.019	0.019
N	140	107	79	153

The dependent variable is fund *i*'s IRR. $IRR_{mi\text{-}1}$, $IRR_{mi\text{-}2}$ and $IRR_{mi\text{-}3}$ are the IRRs of the predecessor funds *i-1*, *i-2* and *i-3*. IRR_{all} is the average of all funds of the manager *m* that preceded the fund *i*. Standard errors are in parentheses and are adjusted for serial correlation and heteroscedasticity. ***, **, * indicates significance at the 1, 5, and 10% levels, respectively

Table 8 Performance persistence depending on predecessor's fund quantile for IRR-based sample

Dependent variable: *IRRmi*		
	(1)	(2)
IRRmi-1*1st tercile	−0.086 (0.272)	
IRRmi-1*2nd tercile	0.031 (0.313)	
IRRmi-1*3rd tercile	−0.034 (0.066)	
2nd tercile	−0.007 (0.045)	
3rd tercile	−0.095** (0.043)	
IRRmi-1*1st quartile		−0.121 (0.289)
IRRmi-1*2nd quartile		−0.156 (0.602)
IRRmi-1*3rd quartile		0.152 (0.499)
IRRmi-1*4th quartile		0.045 (0.074)
2nd quartile		−0.010 (0.050)
3rd quartile		−0.58 (0.051)
4th quartile		−0.074 (0.044)
Constant	0.033 (0.035)	0.039 (0.40)
R^2	0.087	0.052
N	140	140

This table reports average marginal effects from the pooled OLS regression, where focal fund's IRR, $IRR_{mi,}$ is the dependent variable, and predecessor's fund quantile, $Q_{mi\text{-}1}$, IRR, $IRR_{mi\text{-}1}$ and their interaction are independent variables. Column 1 presents the results on estimation for terciles and column 2 for quartiles. The omitted group for the main effect of the categorical variable is 1st tercile in Column 1 and 1st quartile in column 2, respectively. Standard errors are in parentheses and are adjusted for serial correlation and heteroscedasticity. ***, **, * indicates significance at the 1, 5, and 10% levels, respectively

overall probability of 58%. Reinvested funds that follow after tercile non-winner predecessors as a group are 25 pp. more likely to become winners. We believe that such prominent effect of reinvestment on the second tercile is due to the fact that IRR is a raw non-risk-adjusted performance metric, and therefore it is a noisy measure of managerial skill. As a result, reinvestment takes upon the role of the primary managerial skill predictor. For quartiles, three bottom quartiles as a group have a 14 pp. higher probability of winning at a 10% significance with overall probability of 22%.

Conclusion

This article contributes to the scarce PERE literature by specifically focusing on managerial skill of PERE GPs from two perspectives. First, we look at managerial skill though persistence in fund abnormal returns. Choosing abnormal returns as a performance metric ensures that performance persistence results are not driven by persistence in fund characteristics. We find performance persistence in terms of correlation between abnormal returns of the funds by the same fund manager. Persistence found in our sample spans for two lagged funds, but is of smaller magnitude than previously found in PERE studies. When scrutinizing how performance persistence

Table 9 Probability of winning or losing performance for the IRR-based sample

	Panel A: probability of winning		Panel B: probability of losing	
Quantile	Average marginal effect	Predictive margin	Average marginal effect	Predictive margin
Terciles				
1st tercile	0.221** (0.086)	0.390	*reference*	0.317
2nd tercile	0.206** (0.085)	0.375	−0.092 (0.100)	0.225
3rd tercile	*reference*	0.169	0.090 (0.088)	0.407
N	140		140	
Log-likelihood	−80.735		−86.801	
Chi^2	9.78		2.83	
Pseudo R^2	0.046		0.021	
Quartiles				
1st quartile	0.192** (0.090)	0.294	*reference*	0.147
2nd quartile	0.244*** (0.094)	0.346	0.161 (0.124)	0.308
3rd quartile	0.059 (0.075)	0.161	0.111 (0.097)	0.258
4th quartile	*reference*	0.102	0.139* (0.082)	0.286
N	140		140	
Log-likelihood	−67.212		−77.263	
Chi^2	12.56		3.06	
Pseudo R^2	0.059		0.019	

This table reports average marginal effects and predictive margins from a probit model $\Pr(W_{mi} = 1) = \Phi(\beta_0 + \beta_1 Q_{mi-1})$ that estimates the probability of winning focal fund performance (Panel A); and model $\Pr(L_{mi} = 1) = \Phi(\beta_0 + \beta_1 Q_{mi-1})$ that estimates the probability of losing focal fund performance (Panel B) for each predecessor's tercile and quartile. Average marginal effects at each predecessor quantile represent the difference in probably of winning (losing) performance as compared to the lowest (top) quantile. Predictive margins show overall probability of a winning (losing) focal performance for the predecessor quantile in question. Standard errors are in parentheses and are adjusted for serial correlation and heteroscedasticity. ***, **, * indicates significance at the 1, 5, and 10% levels, respectively

depends on the predecessor fund quantile, we discover that persistence for the top performing funds is stronger than for the whole sample, whereas for loser predecessor performance does not persist. Next, addressing persistence from the point of view of probability, we confirm our earlier results: there is a lack of performance persistence for loser funds and a strong probability of winner performance for previous winners. Our results provide evidence that some PERE GPs do possess skill and are able to consistently deliver successful risk-adjusted performance.

Second, we for the first time investigate managerial skill of PERE GPs from the perspective of LP reinvestment. If current fund LPs decide to invest their capital in the GP's next fund, that should signal LP's content and that fund manager possesses managerial skill. We provide evidence that reinvestment signals skill, as reinvested funds have a higher probability to become winners, when compared to their non-reinvested peers. Importantly, reinvestment allows to discern skillful managers among the managers of poorly performing funds, and thus appears to be a more robust indicator of managerial skill than performance persistence, as it is less sensitive to

Table 10 Effects of reinvestment on probability of winning performance for IRR-based sample

	Average marginal effect (1)	Predictive margins	Average marginal effect (2)	Predictive margins	Average marginal effect (3)	Predictive margins
Terciles						
$reinv_{mi-1}$	0.262*** (0.089)	0.412				
$reinv_{mi-1}$ at 1st tercile			0.271 (0.186)	0.438	0.271 (0.186)	0.438
$reinv_{mi-1}$ at 2nd tercile			0.472*** (0.173)	0.583		
$reinv_{mi-1}$ at 3rd tercile			0.142 (0.092)	0.208		
$reinv_{mi-1}$ at (2nd to 3rd tercile)					0.250*** (0.090)	0.333
N	108		82		82	
Log-lik	−62.978		−40.914		−43.467	
Chi^2	6.83		12.78		8.29	
Pseudo R^2	0.064		0.142		0.089	
Quartiles						
$reinv_{mi-1}$	0.234*** (0.065)	0.309				
$reinv_{mi-1}$ at 1st quartile					*n/e*	0.267
$reinv_{mi-1}$ at (2nd to 4th quartile)					0.136* (0.076)	0.216
N	108				77	
Log-lik	−52.690				−34.985	
Chi^2	9.14				3.45	
Pseudo R^2	0.079				0.042	

This table reports average marginal effects and predictive margins from probit regressions, which estimate the probability of focal fund winning performance for various types of predecessor funds. Average marginal effects show the effect of reinvestment, $reinv_{mi}$ on the probability of winning performance for the whole sample of predecessors (1), at each predecessor tercile or quartile (2) or at top and non-top predecessor groups (3). Predictive margins show the overall probability of winning performance for the respective marginal effect. For the first and third quartile the lack of observations does not allow to estimate average marginal effects of reinvestment, consequently, the result for these quartiles is marked "n/e" – not estimable. Standard errors are in parentheses and are adjusted for serial correlation and heteroscedasticity. ***, **, * indicates significance at the 1, 5, and 10% levels, respectively

the effect of the random events. Overall LP reinvestment serves as a valuable signal of GP skill for LPs in their fund-selection process often characterized by information opacity and scarceness.

Findings of this study not only extend existing knowledge by using risk-adjusted returns and LP reinvestment in the analysis of PERE GP skill for the first time, but also have important practical implications that can be useful for institutional investors during their fund-selection and portfolio management processes. Institutional investors

should dedicate efforts to learn about the skill of the GP, as it is related to excess returns, while potential PERE investors should pay attention to reinvestment intentions of existing LPs, as they are likely to be associated with skill. For existing PERE investors, the skill of the GP is a good indicator of future returns.

This study also provides some evidence on the fund-selection skill of incumbent LPs. Our results suggest that fund LPs reinvest into funds that are set to become top performers in terms of both raw and risk-adjusted returns. However, whether LPs have actually learnt additional information about GPs from fund participation remains outside of the scope of this study and warrants future investigation. One possible test could be a comparison of the first-time funds' performance, where all the investors have equal access to information, against the performance of reinvested funds.

Finally, in this paper, we were not able to disentangle the effects of managerial skill due to GP firm from personal characteristics individual managers. Identifying the channels of managerial skill that can lead to outperformance represents an important direction for future research.

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