Access versus Selection: What Drives Limited Partners' Private Equity Returns?

Otso Manninen[a*], Mikko Jääskeläinen[a], and Markku Maula[a]

[a]*Aalto University, Finland*

This version: November 1, 2010

ABSTRACT

An institutional investor's private equity fund investment returns are determined by his/her access to and skills in selecting the best funds, but little is known about the extent of these two effects. Using a large sample of European pension funds' private equity fund investments, we observed that limited partners are unable to select better funds for reinvestment compared to funds in which they choose not to reinvest. Our results imply that selection skills alone may not be an adequate explanation of the systematic differences between different limited partners' returns, as suggested by previous research.

[*] Corresponding author: Otso Manninen.
Address: Aalto University, PO Box 15500, 00076 Aalto, Finland
Tel.: +358-40-4102642
Fax: +358-9-47023095
E-mail address: omannine@cc.hut.fi

1. Introduction

Private equity funds have drawn a significant amount of interest in the past years (Kaplan and Strömberg, 2009) with the assets under management reaching USD 2.5 trillion in 2008 (Preqin, 2009). A significant portion of this capital originates from institutional investors, including banks, insurance companies, and pension funds. In the wake of this capital flow, an increasing amount of academic research has focused on the risk-return relation of private equity. While traditional research has treated private equity similar to other asset classes, recent years have witnessed the emergence of studies acknowledging some of the differences between asset classes.

Unlike in many other asset classes (e.g., stocks), access to investment opportunities affects the subsequent returns to institutional investors investing in private equity funds. With private funds being typically structured as limited partnerships (see, e.g., Sahlman, 1990), in which the investors act as limited partners (LPs) and the fund manager as a general partner (GP), there is no open market for investment opportunities and LPs must be able to invest in a fund in addition to knowing about the fund's existence. As such, access to new private equity funds established by GPs with high prior returns makes it more likely for an LP to have higher portfolio returns (Meyer and Mathonet, 2005; Mathonet and Meyer 2007). Because returns to a GP's subsequent funds tend to be persistent (Kaplan and Schoar, 2005; Sørensen, 2007; Phalippou and Gottschalg, 2009) and because prior fund returns tend to be the only public indicator of future returns (Kaplan and Schoar, 2005; Sørensen, 2007; Phalippou and Gottschalg, 2009), LPs seek to invest in the best GPs that they have access to. The role of access is further intensified by the fact that GPs with high returns can often choose their investors (Lerner and Schoar, 2004). Despite the evident relevance of access in private equity investing, the effect of access on an LP's investment

returns has thus far received relatively little attention (for an exception, see Lerner, Schoar, and Wongsunwai, 2007).

However, from within the heterogeneous set of all existing funds on the market, LPs must first gain access to some of the funds and then select the best opportunities available to them. Very little is known about which of the two drivers, access or selection, is a more important determinant of the LPs' subsequent returns. In this paper, we demonstrate that access is a more consequential explanation for return differences among LPs than selection skills. Our findings imply that when access to funds and GPs' track records are controlled for, LPs are not able to select better funds for their reinvestments. When taking into account both the LP's access to funds established by certain GPs and these GPs' previous funds' returns, there are no systematic differences between the returns attained by different LPs on the funds in which they chose to invest. Using a sample of reinvestments made by large institutional investors, we are able to control for LPs' access and thus have strong support to rule out the selection skills of LPs as the main driver of return differences among different LPs, as observed in Lerner, Schoar, and Wongsunwai (2007). Instead of LPs' selection skills, our findings suggest that access to different funds is a more important determinant of LPs' private equity fund investment returns. As such, our results are in contrast to the findings presented in Lerner, Schoar, and Wongsunwai (2007).

Employing a large set of data on private equity fund reinvestments made by the largest European pension funds and insurance companies, we also demonstrate that the number of previous investments made by an LP has no effect on his/her returns. Similarly, the number of funds raised by the GP is also insignificant for the investors' returns. In fact, the only factor that helps limited partners in their investment selection is the GP's track record. When the information contained in the prior returns is controlled, a limited partner's returns to his/her

reinvestments are close to the average of the fund returns of all of the funds in which he/she could have invested. These results that emphasize the importance of access over selection imply that investing in funds raised by new GPs without established track records can be a way for an LP to secure future access to potentially high performing GPs.

Our findings have important implications for both institutional investors investing in private equity funds and for research on the dynamics of private equity fund returns. Indeed, our findings suggest that access, thus far overlooked in private equity research, is a key determinant of limited partners' investment returns. Our results also show that limited partners are highly persistent in the returns that they attain on their private equity funds, not because of their skills, but due the persistence of the general partners' private equity fund returns and the tendency of an LP's reinvestments producing the average returns of all the funds available to that LP. This implies that limited partner's initial decision to invest in a private equity fund will both affect his/her returns through the returns of that specific fund and have a longer-term effect by enabling access to subsequent funds. Therefore, any initial investment decision will have an "echo" on the successive investment returns of a limited partner far outreaching the single fund's returns. Accordingly, our results imply that building access to the funds of potentially high-performing GPs may be an effective way for limited partners to improve their portfolio returns. Therefore, initial investments can be seen as containing a call option for further funds, which offers an explanation for why a limited partner would want to invest in a first-time fund despite its disadvantages compared to a fund with a proven track record.

The remainder of this paper is structured as follows: Section 2 covers related literature on private equity fund investing. Section 3 presents our data, along with a description of the variables used. Section 4 covers our results, including additional robustness checks, and Section

5 discusses the results and their implications in light of previous research. Finally, Section 6 concludes the paper.

2. Related literature

In private equity investing, the importance of investment decisions is highlighted by the illiquidity of the investments, long investment durations, and large individual investments. However, the selection of investment targets, which is the dominant problem in most other asset classes, is not the only determinant of returns to private equity funds. Two of the major differences between private equity and many other asset classes are the strictly limited number of investors in a single private equity fund and the lack of public, open markets for investment opportunities. Therefore, LPs are only able to invest directly into funds that they are aware of and have access to.

While private equity returns have been studied to some extent over the past decade (Cochrane, 2005; Kaplan and Schoar, 2005; Phalippou and Gottschalg, 2009), this prior research has largely focused on the descriptive analysis of average returns to private equity. Prior studies have typically excluded the analysis of the drivers for LPs' realized returns (for a recent exception, see Lerner, Schoar, and Wongsunwai, 2007). However, thus far, what drives LPs' returns to their investments in private equity funds has received little attention. The effect of access and selection skill on the subsequent returns is not explicitly known, though the importance of these factors is recognized in the industry (see, e.g., Meyer and Mathonet, 2005).

Because GPs with high returns to their previous funds can typically choose their investors for new funds (Kaplan and Schoar, 2005; Diller and Kaserer, 2009), being able to invest in a given fund often means that: i) the LP has invested in a prior fund managed by the same GP

(Lerner and Schoar, 2004; Hochberg, Ljungqvist, and Lu, 2010), ii) the fund is set up by a GP which does not have prior funds, or iii) that the GP has poor returns to its prior funds. While the first option is preferable, very few LPs are in such a position to choose their new investments exclusively from within this group. In the second case, there are very few pieces of information that can help, ex ante, LPs to choose novel GP's whose funds will turn out to be high performers. Factors such as funds' diversification across portfolio companies (Lossen, 2006), fund type (Ljungqvist and Richardson, 2003), and general fund inflow to all private equity funds during the year in question (Gompers, 1996; Diller and Kaserer, 2009) are of no use in discriminating between two similar alternatives in a given year. The main predictor of a fund's performance is the performance of the previous funds set up by the same GP (Kaplan and Schoar, 2005; Sørensen, 2007; Phalippou and Gottschalg, 2009). While the performance proxy serves as a warning sign in the case of low-performing funds, it is unavailable for new funds, and therefore relying solely on it is not preferable for many LPs (Meyer and Mathonet, 2005; Groh and Liechtenstein, 2009).

Lerner, Schoar, and Wongsunwai (2007) suggest that there are systematic differences in the returns that different types of LPs are able to attain even when access is controlled for. However, in their study on reinvestment decisions, Lerner, Schoar, and Wongsunwai (2007) do not explicitly take into account the funds available to different investors and the GPs' track records. Due to the return persistence on the general partner level (Kaplan and Schoar, 2005; Sørensen, 2007; Phalippou and Gottschalg, 2009), differences between GPs' returns can pass on to the limited partner level.

In this paper, we advance this line of research by explicitly controlling for access by limiting our analysis to reinvestment decisions and by explicitly modeling the previous fund's

performance in our analyses, thereby extending the research setting developed by Lerner, Schoar, and Wongsunwai (2007). Whereas Lerner, Schoar, and Wongsunwai (2007) focus on performance differences between different types of LPs, we limited the unobserved heterogeneity between LPs by focusing on one major type of LP (pension funds) in one geographic area (Europe).

3. Data

Our data cover almost 1,500 private equity investment decisions made by more than 150 of the largest European pension funds and pension insurance companies. The data used in our study were obtained from Private Equity Intelligence (Preqin[1]), which is the largest and most comprehensive database on LPs' investments in private equity funds. While Preqin has recently been used in some other studies on private equity (see, e.g., Lerner, Schoar, and Wongsunwai, 2007; Hobohm, 2008; Ljungqvist, Hochberg, and Vissing-Jorgensen, 2009), our data set is unique in two ways. First, by combining information on LPs' actual investments with information on all of the funds that were available to the market, we built a data set that covers funds in which the LPs invested, as well as the funds in which they chose not to invest. Second, we concentrated solely on the LPs' reinvestment decisions. Because LPs are almost always able to reinvest in a new fund by a GP in whose fund(s) they have invested before, limiting the sample to reinvestment decisions effectively and accurately takes into account the availability of investment opportunities (i.e., access to funds). Accordingly, our data set represents the accessible investment opportunities LPs face when making investment decisions.

[1] The Preqin database is accessible at www.preqin.com. Preqin collects its data from both limited partners and general partners, as well as from different news sources and official filings. Based on our discussion with private equity professionals at pension funds, Preqin is often used by the pension funds themselves, thus presenting the minimum information that can be assumed to be available to professionals at pension funds when they make their investment decisions.

3.1. Description of sample construction

We began the data-gathering process by identifying several hundred of Europe's largest pension funds and insurance companies.[2] We did this by searching for information on company websites, company annual reports and other national and European-wide information sources (including Organization for Economic Co-operation and Development, European Union, and a number of publications on pension funds and insurance companies). The purpose of screening these companies by size was to ensure that they were sophisticated institutional investors and to maximize the likelihood that they had invested in private equity funds.[3]

Next, we matched our list of the largest European pension funds with the LPs that had their investments listed on the Preqin database. With the invested funds known, we collected information on these funds' GPs and all of the other funds listed on Preqin that these GPs had set up. To ensure that our sample consisted of funds with similar characteristics, we included only funds listed on Preqin that belong to one of the following types: balanced, buyout, collateralized loan obligation/Collateralized debt obligation/senior loan, co-investment, distressed debt, early stage, early stage: start-up, expansion, fund of funds, mezzanine, secondaries, turnaround, and venture (general).[4]

---

[2] The size of the pension fund was measured as the total assets under management. There is no single comprehensive database for the largest such institutions in Europe, so it is difficult to assess the comprehensiveness of our data. Compared to a Pension Funds Online list of the Top 100 European Pension Funds, our sample contains 64 of this 100, with varying information on them. The pension funds in our sample mainly come from the UK, France, Germany, the Netherlands and the Nordic countries.

[3] Sophistication here means only that the institutional investor has enough resources available to be able to access the same information as others about opportunities available to it, i.e., it can benchmark the funds it has invested in against other similar funds.

[4] Effectively, we exclude funds such as infrastructure, natural resources, and real estate funds. Based on our discussions with private equity investment teams at pension funds, these investments are not typically managed by the institutional investors' private equity teams due to differences in dynamics and logics.

With all of the limited partners and funds known, we created a data matrix in which all of the LPs were on one axis, and all of the private equity funds set up by the GPs were on the other. A binary variable for each cell indicated whether the focal LP invested in the focal fund. From this matrix, we excluded LPs with no known investments and funds for which we did not have adequate information (i.e., with no vintage, type, location, or general partner known).

In the final step, we restricted the data set to only those observations where the LP had already invested in at least one of the focal GP's prior funds. Ultimately, this process yielded a data set of 1,485 reinvestment decisions, 501 in which investment took place and 964 in which it did not. These investment decisions were made by 156 LPs in 390 funds set up by 137 GPs. Because we do not have complete data on all variables on all observations, some of our analysis is based on a smaller subset of this data set. Thus, sample sizes are reported separately for each analysis.

3.2. Description of variables

Fund Returns. Our dependent variable was the focal fund's return, and we used two complementary measures of returns. The first measure is the natural logarithm of the internal rate of return (IRR). We obtain these IRRs directly from the Preqin database, which collects this data from both the GPs and the LPs. While IRR is the most commonly used measure of private equity returns and takes into account both the returns and their timings, the Preqin database does not report the IRR for all funds. To both account for recent concerns regarding the IRR as a measure of private equity fund performance (for more discussion, see Phalippou, 2008) and to use a measure that is available for a larger sample of funds, we also used the natural logarithm of the return multiple as another dependent variable in our analysis. While multiples do not take into

account the timing of cash flows, they provide a somewhat different view on the returns than the IRR; a small return over a short time period may lead to a high IRR while being low in the scale of multiples. Also, the opposite is true for high returns over a long period of time, and thus to better assess the true returns, both measures should be taken into account. In addition, to ensure that the lack of observation on IRR data does not lead to biased estimates due to systematically different reporting of high and low return funds, we used a Heckman selection model to correct for potential sample selection issues.

Prior Fund Returns. Previous studies have shown a strong persistency in a GP's fund returns (Kaplan and Schoar, 2005; Phalippou and Gottschalg, 2009). We controlled for this persistency by identifying the previous funds of the GP and using the natural logarithms of either the IRR or the multiples of the previous fund (corresponding to the dependent variable). We determined the previous fund as the fund immediately preceding the focal fund and as being of the same type as the focal fund.

Because we observed the fund returns and multiples reported in Preqin in the summer of 2008, our performance data for previous funds are closer to the final outcome than the data that are available to LPs at the time of a reinvestment decision. In our data, the difference in vintage years between the focal fund and its processor fund is, on average, slightly less than three years. To test the robustness of our results against potential differences regarding available information on the returns of prior funds, we repeated analyses using fund returns from the funds preceding the immediate predecessor. In this case, there is an average of five years between the two funds, which was found to be a sufficient length of time to produce fund return estimates that are highly correlated with the final returns (Kaplan and Schoar, 2005). The results from these analyses were qualitatively identical to estimates using the performance of immediate predecessor.

Re-Investment Decision (Re-Ups). A central variable in our study is a binary variable indicating whether a LP reinvested or not into the GP's new fund. We treated an observation as a reinvestment decision if the focal LP had invested in any of the focal GP's previous funds of the same type.[5] The variable was coded 0 for observations where the LP did not reinvest and 1 where he/she did reinvest. This approach enabled us to analyze also those investment decisions where no investment was made rather than focusing solely on positive investment decision, as in earlier studies (see, e.g., Lerner, Schoar, and Wongsunwai, 2007). By analyzing the returns to LP' investments while taking into account the returns to funds not invested in by those LPs, we were better able to rule out alternative explanations for differences in returns to different LPs.

We acknowledge that one of the main reasons for why LPs might refuse to reinvest despite the GP's previous funds' good performance are changes of personnel at either the GP or LP level (Coller Capital, 2008). The reasons for refusing to reinvest in such case can be due to that the LP associates the performance of a fund to certain key individuals at the GP organization or that personnel turnover may indicate internal conflicts at the GP organization. While our data are on the level of organizations, we also ran our analyses with limited timeframes to control for the effects of personnel turnover. In the two robustness analyses, we restricted the time between a fund and its predecessor to less than 3 and 5 years respectively and found no differences in the results.

LP Experience/GP Experience. We measured LP's experience by counting the number of the same type of funds in which the focal LP had invested in prior to the year of the focal

[5] This means that in order for an observation to be considered as reinvestment decision the following two conditions had to be met: i) the LP had to have invested in a fund set up by that same GP in any year prior to the year of the observation, and ii) that previously invested fund had to be of the same type as the fund in the observation.

investment decision. This is not only a proxy of the LP's experience but also controls for the number of available opportunities the LP is likely to have; GPs are fairly constant in the pace in which they set up new funds. Thus, a LP with more prior investments is more likely to have more opportunities for reinvesting each year. We similarly measured a GP's experience by counting the focal GP's funds that are of the same type as the focal fund and that have their vintage year before the focal fund's vintage.

LP-GP Relationship. We measured the strength of the relationship between the focal LP and the focal GP by counting the number of the focal GP's similar funds in previous years in which the LP had invested. The strength of the relationship also indicates how much work is required from the LP during the due diligence. Therefore, this is also a measure of inertia, because reinvesting in a GP's new funds is easier the more times the LP has invested into that GP's prior funds.

Control variables. In our analyses, we used several control variables to rule out potential alternative explanations. First, we controlled for the vintage to ensure that our data were valid for returns (Kaplan and Schoar, 2005). We included vintages between 1991 and 2005. Second, we controlled for fund size, because it correlates with fund returns (Kaplan and Schoar, 2005). Third, we controlled for the fund type, because it has also been shown to affect fund returns (Ljungqvist and Richardson, 2003). Fund types were modeled as follows: one dummy variable is for buyouts (listed as buyouts in the Preqin database), another is for mezzanine funds (mezzanine in Preqin), a third dummy is for funds-of-funds (Fund of Funds), while a fourth dummy is for venture capital funds (consisting of funds listed on Preqin with any of the following codes: venture (general), expansion, early stage, early stage: seed, or start-up). The base case was all of the other funds (i.e., funds that are listed on Preqin as balanced, CLO/CDO/senior loan, co-

investment, distressed debt, secondaries, or turnaround). Finally, we controlled for the fund location using dummy variables for funds listed in the US and Europe, with the base case being the funds located in the rest of the world.

4. Empirical findings

4.1. Descriptive statistics

Panel A of Table 1 reports descriptive statistics for our sample of all observations between 1991 and 2005 with IRR data on both the focal fund and its prior fund. Panel A has two components: columns 1-4 are for observations in which the LP chose to reinvest, and columns 5-8 are for those in which the LP chose not to reinvest. In the reinvested sample, we have 147 observations, whereas the non-reinvested sample includes 273 observations. Column 9 shows the comparison between the means of the two samples using a standard t-test for the difference in means. According to the test, the difference in the returns is statistically significant at the 5% level. A Kolmogorov-Smirnov test also showed that the two samples do not have similar returns at the 5% level. Because funds in which the LPs reinvested are a bit older, the small difference in returns may still be explained with the vintages alone.

[Insert Table 1 about here]

In other areas, funds in which the LPs have reinvested tend to be larger. LPs also tended to reinvest more often in funds in which there are more prior investments made by the LP to the GP. This may be explained with less resource-consuming due diligence in cases where the LP and GP already are familiar with each other. In the reinvested sample, the GPs tend to have fewer prior funds. This might result from the fact that it usually takes a few funds until the GP's

quality becomes apparent, and LPs need to reinvest at least once to a new GP's funds to be able to determine the GP's quality. The LP could not be able to choose not to reinvest, because if the GP later turns out to be highly skilled, the LP might not anymore be able to invest in the GP's subsequent funds.

Panel B of Table 1 shows the same statistics for observations that have information on the focal multiple, previous fund's multiple, and second previous fund's multiple. Here the reinvestment sample consists of 253 observations, whereas the non-reinvested sample contains 450 observations. Based on multiples, no difference in returns exists between the two samples. Again, we note that reinvestments tended to be larger and that the LPs tended to be more familiar with the GP. US funds are less likely to be reinvested in, while European funds are more likely to be. This is a curious result. One would think it would be less difficult for the LP to find new funds in Europe than in the US because our sample consists of LPs that are European.

4.2. Simple analysis of fund return differences

A central requirement for our argument is that there are differences in the returns that different LPs attain on their investments to private equity funds. Based on the histogram of LPs' average returns to their investments, this is evident in our sample (see Fig. 1). We restricted this simple analysis to funds with vintages prior to 2005, and to LPs that invested in at least three such funds. Similar results are attainable with practically any restrictions, so the effect is not sensitive to these restrictions.

The descriptive statistics also provide some support for the claim that there could be a difference in the fund returns between funds in which the LPs chose to reinvest and those in which they chose not to reinvest. The difference in IRRs was deemed statistically significant at

the 5% level (see Panel A of Table 1). However, the slight difference in multiples was not statistically significant (see Panel B of Table 1). We next analyzed this question in greater detail by first observing the difference in returns of reinvested and not reinvested funds.

Table 2 shows the IRRs of reinvested and not reinvested averaged annually. Only a few of these annual differences are statistically significant. Additionally, the total difference in returns between the two groups is 0.03, indicating that LPs would be able to select better funds when reinvesting. This difference is, however, not statistically significant. On the limited partner level, our further analysis on the return difference revealed that there are only a few LPs that have been able to systematically reinvest into better funds, while most LPs have the same average returns on the funds in which they chose to reinvest and in which they chose not to reinvest (see Appendix for further information).

[Insert Table 2 about here]

Table 2 also provides a similar analysis done on the fund return multiples. We found only two years during which the difference is statistically significant, with one of the differences being positive and another negative (the significance is again a likely result of having relatively few observations during those years). A total of seven out of the 15 annual differences are negative, with eight being positive, suggesting that there is no difference in the returns of funds in which the limited partners chose to reinvest and those in which they chose not to reinvest.

Thus, Table 2 provides support for the conclusion that LPs are not able to select better performing new funds among the opportunities that they have. Because we have controlled for access by focusing on reinvestment decisions and found no evidence that there are any differences between the returns that LPs are able to attain for the funds in which they invest and

those in which they chose not to invest, we hypothesized that there are ultimately no systematic differences in the selection skills of different limited partners.

4.3. Multilevel mixed-effects linear regression model

To more accurately analyze the returns of funds in which LPs have reinvested and in which they have not, we now turned to a multilevel mixed-effects linear regression model (for more information, see, e.g., Baltagi, Song, and Jung, 2001; Rabe-Hesketh and Skrondal, 2005). In this model, limited partners are modeled on the highest level (identifier *k*), the general partners are modeled on the second-highest level (identifier *j*) and nested within the first level, and the funds are modeled on the lowest level (identifier *i*).

We further treated each GP and fund as unique identities, despite them being nested under different LPs. We used this type of setup to control for LP- and GP-specific differences (as in Hochberg, Ljungqvist, and Lu, 2010). This reflects the assumption that all LPs in a certain fund have the same kind of contract and cash flows, an assumption that is rarely challenged in the context of private equity funds.

With the above-stated assumptions, our model can be expressed as

$$r_{ijk} = \beta_1 + X\beta + \zeta_j + \zeta_k + \varepsilon_{ijk}, \quad (1)$$

where r_{ijk} is the return variable for the observation ijk, β_1 is a constant, matrix X consists of the independent variables, ζ_k represents random effects due to LP (constant for limited partner k in all observations), ζ_j represents random effects due to GP (constant for general partner j in all observations), and ε_{ijk} is the error term associated with the observation ijk. Therefore, the

statistical significance of either of the ζs indicates that there are systematic differences in the returns at that level.

In the analysis, we used the default convergence criteria in STATA version 11, except that we disabled the use of the Hessian-scaled gradient because we did not achieve convergence when the Hessian-based convergence criterion was used. This is likely due to the fact that we have a large number of funds in which we have only one investor, leading the method to be unable to differentiate between random effects and the error term.

For our analysis, we used all of the funds for which we have information on all of the required variables. Ultimately, we use five models with slightly different variables included. Models 1 and 2 use IRRs for fund returns, while Models 3-5 use return multiples. The results of the regression models are presented in Table 3.

[Insert Table 3 about here]

In Model 1 in Table 3, we did not control for the GP's prior fund performance. There is a positive coefficient on the 'LP reinvested' variable but it is significant only at the 10% level. This model indicates that LPs could be able to select better-performing funds and invest in them. However, in Model 2, where we specifically controlled for prior performance, the 'LP reinvested' variable becomes statistically insignificant. This indicates that limited partners tend to reinvest in funds that are established by general partners whose previous fund has had high returns. When previous returns are controlled for, the LPs are not able to choose better funds for reinvesting among all of the funds in which they could reinvest into. Additionally, fund size becomes insignificant when the previous fund's performance is controlled, supporting the

findings in previous research stating that better-performing general partners tend to raise more funds (Kaplan and Schoar, 2005).

Furthermore, the statistically significant random coefficient on the GP identifier variable in the random-effect part of the regression indicates that there are certain GPs that are able to systematically outperform others. In contrast, the LP level indicator is insignificant, suggesting that any systematic difference in the returns of LPs eventually boils down to differences at the GP level.

In Models 3-5 in Table 3 we ran the regression model with returns measured in multiples. In addition to these models' different measure of investment performance, we had more data on multiples and thus had larger samples with multiples. However, using multiples, we needed to control for the fund vintages, because the fund multiple tends to increase with time passed since the fund's vintage. In Model 3, we did not control for a general partner's prior performance. In Model 4, we controlled for the previous fund's performance, and in Model 5, we controlled both the previous and the second previous funds' returns. Because the average time between a fund and its preceding fund was only two and a half years, the fund returns may not be accurate when the LP has to consider investing into the next fund. The second previous fund in our sample was four and a half years old at that time and thus gives a more accurate prediction on the prior fund performance.

In Model 3 in Table 3, we did not control for prior fund returns and found that fund size is statistically significant. This is likely because the fund size has a high correlation with past fund performance. In addition, several of the fund vintages and a few fund types are statistically significant. Model 4 in Table 3 shows estimates for a model where the GP's previous fund's

returns are controlled. The results are similar to the results in Model 3, except fund size is no longer statistically significant, suggesting that fund size correlates with the prior fund's returns. Finally, in Model 5 in Table 3 we controlled for both the GP's previous fund's and the second previous fund's returns. Fund size is again significant, but the previous fund's return is not. If we run a similar regression without the fund size, the previous fund's returns become highly negative (coefficient -0.15) and statistically significant at the 0.1% level. This indicates that the differentiation between fund size and the previous fund's returns is not a simple task, but including one without controlling for the other biases estimates.

In Model 5 in Table 3, the LP experience is statistically significant at the 10% level, with no significance in Model 3 and in Model 4. It is also interesting to note that the previous fund's returns are not statistically significant, whereas the second previous fund's returns are. This is because the previous fund is, on average, less than three years old at the time of investment, and fund returns at that age are not accurate in determining the future returns. Second previous funds' returns are much more accurate, but there are fewer funds whose second previous returns are known compared to those with only the most previous funds returns known.

Cumulatively, Table 3 shows that while LPs are similar to each other in terms of the returns they provide on their investment decisions, the general partners are systematically different. When we controlled for prior fund returns, LPs are unable to select better funds. This indicates that all relevant information is contained in the GP's prior funds' returns.

4.4. Additional robustness checks

We utilized Heckman-like correction for potential selection bias by regressing the selection likelihood (lambda) for every observation with Probit regression (see Table 4). In the selection

model, we controlled for the following factors: vintage, fund type, fund location, fund size, previous fund's IRR reported, number of known investors in the fund, and whether the GP raised subsequent funds after the focal fund.

[Insert Table 4 about here]

Utilizing the selection regression, we calculated the lambda and then redid the previous analysis with the lambda as an additional independent variable to ensure that sample selection did not bias our results. The results of these analyses are presented in Table 5. As noted, the regression coefficients are similar compared to Table 3. However, some caution is advised because the variables included in both the selection and econometric models are not directly interpretable in the table. In addition, the lambda coefficient is positive and significant in only one of the models (and negative and significant in one other), while being insignificant in all others.

[Insert Table 5 about here]

To better understand our results, we also analyzed the returns to reinvestments versus non reinvestments for each individual LP (see Appendix for more information). These results show that the LPs, as a whole, are unable to select better funds to reinvest and that the individual LPs are unable to do this. This implies that no individual LP is any better than others in selecting funds when access is controlled for. This analysis also proved that the results obtained with one return variable are not the same as the results obtained with the other return variable. Therefore, our main analysis with both IRRs and multiples is a way to ensure the robustness of our results. Because our results are similar with both return variables, the results are more valid than if we had used only one of the return variables.

To further ensure the robustness of our results, we also modeled Models 1 and 2 in Table 3 with funds that have vintages between 1993 and 2002 to ensure that our results are not driven by funds established between 2003 and 2005. The results of these analyses are not reported here because they contain very little new information. This also controls for the duration of the ties between limited partners and general partners. Therefore, our results will not be driven by ties between general partners and limited partners that initiated long ago. Indeed, our results are similar with this setup. Similarly, if we include only observations where the time between a fund and its predecessor fund is more than five years, the results are similar. The shortcoming here, however, is that the sample size is less than half of the original model, which is why all of the coefficients are statistically insignificant.

5. Discussion

Our findings imply that when access to funds and general partners' track records are controlled for, limited partners are not able to choose better funds for their reinvestments. As such, there seems to be no indication that some limited partners are more skilled in selecting better performing funds for their reinvestments. Given that there are differences in the limited partner's returns (as is evident based on the Fig. 1, and as suggested by Lerner, Schoar, and Wongsunwai, 2007) and that these differences are nonexistent when the access and prior fund returns are controlled for as in this paper, we propose that the systematic differences in fund returns between different limited partners must be due to LPs having systematically different access to better-performing funds/GPs.

Because our results also show that limited partners are not able to increase their private equity fund portfolio returns by mere reinvestment decisions alone, we feel safe in arguing that

building access, either by investing in funds with no proven track record or otherwise proactively building relationships with other limited partners and general partners, is a crucial determinant of limited partners' overall private equity returns. This suggests that instead of focusing too heavily on reinvestment decisions, limited partners should focus on finding new general partners to invest in.

Our findings shed light on the puzzle of why any LP would invest in a GP without a proven track record even though such an investment has higher risks. Our results imply that such an investment could help the LP to secure access to the best future funds because being an investor in prior funds is the best way to gain access to subsequent funds. In the case of successful GPs, this could be the only way for most LPs to gain access to such a GP's new funds. Therefore, the simplest and most certain way for a limited partner to gain access to top tier GP's funds is by being an investor in that GP's first funds.

As such, the focus of private equity research and private equity practitioners should be on building access. Reinvestment decisions on most occasions can then be made based on performance, but building access to a new GP or finding suitable first funds is a much more difficult task. In cases where no track record is yet available, the investment decision is more difficult but, at the same time, has a more substantial impact on the LPs' portfolio returns. In cases where access needs to be made to funds with a top quartile GP, it requires substantial contact and communication, often along with one or more recommendations from within the private equity sector.

Furthermore, our results suggest that there is no significant institutional learning on either the GP or on the LP levels; the more funds that the LP has previously invested in or the more the

funds raised by the GP do not help the LPs to achieve better returns. Because the number of prior funds in which the LP has invested in also serves as a proxy of how many opportunities the LP has from which to choose his/her investments (at least if we assume that there is no difference in how often the GPs raise new funds), the portfolio size may have a positive effect on returns. However, even then, the effect is only due to LPs being better able to choose funds with high prior returns. This further supports our argument that limited partners are only able to get reinvestment returns that are, on average, close to the portfolio average. Because LPs with different portfolio sizes make approximately the same number of investments each year, if we would assume that some of the LPs are more skilled in selecting better opportunities (within a homogenous GP set), the LPs with most previous investments should be able to choose better investments and thus have higher overall returns. However, because this is not the case, we can confidently conclude that the LPs are not able to choose better investments.

Phalippou (2009) argues that with a sophisticated investor base, there is no persistence in fund returns.[6] However, based on our analysis of sophisticated investors, we find performance persistence and prior performance as important determinants of future performance (as is suggested by Phalippou and Gottschalg, 2009). Although we used only a proxy of the prior fund performance, our random effect on GPs was also statistically significant. If we interpret this as the skill of the GP, we can safely claim that GP skill (manifested most commonly in the prior fund performance) is an important determinant of future fund returns. Apart from prior fund returns, though, other determinants of fund returns are difficult to identify. If it were not difficult,

[6] Phalippou (2009) assumes that funds with higher returns are backed by more skilled investors. Our paper uses the term sophistication for all investors that have enough investments. While these definitions are not the same, we feel that our results do not fully support the previous findings.

we would expect to see better performance with the reinvested funds than with the non-reinvested funds.

Our findings also relate to prior research in a third way. In their paper, Kaplan and Schoar (2005) claim that better-performing GPs are more likely to raise follow-on funds and larger funds. This sounds rational, given the high persistence in fund returns. However, our results could indicate the causality here being of the opposite direction: better-performing GPs lure LPs to reinvest (and new LPs to invest) in the next fund, and these investors are more willing to invest more capital, thus enabling the GP to raise larger new funds (and perhaps even more often).[7]

An important question that remains is what determines the returns to GPs' first funds. Because these are the ones where the LPs have to make their decisions and (due to the reinvestment process) this return can be persistent, it is crucial to understand what differentiates a top-performing new GP from low performers. One explanation for the first funds returns is presented by Zarutskie (2010), who suggests that fund managers' human capital (measured as experience in the fund's target industry and in the venture capital industry, education, etc.) is one determinant of the successful exit rates of venture capital funds. Still, other factors are also at play here, and how they relate to this human capital aspect is unknown.

Other potential questions for future research could be to differentiate the institutional level skills of GPs and LPs from the skills of their professionals and observe the investment return at the level of individual professionals. This issue is also briefly discussed in Zarutskie (2010) but it

[7] LPs' dependence on prior fund returns might explain the anomaly in everyday private equity fund investing in which there seems to be only first-quartile (or upper-half) funds. This is because GPs know of the luring effect that a high prior fund performance has among the potential investors, and the GPs aim to find a measure according to which they can claim to be top fund managers.

still requires more careful analysis to be understood fully. By observing the investment behavior of certain individuals before and after changing their workplace from one LP to another and then by observing the returns that their investments have, we could answer two important questions. First, we could answer how personalized the access to funds is, i.e., whether we can even treat access as institutional-level concept if we do not control for the people working at the LP. Second, it would help us to answer how much of the LP returns is due to the skills of individuals working at the LP versus these peoples' access to better GPs. Furthermore, taking this individual professional approach to the GP level as well would enable an even more accurate explanation for the reinvestment decisions and their outcomes, and it could even help to explain the initial return differences between LPs.

6. Conclusions

A limited partner's private equity fund investment returns can be driven either by that limited partner's access to better-performing funds or by his/her skills in choosing better-performing funds among the funds to which he/she has access. While previous studies have favored the selection skill explanation, it is difficult to argue why systematic differences in the selection skills among limited partners could exist over long periods of time given the nature of private equity investing.

In this paper, we suggest that systematic differences in the returns that different limited partners achieve are not due to some limited partners having better skills in choosing their funds but rather due to some LPs having better access to general partners whose funds are more likely to produce high returns. With access and general partners' prior fund returns being controlled

for, funds reinvested in by the limited partners tend to produce similar returns as the funds in which they choose to not reinvest.

We also documented that limited partner experience and general partner experience do not have significant effect on the investment returns. The only variables that have a significant effect on the returns are the general partners' previous fund performances and the general partners themselves. This result is in line with previous studies that have found that general partner quality is practically the only ex ante known public determinant of a private equity fund's returns.

Appendix

To determine whether our results are driven by few extreme limited partners (LP), we conducted an LP-specific test on whether the LPs had higher returns on the funds in which they chose to reinvest or in which they chose not to reinvest. The results of this analysis are presented in Table A.1.

[Insert Table A.1 about here]

Table A.1 indicates that there are only a few LPs that have a statistically significant difference in the returns to reinvested and not reinvested funds with both return variables. The most clearly significant coefficients are negative. In only one case does a statistically significant difference in one return variable mean that the difference in the other return variable would also be statistically significant. This stresses the significance of using several return variables when analyzing private equity returns; results obtained with one return variable might not be confirmed with another return variable.

Another point to note in Table A.1 is that the LPs with a statistically significant (and positive) return difference (i.e., those LPs that have reinvested in better funds than those in which they have not reinvested) are not the ones with the most investments. More precisely, although this is not statistically significant, LPs with the most reinvestments and non-reinvestments also tend to have lower returns for their reinvested funds.

References

Baltagi, B.H., Song, S.H., Jung, B.C., 2001. The unbalanced nested error component regression model. Journal of Econometrics 101, 357-381.

Cochrane, J.H., 2005. The risk and return of venture capital. Journal of Financial Economics 75, 3-52.

Coller Capital, 2008. Coller Capital's Global Private Equity Barometer - Winter 2008-09.

Diller, C., Kaserer, C., 2009. What drives private equity returns? - Fund inflows, skilled GPs, and/or risk? European Financial Management 15, 643-675.

Gompers, P.A., 1996. Grandstanding in the venture capital industry. Journal of Financial Economics 42, 133-156.

Groh, A.P., Liechtenstein, H., 2009. The first step of the capital flow from institutions to entrepreneurs: the criteria for sorting venture capital funds. Unpublished working paper.

Hobohm, D., 2008. Investors in private equity funds: large-scale performance analysis and the question if location matters. Unpublished working paper.

Hochberg, Y.V., Ljungqvist, A., Lu, Y., 2010. Networking as a barrier to entry and the competitive supply of venture capital. The Journal of Finance 65, 829-859.

Kaplan, S.N., Schoar, A., 2005. Private equity performance: returns, persistence, and capital flows. Journal of Finance 60, 1791-1823.

Kaplan, S.N., Strömberg, P., 2009. Leveraged buyouts and private equity. Journal of Economic Perspectives 23, 121-146.

Lerner, J., Schoar, A., 2004. The illiquidity puzzle: theory and evidence from private equity. Journal of Financial Economics 72, 3-40.

Lerner, J., Schoar, A., Wongsunwai, W.A.N., 2007. Smart institutions, foolish choices: the limited partner performance puzzle. Journal of Finance 62, 731-764.

Ljungqvist, A., Hochberg, Y.V., Vissing-Jorgensen, A., 2009. Informational hold-up and performance persistence in venture capital. Unpublished working paper.

Ljungqvist, A., Richardson, M.P., 2003. The cash flow, return and risk characteristics of private equity. Unpublished working paper.

Lossen, U., 2006. The performance of private equity funds: does diversification matter? GESY Discussion Paper No. 192.

Mathonet, P.-Y., Meyer, T., 2007. J-Curve Exposure: Managing a Portfolio of Venture Capital and Private Equity Funds. John Wiley and Sons, Chichester, UK.

Meyer, T., Mathonet, P.-Y., 2005. Beyond the J Curve: Managing a Portfolio of Venture Capital and Private Equity Funds. John Wiley and Sons, Chichester, UK.

Phalippou, L., 2008. The hazards of using IRR to measure performance: the case of private equity. Unpublished working paper.

Phalippou, L., 2009. Venture capital funds: flow-performance relationship and performance persistence. Journal of Banking and Finance 34, 568-577.

Phalippou, L., Gottschalg, O., 2009. The performance of private equity funds. Review of Financial Studies 22, 1747-1776.

Preqin, 2009. 2009 Preqin Global Private Equity Review. Preqin Ltd., London.

Rabe-Hesketh, S., Skrondal, A., 2005. Multilevel and Longitudinal Modeling Using Stata. Stata Press, College Station, Texas.

Sahlman, W.A., 1990. The structure and governance of venture-capital organizations. Journal of Financial Economics 27, 473-521.

Sørensen, M., 2007. How smart is smart money? A two-sided matching model of venture capital. Journal of Finance 62, 2725-2762.

Zarutskie, R., 2010. The role of top management team human capital in venture capital markets: evidence from first-time funds. Journal of Business Venturing 25, 155-172.

Table 1

Entire sample summary statistics. The first four columns show descriptive statistics for the sample of re-investment decisions, where the limited partner (LP) has decided to invest in the fund, while columns 5-8 show the same statistics calculated for those observations where no reinvestment took place. LP experience is measured as the number of similar private equity funds in which the focal LP has invested over the prior years. Total number of funds set up by the focal general partner (GP) is represented by the GP experience. Vintage is the year when the fund started its operations. Fund size is a logarithm of the fund size measured in USD million. The LP-GP relationship tells how many of the focal GP's funds the LP invested in prior years. Fund returns (IRR) is the logarithm of the fund internal rate of return (IRR, but calculated as 1+IRR) as reported in the Preqin database in summer 2008. Prior fund returns (IRR) is the logarithm of the GP's previous fund's IRR (1+IRR) as reported in the Preqin database. Similarly, for funds with multiple information sources, the fund returns (multiple) is the logarithm of the return multiple reported in the Preqin database for the observation. Fund locations indicate the locations of funds as measured by the dummy variables. Similarly, fund type dummies indicate the fund types. Column 9 reports the difference in the means between the two populations, along with the significance level of a t-test for the difference. The sample size for reinvested funds with IRR information is 147 and for non-reinvested funds is 273. The sample size for observations with information on return multiples is 253 reinvested and 450 not reinvested. * denotes statistical significance at the 5% level, ** at the 1% level, and *** at the 0.1% level.

Panel A: Observations with Fund Returns in IRR

	Reinvested Funds				Not Reinvested Funds				Difference
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	
Fund return (IRR)	0.182	0.144	-0.14	0.61	0.150	0.150	-0.27	0.86	0.03*
Prior fund return (IRR)	0.175	0.171	-0.29	0.86	0.170	0.174	-0.27	0.99	0.01
LP experience	10.810	11.333	1	52	9.205	10.180	1	52	1.60
LP-GP relationship	2.170	1.776	1	11	1.553	1.137	1	9	0.62***
Fund size	7.174	1.375	3.22	9.16	6.468	1.594	2.64	9.16	0.71***
GP experience	5.476	6.040	1	25	7.136	6.918	1	25	-1.66*
Vintage	2001.007	3.437	1991	2005	2001.604	3.612	1991	2005	-0.60
Fund location: US	0.272	0.447	0	1	0.359	0.481	0	1	-0.09
Fund location: Europe	0.714	0.453	0	1	0.634	0.483	0	1	0.08
Fund location: RoW	0.014	0.116	0	1	0.007	0.085	0	1	0.01
Fund type: Buyouts	0.558	0.498	0	1	0.484	0.501	0	1	0.07
Fund type: Mezzanine	0.163	0.371	0	1	0.216	0.412	0	1	-0.05
Fund type: Fund-of-funds	0.170	0.377	0	1	0.231	0.422	0	1	-0.06
Fund type: Venture capital	0.007	0.082	0	1	0.022	0.147	0	1	-0.02
Fund type: Other	0.102	0.304	0	1	0.048	0.213	0	1	0.05*

Panel B: Observations with Fund Returns in Multiples

	Reinvested Funds				Not Reinvested Funds				Difference
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	
Fund return (multiple)	0.910	0.252	0.34	1.79	0.890	0.261	0.25	2.42	0.02
Prior fund return (multiple)	1.006	0.265	0.15	1.79	0.965	0.271	0.25	2.42	0.04*
2nd previous fund's return	1.028	0.299	0.15	1.98	1.050	0.334	0.25	2.68	-0.02
LP experience	10.277	10.255	1	52	8.560	9.724	1	52	1.72*
LP-GP relationship	2.308	1.714	1	13	1.420	0.919	1	10	0.89***
Fund size	6.882	1.452	1.79	9.12	6.482	1.489	2.64	9.12	0.40***
GP experience	5.387	5.073	2	25	5.153	4.350	2	22	0.23
Vintage	2001.470	3.278	1992	2005	2001.933	3.409	1991	2005	-0.46
Fund location: US	0.142	0.350	0	1	0.236	0.425	0	1	-0.09**
Fund location: Europe	0.854	0.354	0	1	0.758	0.429	0	1	0.10**
Fund location: RoW	0.004	0.063	0	1	0.007	0.081	0	1	0.00
Fund type: Buyouts	0.652	0.477	0	1	0.562	0.497	0	1	0.09*
Fund type: Mezzanine	0.138	0.346	0	1	0.176	0.381	0	1	-0.04
Fund type: Fund-of-funds	0.126	0.333	0	1	0.216	0.412	0	1	-0.09**
Fund type: Venture capital	0.012	0.108	0	1	0.020	0.140	0	1	-0.01
Fund type: Other	0.071	0.258	0	1	0.027	0.161	0	1	0.04**

Table 2

t-test for differences in annual returns to reinvested vs. not reinvested funds. This table reports average returns for all reinvestments and not reinvested observations. The comparison was done annually to control for the timing of the vintages because there are a different number of observations in reinvested and non-reinvested groups in different years. The returns are averaged over all limited partners. N indicates the number of observations in each category, and mean and Std. Dev. are calculated for the natural logarithms of the returns in observations. Difference is the difference in the means of the two populations. The last row is just for illustration, and it shows the average multiple in the two populations in the entire sample without a year control. In the IRR, we must note that the highly statistically significant differences during the first few years are simply the result of having few observations and very little variation between them. Apart from that, t-tests clearly indicate that the reinvestments do not have higher multiples than observations with no reinvestment. * denotes statistical significance at the 5% level, ** at the 1% level, and *** at the 0.1% level.

		Fund Returns in IRR				Fund Returns in Multiples			
Vintage	Reinvestment	Mean	Std. Dev.	*N*	Difference	Mean	Std. Dev.	*N*	Difference
1991	Not reinvested	0.225	0.001	5	0.002***	1.239	0.120	14	0.101**
	Reinvested	0.226	0.000	3		1.340	0.151	9	
1992	Not reinvested	0.236	0.072	10	0.172***	1.273	0.333	20	-0.028
	Reinvested	0.408	0.166	2		1.246	0.278	3	
1993	Not reinvested	-	-	0	-	1.278	0.171	3	-0.495**
	Reinvested	-	-	0		0.783	0.238	6	
1994	Not reinvested	0.331	0.152	2	-0.073	1.329	0.397	16	-0.060
	Reinvested	0.257	0.138	4		1.268	0.207	9	
1995	Not reinvested	0.168	0.033	4	0.179***	1.108	0.477	25	0.241
	Reinvested	0.347	0.020	2		1.349	0.632	13	
1996	Not reinvested	0.110	0.082	4	-0.006	1.009	0.170	8	-0.032
	Reinvested	0.104	0.000	4		0.977	0.150	10	
1997	Not reinvested	0.183	0.218	6	0.124	0.937	0.282	50	0.035
	Reinvested	0.306	0.231	7		0.972	0.196	30	
1998	Not reinvested	0.080	0.149	14	0.032	0.775	0.315	47	0.105
	Reinvested	0.112	0.050	7		0.880	0.196	27	
1999	Not reinvested	0.047	0.160	16	0.063	0.846	0.335	60	-0.021
	Reinvested	0.111	0.135	9		0.825	0.200	38	
2000	Not reinvested	0.143	0.099	27	-0.013	0.914	0.244	72	-0.005
	Reinvested	0.130	0.130	20		0.908	0.299	45	
2001	Not reinvested	0.211	0.138	23	-0.043	0.931	0.209	100	-0.029
	Reinvested	0.168	0.125	23		0.902	0.183	61	
2002	Not reinvested	0.123	0.157	25	0.120*	0.881	0.191	110	0.051
	Reinvested	0.243	0.124	9		0.932	0.195	45	
2003	Not reinvested	0.201	0.131	31	-0.054	0.851	0.132	110	0.006
	Reinvested	0.147	0.070	15		0.857	0.118	43	
2004	Not reinvested	0.171	0.112	23	0.068	0.883	0.205	123	0.037
	Reinvested	0.239	0.189	11		0.921	0.243	63	
2005	Not reinvested	0.130	0.171	83	0.055	0.746	0.132	226	0.065
	Reinvested	0.186	0.152	31		0.812	0.176	99	
Total	Not reinvested	0.150	0.150	273	0.032	0.880	0.256	984	0.033
	Reinvested	0.182	0.144	147		0.910	0.252	501	

Table 3

Multilevel mixed-effects regression without correction for sample selection. The Table III shows the estimates for multilevel mixed-effects regression model on fund returns reported in Private Equity Intelligence database (Preqin), measured as the logarithm of internal rate of returns (IRRs) in Models 1 and 2, and in the logarithm of multiples in Models 3-5. LP reinvested is a dummy variable indicating whether the limited partner (LP) reinvested (indicated by 1) or not (0) to the fund in the observation. Prior fund return is the natural logarithm of the focal general partner's (GP) previous fund's return (again in the logarithm of IRRs in Models 1 and 2 and in multiples in Models 3-5). Second previous fund's return indicates focal GP's second previous funds' return measured in multiples (no such IRR model is available due to the IRR sample being too small). GP experience is the number of the same type of funds the GP has set up during previous years. Fund size is the logarithm of fund size in USD million as reported on Preqin. The LP-GP relationship is the number of the GP's similar funds in which the focal LP has invested during previous years. LP experience is the overall number of same type of private equity funds in which the LP has invested during previous years. Fund type is the dummy variable for fund types, while category labeled 'other funds' is the default. Fund locations are dummy variables indicating fund locations, with the category "Rest of the World" being the default. In Models 1 and 3, we did not control for previous performance, whereas in Models 2 and 4, we did. In Model 5, we also controlled for the second previous fund's returns. In Models 3-5 we have controls for vintages from 1992 to 2005 (1991 being default), but these are not included in the Table. † denotes statistical significance at the 10% level, * at the 5% level, ** at the 1% level, and *** at the 0.1% level.

	Dependent variable				
	IRR		Multiple		
Fixed Effects	Model 1	Model 2	Model 3	Model 4	Model 5
LP reinvested	0.019†	0.017	0.004	-0.007	0.002
	(0.011)	(0.014)	(0.011)	(0.011)	(0.012)
Prior fund returns (IRR)	-	0.046	-	-	-
	-	(0.038)	-	-	-
Prior fund return (multiple)	-	-	-	-0.011	-0.022
	-	-	-	(0.024)	(0.039)
2nd previous fund's returns (multiple)	-	-	-	-	0.149***
	-	-	-	-	(0.030)
LP experience	0.000	0.000	0.000	0.000	0.009†
	(0.000)	(0.001)	(0.001)	(0.001)	(0.005)
LP-GP relationship	-0.007†	-0.005	-0.002	0.006	0.000
	(0.003)	(0.005)	(0.003)	(0.004)	(0.001)
GP experience	-0.002	0.000	0.000	-0.001	0.005
	(0.001)	(0.002)	(0.002)	(0.002)	(0.004)
Fund size	0.012*	0.006	0.015**	-0.003	-0.069***
	(0.005)	(0.007)	(0.006)	(0.007)	(0.010)
Fund location: US	-0.093	-0.182*	-0.019	-0.042	0.127
	(0.088)	(0.086)	(0.112)	(0.122)	(0.149)
Fund location: Europe	-0.075	-0.157†	-0.012	-0.026	0.091
	(0.088)	(0.085)	(0.111)	(0.121)	(0.150)
Fund type: Buyout	0.110***	0.071*	0.079***	0.102**	0.157*
	(0.026)	(0.035)	(0.025)	(0.035)	(0.064)
Fund type: Mezzanine	-0.006	-0.049	-0.147***	-0.174***	-0.224***
	(0.028)	(0.039)	(0.028)	(0.035)	(0.067)
Fund type: Fund-of-funds	0.040	0.006	-0.052	0.007	-0.156†
	(0.036)	(0.046)	(0.033)	(0.046)	(0.086)
Fund type: Venture capital	-0.036	-0.014	-0.039	-0.058	-0.030
	(0.049)	(0.059)	(0.047)	(0.052)	(0.071)
Random Effects	Model 1	Model 2	Model 3	Model 4	Model 5
LP	0.001	0.000	0.004	0.003	0.001
	(0.005)	(0.028)	(0.004)	-	(0.005)
GP	0.096	0.070	0.136	0.146	0.177
	(0.010)	(0.011)	(0.011)	-	(0.019)
Residual	0.129	0.123	0.164	0.152	0.131
	(0.003)	(0.005)	(0.003)	-	(0.004)
N	902	420	1485	1075	703

Table 4

Sample selection regression model. The Table 4 shows estimates for the Probit estimation of the selection model for both return variables. These estimates are used for the calculation of lambdas in Table 5. Fund size represents fund size in million USD. GP's previous fund's performance is a binary variable indicating whether the General partner's (GP) previous fund's return is reported in the Preqin database. Number of LPs in the fund indicates the number of limited partners (LP) in our sample that invested in the focal fund. Subsequent fund raised by the GP is a binary variable indicating whether the general partner raised any following funds after the focal fund. Fund location: US controls for funds located in the US, while Fund location: Europe controls for funds located in Europe. The base case is funds located in the rest of the world. Fund type control variables control for the respective types of funds with the remaining types of funds being included in the base case. Additionally, vintages were controlled for in the estimation, although these coefficients are not reported in the table. † denotes statistical significance at the 10% level, * at the 5% level, ** at the 1% level, and *** at the 0.1% level.

	Dependent variable	
	IRR reported	Multiple reported
Fund size	0.000***	0.000**
	(0.000)	(0.000)
GP's previous fund's returns reported	1.065***	1.116***
	(0.079)	(0.079)
Number of LPs in the fund	0.041*	0.226***
	(0.020)	(0.027)
Subsequent fund raised by the GP	0.017	0.029
	(0.106)	(0.103)
Fund location: US	0.281†	0.212
	(0.164)	(0.165)
Fund location: Europe	-0.465**	-0.365*
	(0.168)	(0.167)
Fund type: Buyout	0.324**	0.065
	(0.122)	(0.123)
Fund type: Mezzanine	0.257	0.090
	(0.188)	(0.186)
Fund type: Fund-of-funds	0.005	-0.050
	(0.136)	(0.137)
Fund type: Venture capital	0.089	-0.039
	(0.124)	(0.123)
N	1691	1691

Table 5

Multilevel mixed-effects regression with correction for sample selection. The Table 5 shows the estimates for multilevel mixed-effects regression model on fund returns reported in Private Equity Intelligence database (Preqin), measured as the logarithm of internal rate of returns (IRRs) in Models 1 and 2, and in the logarithm of multiples in Models 3-5. The model incorporates Heckman-like correction for sample selection. LP reinvested is a dummy variable indicating whether the limited partner (LP) reinvested (indicated by 1) or not (0) to the fund in the observation. Prior fund return is the natural logarithm of the focal general partner's (GP) previous fund's return (again in the logarithm of IRRs in Models 1 and 2 and in multiples in Models 3-5). Second previous fund's return indicates focal GP's second previous funds' return measured in multiples (no such IRR model is available due to the IRR sample being too small). GP experience is the number of the same type of funds the GP has set up during previous years. Fund size is the logarithm of fund size in USD million as reported on Preqin. The LP-GP relationship is the number of the GP's similar funds in which the focal LP has invested during previous years. Lambda is calculated for each observation based on the selection regression model presented in Table 4 and effectively gives the likelihood for such an observation to be included in the analysis. LP experience is the overall number of same type of private equity funds in which the LP has invested during previous years. Fund type is the dummy variable for fund types, while category labeled 'other funds' is the default. Fund locations are dummy variables indicating fund locations, with the category "Rest of the World" being the default. In Models 1 and 3, we did not control for previous performance, whereas in Models 2 and 4, we did. In Model 5, we also controlled for the second previous fund's returns. In Models 3-5 we have controls for vintages from 1992 to 2005 (1991 being default), but these are not included in the Table. † denotes statistical significance at the 10% level, * at the 5% level, ** at the 1% level, and *** at the 0.1% level.

	Dependent variable				
	IRR		Multiple		
Fixed Effects	Model 1	Model 2	Model 3	Model 4	Model 5
LP reinvested	0.017†	0.011	0.003	-0.000	0.004
	(0.011)	(0.015)	(0.011)	(0.011)	(0.013)
Prior fund returns (IRR)	-	0.047	-	-	-
	-	(0.038)	-	-	-
Prior fund return (multiple)	-	-	-	0.001	-0.017
	-	-	-	(0.025)	(0.040)
2nd previous fund's returns (multiple)	-	-	-	-	0.149***
	-	-	-	-	(0.030)
LP experience	0.000	0.000	-0.000	-0.000	-0.000
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
LP-GP relationship	-0.007*	-0.005	-0.002	0.005	0.008†
	(0.003)	(0.005)	(0.003)	(0.004)	(0.005)
GP experience	-0.001	0.001	0.000	-0.001	0.004
	(0.001)	(0.002)	(0.002)	(0.002)	(0.004)
Lambda (from selection model)	-0.027†	-0.059*	-0.009	0.134	0.061
	(0.015)	(0.024)	(0.019)	(0.054)*	(0.064)
Fund size	0.008	-0.002	0.013*	0.009	-0.062***
	(0.001)	(0.007)	(0.007)	(0.008)	(.0.011)
Fund location: US	-0.093	-0.187*	-0.018	-0.033	0.128
	(0.088)	(0.084)	(0.111)	(0.120)	(0.147)
Fund location: Europe	-0.065	-0.143†	-0.012	-0.020	0.091
	(0.088)	(0.084)	(0.111)	(0.120)	(0.147)
Fund type: Buyout	0.103***	0.056	0.079**	0.098**	0.154*
	(0.026)	(0.035)	(0.025)	(0.035)	(0.063)
Fund type: Mezzanine	-0.010	-0.058	-0.149***	-0.179***	-0.223**
	(0.028)	(0.039)	(0.028)	(0.035)	(0.067)
Fund type: Fund-of-funds	0.035	-0.001	-0.053	0.000	-0.154†
	(0.036)	(0.035)	(0.033)	(0.046)	(0.085)
Fund type: Venture capital	-0.053	-0.039	-0.040	-0.071	-0.038
	(0.050)	(0.059)	(0.047)	(0.052)	(0.072)
Random Effects	Model 1	Model 2	Model 3	Model 4	Model 5
LP	0.001	0.000	0.004	0.002	0.001
	-	(0.021)	-	(0.005)	-
GP	0.095	0.068	0.136	0.144	0.174
	-	(0.011)	-	(0.013)	-
Residual	0.129	0.123	0.164	0.152	0.131
	-	(0.005)	-	(0.003)	-
N	902	420	1485	1075	703

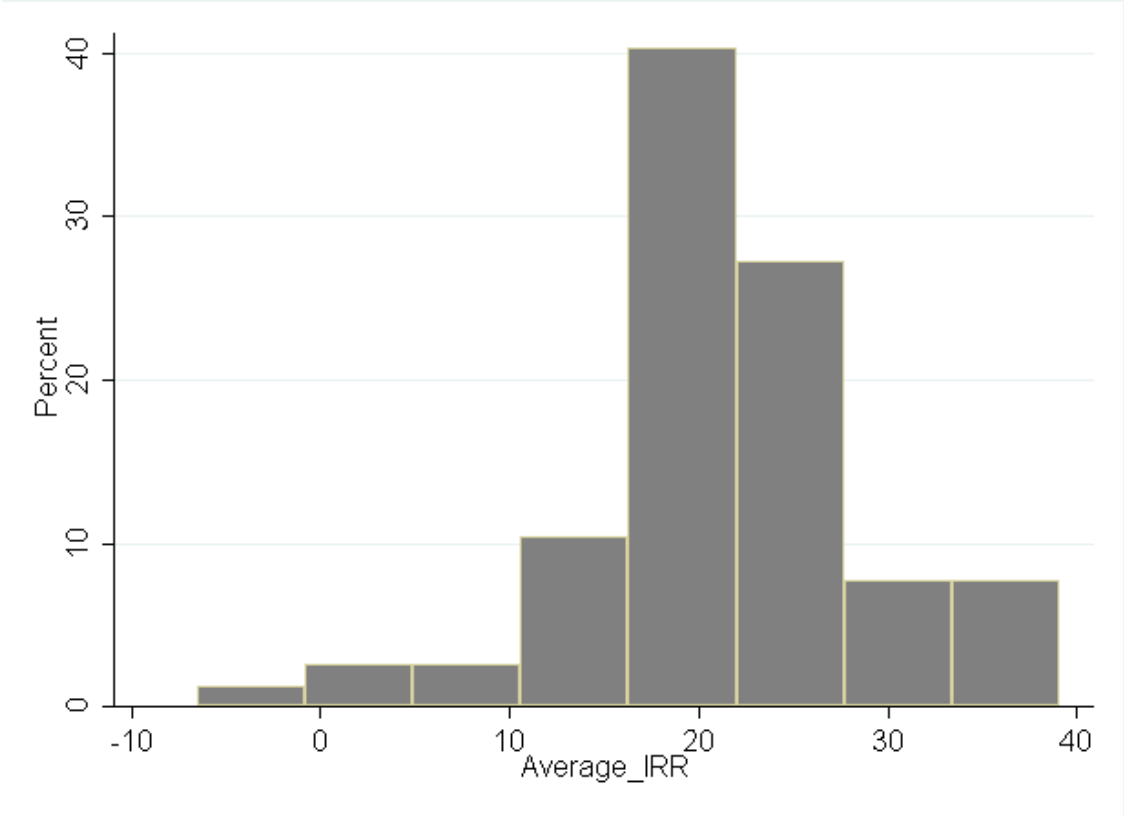

Fig. 1. Histogram of Limited Partners' Average Returns. Histogram of limited partners' portfolios' average internal rate of return (IRR). Funds were included in the calculation if their vintage year is before 2005, and limited partners were included if they had at least three funds in their portfolio. The table contains information on 76 limited partner's average portfolio returns. The number of funds in each portfolio ranges from three to 73.

Table A.1

t-test for LP-specific differences in returns from reinvested vs. not reinvested funds. The table reports LP-specific calculations for the differences in the limited partner's (LP's) returns to funds in which he/she has reinvested as opposed to funds in which he/she has chosen not to reinvest. In order for an LP to qualify for this comparison, we required that he/she has at least two reinvestments and two non-reinvestments between 1991 and 2005 in observations for which we have return information. The first four columns are for fund returns in IRR, and the next four columns are for fund returns in multiples. With multiples, we did not control for vintage, so there may be some bias due to LPs' reinvestments being from a different year than the non-reinvestments. Due to slight variation in the available information, some LPs might be included only in the other comparison. The fund returns are the logarithm of the corresponding return, as reported on the Preqin database. LP reinvested indicates whether the statistics are calculated for the reinvestments or non reinvestments. Difference is for the difference in means for the LP in the two populations. Stars indicate the statistical significance of a simple t-test for the difference in means. The lowest two rows indicate averages over populations and their standard deviations (where each LP is treated as a single observation). Neither of the population-level averages is different from zero with standard significance levels. * denotes statistical significance at the 5% level, ** at the 1% level, and *** at the 0.1% level.

		Fund Returns in IRR				Fund Returns in Multiples			
	Reinvestment	Mean	Std. Dev.	*N*	Difference	Mean	Std. Dev.	*N*	Difference
LP1	Not reinvested	0.108	0.098	20	0.021	0.819	0.209	33	0.002
	Reinvested	0.130	0.081	5		0.821	0.066	9	
LP2	Not reinvested	0.110	0.061	8	0.121*	0.811	0.130	11	0.022
	Reinvested	0.231	0.186	13		0.833	0.245	24	
LP3	Not reinvested	0.121	0.318	7	0.028	0.809	0.500	16	-0.012
	Reinvested	0.149	0.157	4		0.796	0.247	10	
LP4	Not reinvested	0.120	0.081	5	-0.008	0.754	0.245	11	0.039
	Reinvested	0.112	0.054	4		0.793	0.049	4	
LP5	Not reinvested	0.244	0.114	2	0.027	0.938	0.294	4	0.175
	Reinvested	0.271	0.113	3		1.113	0.096	3	
LP6	Not reinvested	0.080	0.022	2	0.085	0.776	0.063	11	-0.081
	Reinvested	0.166	0.229	2		0.695	0.254	5	
LP7	Not reinvested	0.229	0.191	7	-0.101	0.801	0.198	13	0.068
	Reinvested	0.128	0.115	4		0.869	0.271	9	
LP8	Not reinvested	0.181	0.122	6	-0.035	0.857	0.289	10	0.124
	Reinvested	0.146	0.135	2		0.981	0.345	4	
LP9	Not reinvested	-	-	-	-	0.766	0.084	12	0.316*
	Reinvested	-	-	-		1.082	0.241	5	
LP10	Not reinvested	-	-	-	-	0.788	0.100	2	0.051
	Reinvested	-	-	-		0.840	0.085	2	
LP11	Not reinvested	0.170	0.146	3	0.184	0.790	0.166	8	0.027
	Reinvested	0.354	0.063	2		0.817	0.099	4	
LP12	Not reinvested	-	-	-	-	0.680	0.147	2	-0.004
	Reinvested	-	-	-		0.676	0.222	2	
LP13	Not reinvested	-	-	-	-	0.736	0.107	5	0.448
	Reinvested	-	-	-		1.184	0.254	2	
LP14	Not reinvested	0.140	0.106	15	0.080	0.896	0.206	26	0.479
	Reinvested	0.219	0.116	3		1.375	0.442	3	
LP15	Not reinvested	0.142	0.171	31	0.004	0.824	0.177	46	0.112
	Reinvested	0.146	0.109	9		0.936	0.237	10	
LP16	Not reinvested	0.071	0.124	9	0.141*	0.787	0.283	12	0.074
	Reinvested	0.212	0.145	10		0.861	0.214	23	
LP17	Not reinvested	0.126	0.179	19	0.100	0.860	0.224	41	0.152*
	Reinvested	0.226	0.124	19		1.012	0.382	47	
LP18	Not reinvested	0.195	0.224	5	0.051	1.225	0.456	5	-0.269
	Reinvested	0.246	0.246	4		0.956	0.231	4	
LP19	Not reinvested	0.129	0.140	20	0.078	0.826	0.209	34	0.129
	Reinvested	0.208	0.141	9		0.955	0.170	10	
LP20	Not reinvested	0.153	0.132	6	0.012	0.839	0.318	12	0.197
	Reinvested	0.164	0.176	8		1.036	0.392	11	
LP21	Not reinvested	0.101	0.080	5	-0.031	0.786	0.209	5	-0.120
	Reinvested	0.070	0.284	5		0.665	0.079	4	
LP22	Not reinvested	0.205	0.210	27	0.024	0.972	0.318	36	-0.084
	Reinvested	0.229	0.165	16		0.889	0.275	37	
LP23	Not reinvested	0.155	0.136	9	0.125	0.791	0.103	10	0.369*
	Reinvested	0.280	0.168	2		1.160	0.197	4	
LP24	Not reinvested	-	-	-	-	0.788	0.100	2	-0.014
	Reinvested	-	-	-		0.774	0.091	4	

(continued)

Table A.1–Continued

		Fund Returns in IRR				Fund Returns in Multiples			
	Reinvestment	Mean	Std. Dev.	*N*	Difference	Mean	Std. Dev.	*N*	Difference
LP25	Not reinvested	0.048	0.157	4	0.160	0.831	0.161	11	0.029
	Reinvested	0.207	0.186	5		0.860	0.183	13	
LP26	Not reinvested	-	-	-	-	1.047	0.376	11	-0.562***
	Reinvested	-	-	-		0.485	0.013	2	
LP27	Not reinvested	-	-	-	-	0.788	0.100	2	-0.014
	Reinvested	-	-	-		0.774	0.091	4	
LP28	Not reinvested	0.419	0.317	4	-0.295	1.036	0.263	8	-0.046
	Reinvested	0.124	0.044	2		0.990	0.334	3	
LP29	Not reinvested	0.196	0.093	6	-0.072	0.818	0.016	5	-0.026
	Reinvested	0.124	0.056	4		0.792	0.060	3	
LP30	Not reinvested	0.176	0.182	54	0.023	0.945	0.269	75	0.092
	Reinvested	0.199	0.143	13		1.036	0.364	18	
LP31	Not reinvested	-	-	-	-	0.867	0.121	4	0.077
	Reinvested	-	-	-		0.944	0.169	4	
LP32	Not reinvested	-	-	-	-	0.552	0.128	5	0.236*
	Reinvested	-	-	-		0.788	0.131	6	
LP33	Not reinvested	-	-	-	-	0.980	0.223	11	-0.008
	Reinvested	-	-	-		0.973	0.008	2	
LP34	Not reinvested	0.067	0.133	8	0.096	0.765	0.090	8	0.072
	Reinvested	0.163	0.007	2		0.837	0.006	2	
LP35	Not reinvested	0.215	0.090	5	-0.323**	0.797	0.053	6	-0.270
	Reinvested	-0.108	0.049	2		0.527	0.171	3	
LP36	Not reinvested	-	-	-	-	0.719	0.088	13	0.306
	Reinvested	-	-	-		1.025	0.328	3	
LP37	Not reinvested	-	-	-	-	0.748	0.047	5	-0.004
	Reinvested	-	-	-		0.744	0.030	2	
LP38	Not reinvested	0.128	0.115	6	-0.014	-	-	-	-
	Reinvested	0.114	0.070	2		-	-	-	
LP39	Not reinvested	0.125	0.154	17	0.071	0.834	0.247	24	0.195*
	Reinvested	0.196	0.143	7		1.028	0.168	7	
LP40	Not reinvested	-	-	-	-	0.731	0.075	4	0.048
	Reinvested	-	-	-		0.779	0.133	3	
LP41	Not reinvested	0.109	0.222	10	0.188*	0.819	0.282	15	0.182*
	Reinvested	0.297	0.194	15		1.001	0.173	18	
LP42	Not reinvested	0.116	0.126	13	0.042	0.970	0.330	14	-0.131
	Reinvested	0.157	0.117	3		0.839	0.255	8	
LP43	Not reinvested	0.071	0.045	5	0.068	0.753	0.085	9	0.015
	Reinvested	0.139	0.073	2		0.768	0.084	3	
LP44	Not reinvested	0.100	0.122	4	0.242*	0.950	0.277	7	0.094
	Reinvested	0.342	0.066	3		1.044	0.054	3	
LP45	Not reinvested	0.240	0.217	20	-0.179	0.983	0.342	23	-0.078
	Reinvested	0.060	0.063	2		0.905	0.161	14	
LP46	Not reinvested	0.091	0.183	5	-0.006	0.882	0.204	14	-0.097
	Reinvested	0.085	0.034	2		0.785	0.069	5	
LP47	Not reinvested	-	-	-	-	0.798	0.101	9	0.009
	Reinvested	-	-	-		0.807	0.204	2	
LP48	Not reinvested	0.155	0.114	6	-0.001	0.888	0.377	8	0.087
	Reinvested	0.155	0.123	2		0.975	0.356	2	
LP49	Not reinvested	0.090	0.062	6	0.096	0.779	0.192	13	0.194
	Reinvested	0.186	0.194	3		0.973	0.263	6	
LP50	Not reinvested	0.168	0.189	47	-0.025	0.911	0.252	66	-0.002
	Reinvested	0.143	0.164	45		0.909	0.260	62	
LP51	Not reinvested	-	-	-	-	0.860	0.178	3	-0.098
	Reinvested	-	-	-		0.762	0.048	3	
LP52	Not reinvested	0.182	0.268	6	0.037	0.874	0.192	7	-0.007
	Reinvested	0.219	0.112	8		0.866	0.162	12	