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Size, Returns, and Value: Do Private Equity Firms Allocate Capital According to Manager Skill?

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ABSTRACT

Using a novel data set linking private equity (PE) deals to individual managers, we document evidence of manager skill in terms of generating net present value (NPV), a performance measure that captures both scale and returns. PE firms have strong economic incentives to raise larger funds and execute larger deals. While relative returns decline with scale, NPV persists and even increases. Skilled managers are entrusted with more capital and achieve better career outcomes, and approximately 40% of NPV is attributable to internal capital allocation decisions. These findings highlight the role of PE firms in creating value through performance-based capital deployment.

THE PRIVATE EQUITY (PE) SECTOR HAS expanded dramatically in recent decades, with leveraged buyout (LBO) fund assets under management (AUM) rising from just over $300 billion in 2000 to nearly $2.4 trillion by 2020.[1] Much of this expansion is due to existing funds becoming larger: The 20 largest funds raised $66 billion in 2000 compared to $162 billion in 2020. Substantial capital inflows create challenges for both investors and fund managers. In the context of mutual funds, Berk and Green (2004) argue that, in an efficient market, skilled fund managers either attract more capital, and experience

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[1] In this paper we equate PE with buyout funds (in contrast to venture capital [VC] funds). AUM include the value of existing investments in portfolio companies and the amount raised from investors that has not yet been invested (known as "dry powder"). We include dry powder because fees are earned on such capital commitments. The AUM estimates are derived from Burgiss-MSCI.

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diseconomies of scale, or maintain fund size, and increase their fees. Berk and van Binsbergen (2015) find evidence that skilled managers continue to increase gross value-added in dollar terms as their relative performance wanes. However, the complex interplay between skill, scalability, and returns renders it difficult for investors to allocate their funds optimally (Zhu (2018), Barras, Gagliardini, and Scaillet (2022)). These issues may be even more relevant in PE, where investors make long-term funding commitments, information about individual manager skill is particularly scarce (Korteweg and Sorensen (2017)), and the controlling stakes that LBO funds typically take in portfolio companies provide more opportunities to generate value.

Building on existing mutual fund literature, in this paper we address the following questions. First, as PE funds scale, what is the appropriate way to measure performance and skill? Second, given the challenges of deploying larger amounts of capital, is there evidence of skill at the individual manager level? And, third, do PE firms use private information about past performance to allocate more capital to higher performing managers, and, if so, to what extent do such capital allocation decisions contribute to value creation?[2]

We calculate both relative returns, using public market equivalent (PME) returns (Kaplan and Schoar (2005)), and net present value (NPV), which combines the impact of performance and scale. One advantage of the PE setting is its "buy-to-sell" nature—deals are time-limited, and so realized deals' NPVs can be calculated without having to make assumptions about terminal values. We employ discount rates based on public market returns, with a premium for leverage and illiquidity. Consequently, the NPVs we estimate are similar to scale-adjusted PMEs.[3]

Our results reveal that, at the fund level, average returns have declined, and the dispersion of returns has narrowed, as funds have grown larger. This result is consistent with previous findings of waning performance persistence in buyouts (Braun, Jenkinson, and Stoff (2017), Harris et al. (2023)). Larger funds do larger deals, rather than significantly more deals. Since larger deals do not require proportionately larger deal teams, there are significant operational economies of scale associated with running a larger fund. The individuals managing larger funds may therefore earn considerably higher remuneration, given the observed invariance in fund economics. The main challenge is how to grow fund size while minimizing the impact on returns.

We find that fund-level NPV has generally increased as PE firms raise successively larger funds. By contrast, in the time series, we find that for funds formed between 2005 and 2010, the mean and median fund NPV fell slightly as funds roughly doubled in size relative to the previous five-year period. This result demonstrates the potential pitfall of raising ever-larger

[2] We use "PE firm" to differentiate the organization from the individual managers who work for the organization or from the funds they raise. The PE firm will be the general partner (GP) of a series of funds, but since individuals are often also referred to as GPs, we avoid using this term.

[3] Standard PMEs discount capital contributions and distributions using an equity market return. We assume that the discount rates relevant to PE are somewhat higher, reflecting the generally higher leverage and illiquidity.

funds. In contrast to PME persistence, which has waned as funds have become larger, we find that NPV persistence has increased in terms of both economic magnitude and significance over time.[4]

At the deal level, we find that the nature of persistence has changed over time. In the early part of our sample period, relative PME returns are persistent across successive deals by the same manager. However, as deals became larger, such PME persistence has disappeared and has been replaced by strong evidence of individual managerial skill in terms of ability to generate NPV. We apply the approach developed by Barras, Gagliardini, and Scaillet (2022), in the context of mutual funds, to the PE setting and find that 79% of managers exhibit a positive skill coefficient. The scalability parameter is negative in 74% of cases, suggesting that diseconomies of scale in PE are somewhat less severe than in mutual funds.

We next find that managers who generate higher NPV relative to their peers are subsequently entrusted with more capital. Specifically, outperformers manage 20% more capital than managers with a below-average track record within the same organization. This suggests that PE organizations reallocate capital across managers to mitigate the impact of scale on returns.

Allocation of capital within a fund focuses on the intensive margin, but we also examine the extensive margin by analyzing whether our measure of skill affects career progression. Although turnover rates are generally very low in our sample, underperforming managers are more than twice as likely to leave their current firm relative to more successful managers. In contrast, outperforming managers are 37% more likely to be promoted to a partner position.

Finally, we examine the PE firm's contribution, by its capital allocation decisions, to NPV. Berk, van Binsbergen, and Liu (2017) show that capital reallocation decisions by mutual fund organizations create roughly 30% of the total value-added of the industry. Ex ante, one might expect a more important role for capital allocation decisions by PE firms given the closed-end nature of the funds, as investors cannot themselves withdraw or increase capital upon observing performance. It also seems likely that information asymmetries regarding managerial skill could be more significant for investors in private markets. Countervailing effects, however, could reduce the role of capital allocation decisions. Deal size is largely exogenous in the sense that investment managers' deal sourcing relies on investment opportunities that are available and can be won in potentially competitive processes. The PE firm's investment committee also has to approve the deal. Capital allocation decisions therefore depend on the quality and size of the deals being proposed by individual managers, as well as their ability to convince the PE firm to back them. Despite

[4] Investors seeking to increase their allocation to PE may find the greater capacity of larger funds, along with the lower risk and return, attractive, especially if they have limits on personnel that make investing in many smaller funds infeasible. Significant due diligence, legal, and monitoring costs are incurred by limited partners (LPs) when investing in a fund. Therefore, if investors want to increase their investments in PE without increasing allocations to larger funds, this would involve more staff being employed. Many LPs, particularly public pension schemes, operate with few investment professionals and with limited budgets.

capital allocation decisions being more complex than in the mutual fund family context, we find a similar—and indeed slightly more important—role for PE organizations, with around 40% of NPV from such capital allocation decisions.

Our ability to address the issues of managerial skill, scalability, and capital allocation relies on unique deal-level data that allow us to identify the individual managers responsible for a deal. We employ a proprietary data set covering 12,910 unique deals undertaken by 309 PE firms across 940 PE funds. This is an updated version of the data set previously used by Braun, Jenkinson, and Stoff (2017) and Braun, Jenkinson, and Schemmerl (2020). For each deal, we observe the cash committed to the investment and the cash returned to the fund, as well as, in the case of unrealized deals, the remaining fair value. These data allow us to compute gross returns and NPVs, which can then be cumulated into fund-level gross returns and NPVs. We augment this data set with new, hand-collected data on 3,857 individual managers who are identified as leading deals. This information is particularly challenging to assemble, and, despite employing several different data sources, is not always available.

One important challenge in using data that attribute deals to individuals is the possibility of backfilling and survivorship bias, that is, claiming responsibility for deals that turned out well and denying involvement with the bad deals. We take this concern seriously and therefore rely on various sources for deal attribution data. For a subset of the sample, we obtain data in which individuals are identified as managing deals well before the outcome is known. The similarity of the results for this sample suggests that our findings are robust to such concern.

Our paper contributes to several strands of the literature. We draw heavily on the mutual fund literature on the interplay of scalability, skill, and performance measurement.[5] However, the main contributions of our paper are to strands of the PE literature on performance persistence (Kaplan and Schoar (2005), Hochberg, Ljungqvist, and Vissing-Jørgensen (2014), Braun, Jenkinson, and Stoff (2017), Korteweg and Sorensen (2017), Korteweg (2019), Gupta and van Nieuwerburgh (2021), Harris et al. (2023)), fund manager economics (Metrick and Yasuda (2010), Chung et al. (2012)), and the impact of fund size on returns.[6] This paper provides a link between scale and falling persistence in relative returns by focusing on NPVs.

[5] A large literature examines diseconomies of scale in the mutual fund setting. While earlier literature finds mixed evidence (e.g., Chen et al. (2004), Elton, Gruber, and Blake (2012), Ferreira et al. (2013), Pástor, Stambaugh, and Taylor (2015)), more recent studies find robust evidence of negative diseconomies of scale (Zhu (2018), Harvey and Liu (2021), van Binsbergen, Kim, and Kim (2021), Barras, Gagliardini, and Scaillet (2022), Pástor et al. (2022)).

[6] The PE literature finds mixed evidence regarding (dis)economies of scale. Robinson and Sensoy (2016) find a positive association between fund size and fund returns, while Kaplan and Schoar (2005), Robinson and Sensoy (2013), Harris, Jenkinson, and Kaplan (2014), and Ljungqvist, Richardson, and Wolfenzon (2020) document no significant effect. Humphery-Jenner (2012), Lerner et al. (2022), and Lopez-de-Silanes, Phalippou, and Gottschalg (2015) find diseconomies of scale. The latter paper also finds that the greater the *number* of investments held by a PE firm at any time, the lower the returns.

We also contribute to the literature on the importance of the individual relative to the organization, drawing on the work of Bertrand and Schoar (2003) and Ewens and Rhodes-Kropf (2015). The latter paper, which investigates the importance of VC firms by looking at managers who switch firms, motivates part of our analysis. Finally, our paper is relevant to research on internal capital and labor markets.[7] We show how PE fund practices can mitigate some of the inefficiencies documented in diversified firms. Specifically, the allocation of larger deals to skilled managers aligns incentives and ensures that capital is allocated based on performance rather than internal politics, reducing the risk of rent-seeking behavior and inefficient resource distribution (Scharfstein and Stein (2000)). These findings are in line with Jensen's (1989) observation that the LBO model employs pay-for-performance compensation systems for company managers who limit cross-subsidization and the waste of free cash flow.

The remainder of the paper proceeds as follows. In Section I, we discuss the incentives that PE firms face and the measurement of individual manager skill. In Section II, we describe our data and discuss general trends relating to size and returns. Section III analyzes the fund-level relationship between size, relative performance, and NPV. We then shift the focus to the manager-deal level. In Section IV, we test for skill at the individual manager level. In Section V, we analyze whether our NPV-based measure of individual manager skill influences the amount of capital allocated to individual managers, and whether it is correlated with internal labor market outcomes (promotion, exit, etc.). We also estimate the effect capital allocation has on PE firms' ability to continue to grow NPV as they raise larger funds. Section VI concludes.

I. Incentives, Skill, and Capital Allocation

In this section, we start by discussing the incentives PE firms face and how performance may depend on the scale of investment. We then discuss how individual skill can be measured in the context of PE, and the role PE firms may play in allocating capital.

A. Incentives

PE firms are financial intermediaries that raise and manage funds on behalf of investors. They identify companies to acquire and arrange debt financing for these investments alongside the equity committed to the fund by investors. As compensation for their services, PE firms earn a management fee, usually 1.5% to 2% of committed capital for the first four or five years (the investment period), after which the fee is based on net invested capital for the remainder

[7] Early literature mostly investigates capital allocation decisions (e.g., Lamont (1997), Shin and Stulz (1998), Maksimovic and Phillips (2002), and Giroud and Mueller (2015). More recent research examines the role of internal labor markets (e.g., Fang, Kempf, and Trapp (2014), Tate and Yang (2015)).

of the fund's life.[8] The PE firm, and senior individuals working for the firm, commit some capital to the fund (often totaling around 1% to 2%) and receive a "carried interest" in the profits earned by the fund.[9]

The seminal work of Berk and Green (2004) considers heterogeneity in mutual fund manager skill, which investors learn about. In the face of increased investor demand, skilled managers increase the price of their services or seek to increase their remuneration by growing AUM. If fees increase, gross returns may stay the same but net returns fall. If AUM increases, diseconomies of scale reduce gross and in turn net returns. In equilibrium, investors earn no excess return.

Similar forces exist in the case of PE, but the equilibrating mechanism is growth in AUM. Success rarely leads to increases in carried interest, which is almost always 20% irrespective of fund size or prior performance (Lim (2023)). Management fees, traditionally 2% per annum, were originally designed to cover operating expenses, rather than a source of profit, and hence are rarely increased following good performance. In fact, management fee rates tend to fall slightly as funds get larger (Lim (2023) finds an elasticity of −0.06). This is probably linked to the generous carried interest provisions, which were designed to align incentives. The relative invariance of PE fund economics produces strong incentives to increase AUM (Metrick and Yasuda (2010), Chung et al. (2012)).

While a few exceptions to this pattern occur (as noted by Robinson and Sensoy (2013)), the reluctance of successful PE firms to put up fees may be due in part to the contractual nature of PE investing. Mutual funds are open ended and so investors can invest more, or less, at any time, and fund managers have discretion to change their fees. In contrast, PE funds are closed-ended.[10] Each fund raised is distinct and structured as an LP. Investors commit capital to the fund and once fundraising has been completed—known as the final closing—the fund size is fixed and the Limited Partnership Agreement (LPA), which includes the agreed fees and carried interest, is signed by investors and the fund manager. Each fund self-liquidates over time as investments are realized, since the fund manager is only permitted to reinvest proceeds

[8] In some fund agreements, the management fee rate is reduced after the investment period, but the basis of the charge remains committed capital. In a minority of cases, the basis is reduced to net invested capital and the management fee rate is reduced as well.

[9] Profits are calculated after management fees and, in most funds, require a preferred return or "hurdle" —normally 8% calculated as an internal rate of return (IRR) of the cash flows—to be achieved. Note, however, that this is a "soft" hurdle: Once the preferred return has been achieved, the PE firm receives 20% of the total profits. In contrast, a "hard" hurdle, as used in performance fees in mutual funds and other asset classes, defines profits in terms of the excess return earned over and above the hurdle rate.

[10] The fact that the size of each PE fund is fixed, and investors cannot commit further money even if performance is strong, has advantages from a research design perspective. One of the issues faced in mutual fund research is that AUM responds to performance, which can confound estimates of skill.

within strict limits.[11] Therefore, AUM can be increased only by raising a larger subsequent fund, and the fund economics, once negotiated, cannot be changed. In certain funds, there may be some scope for fund managers to increase their remuneration by practices such as charging fees to portfolio companies (Phalippou, Rauch, and Umber (2018)). However, such practices have declined in recent years as regulators police the grey areas of LPAs more vigorously.

The closed-end, self-liquidating nature of PE funds means that negotiations over fund economics only occur every few years when a new fund is raised. At that point, fees and carried interest become highly salient, especially if a larger fund is being raised. The mantra of PE is alignment of interest with investors, and while significant carried interest for the fund manager aligns incentives, higher management fees—far in excess of the costs of running the fund—become difficult to justify. Investors are provided with a red-line version of the previous LPA, and any proposed change in fees or carried interest is immediately apparent and subject to close scrutiny. The outcome has been that headline fund economics—as recorded in LPAs—change very little as AUM increases. Many PE firms attempt to build long-term relationships with a stable group of investors, with the implicit understanding that when fundraising is more challenging, these investors will continue to commit further capital to new funds. While in times of buoyant demand, it may in principle be possible to increase management fees or carried interest rates, in practice this happens only rarely and PE funds prefer to increase fund size.

The relative stability of headline fund terms can disguise significant unobserved dispersion in fees across investors. Investors with higher bargaining power enjoy preferential fee structures (Begenau and Siriwardane (2024)) or invest partially via separate accounts or vehicles (in particular, co-investments) with lower fees and carried interest (Braun, Jenkinson, and Schemmerl (2020), Lerner et al. (2022)). These discounts may accrue to early, large, repeat investors and those willing to provide liquidity when it is scarce. Any preferential treatment is largely hidden in side-letters, but such arrangements further reduce the cost to more experienced or sophisticated investors.

As PE funds multiply in size, the fee rates paid by investors fall marginally, and the equilibrium mechanism is for firms perceived to be of high quality to increase expected remuneration through increasing AUM, subject to the constraint that if performance suffers, hurdle rates may not be achieved and future fundraising will become more difficult.

Larger funds could, in principle, be deployed across more deals, keeping deal size constant. In practice, however, there are also strong incentives to increase deal size. There is a limit to the number of simultaneous deals an individual manager can source and execute. Moreover, Lopez-de-Silanes, Phalippou, and Gottschalg (2015) find that average performance falls as the number of contemporaneous investments increases. More deals imply greater complexity and workload, and therefore require additional managers. These

[11] Some funds allow "recycling" of realizations if they are achieved during the first few years of the fund's life.

managers would also demand a share of the fund's economics (Ivashina and Lerner (2019)). Thus, from the perspective of the PE firm owners, as well as the individuals running the funds, there are strong incentives to grow fund size and average deal size. Section III below shows that this is indeed what we observe in the data, as funds scale, revenue per dollar raised may fall, but not the revenue per investment professional (Metrick and Yasuda (2010)).

B. Skill and NPV

The strong incentives to increase fund and deal size have important implications for the analysis of performance and persistence over time. The first analysis of U.S. PE funds by Kaplan and Schoar (2005) documents evidence of performance persistence, based on both PME and IRR, across successive funds. Their fund-level returns are net of management fees and carried interest payments.[12] However, differences in fund size were limited in the early years of the PE sector. More recent papers find that performance persistence, as measured relative to other funds raised at the same time, has weakened over time (Harris et al. (2023)) as successive funds have become larger and competition has increased. We explore these changes further in Section III.

However, waning relative performance does not imply an absence of manager skill. Investigating the mutual fund industry, Berk and van Binsbergen (2015) argue that net alpha cannot accurately measure the skill of a fund manager because, in competitive financial markets, any positive net alpha is eroded by scaling and compensation. As fund size increases, gross alpha tends to decrease, while increased compensation for skilled managers widens the gap between gross and net alpha, pushing net alpha toward zero in equilibrium. They introduce the value-added (VA_f) of fund f, obtained from multiplying inflation-adjusted AUM at the end of the previous period ($q_{t\text{-}1}$) by its benchmark-adjusted *gross* return α_f^g, which itself depends on the scale of AUM,

$$VA_f = q_{f,t-1}\alpha_f^g\left(q_{f,t-1}\right), \tag{1}$$

where gross alpha is defined as the difference between the gross fund return R_f^g and the benchmark return R_f^B for fund f,

$$\alpha_f^g = R_f^g - R_f^B = \alpha_f^n + \text{fees}, \tag{2}$$

Gross alpha is also equivalent to net alpha α_f^n plus fees (as a collective term for manager compensation). In the Berk and Green (2004) equilibrium, α_f^n converges to zero but managers generate a gross return that determines the fees they charge.

[12] These net return measures are based on cash flows to and from the investor. For assets that have yet to be fully realized, the recent NAV of the remaining investments is treated as a terminal cash flow. However, it is important to note that NAVs include a provision, where applicable, for carried interest payments to the fund manager, and so PMEs remain a valid measure of net returns even in the case of unrealized investments.

We explore whether such forces exist in the case of PE. We are interested in whether individual manager skill can be identified, which requires deal-level data and the assignation, where possible, of deals to specific managers. The closed-end nature of PE funds means that any evidence of skill will only increase the size of the following fund. Capital therefore follows performance with a significant lag. Investors are asked to commit capital to the next fund midway through the life of the current fund, at which point the ultimate profitability of the current investments is uncertain. Therefore, while good performance should result in increased capital flowing to the manager, who will then be able to undertake larger deals, the timescale will be measured in years for PE. In contrast, mutual fund investors observe performance, and can reallocate capital, on a daily basis.

With these differences in mind, a close analogy to equation (1) in the context of PE is NPV. The expected value V of a transaction n by individual manager i is

$$NPV_{i,n} = \mathrm{E}\left[\sum_{t=0}^{T}(cf_{n,t}^{-} + cf_{n,t}^{+}) \cdot D_0^t\right], \tag{3}$$

where cf^- and cf^+ denote, respectively, the (negative) cash flows into and the (positive) distributions realized from the deal at date t, D_0^t is the discount factor, and T is the holding period of the investment. At the deal level, cash flows exclude management fees and carried interest, both of which are levied at the fund level, and so the returns will be gross. For unrealized deals we use the most recent fair value of the investment, as estimated by the fund manager or their auditors, as a terminal cash flow. These valuations have been shown to be unbiased predictors of the NPV of the future cash flows (Jenkinson et al. (2020)). One advantage of the PE setting is that deals have a finite life, and so it is possible to measure the success of individual investment decisions. These deal-level returns can then be cumulated into fund-level gross returns and can also be used to generate gross versions of existing performance measures, such as PME, multiples of invested capital (MOIC), and IRR.[13]

Having calculated deal-level NPV, it is straightforward to produce a similar measure at the fund level, which we refer to as the NPV of fund f,

$$NPV_f = \sum_{n \epsilon f} NPV_n, \tag{4}$$

that is, fund-level NPV is the NPV of all the deals within the respective fund. Note that a manager's track record will usually include deals across multiple funds, and when calculating the fund's NPV, each deal is accounted for only once, even if multiple managers are involved in the same deal.

[13] From an empirical perspective, the capital commitments to a fund are observable, but management fees and carried interest payments are not. Therefore, gross fund returns cannot be derived from the net returns that are reported by the main PE databases such as Burgiss-MSCI and Preqin.

Regarding expectations and the discount rate, we assume that PE investments are expected to produce somewhat higher returns than public market investments. Buyouts tend to target relatively stable companies with lower asset betas that can support high levels of debt (Axelson et al. (2013)), and so may have asset betas below one. However, the higher average leverage of buyouts is likely to increase equity betas above one. Estimating PE betas is challenging as returns are observed infrequently and, until the investments are realized, are based on self-reported valuations that have been shown to be smoothed. Previous research based on various sample periods, methodologies, and data periods has produced a wide range of results (see Korteweg (2019, 2023)). Estimates derived from filtering returns, to overcome the shortcomings of observed data, find average betas slightly above one: Brown, Ghysels, and Gredil (2023) find a mean buyout beta of around 1.1, and Ang et al. (2018) report an estimate of 1.3. Korteweg and Nagel (2016) address the statistical properties of the discount factor in the context of PE and propose an exponentially affine stochastic discount factor, which they call Generalized PME (GPME). Estimates using the stochastic discount factor approach yield betas close to one: most recently, Korteweg and Nagel (2025) find a beta of 0.9 for buyouts using their GPME approach.[14] Drawing on this evidence, and assuming that investors require a premium to compensate for the illiquidity of PE investments, in our baseline calculations, we assume that expected PE returns are, on average, equal to out-turn public market returns plus a premium of 200 basis points (bps).

This assumption is consistent with the expected returns used by investors when determining portfolio weights. Andonov and Rauh (2022) document asset class expected returns for a large sample of U.S. public pension schemes and find median expected arithmetic (geometric) returns of 11.8% (9.95%) for PE and 9.34% (8.63%) for public equity, implying a PE premium of 246 bps (13 2bps). This assumption is also in line with the long-term historical returns, for instance, Harris, Jenkinson, and Kaplan (2014) find that out-turn U.S. buyout returns exceeded the S&P 500 index by 200 bps to 300 bps. However, given the inevitable uncertainty about how to estimate expected returns, we also calculate NPVs based on alternative discount rate assumptions.[15] Since we base the discount rate on realized public equity returns, our NPV estimates can be thought of as scale-adjusted PMEs.[16]

To partially, but imperfectly, address risk differences across deals, and to avoid exchange rate issues, we base the discount rate on regional MSCI equity indices (Asia, Europe, and North America) according to the location of the deal. While this controls for geography, it clearly does not control for differences in risk between deals. However, it is difficult to assign deals to industries, and appropriate industry-level public indices are not available for much of the sample

[14] Sorensen and Jagannathan (2015) provide a formal justification for PME as a performance measure and show that under certain assumptions the validity of PME does not depend on the risk of the underlying investments.

[15] The results are robust to applying a relative premium to the discount rate (e.g., 20%).

[16] PMEs discount cash flows using out-turn public market returns, but with no premium for leverage or illiquidity.

period. This will likely introduce noise into our estimates. We show, however, that the results are robust to using alternative benchmark returns.

We compute the estimated gross NPV for each deal, along with the gross PME. We then test whether there is evidence of individual manager skill in generating NPV and/or PME across deals, and if so whether this has changed over time as deals (and funds) have become larger. There are many ways through which PE funds can create value in the portfolio companies that they control. Kaplan and Stromberg (2009) distinguish three potential sources of value creation—financial, governance, and operational engineering. Jenkinson, Kim, and Weisbach (2023) provide a taxonomy of the different types of deals that PE funds undertake. Some may involve value transfers from other parties, such as the tax authorities (in the case of financial engineering) and workers, suppliers, or customers (in the case of operational engineering). In this paper, we do not attempt to classify the sources of value, but rather equate skill with the ability to generate value, which is then shared between the LPs and GPs.[17]

One of the main challenges facing PE firms is how to grow fund size while minimizing the impact on returns. Unlike mutual funds, which are generally run by one or two fund managers, PE funds employ teams of investment professionals, and so one way in which the PE firm may add value is by identifying skilled managers and allocating increasing amounts of capital to them.

C. Organizations and Capital Allocation

PE funds are run by a group of managers who source deals and become active shareholders in the firms (Jensen (1989)). For the managers responsible for a given deal, their expertise, experience, and networks are likely to matter in identifying, accessing, and supporting portfolio firms. If managers have heterogeneous levels of skill, the PE organization could add value by learning about such patterns and allocating more capital to their skilled managers.

In the case of VC funds, Ewens and Rhodes-Kropf (2015) show that the individual is substantially more important than the VC organization in explaining the cross-section of investment performance. By increasing the sensitivity of capital allocation to manager skill, the average skill level per dollar invested increases, along with overall fund success. Berk, van Binsbergen, and Liu (2017) show that this pattern holds for the mutual fund industry. However, compared to PE managers, mutual fund manager performance is easier to track, performance signals are much more frequent, and capital can be withdrawn easily. In contrast, PE managers are

[17] Given mutual fund managers have limited control and influence over the companies in which they invest, Berk and van Binsbergen (2015) equate fund manager skill with the value they *extract* from financial markets. In contrast, PE funds are not passive investors but rather are controlling shareholders that buy companies with a plan to create value, and so we do not equate value created in PE deals solely with value extraction.

only involved in a few transactions, reliable returns at the deal level are opaque, difficult to benchmark, are observed only years later, and capital cannot be withdrawn during the life of the fund without significant cost.

This opaqueness and illiquidity may help explain why PE firms are organized as partnerships in which partners within the organization monitor each other (Ivashina and Lerner (2019)). The governance body for the partnership is the investment committee, in which senior investment professionals' information and expertise are aggregated to make informed investment decisions (Malenko et al. (2024)). Partners are expected to source deals, champion them through the investment process, and convince the investment committee to vote in favor of an investment. Decision-making by investment committees varies, but in their survey of VC firms, Gompers et al. (2020) find that 49% of organizations require unanimous approval. Although we are not aware of any equivalent empirical evidence, there are reasons to believe this proportion may be even higher among PE organizations.[18]

In this organizational setting, observed deal sizes are partially exogenous because managers can only source and pick from the set of investment opportunities available at the time. However, given this set of opportunities, the decisions regarding which deals to pursue, and how much capital to deploy, are key. An important contribution of this paper is to test whether there is evidence of individual manager persistence, and if so whether PE organizations allocate capital or promote managers according to such skill.

II. Data and Summary Statistics

A. Sources of Data and Sample Construction

This paper employs a comprehensive deal-level database of buyout transactions. This proprietary database was sourced from three large institutional investors that collected fund- and deal-related data as part of their due diligence processes. Earlier versions of the data were used by Braun, Jenkinson, and Stoff (2017) and Braun, Jenkinson, and Schemmerl (2020), who provide a detailed description of the data. For nearly all PE firms in the data set, we observe their complete investment history across multiple funds of the same fund family, that is, subsequent funds following the same investment strategy (for 6% of firms, some early deals are missing). The database provides monthly gross cash flows between funds and their respective portfolio companies as

[18] In a survey of more than 100 VC and PE investment professionals in 2018, The British Private Equity & Venture Capital Association (BVCA) found that 76% of organizations require consensus voting in their investment committee (source: https://bvca.medium.com/demystifying-the-investment-committee-860e50d5db44; retrieved: February 24, 2022). In another paper on VC investment committee voting, Malenko et al. (2024) argue that the optimal rule for aggregating information in investment committees depends on the underlying distribution of signals. They reason that the more mature the company, the more relevant is a well-rounded view, and the better are decisions made by majorities or unanimous approval. This applies to mature LBO firms that require stable cash flows to finance leverage.

well as fund- and deal-related characteristics. If an investment has not been fully realized at the time of reporting, we observe the latest fair value. The timed cash flow data allow us to measure gross performance and NPV for every transaction and PE firm in our database, which renders the data set particularly well suited to analyze manager skill.

We augment this database by adding novel information, wherever possible, on the manager(s) responsible for each investment. We source individual-level information from five public databases. We start by collecting data from Preqin, which contains information on more than 40,000 manager-deal involvements between 1970 and 2017. We add additional manager-deal involvements from Pitchbook and MergerMarket. Next, we search VentureSource for PE managers with board memberships at PE-backed firms. Following Ewens and Rhodes-Kropf (2015), we interpret an individual manager having a board seat as being one of the lead investment professionals for the corresponding buyout investment. Finally, we collect data from the "Who's Who in Private Equity" series. These industry directories, published annually, list individual investment managers and their latest deal involvements, where information on deal involvements comes from an annual survey. Since managers are surveyed frequently, information about deal involvements is usually reported during the holding period rather than after the investment has been exited. We exploit this feature to examine the role of potential reporting biases. Furthermore, considerable overlap between the above sources allows for cross-checks on manager-deal involvements.[19]

To examine the intersection of performance, capital allocation decisions, and career outcomes, we further hand-collect information on managers' job titles, as well as their start and end dates, from BoardEx, LinkedIn, PitchBook, VentureSource, and web searches. This allows us to investigate whether PE managers leave for another firm or establish their own firm. In addition, we manually standardize PE managers' job titles to explore when investment managers are promoted to partner, which typically involves being allocated a share of future carried interest.

Finally, to analyze the relation between fund performance, AUM, and PE firm compensation, we source information on management fees, carried interest, and hurdle rates for a subsample of 328 funds for which we obtain private placement memoranda and LPAs.

Having combined all these data sources, the final sample comprises 940 buyout funds raised by 309 PE firms with vintage years spanning 1974 to 2011.[20] Since the funds deploy capital raised over a four- to five-year period, our deal sample spans 1974 to 2015. We restrict the sample in this way to ensure a large proportion of the deals are fully realized. The cash flows, and the reported fair value of any unrealized investments, are observed until the

[19] In Internet Appendix Table IA.III, we provide details on this subsample. The Internet Appendix is available in the online version of this article on *The Journal of Finance* website.

[20] We exclude two very small funds that raised less than $5m. We also exclude very small deals where less than $100K was invested.

Table I
Fund Characteristics

This table presents univariate statistics for a sample of 940 buyout funds. It reports the mean and median values for the following variables: fund size (in millions of 2000 U.S. dollars), the multiple on invested capital (MOIC) gross return, the gross Kaplan-Schoar public market equivalent (PME) gross return (calculated relative to three regional MSCI indices: Asia, Europe, and North America, in local currency), and fund net present value (NPV). Fund NPV is the NPV of all deals in a fund, discounted using the same three regional MSCI indices plus 200 bps p.a. Fund vintage years are based on the year in which the first investment was made.

		Fund Size		MOIC		PME		NPV	
	Obs.	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Full sample	940	931.2	330.9	2.44	2.04	1.91	1.67	333.8	103.5
Regions									
North America	458	1,218.0	487.5	2.56	2.06	1.88	1.69	389.4	126.5
Europe	426	687.7	238.5	2.34	2.04	1.91	1.66	302.3	91.9
RoW	56	438.1	262.9	2.26	1.90	2.07	1.63	118.0	52.5
Fund Vintage Years									
1974–1989	75	380.5	138.6	4.31	3.23	2.22	1.74	68.8	36.0
1990–1994	112	359.7	173.1	3.22	2.77	1.96	1.73	139.6	46.2
1995–1999	245	621.4	313.2	2.43	2.07	2.08	1.85	363.1	116.6
2000–2004	263	845.4	331.6	2.38	2.22	1.96	1.84	467.8	168.0
2005–2010	245	1,762.9	658.5	1.60	1.39	1.55	1.42	330.3	124.5

end of 2018. The sample funds invested in 12,910 deals (15 deals per fund on average). For 4,873 (40%) of these deals, we can find information on at least one manager responsible for the transaction. In total we identify 3,857 unique managers. As many of the deals in the sample have multiple managers associated with the deal, be it from within a GP or a club deal, we arrive at 10,065 manager-deal involvements.

B. Fund-Level Descriptive Statistics

Table I summarizes fund-level characteristics for our sample. Fund and investment sizes are converted to constant 2000 U.S. dollars. Fund size refers to the total commitments made by investors. There is a substantial discrepancy between mean and median fund sizes, which are $931.2m and $330.9m, respectively. There is also right-skewness in terms of gross performance. The mean (median) MOIC gross return is 2.44 (2.04).[21] The mean (median) gross PME, calculated relative to three regional MSCI indices, is 1.91 (1.67), and the mean (median) NPV per fund is $333.7m ($103.5m).

Table I also summarizes the data across geographic areas and market periods. Most of the data come from North American (48.7%) and European

[21] MOICs are absolute return measures, and so do not correct for equity market movements, but they are widely employed by investors and PE firms.

(45.3%) funds. While we do not find substantial differences in terms of MOIC or PME between Europe and North America, larger fund sizes in the latter group are associated with considerably higher NPV: The mean (median) NPV in North America is $389.4m ($126.5m), while the corresponding NPV in the European subsample is $302.3m ($91.9m).

Obviously, the estimated NPV is sensitive to the assumed discount rate (see Internet Appendix Table IA.I). However, our analysis below on persistence, skill, and capital allocation, which are based on *differences* in NPV between funds and deals undertaken at similar times, vary little when we use alternative benchmark returns and premia.

Average fund size has increased significantly over time. While the mean (median) fund raised before 1990 managed $380.5m ($138.6m), these values increased to $1,762.9m ($658.5m) by the late 2000s. Returns have trended lower over time, particularly for funds formed from 2005 to 2010, although this period includes the funds raised in the few years before the global financial crisis, which have the lowest average returns over the sample period. However, while gross returns have trended downwards, fund NPV has, in general, increased over time. The exception to this trend is the mean NPV in the final five-year period, where mean NPV fell to $330.3m from $467.8m in the prior five-year period. This reflects the considerable decline in PMEs, which more than offset the increase in fund size. This effect was particularly pronounced in the largest funds; the median fund NPV barely changed.

C. Deal-Level Descriptive Statistics

Table II provides descriptive statistics at the deal level. Average values for the full sample of 12,910 investments are displayed in columns (1) and (2) of Panel A. Investment size is the equity invested into a portfolio company by the PE fund (in club deals we observe equity invested by each PE firm separately), with a mean (median) value in our sample of $48.0m ($15.4m). As intuition would suggest, we find even more skewed gross returns at the deal level: The mean MOIC in our sample is 2.62, while the median is only 1.53. The same applies to PME, with a mean of 1.99 and a median of 1.25. However, the discrepancy is most pronounced for deal-level NPV, with a mean of $24.3m and a median of $1.0m. It is interesting to note that, using our assumed discount rate, around 44% of deals do not generate value ex post.

Columns (3) and (4) in Panel A repeat average deal characteristics for the subset of 4,873 unique deals for which we observe at least one investment manager. Manager information tends to be available for larger and more recent deals, but average performance is similar for the full sample and the subsample for which we have identified individuals. On average, 2.07 individual managers are involved with a deal (median: 2). We provide summary information about the manager characteristics in Internet Appendix Table IA.II: 96% are male, 51% have an MBA, and 36% attended an Ivy League university. With an average age of 39.7 years, the sample mainly consists of established professionals.

Table II
Deal Characteristics

Panel A shows univariate statistics at the deal level for three different samples. The overall sample of 940 funds contains 12,910 unique deals (*full sample*). For 4,873 of these deals, we could identify at least one individual manager running the deal for a GP organization (*matched sample*). As some deals were managed by several individuals from one PE firm, or as club deals were managed by individual managers from different PE firms, we observe 10,065 *deal involvements* (i.e., manager-unique deal dyads). We report the multiple on invested capital (MOIC) gross return, the gross Kaplan-Schoar public market equivalent (PME) return, calculated relative to three regional MSCI indices (Asia, Europe, and North America) in local currency, and deal net present value (NPV), discounted using the same three regional MSCI indices plus 200 bps p.a. *Investment Size* denotes the PE firm's investment measured in millions of 2000 US dollars. *Holding Period* indicates the difference between an investment's date and the exit date or the latest reported valuation (in the case of unrealized transactions), measured in years. *Investment Year* is measured based on the first cash flow into a deal. *Realization Status* is a dummy variable set to one if a deal is at least partially realized, and zero otherwise. *Managers on Deal* indicates the number of managers we were able to assign to a given deal. In Panel B, we report equity investment size (in millions of 2000 U.S. dollars), PME, and NPV for several time categories.

Panel A: Deal characteristics by sample type

	Full Sample (n = 12,910)		Matched Sample (n = 4,873)		Deal Involvements (n = 10,065)	
Variables	Mean (1)	Median (2)	Mean (3)	Median (4)	Mean (5)	Median (6)
Investment Size	48.0	15.4	66.3	27.6	91.1	35.2
MOIC	2.62	1.53	2.67	1.56	2.47	1.52
PME	1.99	1.25	2.16	1.36	2.03	1.35
NPV	24.3	1.0	37.3	5.4	47.3	6.8
thereof positive	*56%*		*61%*		*61%*	
Holding Period	4.25	3.75	4.10	3.67	4.02	3.67
Investment Year	2001	2001	2003	2004	2004	2005
Realization Status	0.83	1.00	0.77	1.00	0.74	1.00
Managers on Deal	-	-	2.07	2.00	3.21	3.00

Panel B: Deal characteristics over time (full sample)

	Obs.	Investment Size		PME		NPV	
		Mean	Median	Mean	Median	Mean	Median
1974–1989	792	21.5	2.7	2.15	0.89	1.6	−0.3
1990–1994	1,349	16.1	5.5	1.81	1.23	6.6	0.1
1995–1999	3,087	35.2	10.7	2.20	1.25	17.5	0.6
2000–2004	3,565	42.7	16.8	2.13	1.50	34.6	3.7
2005–2010	4,117	77.6	31.6	1.75	1.15	30.7	2.7

In columns (5) and (6) of Panel A, we report results for the same variables, but now observed at the deal-involvement level, that is, for each of the 10,065 manager-deals. Again, mean and median values for all deal characteristics are similar to those for the full universe and the subsample of matched deals,

although average deal size is higher since larger deals involve more managers and are therefore included multiple times.

Panel B of Table II shows deal-level time trends. We document a steady increase in mean (median) investment size from \$21.5m (\$2.7m) before 1990 to \$77.6m (\$31.6m) after 2004. The average deal gross PME is more cyclical. The difference between the mean and median deal-level PMEs suggests that the right-skewness of returns was substantially higher during the pre-1990 period. Indeed, median deal PMEs in this period were below one, even though the mean PME was above two. Consequently, mean (median) NPV per deal rises from \$1.6m (−\$0.3m) in the 1970s and 1980s to \$34.6m (\$3.7m) over the period 2000 to 2004. The corresponding NPV values for the most recent period are slightly lower, again reflecting the lower average performance.

To assess potential sample selection issues, we proceed in two steps. In Internet Appendix Table IA.III, we compare our fund-level data with the Burgiss-MSCI database (first employed by Harris, Jenkinson, and Kaplan (2014)). Then, in Internet Appendix Table IA.IV, we compare our data to the Burgiss-MSCI deal-level database described by Brown et al. (2020). Since our analysis relies on mature funds and deals, our sample exhibits earlier investment years. This also helps explain why our deals are somewhat smaller. However, although there are some structural differences between the data sets, both fund- and deal-level returns are similar. For example, the median gross PME of all realized deals in the Burgiss-MSCI sample is 1.36 versus 1.38 in our sample, which suggests that sample selection biases may be limited.

III. Fund-Level Analysis: Size, Returns, and NPV

Most PE studies are conducted at the fund level. In this section, we focus on the impact of increasing fund size on relative gross fund returns, NPV, and the implications for PE firm compensation. In Table III, we start by analyzing successive funds raised by PE firms. Panel A tabulates mean gross fund performance, and Panel B documents how fund size, number of deals, and average investment size vary by fund sequence.[22] We observe a drop in relative returns with increasing fund sequence. Average gross PME (MOIC) for first funds is 2.21 (3.07), with returns falling steadily as successive, larger, funds are raised.[23] PME (MOIC) for fifth and subsequent funds average 1.62 (1.96).

As successive funds are raised, average size increases significantly. The average first fund raises \$372.3m. By the third fund, average size more than doubles to \$838.5m. Clearly there is some attrition in the data, as less successful PE firms fail to raise follow-on funds. For those PE firms that raise fifth (and subsequent) funds, average fund size is over \$2bn. This reflects the

[22] As some PE firms raise different fund types (e.g., U.S. large-cap buyouts, European mid-cap buyouts), we follow the approach in Braun, Jenkinson, and Stoff (2017) and sequence funds separately for each fund family.

[23] Internet Appendix Table IA.V shows the corresponding median values, which exhibit very similar patterns.

Table III
Scale and Performance by Fund Sequence

This table shows mean values for our sample of 940 buyout funds. Panel A tabulates gross fund performance by fund sequence. Relative returns are measured by the multiple on invested capital (MOIC) and the gross Kaplan-Schoar public market equivalent (PME) returns, calculated relative to three regional MSCI indices (Asia, Europe, and North America) in local currency. Fund NPV is the net present value of all deals in a fund, discounted using the same three regional MSCI indices plus 200 bps p.a. Panel B shows fund size, the number of investments per fund, and average investment size, again by fund sequence. Both size variables are in millions of 2000 U.S. dollars. For a subsample of 328 funds with available information on compensation, Panel C shows management fees (in % of AUM), carried interest (in % of profits), and the hurdle rate (in %). Panel D extrapolates the fee information in Panel C to all of our sample funds and calculates the corresponding (unweighted) total gain split between the funds' LPs and the PE firm (in millions of 2000 U.S. dollars). Note that fund size reflects committed capital, and so is not the same as the number of deals multiplied by average investment size (as not all funds have fully invested and some portion of committed capital will be used for management fees).

		Fund Sequence				
		First	Second	Third	Fourth	Fifth and Higher
		$n = 280$	$n = 229$	$n = 158$	$n = 104$	$n = 169$
Panel A: Gross performance						
MOIC	2.44	3.07	2.42	2.13	2.09	1.96
PME	1.91	2.21	1.91	1.82	1.67	1.62
NPV	333.7	237.6	184.9	376.8	511.5	543.8
Panel B: Scale						
Fund Size	931.2	372.3	529.5	838.5	1,302.3	2,258.0
Number of Deals	15.2	14.5	12.8	14.9	17.2	18.8
Avg. Investment Size	44.9	21.1	35.2	42.4	66.3	86.5
Panel C: Fund economics						
Management Fee	1.83	2.00	1.96	1.81	1.78	1.74
Carried Interest	20.27	20.38	20.06	20.14	20.33	20.46
Hurdle Rate	7.95	8.05	8.18	7.80	7.93	7.76
Panel D: NPV split						
Limited Partners	212.5	154.1	124.6	228.4	319.1	347.2
PE Firm	121.4	83.6	60.5	148.4	192.6	196.8
PE Firm/$100 Total NPV	36.4%	35.2%	32.7%	39.4%	37.6%	36.2%

incentives discussed in Section I. Most of this growth comes from larger deals as opposed to more investments. First funds invest in an average of 14.5 deals with an average investment size of $21.1m. By a firm's fifth fund, the average number of deals increases modestly to 18.8 but the average investment size quadruples to $86.5m.

This clear trend for PE firms to raise larger funds that produce, on average, lower returns, results in the cross-sectional distribution of returns shown in

Figure 1, Panel A. The largest quartile of funds (within each vintage year) produces lower returns, but the standard deviation of returns is also much lower. This may explain why large investors, with significant amounts of capital to deploy into PE, can find the lower risk and return associated with large funds attractive. Small funds can sometimes produce very high returns on the back of a few deals that perform spectacularly. This can be seen from the underlying deal-level return distributions in Figure 2. Such returns are much harder to generate for larger—and therefore more established—portfolio companies, where information asymmetries between sellers and potential buyers are likely to be lower. Of course, small funds can also result in significant losses for investors.

While returns tend to decrease as firms raise successively larger funds, average fund NPV increases from $237.6m for first funds to $543.8m for fifth (and higher) funds. The cross-sectional distribution of NPV, by fund size, is presented in Figure 1, Panel B. There is considerable variation in NPV, as would be expected given the variation in fund size, and a positive skew. There are also some large negative outcomes, as some large funds perform poorly. Across the whole sample, 13.3% of funds produced negative NPV. Panel B of Figure 2 shows the same risk-return trade-off at the deal level, with investment size acting as an amplifier of NPV outcomes. It should be noted, however, that returns differ considerably according to when funds or investments are launched. We account for such "vintage year" effects in our econometric analysis, but the general trend, as funds and investments get larger, is for relative returns to trend downwards but NPV to grow.

This analysis begs the question: how is NPV shared between investors and the PE firm, and does this change as larger funds are raised? Information on PE fund economics—management fees, carried interest, and hurdle rates—is not always made public. We obtain such information for 328 funds in our sample. Panel C of Table III shows that, across those funds, the average management fee is 1.83%, average carried interest is 20.27%, and average hurdle rate is 7.95%. Carried interest and hurdle rates remain largely stable as firms raise subsequent funds, but management fees decrease moderately from 2.00% (first fund) to 1.74% (fifth or higher funds). This analysis confirms that successful PE firms do not, in general, increase fees, but rather seek to raise larger funds, which increases remuneration.

In Panel D, we extrapolate the fee information in Panel C to our full sample of funds and calculate the corresponding split of gross NPV between investors and the PE firm.[24] These calculations are in simple cash terms, and do not account for the timing of payments, as we do not have information on when carried interest payments are received.[25] Across the whole sample of funds, the mean NPV is $333.8m, with $121.4m, or 36.4%, accruing to the PE firm

[24] We impute unobserved net returns using the 328 funds for which we observe this information and additional fund-level information that we include in the regressions in this paper (fund size, fund sequence, vintage year, and region).

[25] On an NPV basis, we would expect the proportion of NPV accruing to PE firms to be somewhat lower, as carried interest payments occur later in a fund's life (although the timing varies for

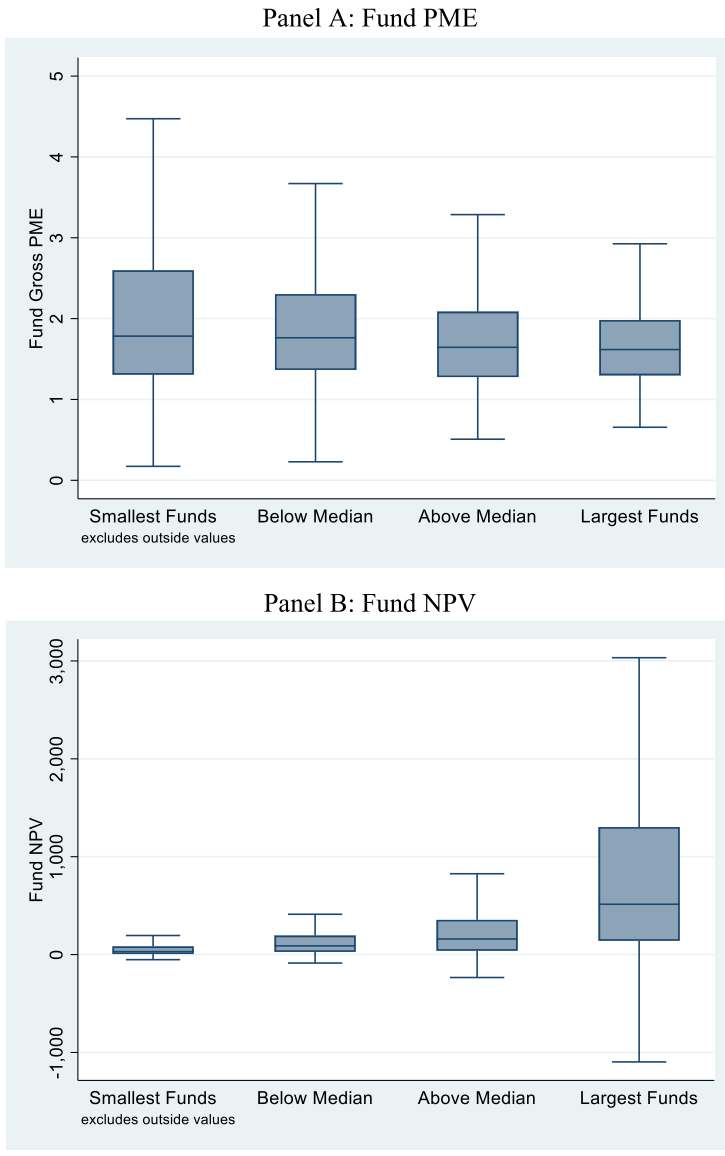

Figure 1. Fund-level gross PME and NPV. This figure shows Whisker box plots of absolute Kaplan-Schoar gross public market equivalents (PME) and net present value (NPV) for our sample of 940 buyout funds by annual fund size quartiles. PME is calculated relative to three regional MSCI indices (Asia, Europe, and North America) in local currency. Fund NPV is the NPV of all deals in a fund, discounted using the same three regional MSCI indices plus 200 bps p.a. The boxes represent the 25th, 50th (median), and 75th percentiles. As common with Whisker versions of box plots, the adjacent lines indicate values 1.5 times the interquartile range above (below) the 75th (25th) percentile. (Color figure can be viewed at wileyonlinelibrary.com)

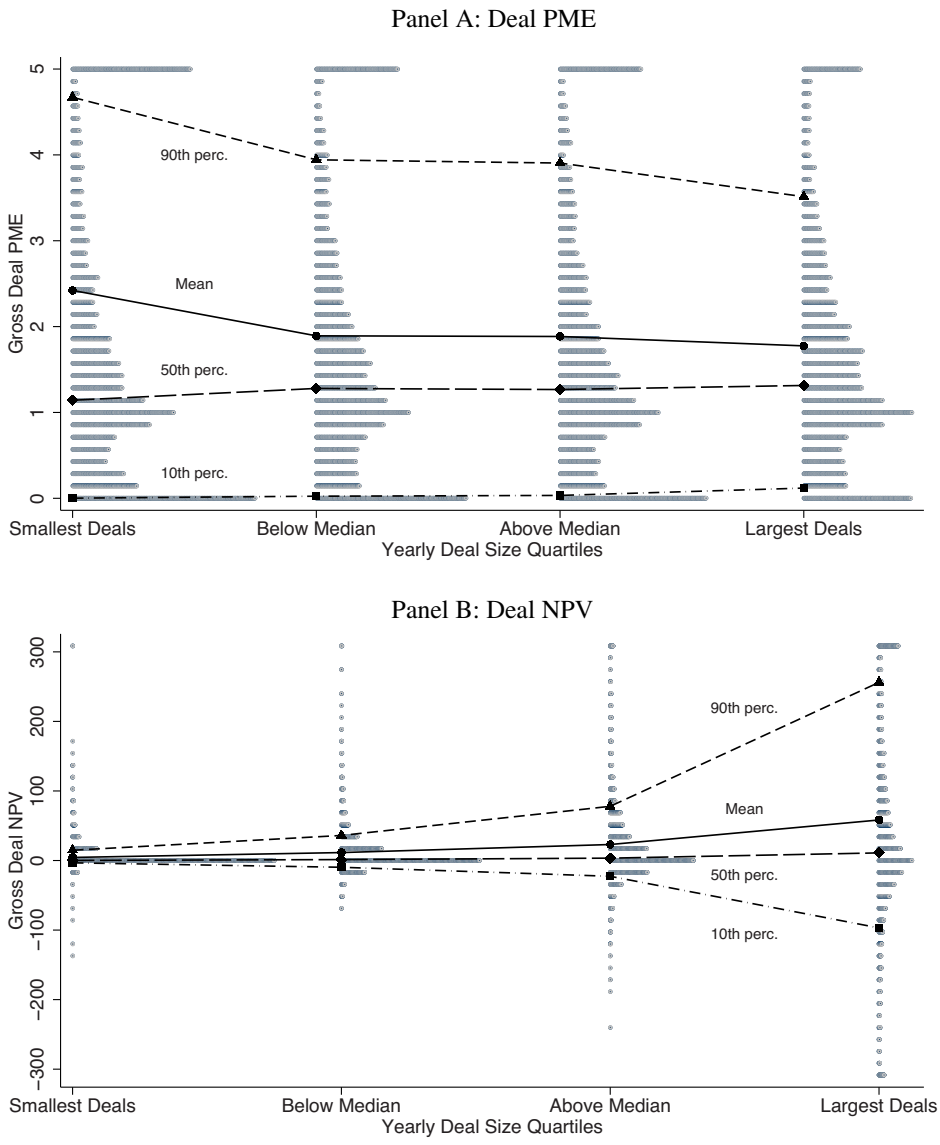

Figure 2. Deal-level gross PME and NPV. This figure shows Kaplan-Schoar gross public market equivalents (PME) and net present value (NPV) for our sample of 12,910 unique deals by annual investment size quartiles. Investment size quartiles are computed by investment year, that is, each deal in our sample is assigned to a quartile based on its equity investment size compared to all other deals from the same investment year. PME is calculated relative to three regional MSCI indices (Asia, Europe, and North America) in local currency. NPV is the NPV of the deal (in millions of 2000 U.S. dollars), discounted using the same three regional MSCI indices plus 200 bps p.a. Investment size is measured in millions of 2000 US dollars. Each panel displays unweighted averages, as well as the 10^{th}, 50^{th}, and 90^{th} percentiles by deal size quartile. For illustration purposes, performance values larger than a gross PME (NPV) of 5 ($300m) are grouped into one bracket. (Color figure can be viewed at wileyonlinelibrary.com)

in the form of management fees and carried interest. Obviously, the PE firm has costs, and so this is not profit. The proportion of NPV going to the PE firm is lowest for first- and second-time funds, where the average is 35.2% and 32.7%, respectively. For later funds, both the gain of the investors and the revenue to the PE firm increase considerably in absolute terms, although the PE firm's share stays relatively constant. Given the organizational efficiencies associated with larger funds, this results in considerably higher profits per investment professional.

The sample of 328 funds for which we have net returns exhibits some bias, with higher gross performance than the remaining funds (mean PMEs of 2.03 versus 1.84), and these funds are also somewhat smaller ($802.2m versus $996.1m). However, the average proportion of NPV going to the PE firm in this sample is only slightly lower at 34.3%. This result reflects the fact that, in well-performing funds, the present value of management fees—which are inelastic to performance—becomes a less significant component of the overall income distribution.

Our findings are in line with existing empirical evidence that PE firms do not extract all of the rents. While some early studies suggested that GPs capture all or most excess returns (Phalippou and Gottschalg (2009)), recent research using more reliable data finds meaningful outperformance for investors net of fees (e.g., Harris et al. (2014, 2016)).[26] Indeed, Robinson and Sensoy (2013) find no negative correlation between management fees and net returns. These findings for PE contrast sharply with the mutual fund literature, which documents strong negative relationships between fees and net performance (e.g., Carhart (1997)) and average net "alphas" of zero (e.g., Fama and French (2010)).

PE markets seem to exhibit frictions that limit competitive capital allocation compared to public markets. Performance sensitivity exists (Chung et al. (2012)) but remains imperfect due to a lack of standardized benchmarks and accepted risk-adjustment methods. As discussed in Section I, fees have proven difficult to increase due to institutional constraints, and the relatively standardized fee structure may prevent skilled managers from capturing value creation entirely through higher fees, leading PE firms to scale assets instead. This scaling process itself takes considerable time due to the closed-end nature of funds and the multi-year fundraising cycles. To date, therefore, these frictions have prevented the market from reaching an equilibrium where skilled managers capture all of the rents.

In additional analysis of the relationship between fund size, returns, and NPV, we estimate simple persistence regressions in Table IV. The PE literature consistently found return persistence until the early 2000s, while more recent studies find declining persistence, based on PME, for buyout funds over time

American and European waterfalls). In contrast, management fees are received steadily over the life of the fund and should probably be discounted at a lower rate than carried interest.

[26] Early studies used Thomson Venture Economics data, which were subsequently found by Stucke (2012) to be biased and produced lower returns due to a significant proportion of NAVs not being updated.

Table IV
Fund Persistence Regressions

This table reports results of OLS regressions of the investment performance of a PE firm's current fund on the performance of the firm's previous fund. In models (1) to (3), we look at the gross Kaplan-Schoar PME return, calculated relative to three regional MSCI indices (Asia, Europe, and North America) in local currency. In models (4) to (6), we examine fund NPV in millions of U.S. dollars, discounted using the same three regional MSCI indices plus 200 bps p.a. Early years are all funds closed prior to 1996, while later years range from 1996 to 2011 (see Kaplan and Schoar (2005)). *Log Fund Size* is the natural logarithm of the total committed capital in millions of 2000 US dollars. *Log Fund Sequence* is the natural logarithm of fund sequence within a PE firm's fund family. *Fund Realization Share* measures the share of deals in a fund that have been at least partially realized. This variable drops from models (2) and (4) because all funds are fully realized in the early years. All regressions include vintage year and fund region fixed effects. Standard errors are in parentheses and clustered at the PE firm level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	Fund PME			Fund NPV		
	All	Early Years	Later Years	All	Early Years	Later Years
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Gross PME Previous Fund	0.058*	0.178*	0.043			
	(0.031)	(0.106)	(0.032)			
NPV Previous Fund				0.243***	0.189**	0.243***
				(0.039)	(0.087)	(0.042)
Log Fund Size	−0.082***	0.055	−0.100***			
	(0.029)	(0.097)	(0.031)			
Log Fund Sequence	−0.045	−0.070	−0.045	253.769***	−126.528	272.722***
	(0.082)	(0.283)	(0.085)	(73.732)	(143.499)	(83.776)
Fund Realization Share	0.422***		0.445***	491.315***		542.317***
	(0.130)		(0.133)	(124.971)		(135.834)
Observations	612	89	523	612	89	523
Adj. R^2	0.088	−0.002	0.103	0.134	0.038	0.127
Vintage Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes

(Harris et al. (2023)). We confirm this finding in our data. To facilitate comparison with the analysis of Kaplan and Schoar (2005), who found evidence of PME return persistence (net of fees and carried interest) for early buyout funds, we split the sample into an early period (funds closed prior to 1996) and later funds and estimate similar persistence regressions, but on a gross basis. Models (1) to (3) regress fund gross PMEs in the current fund against the returns achieved in the prior fund along with vintage-year fixed effects, fund size, fund sequence, and realization status (all early-year funds are fully realized). The results confirm that PME return persistence has declined over time. For the early funds, we find a persistence coefficient that is very similar, in terms of both size and significance, to Kaplan and Schoar (2005).[27] For funds raised in

[27] Kaplan and Schoar (2005) obtain a persistence coefficient on prior net PME of 0.17, with a *t*-statistic of 2.1.

later years, the persistence coefficient has decreased by three-quarters. Moreover, whereas fund size was insignificant in the early years, when funds did not differ much in size, the negative impact of fund size on returns is apparent in more recent funds. This result is consistent with scale reducing the ability of successful funds to maintain relative returns.

When we shift the focus to NPV, we find that persistence has increased over time. We exclude fund size from these regressions since NPV is a function of AUM. NPV is persistent in both periods but becomes 30% more persistent in later years. Fund sequence is also positive and significant. These results are consistent, given the lack of significant PME persistence during this period, with PE firms managing the trade-off between fund size and relative performance to grow NPV as they raise successive funds (in line with the sample averages presented in Table IV, Panel A). Moreover, these results continue to hold when we use alternative market benchmarks and assumptions regarding the discount rate (Internet Appendix Table IA.VI, Panel A).

The analysis in this section has been at the fund level. However, the aggregated results may mask more significant differences in skill at the individual manager level within a PE firm. Indeed, the management of the trade-offs between size and performance could be viewed as a core "skill" of PE firms: One way to mitigate the impact on relative returns could be to have the best managers within the firm do the largest deals because they matter most for overall fund performance. In the remainder of the paper, we focus on the deal level and explore whether there is evidence of individual manager skill using our unique data on deal attribution.

IV. Deal-Level Analysis: Individual Manager Skill and Scalability

In this section, we test whether there is evidence for skill at the individual manager level in two ways. We start by testing for performance persistence in both PME and NPV at the manager-deal level. We then adapt the approach proposed by Barras, Gagliardini, and Scaillet (2022) to test for the existence of skill versus scalability in the context of mutual funds to the PE setting.

A. Performance Persistence

PE funds are run by teams of investment professionals, who each source, promote, and manage deals. Two to three named individuals are usually responsible for a deal, with the decision on whether to pursue a given deal taken by the fund investment committee. In the context of VC funds, Ewens and Rhodes-Kropf (2015) conclude that the cross-sectional variation in outcomes is influenced more by the manager leading the deal than the organization they work for. Given that they do not have deal-level cash flow information, they proxy success using deal outcome (IPO or successful acquisition) rather than the financial return. This paper is the first study to assign individual managers to buyout deals, and our data allow us to measure both performance and persistence using PME and NPV. Our analysis is based on the subsample of 4,873

deals that we can match to at least one PE manager. As multiple managers are involved in many deals, this results in 10,065 manager-deal involvements.

In Table V, we follow Braun, Jenkinson, and Stoff (2017) and regress a manager's current deal-level PME and NPV on the performance of the previous deal. Given we require at least one prior deal per manager, the sample drops to 6,166 observations. Standard errors, clustered at the manager level, are reported in parentheses. In Model (1), we control for the realization status of the deal, the (log) holding period, as well as the manager's (log) deal number. To account for differences in investment styles, we add industry, region, and investment year fixed effects.

At the manager level, across the whole sample, we find significant PME persistence and a clear negative impact of scale on returns. Model (1) includes all deals, whether realized or not. However, the impact of unrealized deals in the context of persistence regressions is significant, as the greatest increase in value occurs close to exit and immature deals are often held at or near cost for several quarters after they are initiated (Fernandez-Tamayo et al. (2025)). For instance, if a manager's latest deal was completed only in the latest quarter, that deal will have a reported MOIC very close to one, and the PME will simply reflect movements in the market during the period. Therefore, including such an immature deal in the sequence for a manager is likely to result in downward-biased measures of persistence. To account for this, we focus on realized deals in model (2) and find that the PME persistence parameter does indeed increase.

We next explore whether, in line with the fund-level results, PME persistence has been declining at the manager-deal level. For this analysis we split the sample roughly in half and maintain the focus on realized deals. As deals are the unit of analysis, we can identify the date on which the investment was made, rather than having to rely on fund vintage years. We split the sample into deals undertaken before and during 2004 (the median investment year of realized deals with a prior deal by the same manager) versus deals from 2005 onwards. In the early period we find significant PME persistence at the manager level, while in the later period we find no significant persistence. This pattern is consistent with the deal-level evidence in Braun, Jenkinson, and Stoff (2017), who find no PME persistence for deals after 2000, although their result is based on a PE firm's entire deal sequence, with no manager attribution.

When we use NPV as the performance measure (models (5) to (8)), we find very different results. While early deals already exhibited significant NPV persistence, we find that persistence at the manager level almost doubles for deals initiated in 2005 and thereafter. Interestingly, across all specifications, whether using PME or NPV, we find no significant independent effect of the manager-deal sequence as a proxy for experience. These results are robust to varying the benchmark index and PE premium (Internet Appendix Table IA.VI, Panel B) and to using different samples to control, to the extent possible, for potential backfill and survivorship biases (Internet Appendix Table IA.VII).

Table V

Manager Persistence

This table reports results of OLS regressions of the gross public market equivalent (PME) and deal net present value (NPV) for each manager's current deal on the corresponding performance (PME or NPV, respectively) of the manager's previous deal. For the NPV, we use three regional MSCI indices plus 200 bps p.a. to discount deal gross cash flows. The analysis is at the manager-deal involvement level. In models (1) and (5), we use the entire sample of managers for which we observe at least two deals. In models (2) to (4) and (6) to (8), we restrict our sample to at least partially realized deals. Models (3) and (7) further restrict the sample to deals up until 2004 (the median investment year), while models (4) and (8) only include deals after 2004. All regressions include investment year, deal region, and deal industry fixed effects. Standard errors are in parentheses and clustered at the manager level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable	Deal PME				Deal NPV			
Sample		Realized deals				Realized deals		
	All deals (1)	All (2)	Year ≤ 2004 (3)	Year > 2004 (4)	All deals (5)	All (6)	Year ≤ 2004 (7)	Year > 2004 (8)
Previous Deal Performance	0.087***	0.099***	0.123***	0.055	0.092***	0.172***	0.121***	0.196***
	(0.025)	(0.031)	(0.041)	(0.050)	(0.025)	(0.045)	(0.030)	(0.066)
Log Investment Size	−0.242***	−0.289***	−0.325**	−0.265***				
	(0.047)	(0.068)	(0.126)	(0.059)				
Log Holding Period	0.125***	0.176***	−0.198*	0.558***	4.680	29.614***	−15.837*	72.029***
	(0.035)	(0.066)	(0.120)	(0.067)	(3.883)	(6.165)	(8.816)	(9.625)
Log Manager Deal Sequence	−0.029	−0.078	−0.145	−0.059	−2.740	−9.551	−5.754	−14.070
	(0.050)	(0.067)	(0.126)	(0.088)	(6.057)	(8.229)	(7.481)	(12.913)
Realization Status	0.667***				94.804***			
	(0.058)				(8.760)			
Observations	6,166	4,422	2,329	2,093	6,166	4,422	2,329	2,093
Adjusted R^2	0.056	0.033	0.020	0.069	0.049	0.039	0.029	0.057
Investment Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table VI
Skill and Scalability in PE

This table shows the distribution of the skill and scalability parameters (see table 2 in Barras, Gagliardini, and Scaillet (2022)). The parameters are based on manager-specific OLS regressions of gross PME returns on the natural logarithm of investment size and the natural logarithm of the manager's deal sequence. The sample is restricted to 412 managers with at least five realized deals. Negative scale coefficients indicate diseconomies of scale.

	Moments				Proportions		Quantiles		
	Mean	*SD*	Skewness	Kurtosis	Negative	Positive	5%	50%	95%
Skill Coefficient	3.69	4.83	1.12	7.95	0.21	0.79	−3.34	3.29	11.07
Scale Coefficient	−0.44	0.97	−1.94	27.29	0.74	0.26	−2.20	−0.54	0.44

B. Skill and Scalability

Thus far, we have shown strong absolute performance persistence, consistent with the presence of managerial skill. Barras, Gagliardini, and Scaillet (2022) differentiate between skill and scalability in the context of mutual funds, and we adapt their approach to the PE setting. Their approach is nonparametric, minimizes the risk of misspecification, and adjusts for errors-in-variables (EIV) bias, which arises because true skill parameters are unobservable and must be estimated when determining the distribution of skill and scalability. It would be interesting to explore the potential sources of managerial skill, such as operational or financial engineering, but that would require data that we do not have. This question thus remains an interesting area for future research.

The first step involves running manager-specific regressions of gross deal PME on the natural logarithm of investment size, including an intercept. The skill parameter, as defined by Barras, Gagliardini, and Scaillet (2022), is the intercept, while the size coefficient is referred to as the scale parameter. In our context this is the gross PME on the first million dollars invested (since we measure investment in log terms, and log 1 is zero). Because the time series of deals per manager is very short, compared to typical mutual fund studies, there is a potential for bias in estimating skill and scalability parameters. We restrict the sample to the 412 managers with at least five realized deals. Finally, we use the standard Gaussian kernel to estimate the distribution of skill and scalability parameters and adjust for EIV bias in the kernel density estimator.

The results, presented in Table VI, indicate that the average manager in this sample is estimated to deliver a gross PME of 3.69 on a hypothetical \$1m deal. We find that 79% of these managers have a positive skill coefficient. This result is consistent with the findings of Barras, Gagliardini, and Scaillet (2022) and Berk and Green (2004), who, respectively, report positive skill coefficients of 83% and 80% for mutual funds. We also find that the scalability parameter is negative in 74% of cases. For the average manager in this subsample, a doubling in investment size results in a 0.3 lower gross PME ($= -0.44 \times \log(2)$

= −0.30). This suggests that diseconomies of scale for PE are somewhat less severe than for mutual funds, where Barras, Gagliardini, and Scaillet (2022) report a share of 82%. However, most of the positive scalability parameters for PE managers are small and statistically insignificant.

It is worth stressing that we are pushing our data hard in this part of the analysis. Track records in PE—where a manager may only do 10 deals in their career—are short. Restricting the sample to managers who have realized five deals is a compromise between being able to estimate regressions for each manager and retaining a reasonable sample size, but this compromise may result in positive selection bias in the sample, as poorly performing managers may leave the firm before they complete five deals. Despite these cautionary caveats, it is remarkable how similar the results are for PE and mutual fund managers. These constraints will loosen in the future as deal-level data, with manager attributions, become more abundant.

In summary, the results in this section provide evidence that individual managers have skill, but the challenges in scaling up profitable investment opportunities have resulted in performance persistence being more apparent in NPV than PME.

V. Internal Labor Markets: Matching Capital with Skill

Given the evidence that managerial skill exists, PE firms have strong incentives to monitor performance and allocate more capital to their skilled managers, especially as funds get larger. We also expect the careers of managers to be influenced by their skill. Given that success involves undertaking larger deals, which have on average lower returns, the organization is essentially looking for managers who can manage the trade-off between absolute and relative returns. In this section, we explore the workings of the internal labor market of PE firms along both the intensive margin (capital allocation) and extensive margin (promotion and exit). We also estimate how much value PE firms create by their capital allocation decisions.

A. The Internal Labor Market of PE Firms

Given the economic incentives for PE firms to raise larger funds and do bigger deals, we start by exploring whether managers with better track records manage larger deals. In contrast to mutual fund managers, whose performance can be measured daily, it is very challenging to construct a track record proxy for PE managers. As noted earlier, attributing deals to managers is far from universal, and there is no definitive source for such information. Our approach of merging information from several sources identifies named managers in 40% of the deals in our sample, but even for individuals for whom we can identify their specific deals, in some cases we do not have their complete track record. This is an area where data will improve in the future, as many investors are asking for such deal attribution, but for the time being we acknowledge that any proxy we construct for manager track records will be incomplete and noisy.

With this caveat in mind, we estimate a manager's track record at the time they do a deal by calculating how well their realized prior deals have performed relative to other contemporaneous deals pursued by their PE firm. In this way we proxy for the manager's position in the PE firm's internal labor market at the time of the current deal. This track record evolves over time: For the manager's third deal, for example, we account for the performance of their first two realized deals. The performance of the third deal then becomes part of their track record at the time of their fourth deal. We adopt a simple binary performance indicator according to whether the deal's NPV is greater than the median of all realized deals from the same PE firm in the same year. In this comparison, we include all deals, including those for which we cannot identify an individual manager. A manager's track record is then simply the success rate across all past realized deals. For example, a manager with three past deals, of which two outperformed, has a success rate of 67% at the time of the fourth deal. Since this analysis requires at least one prior realized deal with the same organization, and as we continue to focus on realized deals, our sample consists of 4,854 deal involvements.

In Table VII, we examine differences in capital allocation and career development between 2,625 managers with success rates of at least 50% (outperformers) and 2,229 managers with success rates below this threshold (underperformers). Panel A documents differences in the track records of the two groups. Recall that the track record evolves with each deal, and some managers switch classification between outperformers and underperformers. The median values in Panel A show that outperformers achieve significantly higher relative and absolute returns compared to underperformers.

More importantly, Panel B demonstrates that outperformers' next deals are on average larger.[28] The median deal size for outperformers is $44.6m, which is significantly larger than the $33.0m for underperformers. The PE organization may decide how much capital to entrust to an individual manager, so we also calculate investment size per manager involved with the deal. The difference is also statistically significant, with underperformers' next investment size per manager being $15.4m while outperformers receive $18.6m.

Given the evidence linking a manager's track record to capital allocation, it follows that career trajectories may also differ depending on past performance. To investigate this conjecture, we hand-collect career data for all managers in our sample. One advantage of this data set is that we have complete information on career progression after a deal. However, since job titles can vary in meaning across firms, we focus on the key promotion—becoming a partner. At the time of 2,292 of the total 4,854 buyout transactions examined, the manager in question had not yet attained partner status. Panel C shows that 15.7% of

[28] In our sample, we cannot fully ascertain the extent to which we observe all deals executed by each manager. Consequently, the recorded number of deals, or the observed capital deployed by a manager within a specific timeframe (e.g., over a three-year period), may be influenced by sample selection biases. To minimize potential bias from incomplete records, we focus our analysis on the capital allocation decisions related solely to a manager's observed next deal. This approach limits the sample selection concerns to the presence of at least one subsequent deal.

Table VII

Manager-Performance Sensitivity: Univariate Analysis

This table examines capital reallocation decisions and managerial labor market outcomes based on past deal net present value (NPV, using regional MSCI indices plus 200 bps p.a. as discount rate). The sample is restricted to 4,854 realized deal involvements for which we observe at least one previous realized investment of the same manager with the same PE organization. To determine a manager's prior performance, we benchmark each of the manager's past investments against the median deal NPV in the corresponding PE firm-year (using all of the realized PE firm investments in the deal's investment year). Column (1) shows univariate statistics for the full sample. Column (2) shows deal involvements for managers who outperformed in terms of NPV with at least 50% of their previous deals, while column (3) shows deal involvements for managers with a success rate of previous NPV performances below 50%. Column (4) shows the differences between the out- and underperformers. Column (5) displays the corresponding test statistics. Panel A reports the median for unweighted averages for gross PME and NPV of all previous realized deals. Panel B compares capital reallocation measures to previous deal performance. *Investment Size* is the median size of the current deal. *Investment Size per Manager* is the median size of the current deal divided by the number of managers on the deal. Panel C looks at managerial labor market outcomes within three years after the preceding deal's investment year. *Partner Promotion* is a dummy variable set to one for managers who are promoted to partner, and zero otherwise. For this variable, we restrict the sample to 2,292 deal involvements that occurred when the manager was not yet partner. *Leaves PE Firm* (*Industry*) is a dummy variable set to one if a manager leaves the current firm (PE industry), and zero otherwise. For these variables, we restrict the sample to the remaining 2,562 partner deal involvements. All tests in Panels A and B are rank-sum tests. Tests in Panel C are chi-square tests. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

		Track Record (NPV Success Rate)		(2) – (3)	
	All (1)	Outperformer (2)	Underperformer (3)	Diff. (4)	Test Statistic (5)
Obs.	4,854	2,625	2,229		
Panel A: Average Past Performance					
PME	2.05	2.44	1.73	0.71	***
NPV	22.9	44.2	7.5	36.7	***
Panel B: Capital Allocation (Next Deal)					
Inv. Size	38.4	44.6	33.0	11.6	***
Inv. Size per Manager	17.0	18.6	15.4	3.2	***
Panel C: Career Development (Three Years after Deal)					
Partner Promotion	13.9%	15.7%	11.7%	4.0%	***
Leaves PE Firm	2.5%	2.2%	2.9%	−0.7%	
Leaves PE Industry	2.1%	1.5%	2.9%	−1.4%	**

outperformers were promoted to partner within the next three years, a rate significantly higher than the 11.7% promotion rate observed for underperformers.

We also investigate whether track record influences the probability of leaving the firm. This analysis focuses on 2,562 partner deal involvements, as partners are accountable for failures and have strong economic incentives to remain with their current PE firm. We find that underperformers have a 2.9%

probability of leaving the firm within three years of a deal, compared to 2.2% for outperformers, but this difference is not statistically significant. However, it is important to note that exits may be voluntary, and distinguishing the reasons behind them can be challenging. In particular, successful managers may leave to start their own PE firms. To account for this, we also track whether a manager exits the entire PE industry within three years of a deal. We find that underperformers have a 2.9% probability of leaving the PE industry, compared to 1.5% for outperformers. The corresponding chi-squared test is significant at the 5% level. The difference is similar if the measurement window is extended to five years.[29]

Although these exit probabilities are low, they are in line with those observed in mutual fund studies. For example, Fang, Kempf, and Trapp (2014) find that skilled managers are more likely to be promoted, while Khorana (1996) reports that fund manager turnover is linked to negative performance. Chevalier and Ellison (1999) show that underperformance raises the likelihood of termination. Ewens and Rhodes-Kropf (2015) find that most movers between VC firms are either promoted or remain at the same level, with few experiencing demotions.

Multivariate OLS regressions in Table VIII confirm these results at the intensive and extensive margins. We control for several human capital variables that might influence a firm's decisions, namely, the manager's age at the time of the current deal and whether the manager is female, has an MBA, or attended an Ivy League university. We also control for the manager's deal sequence and include investment year, region, and industry fixed effects. We find that managers with a history of outperformance are allocated, on average, 20.2% larger investment amounts (per manager) than underperformers (model (1)). The economic magnitude of the effect of track record on capital allocation seems reasonable, given the nature of PE investing. While PE firms may encourage successful managers to source larger deals that can generate higher NPV, the pool of suitable private companies for LBOs is limited. Even if a deal is approved in the investment committee, the PE firm may not win it. The amount of equity invested is largely dictated by the transaction's scale, but PE firms can adjust their stake by engaging in club deals or allocating equity to co-investment vehicles. Despite these constraints and the noisy nature of our track record proxy, we consistently find that capital allocation decisions are influenced by a manager's prior track record in terms of generating NPV.

Models (2) to (4) confirm that managerial careers are shaped by past performance in a multivariate setting. Outperformers are 5.6 percentage points more likely to be promoted to partner and 2.0 percentage points less likely to exit the PE industry (or the PE firm), compared to underperformers, within three

[29] Internet Appendix Table IA.VIII splits the sample according to whether a manager's previous investment size was below or above the median investment size in a given firm and year. In general, we observe consistent patterns irrespective of investment size. Interestingly, the career outcomes are generally stronger, both economically and statistically, for managers with smaller deals. Managers who already manage large deals exhibit further increases in investment size (when compared to their previous investment size) when they create more NPV.

Table VIII

Manager-Performance Sensitivity: Multivariate Analysis

This table examines capital reallocation decisions (model (1)) and managerial labor market outcomes (models (2) to (4)) based on past deal net present value (NPV, using regional MSCI indices plus 200 bps p.a. as discount rate). To measure a manager's track record at any given time, we calculate *NPV Success Rate*, the percentage of past realized deals that were outperforming in terms of NPV. We consider a deal to be outperforming when it delivered a NPV greater than the median of all realized deals in the same investment year by the same PE firm. The sample is restricted to 4,854 deal involvements for which we observe two subsequent deals of the same manager within the same PE organization. In model (1), the dependent variable is the natural logarithm of current investment size divided by the number of managers on the deal. In model (2), the dependent variable is a dummy variable set to one for managers promoted to partner within three years after the preceding deal's investment year, and zero otherwise. For this variable, we restrict the sample to 2,292 deal involvements that occurred when the manager had not been a partner yet. In model (3), the dependent variable is a dummy variable set to one for managers who leave the current firm within three years after the preceding deal's investment year, and zero otherwise. In model (4), the dependent variable is a dummy variable set to one for managers who leave the PE industry within three years after the preceding deal's investment year, and zero otherwise. For the last two variables, we restrict the sample to the remaining 2,562 partner deal involvements. All models are OLS regressions. Standard errors are in parentheses and clustered at the manager level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	Capital Allocation (Next Deal)	Career Development (Three Years after Deal)		
Dependent variable	Log Inv. Size per Manager	Partner	Leaves PE Firm	Leaves PE Industry
	(1)	(2)	(3)	(4)
NPV Success Rate	0.202***	0.056**	−0.020*	−0.020**
	(0.072)	(0.026)	(0.012)	(0.010)
Log Age at Deal	0.246*	−0.045	−0.011	0.040**
	(0.148)	(0.047)	(0.016)	(0.020)
Female	−0.183	−0.007	−0.024***	−0.021***
	(0.147)	(0.055)	(0.006)	(0.004)
MBA Degree	−0.008	−0.053**	0.019**	0.001
	(0.075)	(0.023)	(0.009)	(0.009)
Ivy League	0.239***	0.014	−0.010	0.012
Attendance	(0.080)	(0.026)	(0.011)	(0.009)
Log Manager Deal	−0.071	−0.031*	−0.011**	−0.006
Sequence	(0.052)	(0.017)	(0.006)	(0.006)
Observations	4,854	2,292	2,562	2,562
Adj. R^2	0.067	0.012	0.019	0.001
Investment Year FE	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes

years of an investment. While these differences may initially appear small, they are substantial when considered relative to the low baseline incidence rates. Career progression or reversion is clearly influenced by many personal and professional factors beyond the ability to run successful deals.

We conduct several robustness tests for our finding that capital allocation decisions within PE firms are influenced by managers' past performance. In Internet Appendix Table IA.IX, we rerun the analysis on the next deal's overall investment size and on the "Who's Who" book sample. The significant impact of track record on investment size remains. We also find no impact of track record on the number of deals undertaken by a manager, consistent with earlier evidence that PE firms primarily scale by increasing deal size rather than by engaging in more deals. The results also change only marginally when different discounts rates are used (see Internet Appendix Table IA.VI). Finally, in Internet Appendix Table IA.X, we test whether capital allocation responds more to PME or NPV. We find that track records based on PME have a stable and marginally significant impact on capital allocation in both parts (early and late) of the sample. In contrast, the impact of NPV was at similar levels prior to 2005 and has become much larger and more significant over time.

B. PE Firms' Contribution to NPV

Given evidence that more skilled managers invest more capital, in our final analysis we estimate the proportion of value that is associated with PE firms reallocating capital in this way. This question has been analyzed in the mutual fund sector, although the context is somewhat different. As noted earlier, mutual funds are open-ended and hence fund size changes as money is invested or withdrawn, often in response to past performance. In addition, the mutual fund organization can reallocate fund mandates to successful managers. Such "promotion" is the focus of Berk, van Binsbergen, and Liu (2017), who find that around 30% of the overall value-added by the mutual fund sector is associated with capital allocation.

In contrast, PE funds are closed-ended and so investors cannot withdraw, or invest in, funds once the fund has been closed. However, since several managers are running PE funds, successful managers can be "promoted" through the allocation of more capital. To estimate the share of overall NPV contributed by the PE firm, we run the following regression, drawing on the approach of Berk, van Binsbergen, and Liu (2017):

$$NPV_{i,n,t} = \lambda_t + \lambda_r + \lambda_i + \lambda_b + \lambda_f + \beta \cdot Inv.\ Size\ per\ Manager\ Increase_{i,n,t} + \gamma \cdot Inv.\ \ Size\ per\ Manager\ Decrease_{i,n,t} + \bar{\delta} \cdot \overline{Controls} + \epsilon_{i,n,t}, \quad (5)$$

where $NPV_{i,n,t}$ is the gross value-added of deal n performed by manager i in investment year t divided by the total number of managers on the deal, *Investment Size per Manager Increase* is a dummy set to one if a manager's current deal investment size per manager (investment size divided by the number of managers on the deal) significantly exceeds their previous investment size per manager and zero otherwise, and *Investment Size per Manager Decrease* is a dummy set to one if a manager's current investment size per manager is significantly below their previous investment size per manager and zero otherwise. Note that, as in the rest of the paper, we construct manager-specific deal

trajectories, meaning that regardless of whether a deal is managed by multiple individuals, we compare each manager's current deal to their previous one. In cases in which a deal involves multiple managers, it will appear multiple times, once in each respective manager's timeline, adjusted by the number of managers on the deal.[30]

In all regressions, the omitted category is deals whose investment size stays roughly constant relative to the manager's previous deal. We experiment with different thresholds for these investment size effects, but the model attempts to identify capital allocation decisions that significantly deviate from the manager's previous deal size. Although investment size per manager will vary due to exogenous factors, in particular the pool of available investment opportunities, the use of significant thresholds increases the likelihood that observed patterns reflect deliberate capital allocation decisions by the PE organization. This framework therefore allows us to estimate the contribution of the PE firm—through capital allocation decisions—to generating NPV.

The parameters λ_t, λ_r, λ_i, λ_b, and λ_f are investment year, region, manager, industry, and PE fund fixed effects, respectively. The wide array of fixed effects are included to mitigate, to the extent possible, the impact of relevant omitted variables. For instance, the inclusion of PE fund fixed effects rules out the possibility that time-invariant cross-sectional heterogeneity in fund economics drives the capital allocation result. The vector $\overline{Controls}$ includes investment size per manager, the deal's holding period, and the manager's deal sequence.[31]

As in Berk, van Binsbergen, and Liu (2017), the interpretation of the capital allocation dummies warrants explanation. For mutual funds, a manager's value creation can be decomposed into three parts: (i) the manager's value-added without the promotion decision and without external fund flows, (ii) the contribution of the firm's capital allocation decision, and (iii) the contribution of contemporaneous investor flows had the organization not reallocated capital to the manager. For mutual fund managers, component (iii) can be significant if investors endogenously respond to revelations of managerial skill. This is not an issue in our setting given that PE funds are closed-end funds and investors have no say on which deals are pursued. The PE setting therefore provides a potentially cleaner environment to assess the firm's contribution to NPV.

We present the regression estimates in Table IX, where the dependent variable is NPV per manager. In our baseline models we use thresholds of 150% and 50% for significant changes in capital allocation, and we focus on realized deals when determining track record. Model (1) finds a coefficient of 12.9 for size increases, significant at the 5% level. This point estimate suggests that

[30] There may be many reasons why some deals are attributed to multiple managers, and thus future research on the different roles and skills of individual managers could be fruitful.

[31] Note that deal-level investment sizes in the PE setting are considerably noisier than the fund-level AUM in the mutual fund setting. Therefore, in contrast to Berk, van Binsbergen, and Liu (2017) and in line with our earlier analyses, we control for the natural logarithm of investment size instead of the dollar value. Doing so results in a conservative estimate for the firm's capital allocation decisions. If we instead controlled for dollar-value investment sizes, the point estimates for the size increase dummy would be stronger in both economic and statistical terms.

Table IX
Capital Reallocations and NPV

This table reports results of OLS regressions of current *NPV per Manager* on a PE firm's capital allocation decisions. The analysis is at the manager-deal involvement level and includes realized deals only. The dependent variable is the current deal's NPV divided by the number of managers on the same deal. *Investment Size per Manager Increase* is a dummy variable equal to one if a manager's current deal investment size per manager (investment size divided by the number of managers on the deal) exceeds their previous deal's investment size per manager by a specified threshold, and zero otherwise. *Investment Size per Manager Decrease* is a dummy variable equal to one if a manager's current investment size per manager falls below their previous investment size per manager by the same threshold, and zero otherwise. Models (1) to (3) use a threshold of 50%. Model (2) focuses on capital allocations within the same fund. Model (3) uses PE firm instead of fund fixed effects. Models (4) to (6) use alternative thresholds for the dependent variable, with thresholds of 20%, 30%, and 40%, respectively. Standard errors are in parentheses and clustered at the manager level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Dep. Variable	NPV per Manager					
Test	Threshold 50/150			Alternative Thresholds (Baseline)		
	Baseline	Same Fund	PE Firm FE	Threshold 80/120	Threshold 70/130	Threshold 60/140
	(1)	(2)	(3)	(4)	(5)	(6)
Inv. Size per	12.883**	16.454*	12.679***	11.001*	11.687**	13.902**
Manager Increase	(5.645)	(9.473)	(4.857)	(6.233)	(5.401)	(5.554)
Inv. Size per	6.131	8.786	3.727	6.391	7.116	8.689
Manager Decrease	(7.439)	(11.208)	(6.538)	(6.698)	(6.639)	(6.766)
Log Inv. Size	13.096***	20.344**	17.600***	13.829***	13.876***	13.672***
per Manager	(5.036)	(9.627)	(5.109)	(4.675)	(4.835)	(4.962)
Log Holding	−3.654	−4.248	−3.714	−3.964	−3.625	−3.657
Period	(5.083)	(7.477)	(4.733)	(5.076)	(5.104)	(5.077)
Log Manager Deal	10.496	9.371	−11.101	10.615	10.464	10.326
Sequence	(9.850)	(16.637)	(10.091)	(9.886)	(9.898)	(9.842)
Observations	3,611	2,199	3,611	3,611	3,611	3,611
Adjusted R^2	0.167	−0.398	−0.006	0.166	0.166	0.167
Average NPV (m$)	31.7	27.1	31.7	31.7	31.7	31.7
Investment Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Manager FE	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	No	Yes	Yes	Yes
PE Firm FE	No	No	Yes	No	No	No

the PE firm creates $12.9m in value by allocating capital across its managers, which corresponds to approximately 41% of a deal's average NPV ($31.7m in this subsample).

Although, as noted, funds in the PE setting are closed-end funds, a manager's track record will usually span several funds. Some part of the increased deal size will be associated with the general growth in fund size. Therefore, in model (2), we restrict the sample to capital allocation decisions within the

same fund, that is, where both the preceding deal and the current deal are from the same fund, which results in the cleanest setting unaffected by external fund flows. This approach yields a slightly higher point estimate of 16.5. The average NPV of this within-fund sample is $27.1m, and so the estimated share of valuation creation by capital allocation decisions is 61%.

Model (3) replaces fund fixed effects with firm fixed effects. This is the approach taken by Berk, van Binsbergen, and Liu (2017) in the context of mutual funds, where reallocation of fund mandates from one manager to another is common. Such reallocation of managers between funds is less frequently observed in PE, as the team is typically defined at the time of fundraising, including specification of several "key persons" in the LPA who are contractually required to devote most of their time to the specific fund. Furthermore, in general, two funds following the same strategy do not invest at the same time, to avoid potential allocation issues or conflicts of interest. Notwithstanding, the inclusion of firm fixed effects tests for the significance of capital reallocation after controlling for other, unobserved, features of the organization. In model (3), we find a similar coefficient on the size increase dummy, which is highly statistically significant.

The choice of threshold for a significant change in capital allocation is largely arbitrary, and thus in models (4) to (6) we examine whether the results are robust to alternative, higher, thresholds. Higher thresholds attribute similar contributions to deal NPV from capital allocation decisions. The results suggest that approximately 33% to 45% of NPV is associated with capital increase decisions.

The estimates for *Investment Size per Manager Decrease*, by contrast, are smaller. However, this result should be interpreted with caution because our sample is right-censored, resulting in lower power. When a manager leaves a firm, they no longer perform investments and hence we cannot observe their subsequent NPV.[32] In addition, it could be the case that a manager stays with the firm but is no longer allowed to take the lead in a deal. Therefore, the coefficient for size decreases is likely to be a lower bound estimate.

Taken together, our results suggest around 40% of NPV may be associated with capital allocations decisions by PE organizations.[33] Given the very different structure of PE funds, and the more varied ways in which PE managers can add value given that they control their firms, this finding is remarkably similar to the evidence in Berk, van Binsbergen, and Liu (2017) for mutual fund managers.

[32] Berk, van Binsbergen, and Liu (2017) account for this possibility by setting value-added to zero after a manager is "fired," that is, leaves the firm after a decrease in their AUM. Adopting this approach results in economically and statistically stronger point estimates for demotion decisions.

[33] We also estimate the impact of capital allocation decisions at the overall deal level (without controlling for the number of managers involved in the deal) and find that around one-third of NPV is driven by PE organization decisions using this formulation (estimated effects range from 26% to 41%; see Internet Appendix Table IA.XI).

VI. Conclusions

In this paper, we show that the considerable growth of the PE industry has been associated with increasing deal and fund sizes. One of the reasons PE firms seek to raise larger funds is simple: Success does not usually result in changes in headline fees or carried interest. However, increasing fund size and deal size also comes at a cost: Based on a large sample of buyout deals, matched to individual managers where possible, we document lower relative deal- and fund-level returns as deals and funds get bigger, as well as declining relative return persistence, as measured by PME. However, drawing on the insights of Berk and van Binsbergen (2015) in the context of mutual funds, while PE managers may not be able to maintain relative returns as funds scale, the ability to generate value in dollar terms is also important to investors. Since the PE model is "buy-to-sell," we can measure the NPV of each deal—which captures both returns and scale—without needing to make assumptions about terminal values. As PME persistence has decreased, we find that NPV persistence has increased at both the deal and fund level.

To manage the interplay between size and performance, we find that PE firms allocate more capital to managers with a track record of producing higher NPV in their deals. Such skilled managers have an increased likelihood of being promoted to partner and are less likely to leave their firm or the PE industry. By learning about managerial skill, PE organizations have an important role to play in maximizing NPV. This is particularly valuable in the context of PE funds given the limited ability of investors to reallocate capital themselves, having committed contractually to a fund. We estimate that, on average, around 40% of NPV stems from PE firms' capital allocation decisions.

Our research is relevant to investors when choosing a PE firm. Assessing managerial track records, particularly their ability to generate NPV, could be a valuable exercise. Losing key personnel with a great track record should be of concern to investors, while also representing an opportunity if they leave to join or establish a new PE firm. Investors may find it hard to monitor individual performance in the absence of data on deal attribution that we have gathered, although we believe such data will become available over time. In the meantime, we show that PE organizations help mitigate this information asymmetry by allocating more capital to better managers.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Appendix S1: Internet Appendix.
Replication Code.