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Has persistence persisted in private equity? Evidence from buyout and venture capital funds☆

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ABSTRACT

This paper presents new evidence on performance persistence for U.S. private equity (buyout and venture capital) funds. We use high quality cash-flow data from Burgiss's large sample of institutional investors (as of December 2020) which allows us to examine how persistence has changed over more than three decades of fundraising. Venture capital (VC) performance remains remarkably persistent across funds raised by the same general partner (GP). In contrast, buyout funds' performance persistence becomes noticeably weaker over time. The patterns are different when we restrict the analysis to information that would have been available to investors – interim performance on the previous fund at the time a new fund is raised – rather than using final, or latest, performance. We find little evidence of persistence for buyouts, especially post-2000. We continue to find persistence for VC funds though it declines post-2000. The differences are driven by interim performance reported at the time of fundraising being only moderately correlated to final performance and GPs avoiding fundraising when interim performance is poor. Finally, we look at GPs who introduce new fund styles and find that performance is noticeably lower for buyouts (but not VC). Exploring the reasons for these divergent trends in persistence between buyout and VC is a promising area for future research.

1. Introduction

Whether investment managers exhibit performance persistence is a key question for any asset class. If managers have repeatable skill, then how do investors identify and follow such skill? And how do any resulting flows of capital affect net returns? This paper focuses on private equity (buyout and venture capital) to examine performance across successive funds – typically organized as limited partnerships – with the same manager (the general partner or GP). Previous research finds significant performance persistence in private equity, but many of these studies were based on self-reported data from the early days of the sector. We study whether

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performance persistence has persisted as the industry has grown. We pay particular attention to whether investors can recognize high performance in time to reap any benefits that persistence might bring. We also examine whether shifts in a GP's strategy affect persistence (e.g., raising a sector-based fund when the past funds were not in that sector). We use research-quality data from Burgiss which was not available for early research and a new fund sequence classification that we add to the Burgiss data. We study over two thousand funds (U.S. buyout and venture capital) spanning over three decades with data on actual returns, net of fees and carried interest, to limited partners (LPs) through 2020.

Our main results are as follows. First, using a fund's final performance (or, if the fund is still active, the fund's performance at the end of 2020), we confirm findings of earlier research of some persistence in performance. However, patterns differ between buyout and venture capital (VC) and over time. Across the whole sample, persistence is much stronger in VC than in buyout. Prior studies have largely relied on funds formed before 2000, and so miss the large increase in allocations to buyout funds since 2000 as well as the collapse in allocations to VC after the dot-com boom. We analyze results separately for funds raised pre-2001 and post-2000. For buyouts, performance persistence for the top-performing funds has declined while persistence for the worst performing funds has, if anything, increased. For VC, persistence holds in both subperiods though there is some compression of performance differences between top and bottom performing funds.

These patterns of persistence relate to the final outcomes for successive funds – which have lives of a decade or often longer. In practice, investors do not have the benefit of such hindsight when they must decide whether to commit capital to a new fund. GPs typically raise a new fund partway through the life of the prior fund, at which point only interim performance measures are available. Importantly, GPs have discretion on when to raise a new fund.

Accordingly, our second set of results relies solely on interim performance information that would be available when LPs decide on capital commitments to a new fund. Using this lens, we find different patterns, especially for buyouts. Private equity managers – GPs of both buyout and VC funds – tend to avoid fundraising when the interim performance of their current fund is weak. For buyout funds raised after 2000, we find that performance persistence disappears if the LP investor uses interim performance to gauge the results of the prior fund. For instance, when buyout funds are sorted into performance quartiles at the time of fundraising, we find no significant differences in their final outcomes. This means that investors gain little by knowing the relative performance of the current fund when deciding whether to commit to the next buyout fund being raised by the same GP. For VC funds, in contrast, performance persistence still exists using interim performance information available at the time of fundraising, but has become weaker for funds formed after 2000.

Third, throughout the paper we rely on a more detailed classification of the funds raised by a given GP than used in prior research. This has become increasingly important over our sample period as the range of funds raised by the same GP has increased. For example, Bain Capital has Bain Ventures while Sequoia Capital also has Sequoia Growth. While our study focuses on US funds, this issue could also be important for research across different geographies.[1] We measure performance persistence within each fund family or style (so we sequence Sequoia Growth separately from Sequoia Capital). This more granular sequencing also allows us to investigate whether a shift in style has implications for performance. For buyouts, we find that the 'core' fund styles of GPs perform better than 'secondary' style funds that are launched later. In contrast, in VC, we do not find a negative performance effect of being a secondary style fund.

Our results add to the performance persistence literature in several ways: using better and more recent data, taking account of the different fund families launched by the same GP, studying how persistence has changed over time, and examining implications for investing based on when information is available to investors. We largely confirm prior research findings on persistence in the early decades of private equity using research quality data which were not available for those studies. For example, Kaplan and Schoar (2005) find evidence of persistence in venture capital (VC) and buyout funds raised in the 1980s and 1990s. Robinson and Sensoy (2016) obtain similar results for a sample of buyout funds, again raised largely in the 1980s and 1990s. Hochberg et al. (2014), study VC funds raised over the period 1980 to 2002 and find persistence. Chung (2012) studies buyout and VC funds raised through 2000 and finds somewhat less persistence than the other papers. Kaplan and Schoar (2005) rely on Venture Economics data that Stucke (2011) and Harris et al. (2014), HJK, subsequently show to be flawed. Robinson and Sensoy (2016) rely on fund investments of just one investor. Chung et al. (2012) does not have access to fund-level cash flows. Phalippou (2010) uses (the flawed) Venture Economics data for VC funds. Hochberg et al. (2014) also rely on Venture Economics data, supplemented by Preqin.

Our finding that persistence has declined over time for buyouts as the private capital sector has grown in size and sophistication is consistent with prior research from the LP perspective. Sensoy et al. (2014) find that the ability of certain types of investors to achieve higher performance, as originally found by Lerner et al. (2007), has disappeared in more recent years. This may reflect a reduction in performance persistence that GPs achieve, thus decreasing the value of long-established relationships between LPs and particular GPs. We note, however, that performance persistence is stronger in VC than buyout, perhaps reflecting the more difficult challenges of scaling VC investing and thus competing away GP advantages. Our results on persistence are consistent with those in Harris et al. (2018) who find that VC funds of funds earn their fees while buyout funds of funds do not, suggesting that VC funds of funds can identify better performing VC funds ex ante, while buyout funds of funds cannot. Our VC results are also consistent with those in Hochberg et al. (2014) who find performance persistence based on interim performance in VC and attribute this to patterns in how LPs learn about the differential skills of GPs.

We also show that persistence is hard to detect due to the noisy signal that interim performance provides (see Phalippou, 2010). The commitment to invest in a GP's new fund will typically occur partway through the life of the prior fund, at which point only interim

[1] The classification project we have undertaken separately sequences funds for all countries according to their primary investment focus. In this paper we only consider those with a primary US focus.

performance measures are available based, to some extent, on the estimated net asset values of the remaining unrealized portfolio companies. Our findings are consistent with Hochberg et al. (2014) who study VC funds and measure both interim and final performance. They find evidence of performance persistence using interim performance and show that the final performance of a fund is, unfortunately from the perspective of the LP, much more informative about the performance of the GP's next fund than is interim performance. They do not, however, study buyout funds. Our work is also consistent with research studying the interaction of fundraising and interim performance, Brown et al. (2019) and Jenkinson et al. (2013) find that interim performance is a meaningful, but imperfect measure of final performance. These findings suggest that studies using final performance overstate the economic benefits an investor might reap from persistence.

In addition to analyzing the quartile transition probabilities used in prior research and by practitioners, we use a regression framework to examine persistence. The results echo the findings from the transition probabilities. The regression framework also allows us to control for other factors that might affect how fund returns evolve over time for a particular GP. Our results on the impact of GP fund styles are a new addition to the literature and show that, at least in buyout, success in a core style of investing is not fully portable once a GP branches into a new set of funds. This suggests that LPs can benefit from a more thorough examination of a GP's resources (e.g., specific expertise and networks) than is found in prior fund performance information. This is consistent with the substantial investment in manager selection by many sophisticated LPs. We think that future work in this area is particularly promising.

The paper proceeds as follows. In section 2, we discuss the data used. In section 3, we present and discuss our persistence results based on quartile transitions. In section 4, we present performance persistence regressions, and analyze the impact of fund size increases and non-core funds. In section 5, we conclude and summarize the implications of our results.

2. Data and sample statistics

We use performance data for U.S. buyout and VC funds from Burgiss, with valuations and cash-flows up to the end of December 2020, as originally used, and described in detail, by Harris et al. (2014).[2] The Burgiss dataset "is sourced exclusively from LPs and includes their complete transactional and valuation history between themselves and their primary fund investments. The flows are rescaled to be representative of the full fund." In other words, the Burgiss data include all funds and cash flows from the LPs that provide the data. Because the data are net of all fees and carried interest paid to the GP, our performance measures represent the net returns to the LPs who invest in the funds. An important advantage of Burgiss cash-flow data is that the full history of performance can be reconstructed at any point in time. Over 1000 LPs now use the Burgiss platform and comprise a wide array of investors including public and private pension plans, endowments and foundations, family offices, and others.

The underlying cash flow data of the funds are likely to be highly accurate because LPs use Burgiss' systems for record keeping and fund investment monitoring. This "check book" data – recording the exact cash outflows made by the LPs to the GPs as well as the distributions from the GPs back to the LPs – has several advantages for research purposes. The fact that the data are sourced from the back-office systems used by the LPs for reporting and fund accounting, and are cross-checked across investors in the same fund, results in levels of data integrity and completeness that cannot be achieved by surveys, voluntary reporting, or (largely) involuntary reporting using Freedom of Information (FOIA) requests (the main method employed by Preqin). Furthermore, when data are sourced from GPs, it is possible for a GP to strategically stop reporting or to only report on their funds selectively. The Burgiss data also are up to date – given the need for quarterly reporting by most investors – and so there are no problems with a lack of updating as there can be with other commercial databases. In other words, for a given LP, there is unlikely to be any selection or timing bias. This is an advantage over other commercial sources whose data rely on voluntary and FOIA disclosures by GPs and LPs.

The potential bias in the Burgiss data – which it shares with the other commercial sources – is how representative the LPs (and resulting GPs) are. For example, it is possible that the LPs in the Burgiss sample have had better than average experience with private equity, which is why they use Burgiss and allow Burgiss to aggregate their results. However, the results in Harris et al. (2014, 2016) suggest that this bias is not present.

Burgiss identifies the GP and the type of fund (or funds) offered by the GP. Some GPs have the same investment focus for all funds. However, other GPs have used more than one fund strategy – for example, have raised a set of VC funds and then a set of growth equity or sector-based funds. We keep track of each fund strategy separately. From this, we produce a sequence number for each fund in a fund strategy. This procedure also allows us to distinguish between the GP's initial (core) funds and subsequent "secondary style" fund families. We do this because the characteristics and the individual partners of the different types of funds can vary. Researchers should be wary of using fund sequences that do not take account of these distinctions: simply sorting fund data by GP and then vintage year will often not produce a suitable sequence of like-for-like funds investing in similar strategies. We eliminate annex funds and side funds. Annex funds are funds that extend an existing fund. Side funds are invested side-by-side with a main fund and have the same performance.

Our analyses compare performance for funds raised in a particular fundraising (vintage) year. Burgiss classifies a vintage year as the year in which a fund first draws capital from its LPs. We report performance for vintages from 1984 through 2015. Relatively few funds have available data pre-1984. We do not include vintages after 2015 because we want to give funds sufficient aging to deliver

[2] HJK (2014 and 2016) use cash-flow data up to the end of March 2011 and June 2014. This paper uses cash-flows through December 2020, and so provides an update to the performance analysis. Additional funds have been added to the Burgiss data set, and so the sample size in this paper is somewhat larger.

meaningful performance – in our case, at least five years.

Table 1 provides summary information on the 2337 funds in our sample, by vintage year. We do not report results for early vintage years with fewer than five funds. Panel A describes the 929 buyout funds, which represent committed capital of over $1 trillion. As a comparison, Kaplan and Schoar (2005) sample included 169 buyout funds. For 507 of these funds, we have the performance of the prior fund in the sequence. For instance, if we have funds 1, 2, 4 and 5 from a given fund sequence, we have two adjacent pairs that we can analyze. The other 418 funds are comprised of roughly equal numbers of first-time funds and funds that were not first-time funds, but for which Burgiss lacks prior fund performance information.[3] The latter reflects the fact that our data are derived entirely from LPs who do not necessarily invest in every fund offered by a GP. This inevitably leads to gaps in the fund sequences.

Panel B describes the 1408 VC funds in the sample, which raised over $350 billion in total. Kaplan and Schoar's sample included 577 VC funds. Prior fund information is available for 765 of our sample funds. We also have information for 310 first-time funds and 333 non-first-time funds for which Burgiss lacks prior fund performance.

Table 1 also reports the unrealized portion of the funds remaining, as of the end of 2020, as a percentage of the total value (unrealized plus already realized) for an LP in the fund. For buyout funds, vintage years before 2008 are, on average, at least 90% realized. Only the 2013 through 2015 vintage years are less than 50% realized. For VC funds, vintage years before 2008 are, on average, at least 70% realized. Vintages from 2013 to 2015 are less than 30% realized. However, since 2010, ASC 820 requires that private equity firms value their assets at fair value every quarter, rather than permitting them to value the assets at cost until an explicit valuation change. This has likely had the practical effect of making estimated unrealized values closer to true market values than in the past, particularly for buyout funds. Jenkinson et al. (2020) show that after a few years, the unrealized values of funds' remaining investments are close estimates of the net present value of actual future cash flows, and Brown et al. (2019), suggest that, on average, unrealized values are, if anything, conservative. Both of these studies also use Burgiss data. Easton et al. (2020) present evidence that valuations are more accurate post-ASC 820.

The lack of seasoning for the more recent funds does not affect our results. We obtain qualitatively and statistically similar results when we exclude more recent vintages – those after 2012. Nevertheless, we recognize that the analysis of those funds might be subject to change in the future.[4]

Table 1 also reports average performance by vintage year using three measures. The internal rate of return (IRR) is computed using the timed cash flows into and out of the fund, treating the remaining unrealized NAV (net of fees) as a final positive cash flow. The multiple of invested capital (MOIC) is the ratio of the sum of cash distributions plus remaining NAV to the cash invested in the fund. The IRR and MOIC are the standard performance measures used by PE practitioners. The third measure is the public market equivalent return (PME), which measures performance relative to a market index. We follow the approach of Kaplan and Schoar (2005) in calculating PMEs relative to the S&P 500 total return index. The PME is effectively a market-adjusted multiple of invested capital. It measures how an investment in a private equity funds compares to an investment in public equities. Korteweg and Nagel (2016) and Sorensen and Jagannathan (2015) provide theoretical descriptions and justifications for PME.[5]

For buyout funds, the average net IRR across the sample is roughly 14% per annum, with an average MOIC of 1.81. Buyouts have consistently out-performed public markets with the average PME being 1.18 across the sample. Indeed, for each vintage year since 1994 the average PME has been greater than 1.0. Performance is somewhat lower for post-2005 vintages with an average vintage PME of 1.09. Overall, the post-2005 performance of buyouts is higher than that reported in HJK (2014 and 2016), reflecting the maturation of funds and additions to the sample.

For VC funds, the average net IRR across the sample is roughly 16% per annum, with an average MOIC of 2.36. VC funds, overall, also have out-performed public markets with the average PME of 1.29 across the sample. That performance, however, has been more variable than for buyouts. In the 1980s, most vintage years underperformed public markets; in the 1990s, vintage years largely outperformed public markets; performance was poor, again, for vintages from 1999 to 2006; and since 2007, VC has strongly out-performed public markets.

In the final columns of Table 1, we present average performance for the subset of funds for which we have the previous fund's performance.[6] Trends across these figures are consistent with the full-sample results. For buyouts, the performance averages are almost identical to those for the full sample as shown in the final row of Panel A. For VC, when there is performance history from a prior fund, the fund's performance is, on average, somewhat higher than the full sample. This is primarily due to results in the early decades of VC, but has since largely disappeared. For instance, for vintage years after 2000, the average vintage year MOIC (PME) for the full VC sample is 2.37 (1.22) which is essentially the same as the 2.38 (1.23) figure for VC funds with performance history. We note that there will always be gaps in fund sequences when using data sourced from investors, as the sample of investors may not continue to invest with a particular GP. Gaps in the data are one reason for a prior fund not to be available, but the other reason is first-time funds from a GP. Our approach treats the first fund in any new family as a first-time fund, and we analyze the performance of these first-time funds

[3] Since we sequence each fund family separately, some first-time funds will be first funds for secondary fund styles.

[4] This is particularly true for the more recent funds given the coronavirus shock in 2020.

[5] We do not produce results based on the Generalized PME returns (Korteweg and Nagel, 2016), as this metric is not currently produced by Burgiss. Prior work at the deal level by Braun et al. (2017) found few differences in the results based on PME and GPME. Korteweg and Nagel (2022) introduce a new benchmarking approach for private equity fund performance, α, that they argue is less noisy than both PME and GPME. For buyout funds, PME and α tend to be quite close because buyout fund betas tend to be close to 1.

[6] We do not require a full history of performance for all funds in a fund strategy. Provided we have performance information for at least two adjacent funds (e.g., funds 3 and 4) then these are included in our performance persistence analysis.

separately.

3. Persistence based on quartile performance

Moving from performance to persistence, in Table 2 we present an update to prior studies that use performance quartile transitions (Kaplan and Schoar (2005), Robinson and Sensoy (2016), Braun et al. (2017)). Our analyses focus primarily on PME which measures private versus public market returns. We report results based on measuring public equity performance with the return on the S&P 500. Our results are qualitatively similar when we use the returns on the Russell 2000, an index for smaller capitalization stocks. The IRR and MOIC do not adjust for stock market movements and so vary meaningfully across periods of different market returns. While we focus on PME, our persistence results are qualitatively similar when we sort using IRR or MOIC; these results are presented in an Internet Appendix.

We start by analyzing whether the performance of a previous fund predicts the performance of the next fund. As noted earlier, this strategy is not generally feasible in practice, as the final performance of the previous fund is not known at the time of fundraising. Later we repeat our analyses using only previous fund performance information that is available when the GP is raising the next fund.

3.1. Persistence by quartiles – previous fund

For each vintage year, we sort all funds into one of six groups. We place funds in groups one to four based on the performance quartile of its previous fund (as of December 2020) relative to other funds raised in the same year, if such performance is available. For those non-first-time funds where the prior fund performance is not available, we cannot measure persistence but we can measure performance, and so place them into a fifth group. The sixth group focuses on the performance of first-time funds of a fund family.

Table 1
Summary information on funds.

Panel A: Buyout Funds

Vintage	Total	Ave. Capital Committed ($m)	% Unrealized	Average IRR %	Average MOIC	Average PME	Funds with Performance History	Average IRR %	Average MOIC	Average PME
1984	2						1			
1985	4						1			
1986	4						2			
1987	8	1042	0.0%	17.7	3.26	1.31	5	16.5	3.05	1.26
1988	9	674	0.0%	11.1	1.77	0.80	2			
1989	10	276	0.0%	21.3	2.42	1.28	2			
1990	8	288	0.0%	16.2	2.23	0.99	0			
1991	3						1			
1992	9	446	0.6%	22.3	1.97	1.08	3			
1993	8	570	0.0%	15.6	1.90	0.93	3			
1994	18	409	0.0%	17.3	1.84	1.06	9	19.3	2.05	1.14
1995	26	645	0.0%	13.2	1.62	1.07	9	9.8	1.43	1.00
1996	17	280	0.0%	13.3	1.64	1.15	6	4.7	1.25	0.88
1997	30	930	0.0%	3.8	1.25	1.08	20	6.4	1.40	1.17
1998	39	960	0.0%	5.4	1.43	1.32	21	5.5	1.40	1.27
1999	32	910	0.5%	5.0	1.42	1.22	16	0.4	1.21	1.03
2000	51	1183	0.7%	12.9	1.74	1.39	22	14.2	1.86	1.45
2001	27	770	0.3%	19.2	1.84	1.40	14	17.4	1.80	1.32
2002	20	727	2.9%	17.3	1.86	1.38	9	16.1	1.82	1.32
2003	22	987	0.3%	18.6	2.07	1.56	13	21.0	1.97	1.49
2004	37	876	2.5%	14.2	1.76	1.31	19	12.7	1.81	1.38
2005	56	902	4.5%	10.5	1.73	1.18	30	11.4	1.74	1.20
2006	57	2226	6.6%	8.1	1.65	1.05	32	9.7	1.73	1.07
2007	62	1966	9.6%	12.9	1.84	1.08	33	13.2	1.85	1.08
2008	60	1496	12.9%	13.2	1.78	1.02	34	14.7	1.90	1.06
2009	22	844	15.6%	17.1	2.07	1.15	16	19.7	2.16	1.22
2010	26	718	21.8%	13.2	1.81	1.03	18	13.0	1.83	1.02
2011	46	1333	30.4%	18.0	1.99	1.15	30	18.2	2.00	1.16
2012	47	1125	33.5%	17.4	1.83	1.14	30	19.4	1.90	1.18
2013	50	1517	51.1%	17.3	1.72	1.12	34	17.7	1.73	1.13
2014	65	1166	60.1%	16.4	1.68	1.12	37	16.4	1.71	1.12
2015	48	1296	74.9%	17.0	1.59	1.09	34	17.3	1.63	1.10
Overall Sample	929	1141	17.4%	14.2	1.81	1.18	507	14.2	1.80	1.16

Panel B: Venture Capital Funds

Vintage	Total	Ave. Capital Committed ($m)	% Unrealized	Average IRR	Average MOIC	Average PME	Funds with Performance History	Average IRR	Average MOIC	Average PME
1984	22	67	0.0%	6.92	1.67	0.65	10	6.28	1.60	0.61
1985	26	41	0.0%	7.56	2.03	0.70	7	12.70	2.70	0.89
1986	24	47	0.0%	9.74	1.99	0.85	7	8.80	1.76	0.74
1987	26	55	0.1%	10.68	2.16	0.91	5	20.46	3.43	1.48
1988	28	84	0.0%	12.14	2.03	0.95	12	18.89	2.63	1.30
1989	26	59	0.0%	16.32	2.50	1.15	16	18.23	2.68	1.31
1990	13	64	0.0%	25.13	3.04	1.52	9	28.29	3.28	1.61
1991	6	69	0.0%	19.65	2.63	1.09	3			
1992	17	84	0.0%	23.68	3.19	1.49	14	13.24	1.90	0.87
1993	20	96	0.0%	40.14	5.35	2.34	13	49.18	6.67	2.81
1994	16	92	0.0%	48.09	6.15	2.81	12	52.62	7.16	3.22
1995	29	133	0.0%	59.89	5.40	3.03	16	46.77	3.45	2.03
1996	18	131	0.0%	92.06	6.68	4.17	10	115.37	9.98	6.25
1997	44	132	0.0%	79.53	3.71	2.91	19	120.10	5.33	4.21
1998	54	196	0.7%	28.50	1.94	1.73	35	36.74	2.34	2.10
1999	88	321	1.0%	−3.72	0.87	0.75	47	−2.66	0.87	0.77
2000	112	372	1.8%	−2.99	0.92	0.71	57	−1.50	0.98	0.74
2001	59	370	6.1%	1.60	1.35	0.87	36	2.10	1.43	0.91
2002	16	288	1.9%	−1.21	1.09	0.74	9	−0.82	1.00	0.69
2003	19	254	13.8%	−1.48	1.92	1.13	11	6.56	1.90	1.23
2004	38	274	16.5%	1.17	1.75	0.97	17	1.71	1.50	0.82
2005	62	279	16.3%	3.52	1.65	0.96	39	4.44	1.80	1.09
2006	79	355	19.2%	2.33	1.64	0.82	42	2.34	1.91	0.90
2007	74	325	27.2%	9.96	2.44	1.15	45	12.42	2.40	1.18
2008	57	316	30.8%	9.79	2.49	1.10	35	13.87	3.02	1.29
2009	27	419	39.4%	18.42	3.47	1.45	17	14.91	3.09	1.25
2010	31	334	49.1%	17.46	3.00	1.34	24	15.21	3.05	1.29
2011	46	269	57.9%	16.81	2.96	1.40	25	19.06	3.24	1.50
2012	58	337	62.0%	21.86	3.65	1.80	38	22.41	3.93	1.94
2013	55	234	73.3%	21.56	3.69	1.95	29	19.65	2.64	1.43
2014	76	315	79.8%	24.68	2.35	1.36	46	32.15	2.57	1.49
2015	91	265	87.0%	21.33	2.14	1.32	47	25.13	2.28	1.42
Overall Sample	1408	251	24.7%	15.86	2.36	1.29	765	19.10	2.56	1.42

This table provides summary information on the sample of funds and their average performance. All data is provided by Burgiss. Buyout funds (VC funds) are summarized in Panel A (Panel B): the sample includes 929 (1408) funds, and for 507 (765) of these funds there is a prior fund that can be used to measure performance persistence. Funds are classified by their vintage year, which is defined as the date when the fund first draws down capital from its investors. The % unrealized column measures the ratio of the remaining net asset value (NAV) reported by the fund, to the sum of the cash returned to investors plus the NAV. The cash flows and NAVs are updated as of December 31, 2020. For each vintage year three performance measures are provided. The average Internal Rate of Return (IRR); the Multiple of Invested Capital (MOIC), and the Public Market Equivalent (PME) return. The MOIC is defined as the ratio of (a) the cash returned to investors plus the remaining NAV, to (b) the cash invested by investors. The PME is computed in the same way as Kaplan and Schoar (2005), using the total return of the S&P 500 as the market index.

3.1.1. *Buyout funds*

Table 2 reports the crosstabs of PME quartiles of subsequent buyout funds relative to the four PME quartiles. For the sample as a whole, the results show modest persistence in buyout fund performance. Funds with a previous fund in the top quartile are in the top quartile 35.4%, and above median 59.0% of the time. Funds with a previous fund in the bottom quartile remain in the bottom quartile 38.8%, and below the median 65.1%, of the time. Bottom-to-top quartile flips across successive funds occur only 13.8% of the time and top-to-bottom flips occur 16% of the time. A chi-square test for equality of the four previous fund quartiles is rejected at the 1% level as is a test of the equality of the top and bottom previous fund quartiles.[7]

In the last three columns, we report the average performance of funds according to our 6-way classification. Funds with the previous fund in the top quartile have an average PME of 1.29 while those whose prior fund was in the bottom quartile have an average PME of 0.97. The difference in means is significant at the 1% level. Funds previously in the second and third quartile have average

[7] As their sample size was smaller, Kaplan and Schoar, 2005 analyzed performance according to terciles.

Table 2
Persistence of buyout funds by quartile performance at fund end.

		Current Fund Quartile					Average Current Fund		
		1	2	3	4	N	IRR (%)	MOIC	PME
Whole Sample									
Previous Fund Quartile at Fund End	1	35.4%	23.6%	25.0%	16.0%		17.2	2.00	1.29
		51	34	36	23	144			
	2	22.8%	23.4%	34.5%	19.3%		15.3	1.88	1.18
		33	34	50	28	145			
	3	20.3%	30.4%	28.3%	21.0%		13.1	1.70	1.11
		28	42	39	29	138			
	4	13.8%	21.3%	26.3%	38.8%		8.9	1.46	0.97
		11	17	21	31	80			
NA, but not first fund		20.3%	30.7%	22.2%	26.9%		13.1	1.74	1.14
		43	65	47	57	212			
First funds		25.7%	22.9%	23.8%	27.6%		15.1	1.92	1.25
		54	45	46	59	204			
Pre-2001 Funds									
Previous Fund Quartile at Fund End	1	42.9%	17.9%	21.4%	17.9%		13.9	1.85	1.39
		12	5	6	5	28			
	2	25.0%	31.3%	28.1%	15.6%		13.4	2.08	1.27
		8	10	9	5	32			
	3	16.3%	20.9%	34.9%	27.9%		6.8	1.58	1.07
		7	9	15	12	43			
	4	14.3%	19.0%	33.3%	33.3%		6.2	1.36	1.00
		3	4	7	7	21			
NA, but not first fund		22.2%	34.7%	27.8%	15.3%		14.3	1.85	1.26
		16	25	20	11	72			
First funds		19.3%	26.1%	23.9%	30.7%		15.1	2.10	1.33
		17	23	21	27	88			
Post-2000 Funds									
Previous Fund Quartile at Fund End	1	33.6%	25.0%	25.9%	15.5%		17.9	2.04	1.27
		39	29	30	18	116			
	2	22.1%	21.2%	36.3%	20.4%		15.8	1.82	1.16
		25	24	41	23	113			
	3	22.1%	34.7%	25.3%	17.9%		16.0	1.75	1.13
		21	33	24	17	95			
	4	13.6%	22.0%	23.7%	40.7%		9.8	1.50	0.96
		8	13	14	24	59			
NA, but not first fund		24.8%	24.8%	21.8%	28.6%		12.5	1.68	1.08
		33	33	29	38	133			
First funds		31.0%	19.5%	22.1%	27.4%		15.1	1.79	1.20
		35	22	25	31	113			

This table shows the relationship between the performance, as measured by PME, of successive buyout funds, according to their performance quartile. For each vintage year the funds are assigned to a quartile according to PME performance. Where the prior fund performance is available, the current fund quartile is matched to the previous fund quartile. Where the current fund was the first in the fund sequence for a given GP, the fund is assigned to the "First funds" category. In the remaining cases – where the previous fund performance is not available in our sample – the funds are allocated to the "NA, but not first fund" category.

PMEs for their current fund that also are significantly lower than those in the top quartile, but higher than those in the bottom quartile. Therefore, if one had been able to know *ex ante* the *previous* funds that would ultimately be in the top quartile, it would have been a good strategy to invest in these funds. Relative to a randomized strategy of investing in buyout funds where the average PME is 1.18, a PME of 1.29 implies that the average increase in PME to be achieved from such prescience would have been 0.11. The 0.11 difference translates into additional annualized outperformance of 2% to 2.5%.

First-time funds have average PME performance of 1.25 which is between that of the previously top quartile and second quartile funds. Investors who insist on a prior track record before investing in a new GP, or a new strategy by an existing GP, have therefore historically missed out on above average performance. Non-first-time funds for which we do not have information on previous fund performance have average performance broadly in line with the rest of the sample, which suggests that missing prior funds does not induce any obvious biases to the persistence analysis using transition matrices.

It is also worth noting that there is a large attrition rate for bottom quartile funds. Of the funds raised that have previous fund performance, only 16% (not 25%) were previously in the bottom quartile. This reflects exit by poorly performing GPs, or decisions by the LPs in our sample to avoid subsequent funds from poorly performing GPs. This is consistent with the results in Kaplan and Schoar (2005) and Chung et al. (2012) that the ability to raise a subsequent fund is significantly related to past performance.

In the remainder of Table 2, we report the analogous results for funds raised before 2001 and after 2000. As noted in the introduction, much of the previous research on persistence used funds raised before 2000 which is why we chose 2000 / 2001 as the breakpoint for our analysis. Given that 2000 / 2001 was the period of the dot-com crash and a recession, it is possible that our results

are sensitive to the breakpoint, however we found similar results using later breakpoints and using a rolling window.[8] When we split the sample the patterns are qualitatively similar in both sub-periods to the patterns overall, although it is noticeable that top quartile performance has become much less persistent since 2000 and bottom quartile persistence has increased. Therefore, more recent, and better quality, data has moderated the extent of performance persistence found in the seminal study by Kaplan and Schoar (2005). This is consistent with the results of Braun et al. (2017) based on deal-level data. Researchers should bear in mind this time variation in performance persistence when conducting empirical work.

3.1.2. VC funds

Table 3 repeats the analysis for the VC funds in our sample. For the entire sample, there is marked persistence in VC fund performance. Funds with a previous fund in the top quartile are in the top quartile and above median, respectively, 45.1% and 68.7% of the time. Bottom-to-top quartile and top-to-bottom quartile flips occur less than 13% of the time. A chi-square test for equality of the four previous fund quartiles is rejected at the 1% level as is a test of the equality of the top and bottom previous fund quartiles.

Funds previously in the top quartile have an impressive average PME of 2.22 while funds previously in the bottom quartile have an average PME of only 0.75. The difference in means is significant at the 1% level. Bottom quartile funds also have a much higher attrition rate in our sample: there are 237 VC funds whose previous funds were top quartile in our sample, but there are only 125 funds whose previous funds were bottom quartile. Funds in the second and third quartile have significantly lower average PMEs than those in the top quartile, and significantly higher than those in the bottom quartile. First-time funds have average performance slightly above that of funds in the second quartile.

When we split the sample before and after the 2000 vintages the patterns are generally qualitatively similar in terms of performance persistence. However, there has been a marked drop in average returns since 2000, across all the performance measures. However, the extent of the outperformance of top quartile funds remains impressive with a PME of 1.86, which is far higher than for buyout funds over this later period. In general, there has been a compression of returns, but the top three quartiles of VC funds have continued to beat public market returns.

3.2. Persistence by quartiles – previous fund at fundraise

The investigation in the previous section replicates the type of analyses done in much early research. That form of analysis, however, uses performance information that would not have been available to LP investors at the time they had to make the decision to invest in a fund. At the time they are asked to commit to a follow-on fund, usually some 3 to 5 years into the life of the current fund (or often earlier in the case of VC), investors only observe a noisy signal of ultimate performance.

In Tables 4 and 5 we use fund performance information that would have been available to LPs at the time of fundraising. Specifically, we use the performance of the previous fund measured two quarters before the first capital call of the current fund. Because fund performance is typically reported with a lag of a quarter, this represents the information a potential LP would have about the previous fund one quarter before the first investment in the current fund. We believe this represents the likely time when many, if not most, LPs finalize their commitment to the current fund. The results are not sensitive to using performance results from one quarter earlier or later.

3.2.1. Buyout funds

The results for buyout funds, presented in Table 4, are markedly different from the results in Table 2. For funds raised before 2001, there is evidence of performance persistence: nearly 37% of funds reporting top quartile performance at the time of fundraising produced top quartile returns in their next fund. However, performance persistence disappeared for post-2000 vintage buyout funds (which represent well over half of the overall sample). As a result, in the full sample, when funds are sorted by the performance quartile of the GP's previous funds at the time of fundraising, current buyout fund performance is statistically indistinguishable regardless of quartile. This is particularly true for investment multiples, which are tightly clustered across the previous fund quartiles between 1.78 and 1.81. The differences between top- and bottom-quartile funds are also statistically indistinguishable. Interestingly, first-time funds perform, on average, better than any of these quartile portfolios based on prior funds.

Table 4 also evinces another strong pattern related to GP fundraising: very few GPs raise a fund when the performance of the previous fund is in the bottom quartile. Post-2000, only 39 of 383 or 10% of funds with previous fund performance were in the bottom quartile at the time of fundraising. Similarly, only 132 of 383 or 34% were below median. To understand the extent of that timing, Table 2 indicates that ultimately around 50% more firms – 59 – that raised funds post-2000 ended up having a previous fund in the bottom quartile. This is consistent with LPs being less likely to invest in a new fund of a GP whose previous fund is performing poorly at the time of fundraising. Our results show that issues relating to the extent of available information, and the timing of when

[8] For instance, with 2003 as the breakpoint year the results are qualitatively similar. Top quartile buyout persistence in the early/late period reduces from 42.9%/33.6% using 2001 as the cut off (as reported in Table 2) to 36.8%/34.9% using 2003 as the cut off. This is to be expected given that we found performance persistence to have fallen in recent years for buyouts. For VC, top quartile persistence remains similar, irrespective of the vintage year we use to split the sample. We also looked at performance using funds raised in rolling eight-year periods beginning with 1993 to 2000 and going until 2008 to 2015. This obviously results in smaller sample sizes, but, for both buyout and VC funds, the results for the earlier periods are qualitatively similar to the results for the pre-2001 sample; the results for the later periods are qualitatively similar to the results for the post-2000 sample. These results are available upon request.

Table 3
Persistence of VC funds by quartile performance at fund end.

		Current Fund Quartile					Average Current Fund		
		1	2	3	4	N	IRR (%)	MOIC	PME
Whole Sample									
Previous Fund Quartile at Fund End	1	45.1%	23.6%	19.0%	12.2%		35.6	4.08	2.22
		107	56	45	29	237			
	2	25.5%	26.4%	31.0%	17.1%		17.2	2.19	1.25
		55	57	67	37	216			
	3	16.6%	32.1%	30.5%	20.9%		11.4	1.88	1.05
		31	60	57	39	187			
	4	10%	20%	26%	44%		2.6	1.34	0.75
		13	25	32	55	125			
NA, but not first fund		14.4%	26.1%	28.8%	30.6%		8.6	1.80	0.95
		48	87	96	102	333			
First funds		27.1%	24.8%	21.0%	27.1%		15.6	2.46	1.35
		84	77	65	84	310			
Pre-2001 Funds									
Previous Fund Quartile at Fund End	1	46.2%	20.4%	18.3%	15.1%		52.7	4.57	2.78
		43	19	17	14	93			
	2	30.1%	24.1%	32.5%	13.3%		25.2	2.45	1.49
		25	20	27	11	83			
	3	19.8%	25.9%	29.6%	24.7%		11.8	1.84	1.05
		16	21	24	20	81			
	4	15%	15%	23%	48%		0.1	1.12	0.67
		7	7	11	23	48			
NA, but not first fund		11.8%	31.7%	28.0%	28.6%		10.3	1.77	0.96
		19	51	45	46	161			
First funds		24.7%	27.3%	24.7%	23.4%		18.3	2.21	1.24
		38	42	38	36	154			
Post-2000 Funds									
Previous Fund Quartile at Fund End	1	44.4%	25.7%	19.4%	10.4%		24.6	3.77	1.86
		64	37	28	15	144			
	2	22.6%	27.8%	30.1%	19.5%		12.1	2.03	1.09
		30	37	40	26	133			
	3	14.2%	36.8%	31.1%	17.9%		11.2	1.91	1.05
		15	39	33	19	106			
	4	7.8%	23.4%	27.3%	41.6%		4.1	1.49	0.80
		6	18	21	32	77			
NA, but not first fund		16.9%	20.9%	29.7%	32.6%		7.1	1.83	0.94
		29	36	51	56	172			
First funds		29.5%	22.4%	17.3%	30.8%		12.8	2.70	1.45
		46	35	27	48	156			

This table shows the relationship between the performance, as measured by PME, of successive VC funds, according to their performance quartile. For each vintage year the funds are assigned to a quartile according to PME performance. Where the prior fund performance is available, the current fund quartile is matched to the previous fund quartile. Where the current fund was the first in the fund sequence for a given GP, the fund is assigned to the "First funds" category. In the remaining cases – where the previous fund performance is not available in our sample – the funds are allocated to the "NA, but not first fund" category.

performance is measured, are particularly important when conducting research on these, and most likely other classes of, private capital vehicles.

3.2.2. VC funds

Table 5 repeats the analysis for VC funds. Significant persistence persists for VC funds using performance at the time of fundraising. Overall, funds with previous funds in the top quartile have an average PME of 1.81 while those with previous funds in the bottom quartile have average PMEs of 1.01. When funds are sorted by the performance quartile of the GP's previous funds at the time of fundraising, a chi-square test for differences in performance across the quartiles is significant at the 5% level. The average PME for top quartile funds are significantly greater than those of the second, third and fourth quartiles funds.

The patterns are qualitatively similar over both sub-periods. However, the magnitude of persistence is lower post-2000 with previous top quartile funds having an average PME of 1.37 and previous bottom quartile funds having an average PME of 1.05. Pre-2001, the chi-square test for all four quartiles is significant at the 5% level. Post-2000, the chi-square test for all four quartiles is not significant, but the difference of the top- and bottom-quartile fund distributions and their average PMEs are statistically different at the 5% level. Our findings for the earlier period are consistent with Hochberg et al. (2014) who study funds raised through 2002.

For the overall sample, first-time funds have an average PME of 1.35, close to the average for previous funds in the 2nd quartile. Post-2000, first-time funds do even better with an average PME of 1.45 that exceeds (albeit not significantly) the average PME of those with previous top quartile funds. This is an area that warrants further research, as conventional wisdom is that the high-profile and established VC firms get the best deal-flow. However, these first-time funds may be set up by experienced individuals who leave

Table 4
Persistence of buyout funds by quartile performance at fundraise.

		Current Fund Quartile					Average Current Fund		
		1	2	3	4	N	IRR (%)	MOIC	PME
Whole Sample									
Previous Fund Quartile at Fundraise	1	26.5%	25.2%	25.2%	23.2%		15.2	1.80	1.19
		41	39	39	36	155			
	2	25.9%	23.6%	31.6%	19.0%		14.5	1.80	1.19
		45	41	55	33	174			
	3	21.7%	22.5%	32.5%	23.3%		13.4	1.78	1.10
		26	27	39	28	120			
	4	19.0%	34.5%	22.4%	24.1%		12.4	1.81	1.15
		11	20	13	14	58			
NA, but not first fund		20.3%	30.7%	22.2%	26.9%		13.1	1.74	1.14
		43	65	47	57	212			
First funds		25.7%	22.9%	23.8%	27.6%		15.1	1.92	1.25
		54	48	50	58	210			
Pre-2001 Funds									
Previous Fund Quartile at Fundraise	1	36.7%	20.0%	23.3%	20.0%		12.9	1.74	1.30
		11	6	7	6	30			
	2	25.0%	31.3%	25.0%	18.8%		11.3	1.75	1.26
		12	15	12	9	48			
	3	18.5%	11.1%	40.7%	29.6%		6.7	1.80	1.00
		5	3	11	8	27			
	4	10.5%	21.1%	36.8%	31.6%		6.9	1.59	1.08
		2	4	7	6	19			
NA, but not first fund		22.2%	34.7%	27.8%	15.3%		14.3	1.85	1.26
		16	25	20	11	72			
First funds		19.3%	26.1%	23.9%	30.7%		15.1	2.10	1.33
		17	23	21	27	88			
Post-2000 Funds									
Previous Fund Quartile at Fundraise	1	24.0%	26.4%	25.6%	24.0%		15.8	1.82	1.17
		30	33	32	30	125			
	2	26.2%	20.6%	34.1%	19.0%		15.7	1.83	1.16
		33	26	43	24	126			
	3	22.6%	25.8%	30.1%	21.5%		15.3	1.77	1.13
		21	24	28	20	93			
	4	23.1%	41.0%	15.4%	20.5%		15.1	1.91	1.18
		9	16	6	8	39			
NA, but not first fund		19.3%	28.6%	19.3%	32.9%		12.5	1.68	1.08
		27	40	27	46	140			
First funds		30.3%	20.5%	23.8%	25.4%		15.1	1.79	1.20
		37	25	29	31	122			

This table shows the relationship between the performance, as measured by PME, of successive buyout funds, according to their performance quartile. For each vintage year the funds are assigned to a quartile according to PME performance. Where the prior fund performance is available, the current fund quartile is matched to the previous fund quartile. Where the current fund was the first in the fund sequence for a given GP, the fund is assigned to the "First funds" category. In the remaining cases – where the previous fund performance is not available in our sample – the funds are allocated to the "NA, but not first fund" category.

established GPs and already have strong track records and networks.

As with buyout funds, relatively few VC GPs raise a fund when the performance of the previous fund is poor. Over the entire sample, only 82 of 765 or 11% of funds with previous fund performance were in the bottom quartile at the time of fundraising. Similarly, only 259 of 765 or 34% were below median. To understand the extent of that timing, Table 3 indicates that, as in the case of buyouts, 50% more firms – 125 – that raised VC funds ended up having a previous fund in the bottom quartile. Investigating what drives this pattern (e.g., GP choices to raise a new fund and/or LP appetite to invest) would be an interesting research topic that might harness data from specialized investment consultants who perform due diligence on new fund offerings.

3.3. Persistence by quartiles – second previous fund at fundraise

The reason we find persistence for buyouts and VC when using final performance of the previous fund, but no persistence for buyouts and weaker persistence for VC using performance at fundraising is that relative performance changes over time. In the Internet Appendix, we present the transition matrix for the same (previous) funds at the time of fundraising compared with their final performance (or, for funds that are not fully realized, the most recent performance at the end of 2020). Only 54% of buyout funds that presented top-quartile numbers at the time of fundraising ultimately turned out to be top quartile performers. And around 21% of the buyout funds that were in the bottom quartile at the time of fundraising ended up above median. Similarly, around 40% of the buyout funds that were in the third quartile at fundraising ended up above median in the overall sample. The patterns are qualitatively similar for VC funds. Therefore, the performance information that LPs have available to them at the time of fundraising is a far from reliable

Table 5
Persistence of VC funds by quartile performance at fundraise.

		Current Fund Quartile					Average Current Fund		
		1	2	3	4	N	IRR (%)	MOIC	PME
Whole Sample									
Previous Fund Quartile at Fundraise	1	33.5%	24.1%	24.8%	17.7%		28.0	3.22	1.81
		89	64	66	47	266			
	2	28.3%	28.8%	23.8%	19.2%		19.2	2.62	1.38
		68	69	57	46	240			
	3	19.2%	23.7%	31.1%	26.0%		10.6	1.89	1.08
		34	42	55	46	177			
	4	18.3%	28.0%	28.0%	25.6%		8.2	1.70	1.01
		15	23	23	21	82			
NA, but not first fund		14.4%	26.1%	28.8%	30.6%		8.7	1.80	0.95
		48	87	96	102	333			
First funds		27.1%	24.8%	21.0%	27.1%		15.6	2.46	1.35
		84	77	65	84	310			
Pre-2001 Funds									
Previous Fund Quartile at Fundraise	1	38.8%	24.5%	20.4%	16.3%		46.1	4.10	2.56
		38	24	20	16	98			
	2	34.7%	21.1%	24.2%	20.0%		26.6	2.71	1.53
		33	20	23	19	95			
	3	14.7%	21.3%	32.0%	32.0%		8.5	1.54	0.92
		11	16	24	24	75			
	4	24.3%	18.9%	32.4%	24.3%		7.1	1.50	0.95
		9	7	12	9	37			
NA, but not first fund		11.8%	31.7%	28.0%	28.6%		10.3	1.77	0.96
		19	51	45	46	161			
First funds		24.7%	27.3%	24.7%	23.4%		18.3	2.21	1.24
		38	42	38	36	154			
Post-2000 Funds									
Previous Fund Quartile at Fundraise	1	30.4%	23.8%	27.4%	18.5%		17.4	2.70	1.37
		51	40	46	31	168			
	2	24.1%	33.8%	23.4%	18.6%		14.4	2.57	1.29
		35	49	34	27	145			
	3	22.5%	25.5%	30.4%	21.6%		12.2	2.15	1.19
		23	26	31	22	102			
	4	13.3%	35.6%	24.4%	26.7%		9.0	1.86	1.05
		6	16	11	12	45			
NA, but not first fund		16.9%	20.9%	29.7%	32.6%		7.1	1.83	0.94
		29	36	51	56	172			
First funds		29.5%	22.4%	17.3%	30.8%		12.8	2.70	1.45
		46	35	27	48	156			

This table shows the relationship between the performance, as measured by PME, of successive VC funds, according to their performance quartile. For each vintage year the funds are assigned to a quartile according to PME performance. Where the prior fund performance is available, the current fund quartile is matched to the previous fund quartile. Where the current fund was the first in the fund sequence for a given GP, the fund is assigned to the "First funds" category. In the remaining cases – where the previous fund performance is not available in our sample – the funds are allocated to the "NA, but not first fund" category.

indicator of the final relative performance of the funds. This is consistent with Brown et al. (2019) and Jenkinson et al. (2013) who find that interim performance is an imperfect measure of final performance.

The patterns in VC fit nicely with a theory of how LPs learn about a GP's skill proposed by Hochberg et al. (2014) to explain why there may be persistence in after-fee returns. In that model, a fund's incumbent investors have learned more about the GP's skill than is revealed to outsiders by interim performance figures. This gives incumbent investors hold-up power. If they do not back the GP when it seeks to raise another fund outside investors will interpret that as a sign of a low-quality GP. This hold-up power reduces the GP's ability to raise fees in line with performance.

One implication of our findings is that, if interim performance data is a poor predictor of final performance, then an alternative measure of performance is needed. At the time of fundraising, LPs potentially also have access to the performance of the second previous fund (if the GP has such a fund), which could be informative if there is persistence. The second previous fund is almost certainly more fully realized than the first previous fund, potentially providing a more accurate measure of GP performance. In addition, it is possible that the current and previous funds of a private equity GP include investments in the same company. This is particularly common in VC funds. If some of these investments are particularly successful or unsuccessful, they might mechanically induce persistence across current and previous funds. Investments are much less likely to coincide in the current fund and the second previous fund. The presence of performance persistence between the current fund and the second previous fund, therefore, would be stronger evidence of persistent skill rather than a mechanical relationship.

The main issue facing researchers, however, is that this approach inevitably results in a smaller sample size, as we lose all 2nd funds from our analysis (in addition to first-time funds). Even with our very recent, and extensive, sample the number of buyout (VC) funds

with a second- previous fund drops to 298 (494), which make sub-sample analysis more difficult. The resulting transition matrices are presented in the Internet Appendix. The results for second previous fund are similar to those for the previous fund at fundraising. For buyouts, they show no evidence of persistence across quartiles for the second previous fund to the current fund; but for VC, they show significant persistence. We return to this issue in our regression analysis.

4. Persistence regressions

To this point, we have focused on quartile transition probabilities between performance groupings. While this is a common practice among practitioners and existing academic papers, an alternative approach relates current performance to past performance using a linear regression. This also allows us to control for other factors that might affect how fund returns evolve over time for a particular GP.

Table 6
Fund persistence regressions.

	Panel A: Whole sample			
	Buyout Funds		VC Funds	
(Log) Previous Fund PME	−0.043	−0.051	0.345***	0.346***
	[0.071]	[0.072]	[0.080]	[0.08]
Fund size increases >50%		−0.018		−0.041
		[0.044]		[0.072]
Fund size increases >100%		0.071		−0.059
		[0.048]		[0.087]
Secondary fund style		−0.271***		0.269*
		[0.082]		[0.161]
Vintage Year FE	Y	Y	Y	Y
N	507	507	765	765
R2	0.03	0.05	0.26	0.26
	Panel B: Pre-2001 Funds			
	Buyout Funds		VC Funds	
(Log) Previous Fund PME	−0.139	−0.278*	0.342***	0.350***
	[0.138]	[0.150]	[0.105]	[0.104]
Fund size increases >50%		0.049		−0.255**
		[0.137]		[0.111]
Fund size increases >100%		−0.044		−0.229**
		[0.110]		[0.114]
Secondary fund style		−0.439**		0.316
		[0.175]		[0.344]
Vintage Year FE	Y	Y	Y	Y
N	124	124	305	305
R2	0.13	0.18	0.40	0.43
	Panel C: Post-2000 Funds			
	Buyout Funds		VC Funds	
(Log) Previous Fund PME	0.103	0.098	0.349***	0.293**
	[0.085]	[0.086]	[0.127]	[0.129]
Fund size increases >50%		−0.046		0.047
		[0.044]		[0.096]
Fund size increases >100%		0.121**		0.217
		[0.052]		[0.136]
Secondary fund style		−0.247***		0.265
		[0.095]		[0.177]
Vintage Year FE	Y	Y	Y	Y
N	383	383	460	460
R2	0.07	0.10	0.17	0.19

This table shows regressions of current fund performance, as measured by (log) PME, on previous fund performance. *Previous Fund PME* is measured at the time of fundraising. Dummies are included to capture if the current fund is over 50% and over 100% larger than the previous fund. If over 100% larger both dummies are coded 1. Secondary fund style dummies are included for funds that are not part of the main fund sequence for the GP. All PMEs are measured relative to the S&P 500. Vintage year dummies are included for the current fund and the previous fund. Only funds for which a previous fund exists in our sample are included. See Tables 1 and 7 for further information on the data sample. *, ** and *** denote that the coefficient is significantly different from zero, respectively, at the 10%, 5% and 1% level.

In this section, we estimate regressions using log PME to measure performance (reflecting the fact that the distribution of PME is right skewed). Keeping with the intention of using information available to LPs, we use previous fund performance at fundraise as an explanatory variable. In some specifications, we also include dummy variables to capture if the GP is raising a fund more than 50%, and more than 100%, larger than its previous fund. These dummies are cumulative, in the sense that a fund that increases in size by, say, 120% will have a value of 1 for each dummy. We also include a secondary fund style dummy variable to indicate if the fund being raised differs in style from the GP's initial core funds. The regressions include vintage year dummy variables for both the current and previous funds.

4.1. Buyout funds

Panel A of Table 6 reports previous fund performance regressions for the whole sample period; Panels B and C repeat the analyses, respectively, for pre-2001 and post-2000 vintage funds. For the whole sample of buyout funds, previous fund PME at fundraising is not related to current fund PME. This result holds whether or not dummies for fund size increases or secondary fund style are included. In general, our results suggest that performance is lower for secondary style buyout funds but shows no performance effect for increases in fund size.

Panels B and C show similar patterns in both pre-2001 and post-2000 funds. There is no evidence of performance persistence. For post-2000 funds the coefficient on the second size dummy (fund size increase >100%) is significant at the 5% level; however, the sum

Table 7
Summary information on funds with performance history.

	Panel A: Buyout Funds					
	Number	Avg. Vintage	Avg. Capital Committed	Average IRR (%)	Average MOIC	Average PME
	Whole sample					
All	507	2006	1650	14.2	1.80	1.16
Secondary fund style	25	2003	844	5.3	1.33	0.88
Fund size increases >50%	279	2004	1640	12.8	1.76	1.17
Fund size increases >100%	145	2003	1770	13.6	1.83	1.22
	Pre-2001 Funds					
All	124	1996	1170	10.0	1.73	1.18
Secondary fund style	11	1995	900	2.4	1.25	0.87
Fund size increases >50%	97	1996	1270	9.0	1.66	1.19
Fund size increases >100%	61	1996	1270	9.1	1.65	1.18
	Post-2000 Funds					
All	383	2009	1810	15.6	1.82	1.16
Secondary fund style	14	2010	799	7.6	1.39	0.89
Fund size increases >50%	182	2008	1840	14.8	1.81	1.16
Fund size increases >100%	84	2008	2120	16.8	1.96	1.24

	Panel B: Venture Capital Funds					
	Number	Avg. Vintage	Avg. Capital Committed	Average IRR (%)	Average MOIC	Average PME
	Whole sample					
All	765	2003	337	19.1	2.56	1.42
Secondary fund style	22	2007	375	24.5	2.58	1.45
Fund size increases >50%	307	2000	340	14.9	2.23	1.29
Fund size increases >100%	130	2000	364	6.5	2.02	1.05
	Pre-2001 Funds					
All	305	1995	238	26.1	2.72	1.64
Secondary fund style	5	1997	158	38.9	1.81	1.24
Fund size increases >50%	193	1995	281	15.6	1.99	1.27
Fund size increases >100%	85	1995	328	2.1	1.29	0.8
	Post-2000 Funds					
All	460	2009	403	14.5	2.45	1.27
Secondary fund style	17	2011	439	20.3	2.80	1.51
Fund size increases >50%	114	2008	440	13.7	2.64	1.32
Fund size increases >100%	45	2007	433	14.9	3.40	1.54

This table provides summary information on the sample of funds with performance history. All data are provided by Burgiss. This table partitions data from Table 1 based on whether the current fund is over 50% and over 100% larger than the previous fund. Secondary fund style refers to funds that are not part of the main fund sequence for the GP. The cash flows and NAVs are updated as of December 31, 2020. Three performance measures are provided. The average Internal Rate of Return (IRR); the Multiple of Invested Capital (MOIC), and the Public Market Equivalent (PME) return. The MOIC is defined as the ratio of (a) the cash returned to investors plus the remaining NAV, to (b) the cash invested by investors. The PME is computed in the same way as Kaplan and Schoar (2005), using the total return of the S&P 500 as the market index. Capital Committed is in millions of dollars.

of the coefficients on the two size dummies is not significantly different from zero. In both sub-periods, secondary style funds have lower performance.

Table 7 provides summary information that illustrates the strikingly lower performance for secondary style funds. For buyouts, the average PME, IRR and MOIC are dramatically lower than those for the sample overall or the size buckets measuring fund size increase. This is true for both pre-2001 and post-2000 buyout funds. For the whole sample, the average PME for secondary style funds is 0.88 while the sample average is 1.16. We note, however, that there are relatively few such secondary style funds (25 of the 507 buyout funds with performance history).

Overall, then, the regression results for buyouts suggest there is no evidence of reliable outperformance by the top previous performers, as reported at the time of fundraising, consistent with the findings of our quartile analysis of buyout funds.

Table 8
Fund persistence regression using performance history on second previous fund.

	Panel A: Whole sample			
	Buyout Funds		VC Funds	
(Log) 2nd Previous Fund PME	0.012	−0.019	0.229***	0.246***
	[0.066]	[0.067]	[0.058]	[0.059]
Fund size increases >50%		−0.08		−0.121
		[0.070]		[0.102]
Fund size increases >100%		0.095		−0.04
		[0.061]		[0.109]
Secondary fund style		−0.330**		0.331
		[0.102]		[0.294]
Vintage Year FE	Y	Y	Y	Y
N	298	298	494	494
R2	0.06	0.10	0.28	0.28

	Panel B: Pre-2001 Funds			
	Buyout Funds		VC Funds	
(Log) 2nd Previous Fund PME	0.180	0.330**	0.272***	0.279***
	[0.172]	[0.156]	[0.091]	[0.091]
Fund size increases >50%		−1.028***		0.283
		[0.272]		[0.218]
Fund size increases >100%		1.019***		−0.368**
		[0.231]		[0.185]
Secondary fund style		−0.006		−0.085
		[0.197]		[0.565]
Vintage Year FE	Y	Y	Y	Y
N	62	62	190	190
R2	0.27	0.52	0.44	0.46

	Panel C: Post-2000 Funds			
	Buyout Funds		VC Funds	
(Log) 2nd Previous Fund PME	−0.045	−0.060	0.186***	0.220***
	[0.070]	[0.072]	[0.076]	[0.079]
Fund size increases >50%		−0.004		−0.301***
		[0.070]		[0.114]
Fund size increases >100%		0.022		0.191
		[0.061]		[0.134]
Secondary fund style		−0.336***		0.425
		[0.122]		[0.160]
Vintage Year FE	Y	Y	Y	Y
N	236	236	304	304
R2	0.09	0.12	0.19	0.22

This table shows regressions of current fund performance, as measured by (log) PME, on the 2nd previous fund performance. *2nd Previous Fund PME* is measured at the time of fundraising. Dummies are included to capture if the current fund is over 50% and over 100% larger than the previous fund. If over 100% larger both dummies are coded 1. Secondary fund style dummies are included for funds that are not part of the main fund sequence for the GP. All PMEs are measured relative to the S&P 500. Vintage year dummies are included for the current fund. Only funds for which a previous fund exists in our sample are included. See Tables 1 and 7 for further information on the data sample. *, ** and *** denote that the coefficient is significantly different from zero, respectively, at the 10%, 5% and 1% level.

4.2. Venture capital funds

The right half of Table 6 reports regression results for VC funds. For the entire sample period, Panel A shows that previous fund PME is significantly related to current fund PME. The relationship is similar in both sub-periods. The coefficient of 0.345 in Panel A implies that a 0.20 increase in previous fund PME is associated with a 0.069 increase in current fund performance as measured by PME.

The coefficients on the fund size increase variables are not significant in the overall sample or for post-2000 funds, suggesting that returns are not significantly impacted by increased fund sizes. This is consistent with VC firms being disciplined in not increasing fund size too fast, to the detriment of returns. There is some weak evidence of a negative size effect pre-2001 as shown in Panel B, consistent with the funds having over-expanded in the dot-com era. Unlike the results for buyouts, we find no significant impact on PMEs associated with secondary fund styles for VC. Table 7 shows that for the entire sample period secondary funds style funds in VC have average PMEs of 1.45 compared to the overall sample average of 1.42. However, as in the case of buyout funds, there are relatively few such secondary style funds (22 of the 765 VC funds with performance history).

Overall, then, the regression results for VC funds are consistent with the previous results by fund quartile using previous fund performance at the time of fundraising. There is persistence in VC performance. The results also suggest that secondary style funds in VC have not had lower performance which contrasts with the findings for buyout.

4.3. Results based on performance of second previous fund

We also estimated regressions using the performance (PME) of the second previous fund at fund raise as the explanatory variable as shown in Table 8. For VC funds, the coefficient on second previous fund performance is significant for the whole sample and in both sub-periods. For buyout funds, there is no evidence of persistence in the whole sample period or for post-2000 funds. There is weak evidence of persistence in pre-2001 funds but the sample size for that period is relatively small (62 pre-2001 funds). As noted earlier, our sample size is significantly smaller when we require second previous fund performance, especially for pre-2001 funds. This is particularly true for secondary style funds which precludes detailed analysis of the effect of a style shift.

5. Summary and implications

This paper presents new evidence on the persistence of U.S. private equity (buyout and venture capital) funds using high quality cash-flow data sourced from a large sample of institutional investors. Our results add to the prior literature on performance persistence in using better and more recent data, taking account of the different fund families launched by the same GP, studying how persistence has changed over time and examining the implications for investing based on when information is available to investors.

Using ex post or most recent fund performance (as of December 2020), we confirm previous findings of persistence in both buyout and VC overall, as well as for pre-2001 and post-2000 funds. Performance persistence remains strong in VC while the persistence in buyout has weakened over time.

When we consider information an investor would actually have – interim results on previous fund performance at the time of fundraising rather than final performance – we find different patterns, especially in buyout. We find low correlation between interim performance reported at the time of fundraising and final performance. We also find strong evidence that GPs avoid fundraising when their relative performance is poor, an important factor for researchers and investors to consider.

For buyout, we find that interim performance offers no evidence of persistence, both overall and post-2000. This means that investors gain little by knowing which quartile the GPs current fund is in when they are deciding whether to invest in the next buyout fund. One way around such issues is to measure persistence relative to the second previous fund, which will be largely realized at the time of fundraising for the current fund. However, this results in a significant reduction in sample sizes and does not provide useful information in the case of buyout funds. We find no evidence of persistence using this approach.

In contrast, persistence for VC funds has not disappeared over time using either final or interim performance of the prior fund. Using final realized fund performance, GPs of top quartile funds repeat this feat with their next fund around 45% of the time. Persistence is also apparent using the interim performance of the previous fund (and indeed the second previous fund) at the time of fundraising. This persistence translates into economically significant benefits of using interim performance available to LP investors: in our sample, constructing a VC portfolio of funds in the top quartile based on interim performance at the time of fundraising produced a PME of 1.81. In comparison, investing in GPs currently performing in the second (third) quartile resulted in a PME of 1.38 (1.08). Of course, this raises questions about investor access to top-performing funds, as VC GPs have tended to restrict the amount of capital they raise, and have increasingly relied on their existing LPs and, indeed, have increased the proportion of capital the GP commit themselves. This is an interesting and unusual arrangement that may not be an equilibrium, since economics would usually dictate that either prices (fees and carried interest in this case) or quantity (fund size) should increase when demand from investors is strong. This is a promising area for future research, including related issues such as GP succession and the spawning of new GPs as individuals establish a track record.

Finally, unlike most of the existing literature, our work addresses the trend towards GPs introducing new fund families. This is the first paper to take advantage of a full sequencing of the Burgiss data by fund family, which we think is an important factor in understanding the sustainability of performance. For buyouts we find that when GPs introduce new fund styles, the performance is noticeably lower. However, this is not apparent in the case of VC, where the performance of new fund families is broadly in line with their established funds.

Exploring the reasons for these divergent trends in persistence between buyout and VC is, we think, a fruitful subject for future

research. It is possible that, as the buyout sector has grown and matured, the buyout business has changed, with operating engineering becoming increasingly important (see Kaplan and Strömberg (2009)). Some general partners adjusted while others did not. Alternatively, it is possible that general partners learned from each other and that there are relatively few constraints on human capital in buyout and that has led to the lack of persistence in buyout. The fact that performance persistence has persisted in VC suggests that GP skills and networks for successful VC investing are harder to replicate, and that GPs have been more disciplined in terms of raising money thus avoiding the negative impact of scale on performance observed in most other asset classes.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jcorpfin.2023.102361.

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