The Evolution of Private Equity Fund Value

Gregory W. Brown, Wendy Y. Hu, and Jian Zhang

Gregory W. Brown
is Sarah Graham Kenan Distinguished Professor of Finance at Kenan-Flagler Business School, the University of North Carolina at Chapel Hill, in Chapel Hill, NC.
gregwbrown@unc.edu

Wendy Y. Hu
is a senior researcher at Burgiss in Hoboken, NJ.
whu@burgiss.com

Jian Zhang
is a partner at Adams Street Partners in Chicago, IL.
hjzhang@adamsstreetpartners.com

KEY FINDINGS

- The typical fund experiences a falloff in returns after it is about seven to eight years old. This is true for both VC and buyout funds.
- Contrary to common wisdom, the cross-sectional dispersion of fund performance measured by future internal rate of return and direct alpha tends to increase, not decrease, for funds more than five years old.
- A wide variety of market-wide and fund-specific factors predict future fund performance. These include to-date distributions, dry powder, previous fund performance, fund size, general partner fundraising activity, previous public market stock returns, and credit spreads. Relevant factors are different for VC funds and buyout funds and can vary systematically over funds' life cycles.

ABSTRACT

This article provides the first large-sample analysis of buyout and venture capital fund values over their lifetimes. Specifically, the authors examine fund future investment multiples (TVPIs), internal rates of return (IRRs), and direct alphas based on the current reported net asset values (NAVs) at each year of a fund's life. Using a sample of 1,400 mature buyout and VC funds, they find that the typical fund experiences a falloff in future returns after it is about seven to eight years old. However, the remaining performance is highly variable for funds of all ages, and the dispersion in returns also tends to increase after funds are about eight years old. They examine the cross-sectional determinants of the remaining fund value and find that several fund-specific and market-wide factors determine future performance and that these vary by type and age of fund. For example, young funds tend to be harmed by high market-wide dry powder levels, whereas older funds appear to benefit.

TOPICS

Private equity, performance measurement*

Valuation of seasoned closed-end drawdown funds, such as private equity buyout and venture capital (VC) funds, is difficult because the vast majority of assets have no observed market values. Still, it is important to understand the economic value of funds over their life for a number of portfolio management and compliance reasons. Investors typically rely on net asset values (NAVs) reported by fund general partners (GPs). From these interim NAVs, imperfect as they may be, it is possible to calculate performance metrics for a fund's remaining life once one observes the fund's future cash flows. In this analysis, we conduct these calculations on a large sample of buyout and VC funds to better understand what remaining-life

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fund performance looks like, assuming the GP makes investments at reported NAVs. Our analysis provides an assessment of performance trends over the life of a typical fund and the cross-sectional variation in performance. Implicitly, this allows for understanding when during the life of a fund, the NAVs are "too high" or "too low" on average, but more importantly, we can estimate the determinants of future fund performance from the cross-section of funds.

As a practical matter, it is critical for limited partner investors (LPs) to understand the valuation pattern over a fund's life because LPs often make decisions based on estimates of current value and future expected returns. For instance, LPs need to regularly report valuations for their various stakeholders such as trustees (in the case of endowments, foundations, funds-of-funds, etc.) and regulators (in the case of insurance companies, pension funds, etc.). LPs also regularly rely on valuations for helping determine secondary sale or purchase prices. In addition, valuations are a key reference point for asset allocation and risk management decisions.

The literature has established that NAVs do not follow a random price process, which one would expect in an informationally efficient market, and exhibit too smooth of a valuation pattern (Brown, Ghysels, and Gredil 2020). Specifically, fund managers have historically been sluggish to update assessments of the fund valuation (Gompers and Lerner 1997). Since November 2007, most funds are required to adopt mark-to-market rules (e.g., FAS 157, also known as ASC 820). This requirement has likely made reported values better measures of true economic value over the last decade (Harris, Jenkinson, and Kaplan 2014; Scharfman 2012; Nykyforovych 2017).[1] However, there remains considerable discretion in valuation methodologies and existing research documents' systemic misvaluations. For instance, Brown, Gredil, and Kaplan (2019) find underperforming managers overstate valuation during the time of follow-on fundraising, but top-performing managers understate valuation. As a consequence, fund NAVs likely incorporate a subjective assessment of true economic value.

Surprisingly, the value of funds over their lifetimes is not well documented in the literature. We are aware of no large-sample evidence documenting the range of interim valuations relative to its final value. To fill this void, our article undertakes the first large-sample analysis of private equity buyout fund and venture capital fund values during their lifetimes. We examine both simple performance metrics (e.g., IRRs and TVPIs) and market-adjusted performance (e.g., direct alphas using the method of Gredil, Griffiths, and Stucke 2014).

We find that the median fund's absolute and relative performance tends to decline after a fund is about seven or eight years old. For example, the direct alpha for buyout funds switches from positive to negative when the median fund is seven years old. Although the median VC fund always has a negative direct alpha, it becomes more negative as the fund ages. Contrary to common wisdom, the uncertainty measured by remaining IRR and remaining direct alpha increases as funds get older. In fact, we document that future fund performance is highly variable among funds at each fund age.

We also examine what factors explain the cross-sectional and age-specific variation and document a variety of interesting results. We find that, contrary to common wisdom, buyout funds with substantial uncalled capital (so-called "dry powder") toward the end of the investment period outperform their peers. Strong realized returns (as measured by capital distributions to date) predict better future performance of buyout funds. Consistent with previous literature, we also find persistence in fund performances and that larger funds tend to outperform smaller funds. At times when the market-wide dry powder is high, subsequent performance for young funds

[1] In the context of this article, we think of true economic value as the value of fractional fund ownership that would be observed in a liquid two-sided market for ownership stakes.

will be lower, but performance for older funds will be higher. This is consistent with funds making investments facing higher competition but older funds benefiting from a strong market for exits.

Recent strong returns in public equities and widening credit spreads predict lower future performance for buyout funds. We document that reported fund performance relative to NAV appears to decline after the adoption of fair value accounting (e.g., FAS 157). In general, more factors are significant for explaining future buyout fund performance than future VC fund performance.

In total, we study fund valuation from the perspective of fund performance over the fund's lifetime and the factors that affect it. This study contributes to the literature on private equity valuations and is relevant to participants in the private equity market, especially secondary market investors. Our findings, such as higher performance volatility and diminishing alpha in older funds, are informative for secondary market investors investing in older funds.

The article is organized as follows. The next section provides a discussion of data and descriptive statistics for our sample. After that, we examine the evolution of value over the life cycle of funds for three performance metrics. We then discuss the fund-specific and market-wide factors that determine the remaining performances using a regression model. The last section concludes.

DATA AND DESCRIPTIVE STATISTICS

This study uses private equity fund cash flow and valuation information provided by Burgiss, a global provider of investment decision support tools for the private capital market. Sourced directly from limited partners (LPs), Burgiss data represent a nearly complete sample of institutional-quality private funds used extensively in recent academic work.[2] Cash flows are net of fees and carried interest paid to GPs and represent the actual returns achieved by LPs. We include data in our analysis for all mature funds beginning in 1987 through the end of 2017 from all geographies. We examine only mature funds in this study to have a good understanding of what happens to valuations through the full performance life cycle based on actual cash flows. We generally define a *mature fund* as having (1) a fund vintage before 2009 and (2) an NAV of less than 5% of the fund's total commitment value. We also allow for mature funds where the NAV is more than 5% of commitment value if the vintage year is before 2003. The sample is limited to funds that draw more than 50% and less than 150% of the fund's total committed capital. In total, we examine cash flow data through the end of 2017 for 657 buyout and 743 venture capital funds from 20 vintage years covering 1987 to 2008.

Results presented in Exhibit 1 show that, as expected, almost all funds from vintages 1987 to 2002 meet our definition of mature. For example, there are 38 mature buyout and 28 mature VC funds in 2002, which account for 95% of all buyout funds and 100% of all VC funds in the Burgiss dataset with the same vintage. For most vintage years with less than 100% maturity rate, average mature fund sizes are quite comparable to all funds of the same asset class.[3] For instance, the mature buyout (VC) funds with vintage 2004 have an average size of $793 ($186) million, which is 101% (75%) of the average size of all buyout (VC) funds with a vintage.

[2] See, for example, Harris et al. (2014, 2016).

[3] Though mature funds are relatively small for buyout funds with vintage 2008 and VC fund with vintage 2006–2008, they account for only about 3% of our final sample and even less on a value-weighted basis.

EXHIBIT 1

Number of Funds and Average Fund Size by Vintage

	Buyout				Venture Capital			
Vintage	# of Mature Funds	Matured % of All Funds	Avg. Mature Fund Size	Relative Avg. Mature Fund Size	# of Mature Funds	Matured % of All Funds	Avg. Mature Fund Size	Relative Avg. Mature Fund Size
1987	12	100%	719	100%	30	97%	61	102%
1988	10	100%	617	100%	30	100%	68	100%
1989	12	100%	296	100%	32	100%	110	100%
1990	9	100%	310	100%	16	100%	66	100%
1991	8	100%	257	100%	8	100%	89	100%
1992	11	100%	406	100%	18	100%	83	100%
1993	9	100%	526	100%	24	100%	87	100%
1994	27	100%	377	100%	22	100%	89	100%
1995	31	97%	581	103%	31	100%	127	100%
1996	25	100%	305	100%	22	100%	131	100%
1997	43	100%	772	100%	54	100%	131	100%
1998	63	100%	806	100%	57	100%	183	100%
1999	49	100%	874	100%	110	100%	288	100%
2000	74	99%	960	101%	142	100%	316	100%
2001	46	98%	886	97%	74	97%	307	98%
2002	38	95%	794	98%	28	100%	252	100%
2003	24	65%	469	56%	10	38%	178	83%
2004	48	69%	793	101%	8	18%	186	75%
2005	42	40%	1359	119%	10	12%	193	71%
2006	39	30%	1050	62%	6	6%	144	48%
2007	19	13%	1335	86%	4	4%	158	51%
2008	18	14%	549	36%	7	7%	72	25%
Total/Avg.	657	61%	684	88%	743	64%	151	82%

NOTES: This exhibit reports the number of mature funds; average fund size (fund commitments) is in millions of USD by vintage for buyout and VC funds, separately. "Matured % of all funds" is the number of mature funds as a percentage of all funds (both mature and non-mature). "Relative avg. mature fund size" is the average size of matured funds as a percentage of average size from all funds.

Exhibit 2 reports the distribution of ages when a fund meets our definition of mature. Most buyout funds reach maturity when they are 11 to 17 years old, with the most common age being 12 years (89 funds). The average age for buyout funds to reach maturity is 14 years old. VC funds follow a similar pattern but are more likely to mature when they are slightly older (the most common age is 17, and the average age is 15 years old). We also find that smaller funds are likely to reach maturity somewhat earlier than larger funds.

LIFE CYCLE VALUATIONS

We now turn to the primary question in this article: How do valuations vary over a fund's life? We start by discussing our methods of measuring fund valuation as a function of fund age. In theory, fund value at any given time is just the present value of all future net cash flows. Because our sample comprises (by design) only mature funds, we have a quite complete picture of future cash flows. Specifically, mature funds are either fully liquidated or close to final liquidation; thus, their end values are zero or

EXHIBIT 2

Number of Funds, Average Fund Size, and Average Vintage Year by Fund Age

	Buyout			Venture Capital		
Fund Age	N	Fund Size	Vintage	N	Fund Size	Vintage
<9	14	425	2003	9	185	1999
9	26	481	2003	11	74	2002
10	32	685	2004	23	84	1999
11	59	785	2002	29	114	1998
12	89	942	2001	55	124	1996
13	80	637	2000	64	118	1997
14	67	718	2000	70	162	1997
15	66	749	1998	89	183	1997
16	72	965	1998	95	242	1998
17	63	811	1998	134	315	1999
18	34	827	1998	93	283	1997
19	27	1,005	1997	31	188	1996
>19	28	883	1993	40	137	1993

NOTES: This exhibit reports the number of funds, average fund size (in USD millions), and average vintage year for buyout and VC funds that mature at different fund ages. Funds that mature at less than 9 years and 20 years and older are grouped together.

close to zero.[4] Then, by comparing fund NAV at each age with all future cash flows (plus terminal NAV, if any), we can evaluate the relative valuation of funds at any time during their life. Likewise, we can observe the cross-sectional distribution of valuations for funds of different ages. This provides some indication of cross-sectional fund risk and whether it is increasing or decreasing in fund age. For example, these metrics can be thought of as characterizing the uncertainty facing buyers and sellers in the secondary market.

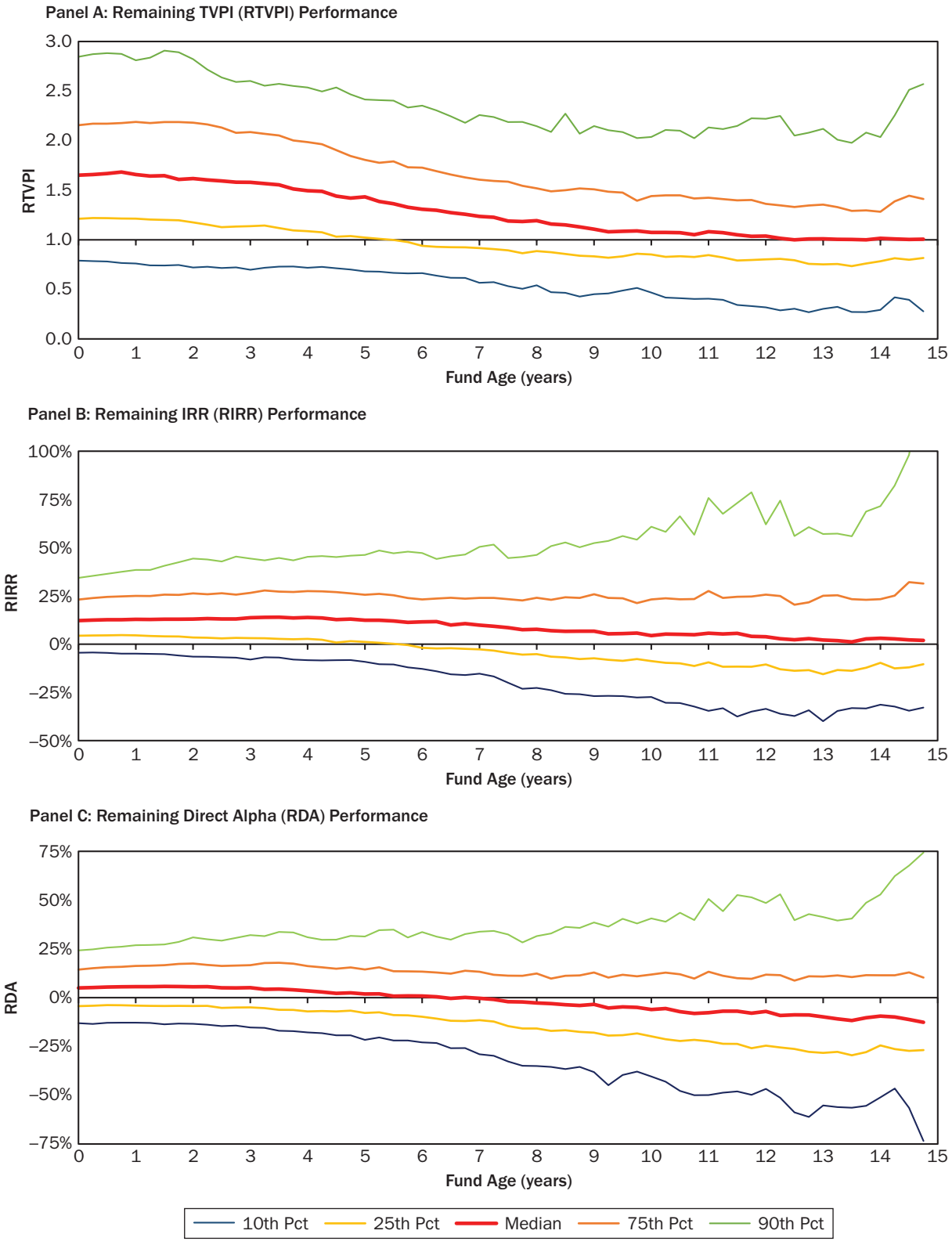
We utilize three performance measures to compare NAVs at each point in a fund's life with future cash flows. For each performance measure, we assume investors buy the fund at the current NAV and contribute any future capital calls in exchange for all future distributions. We calculate two *absolute* performance metrics for the remaining life of a fund. First, the remaining total value to paid-in capital (RTVPI) is the sum of all the future distributions divided by the sum of future contributions plus current NAV. Second, the remaining internal rate of return (RIRR) is defined as the LP's annualized IRR from buying the fund at an interim NAV and holding it to maturity. This RIRR is also calculated at each fund age. In addition to these absolute metrics, we calculate one *relative* performance metric that compares the fund's future performance to a public market benchmark. Specifically, we calculate the remaining direct alpha (RDA) following the Gredil et al. (2014) direct alpha method with the assumption that the current NAV is the first capital call. We prefer the RDA metric in this application to a similar public market equivalent (e.g., Kaplan and Schoar 2005) because we are explicitly examining performance as a function of (a shortening) fund life. The RDA measure is annualized compared to a PME metric that represents performance for the full remaining life of the fund (and should mechanically converge to one). We use the S&P 500 as the public market benchmark for our RDA analysis. We calculate these three performance metrics for every quarter of a fund's life up to age 15 years. We do not examine funds older than 15 years because the sample is small, valuations are low, and the performance metrics can become very noisy.

The remaining performance measures for buyout funds and VC funds as a function of fund age are plotted in Exhibits 3 and 4, respectively. Panel A of Exhibit 3 graphs the RTVPI for buyout funds. The red line represents the median RTVPI and shows that, as expected, valuation multiples approach 1.0 as a fund matures. The plot reveals that a large majority of the median fund's total gross return is realized before a fund is eight years old. Specifically, the RTVPI for an eight-year-old fund is just 1.18, compared to the full-life TVPI of 1.75. However, there exists substantial cross-sectional variation in RTVPIs at all fund ages. The blue and green lines show the 10th and 90th percentiles of RTVPIs for buyout funds and exhibit little narrowing over the fund's life and almost none after age eight. For example, the 90th percentile of RTVPIs is 2.18 for a fund that is seven years old and 2.11 for a fund that is thirteen years old.

[4] However, we do need to make the assumption that any remaining terminal value at the end of the sample period is properly characterized by NAVs. As our results subsequently show, this could result in a slight bias of our valuation results.

EXHIBIT 3

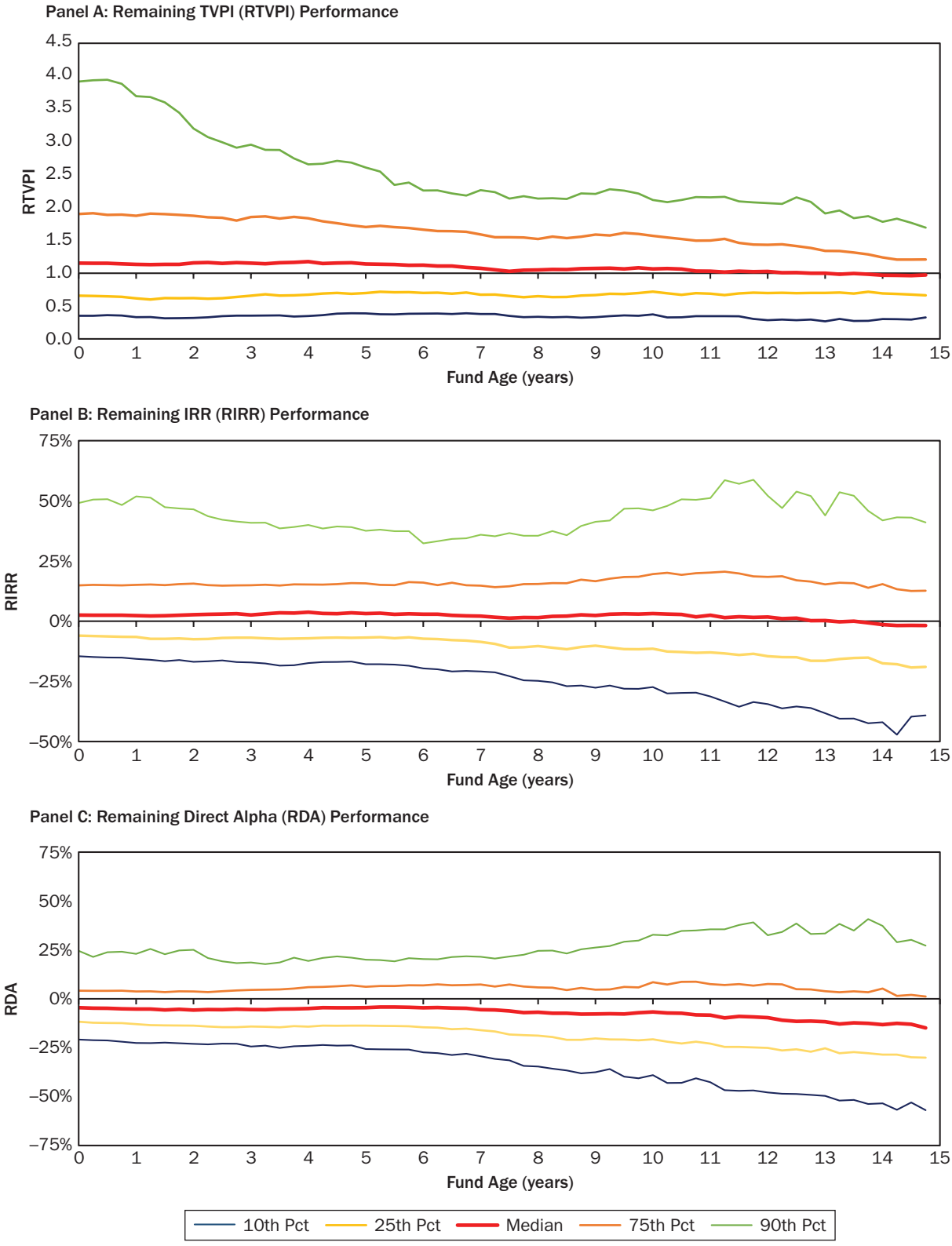
Graphs of Buyout Fund Remaining Performance



NOTES: This exhibit plots buyout fund remaining performance over a fund life (in years) and uses the sample of mature funds. Remaining performance is measured in three ways: the remaining TVPI (RTVPI) in Panel A, the remaining IRR (RIRR) in Panel B, and the remaining direct alpha in Panel C. The green line plots the breakpoint for the top 10th percentile. The red line reports the median. The blue line reports the breakpoint for the bottom 10th percentile.

EXHIBIT 4

Graphs of Venture Capital Fund Remaining Performance



NOTES: This exhibit plots VC fund remaining performance over a fund life (in years) and uses the sample of mature funds. Remaining performance is measured in three ways: the remaining IRR in Panel A, the remaining TVPI in Panel B, and the remaining direct alpha in Panel C. The green line reports the remaining performance of the top 10th percentile. The red line reports the median. The blue line reports the bottom 10th percentile.

The orange and yellow lines plot the 25th to 75th interquartile ranges and tend to exhibit the same patterns as the 10th and 90th percentiles, just with less variation.

RTVPIs may give a distorted view of percentage returns late in a fund's life because NAVs (the basis) can be much lower and the holding period will be shorter. In other words, it is possible that a fund has lower nominal dollar returns, but the percentage returns are high. To see if this is the case, Panel B of Exhibit 3 shows RIRRs for buyout funds. Again, the median RIRR shows that returns approach zero as funds age. In fact, median RIRRs start to taper off steadily at about the same time as for RTVPIs—around age six to eight years. However, the 90th percentile and 10th percentile values for RIRR display a huge dispersion in performance across all ages and this dispersion increases with age. (We expect this given the persistent dispersion in RTVPIs shown in Panel A.) Consequently, the chance of large percentage gains or losses from transacting in mature funds in the secondary market increases with fund age. This finding may seem counter to common wisdom regarding secondary purchases. Buyers often express a feeling that secondary funds are lower risk because they can observe exactly which companies are in the fund's portfolio. We note that one of the reasons the return dispersion widens is that fewer assets are remaining in the portfolio, and thus there is less diversification and more idiosyncratic risk. Also, the timing of exits for these tail assets is highly variable. The perception of lower risk may derive from the fact that the visibility of existing portfolio holdings increases the ability to price these risks.

Panel C of Exhibit 3 plots RDAs for buyout funds. Consistent with the prior results, the RDAs switch from positive values to negative values when the median fund is seven years old. RDAs become quite negative, less than –7% annually, by the time the median fund is eleven years old. As suggested by the results for RIRR, there is tremendous dispersion in RDAs for buyout funds. For funds that are seven years old, the range of RDAs from the 10th to 90th percentiles varies from –25.8% to 32.6%. The spread in RDAs increases steadily by fund age, both on the upside and downside.

Exhibit 4 plots values of our remaining performance metrics as a function of fund age for VCs. The general patterns for VC funds are similar, though there are important differences. Panel A plots values for RTVPIs for VC funds and shows that the median VC fund also experiences a visible moderation in performance around age seven. Yet the performance of the median fund improves for a few years after that, only to dip below 1.0 when it is twelve years old. The 10th and 90th percentile plots show that the dispersion in VC multiples is even greater than for buyout funds, though the spread narrows steadily as funds age.

The median RIRRs plotted in Panel B of Exhibit 4 show a very similar pattern to the RTVPIs. On average, investors earn a return close to zero from the median VC fund after it is about seven years old. As was the case for buyout funds, the cross-sectional dispersion in VC funds is substantial and generally increases with age after a fund is about seven years old. We plot the remaining direct alphas for VC funds in Panel C. The median VC fund always has a negative RDA, and performance deteriorates as the median fund ages. This result is consistent with prior studies that show the median VC fund underperforms public market benchmarks.[5] The dispersion in RDA performance across funds also tends to increase with fund age.

We can tie these results to other anecdotal findings. For example, it is widely believed that older funds usually sell at a discount to NAV in the secondary market. This belief is consistent with the direct alpha for the median buyout fund dropping

[5] However, the average fund outperforms because of substantial positive skewness in VC performance. For example, examining the 10th and 90th percentiles relative to the median shows that younger VC funds have greater positive skew for both RTVPI and RIRR. Interestingly, the positive skewness almost disappears for older VC funds.

to less than zero after seven years. Likewise, it is also not surprising that the direct alpha for the median VC fund is always negative across fund ages, given the right skewness of VC fund performance. Furthermore, this negative direct alpha, combined with the growing performance uncertainty as funds age, will drive deeper discounts for older funds on the secondary market.[6]

DETERMINANTS OF FUTURE FUND PERFORMANCE

The previous analysis shows that the remaining performance among funds is highly variable in the cross-section regardless of fund age. In addition, the skewness of fund remaining performance is large in some cases, especially for venture capital funds and for older buyout funds. We can interpret these findings as showing that a relatively small number of funds generates a large majority of profits. For example, the fact that the remaining direct alpha is negative for the median VC fund of any age shows fewer than half of the funds generate an economic profit. That the 90th percentile of RDA is 20% (or more) indicates that there are some VC funds with exceptional performance at any age. Thus, it is of great interest to know what characteristics determine future performance as a practical matter. This section explores what fund-specific and market-wide factors explain future performance and how the importance of these factors varies over fund life.

Hypotheses and Variable Definitions

Fund-specific characteristics reflect fund quality as well as the fund manager's preferences and skills. Prior research on performance persistence (e.g., Harris et al. 2020) shows that managers with strong past performance are likely to deliver better performance for the current fund. To investigate how important the manager track record is for the current fund's remaining performance, we use the manager's average ranking of funds over the past ten years (i.e., previous TVPI, IRR, and DA rank) to predict the remaining performance of the current fund.

The industry defines fund dry powder as the currently committed, yet undrawn, capital scaled by fund total committed capital (i.e., fund size). Dry powder could be a measure of managerial timing ability. For example, a relatively high level of dry powder at a given fund age could reflect the manager's judgment that there are relatively few favorable investment opportunities and thus a deliberate decision to delay the investments. Gredil (2019) shows that entry and exit timing decisions by GPs add value at the industry level relative to a constant public market investment strategy.

Fundraising activity is typically associated with things going well with a manager's current fund and could be considered a quality indicator or positive expectation for the market environment in the coming years. On the other hand, positive window dressing during the fundraising period could mean worse performance for the remaining fund life (see Brown et al. 2019; Jenkinson, Sousa, and Stucke 2013). Here we use a fundraising dummy variable to determine empirically if there is a relationship between fundraising and future performance. This variable is equal to 1 if the manager launches (makes an initial investment from) a subsequent fund within one year, and 0 otherwise.

A strong realized return, or ability to generate early "points on the board," is often viewed as a potential positive indicator for remaining performance. We use the ratio of distributed capital to paid-in capital (DPI) as a measure of realized exit activity.

[6] Anecdotally, given the shorter duration investors expect to hold these older assets, buyers focus less on IRR and more on required minimum multiples, which can lead to bigger discounts.

To control for outliers, we winsorize DPI at the 99% level for buyout funds and 98% level for VC funds. Given the large positive skewness of DPI, we transform the variable by taking the square root.

Kaplan and Schoar (2005) document that PE performance increases with fund size; Humphery-Jenner (2012) finds large PE funds earn lower returns. On the one hand, managers of larger funds are likely to be more established and tend to have a stronger process and better channels for exiting; thus, larger funds might outperform smaller ones. On the other hand, diseconomies of scale or greater competition for big transactions could lower returns for larger funds. We use the logarithm of total committed capital as a measure of fund size.

Because performance may differ by geography, we also include a dummy variable equal to 1 for funds domiciled in the US and 0 for all other funds.

In addition to fund-specific factors, we examine how broad market conditions affect future fund performance. Both market conditions and the legal environment have been shown to drive private equity investment (see Aldatmaz, Brown, and Demeric-Kunt 2020). For instance, when deal volume is high, it may impair young funds' competitive position at the investment stage—young funds compete for a finite number of deals and thus bid up prices. In contrast, the demand by younger funds could be good for older funds as existing investments will benefit from the high valuation environment. There is more demand for secondary exits. We use market-wide dry powder, the committed, yet uncalled, capital from all funds of the same strategy (e.g., buyout or VC), as a percentage of total committed capital to measure the available money in the market.

Another way to measure the valuation environment is the public stock market price-to-earnings (P/E) ratio. When the P/E ratio is high, it means public assets are relatively expensive. In this environment, private asset valuations have also been shown to be high (see Robinson and Sensoy 2016). Assets bought during this time might, therefore, generate lower subsequent returns. We use the P/E ratio of the S&P 500 Index to measure the public market valuation environment.

Public market conditions potentially also affect future private market performance in general. As documented by Kaplan and Schoar (2005) and Brown et al. (2021), funds raised in a market boom tend to perform poorly. We use the previous one-year percentage return on the S&P 500 Index to measure the public market returns to examine the remaining fund performance for funds of different ages.

A widening credit spread could be a drag on future fund returns because of higher deal financing costs. This is especially true for buyout fund investments, which usually involve substantial leverage at the portfolio company level. We use the 12-month change of Moody's BAA spread to measure this credit spread change.

Economic and market conditions differ by region. To examine how variation in regional conditions affects future fund performance, we calculate MSCI region index returns for public equity markets relative to the MSCI world index return for the previous three years. We use one of four regions based on where the fund is domiciled: (1) Americas, (2) Asia and Pacific, (3) Western Europe, and (4) Middle East and Africa and Eastern Europe.

Regulatory and reporting changes may also affect fund managers' behavior and thus affect the fund valuation and payout patterns. The most significant of these is the widespread move to mark-to-market accounting around 2007–2009 (e.g., FAS 157 in the US). We include in our analysis a dummy variable (FAS 157 dummy) that is equal to 1 for years after 2007 (and 0 otherwise) to help identify the impact of "fair value measurements" on future fund performance.

Buyout Funds

Exhibit 5 shows the regression results for buyout funds. Panel A presents results for the remaining TVPI, Panel B presents results for the remaining IRR, and Panel C presents the remaining direct-alpha results. The findings indicate that many factors related to the market environment and the fund's characteristics are statistically significant predictors of remaining fund performance. At a high level, we observe that the importance of most factors changes over a fund's life, so what explains the future performance of a young fund differs from that of an older fund. However, in most cases, the sign of the relation stays the same, and it is the magnitude (and statistical significance) that changes over time. There are two potential reasons for these changes over time. First, the determinants for specific funds could change as funds age. Second, the sample is changing over time as some funds become fully resolved and exit the analysis. This second effect is only pronounced for fund ages 10, 11, and 12. We also note that several market-wide factors are related to future fund *absolute* performance (RTVPI & RIRR) but not *relative* performance (RDA). This suggests that market-wide characteristics are better at predicting the market-wide component of future fund returns and is consistent with the findings of Brown et al. (2020).

We now turn to examine the results for specific determinants of buyout fund performance in Exhibit 5. The significant positive coefficients on the previous fund ranking show that GPs with strong past performance are more likely to generate value for the current fund's remaining investments. This effect is quite consistent across funds of various ages, as well as all three performance metrics, and only fades for older funds (> 10 years), which typically have few assets remaining in their portfolios. This finding is consistent with prior evidence on performance persistence by GPs (see Kaplan and Schoar 2005 and Harris et al. 2020).

The results in Exhibit 5 also show that funds with more dry powder (in years four to six) have better future performance. This is consistent with managers adding value through good investment timing and inconsistent with managers making poor-quality

EXHIBIT 5

Determinants of Remaining Performance—Buyout Funds

Fund Age	4	5	6	7	8	9	10	11	12
Panel A: Remaining TVPI (RTVPI)									
DPI	0.526	0.682**	0.539	1.022***	0.821**	0.896**	1.466***	1.283***	1.517***
Fund dry powder	2.765***	2.328***	1.781*	0.992	–0.452	–0.656	0.226	0.471	–0.574
Previous TVPI rank	0.135**	0.150**	0.155**	0.221***	0.096	0.162**	0.136**	0.0140	0.041
US dummy	–0.239	–0.223	–0.009	0.113	0.349	0.575**	0.519**	0.316	–0.202
Fund size	0.207**	0.190**	0.139	0.0368	0.274***	0.263***	0.275***	0.298***	0.326***
Fundraising dummy	0.579**	0.752**	0.375	1.631***	0.633	3.978***	1.665***	0.000	3.596***
Market dry powder	–5.368*	–6.289**	–3.291	–4.264	–0.101	–0.328	2.906	3.617	8.484***
Public market return	–0.958	–2.173***	–1.668**	–1.572**	–1.490*	–1.803**	–1.431	–2.187**	–0.663
S&P 500 P/E ratio	–0.070*	–0.0287	–0.059	–0.009	0.009	0.0433	–0.046	–0.062	–0.152***
Rel. regional return	1.618**	2.349***	3.005***	2.405***	3.094***	2.736***	0.852	1.337	2.694**
BAA spread	–0.246	–0.393***	–0.240	–0.284	–0.285*	–0.190	–0.416**	–0.567***	–0.129
FAS 157 dummy	–1.644***	–1.589***	–1.279***	–1.126***	–0.652*	–0.766*	–0.647	0.115	0.432
Intercept	2.459	2.302	2.955	3.515	–2.240	–3.040	–3.133	–3.007	–3.657
Observations	655	655	653	649	646	638	607	575	503
Adjusted R^2	0.114	0.112	0.067	0.073	0.078	0.093	0.093	0.074	0.094

(continued)

EXHIBIT 5 *(continued)*

Determinants of Remaining Performance—Buyout Funds

Fund Age	4	5	6	7	8	9	10	11	12
Panel B: Remaining IRR (RIRR)									
DPI	1.268***	1.247***	0.942***	1.278***	1.055***	0.937**	1.437***	0.988**	1.392***
Fund dry powder	2.570***	2.441***	2.386**	1.414	–0.303	–0.428	0.551	0.722	–0.311
Previous IRR rank	0.131**	0.190***	0.187***	0.201***	0.135*	0.169**	0.163**	–0.012	0.027
US dummy	–0.494**	–0.406*	–0.264	–0.078	0.256	0.528**	0.514**	0.225	–0.344
Fund size	0.183**	0.050	0.076	–0.018	0.242**	0.190*	0.223**	0.305***	0.300***
Fundraising dummy	0.566*	0.791**	0.181	1.480**	1.011	2.393***	2.773***	0.000	2.464***
Market dry powder	–6.724**	–7.024***	–6.993**	–5.852**	–2.222	–2.652	–0.491	2.083	10.64***
Public market return	–0.357	–1.935***	–1.063	–0.979	–1.023	–1.675**	–1.630*	–1.414	–0.793
S&P 500 P/E ratio	–0.092**	–0.072**	–0.079*	–0.025	0.011	0.054	–0.011	–0.019	–0.131***
Rel. regional return	1.416**	2.300***	3.423***	2.444***	3.477***	2.781***	1.405	1.337	2.316**
BAA spread	–0.265*	–0.395***	–0.190	–0.341*	–0.318**	–0.158	–0.448**	–0.408**	–0.102
FAS 157 dummy	–1.962***	–1.754***	–1.628***	–1.237***	–0.905**	–0.825**	–0.917**	–0.068	0.637
Intercept	3.762**	5.718***	5.426**	5.323**	–1.343	–1.175	–1.757	–2.898	–3.859
Observations	**652**	651	648	642	640	631	592	557	476
Adjusted R^2	**0.151**	0.135	0.092	0.078	0.084	0.069	0.087	0.046	0.092
Panel C: Remaining Direct Alpha (RDA)									
DPI	1.425***	1.429***	1.210***	1.475***	1.320***	1.060***	1.408***	1.220***	1.336***
Fund dry powder	2.440***	2.509***	1.756*	1.855**	0.674	0.469	0.757	0.571	–1.587
Previous DA rank	0.117*	0.161**	0.142**	0.151**	0.112*	0.107	0.137**	0.072	0.075
U.S. dummy	–0.241	–0.318	–0.096	–0.053	0.319	0.583**	0.514**	0.267	–0.136
Fund size	0.129	0.090	0.126	0.146	0.314***	0.246**	0.307***	0.307***	0.151
Fundraising dummy	0.663**	0.582*	0.343	1.346**	0.799	2.545***	2.527	0.000	3.022***
Market dry powder	–2.055	–3.267	–2.756	–1.263	2.340	0.217	4.761**	6.345**	10.03***
Public market return	0.275	0.344	0.219	0.145	0.340	–0.549	1.556	0.764	0.120
S&P 500 P/E ratio	–0.022	0.027	0.010	0.069	0.070	0.084*	–0.039	–0.057	–0.121***
Rel. regional return	–1.176*	0.321	0.463	–0.506	0.708	0.567	–1.109	1.313	2.587**
BAA spread	–0.130	0.053	0.061	–0.006	–0.011	–0.057	–0.081	–0.094	0.066
FAS 157 dummy	–2.141***	–1.793***	–1.843***	–1.452***	–0.872**	–0.907**	–0.638	–0.079	–0.042
Intercept	1.944	1.920	1.592	–0.754	–5.307**	–3.408	–4.502**	–4.197*	–0.785
Observations	649	651	646	646	642	632	596	563	488
Adjusted R^2	0.159	0.131	0.113	0.127	0.117	0.085	0.108	0.070	0.093

NOTES: This exhibit reports regressions of buyout fund remaining performance on fund-specific and macro factors. Panel A focuses on remaining TVPI ranking, Panel B focuses on remaining IRR ranking, and Panel C focuses on remaining direct alpha ranking. In each panel, remaining performance ranking is measured in deciles within fund age across funds of all vintages and results for funds age 4 to 12 are reported sequentially. DPI is the square root of DPI defined as fund distributions to date divided by total paid in capital at each fund age. Fund dry powder is the currently committed yet undrawn capital for a fund, scaled by the fund total committed capital. Previous TVPI/IRR/DA rank is the average TVPI/IRR/DA decile ranking of previous fund by the same manager within the same asset class and vintage in the past 10 years. Fundraising dummy equals 1 if the fund is going to invest from the following fund within one year. Fund size is the log of total committed capital. US dummy equals 1 for a US domiciled fund and 0 otherwise. Public market return is the S&P 500 return in the previous year. BAA spread is the change in the BAA credit spread from the previous year. Rel. regional return is the past three-year MSCI regional equity market return (Americas, Asia & Pacific, Western Europe, Middle East & Africa & Eastern Europe) *relative* to the MSCI world index. Market dry powder is the dry powder of the whole asset class as a percentage of total committed capital of the asset class. S&P 500 P/E ratio is the price-to-earnings ratio of S&P 500 stocks. FAS 157 dummy is 1 for all years after 2007 and 0 otherwise. All regressions use mature funds with vintages starting in 1987. The data are through 2017. *, **, *** designate coefficient values that are statistically different from zero at the 10%, 5%, and 1% level, respectively, in a two-tailed test.

transactions late in the investment period just to put money to work. The effect diminishes after year six because most funds are fully invested by that point.

Fundraising by buyout GPs is generally associated with better remaining returns for current funds. Although the size (and significance) of the effect varies considerably with age, the periodicity ties roughly to the two- to three-year fundraising cycle typical for most GPs.

One of the strongest and most consistent results in Exhibit 5 is the positive relation between capital distributed to date (DPI) and future fund performance. The positive coefficients on DPI, especially for older funds when managers are exiting investments, show that a strong realized return predicts a better remaining performance of the same fund. This result is consistent with skilled managers adding value not just to exited investments, but also to existing and future investments. This finding may also associate with a strong alignment of interests. Prior research documents clusters of good or bad decisions from fund managers or groups of managers (Braun et al. 2019). For RTVPI, the result is strongest for older funds. For RIRR and relative remaining performance (RDA), the result is very strong for funds of all ages.

We also find that larger funds tend to outperform smaller funds, but the effect is most pronounced for older funds (and only significant for relative performance for funds older than seven years). One possible explanation for this finding is that larger funds have more resources to manage an older fund with fewer assets and that this allows for better value creation during the harvesting and wind-down phase. In addition, tail assets held by large funds are more likely to be good quality, mature, and resilient assets compared to smaller funds. There are often differences in valuation standards between large and small funds. Anecdotally, it is widely believed that fewer surprises are on the downside for large funds than for small funds.

Overall, many of the fund-specific characteristics are important determinants of both absolute and relative future performance. We now turn to examine the relevance of market-wide factors for buyout funds. Exhibit 5 shows that a high level of market-wide dry powder tends to hurt the future performance of funds in years four or five. This is consistent with more available capital driving up current asset valuations and effectively increasing the cost of new investments for these younger funds. Interestingly, market-wide dry powder is a positive force for the older funds, especially for future relative performance (RDA), as existing investments likely benefit from a high valuation environment upon exit.

The S&P 500 P/E ratio is not generally a significant determinant of future performance after accounting for other factors. The exception is RIRR in early years (4–6) and very late in fund life (year 12), where we find a negative effect. This is an interesting result because of the widespread belief that doing buyout transactions when public market valuation is high will hurt relative returns. Yet, we find only weak evidence of this for relative future performance. Although the pairwise correlation between market-wide valuations and performance does exist, our results indicate that other market-wide (and fund-level) characteristics explain it. That noted, there does exist a generally negative relation between recent broad public market returns and future absolute fund performance, as well as a positive relationship between regional market returns and future absolute fund performance. Neither of these results holds reliably for future relative fund performance (e.g., RDA in Panel C).

A widening credit spread is negatively related to RTVPI and RIRR for buyouts, but the effect is not statistically reliable for relative performance. This again suggests that many market-wide factors affecting buyout performance (in this case, financing costs) are subsumed by market-wide future returns.

The negative coefficients on the FAS 157 dummy variable indicate that the remaining buyout fund performance has been lower after adopting mark-to-market value in 2008. This may be related to other market-wide factors we do not measure or because

the change to fair value accounting required a widespread revaluation of assets. For example, the result is consistent with buyout fund valuation being generally lower and more conservative before fair value accounting (e.g., Cumming and Walz 2009; Nykyforovych 2017). However, the analysis is confounded by the contemporaneous decline in performance from the Global Financial Crisis, so it is difficult to draw any firm conclusions.

Venture Capital Funds

We next explore the determinants of VC fund remaining performance. While the business model for VC funds is quite different from that of the typical buyout fund, prior research has shown both types of funds share many common performance features such as performance persistence, fundraising cyclicality, etc. For simplicity and to make the results comparable, Exhibit 6 reports regression results for VC funds analogous to those reported in Exhibit 5 for buyout funds. All explanatory variables are defined in the same way as in Exhibit 5.

Overall, we find that fewer fund-specific factors (reported in Exhibit 6) are reliable determinants of future VC fund performance. The most consistent finding is that larger VC funds perform better. This result is consistent across all fund ages and all three performance measures, though size is an especially good predictor when funds are younger. One explanation consistent with this finding is that better quality GPs raise more capital (yet we see little effect of previous fund rank on returns). In contrast to buyout funds, fund-level dry powder has a significantly negative impact on future absolute performance. This suggests that when VC funds have put less money to work late in the investment period, they are more likely to have either had a hard time identifying good investments or are likely to make lower-returning subsequent investments. Because this result is not significant for relative performance (Panel C), it is likely related to overall market conditions. Other factors are not reliably significant, though there is some weak evidence that young VC's raising capital for another fund perform better on both an absolute and relative basis.

Exhibit 6 also reports results for the effects of market-wide factors on future VC fund performance. We observe a very strong negative relationship between market-wide dry powder and future performance for funds that are four to eight years old. This result is likely due to the difficulty of finding good investments at reasonable valuations as more capital competes for deals. This is similar to the finding for young buyout funds. We also note that, similar to buyout funds, the coefficients for relative performance (RDA in Panel C) generally turn positive for older funds, although the results are not statistically significant. This finding is consistent with high market-wide dry powder increasing exit opportunities on a market-adjusted basis. Exhibit 6 also indicates that strong returns of regional public stock markets positively impact young VC funds' performance. The effect is observed for all three performance measures but only significant for funds that are four and five years old. The relative performance of older VC funds is positively impacted by strong returns of the public stock market. This may imply a positive impact from market conditions (e.g., the IPO market) on a venture exit strategy. We find the same negative relation between VC fund performance and the FAS 157 dummy variable for buyout funds, suggesting that NAVs were on average marked up after adopting fair value accounting.

We make a final note about the measurement timing of our explanatory variables and the timing of the NAVs we use in our analysis. The estimates of NAVs by GPs must happen after the quarter in which they occur, and typically there is a delay of three to four months before values are reported to LPs. Prior research (see, for example, Czasonis, Kritzman, and Turkington 2019) has indicated that GPs may use this period to adjust valuations based on market and other conditions that occur

EXHIBIT 6

Determinants of Remaining Performance—Venture Capital Funds

Fund Age	4	5	6	7	8	9	10	11	12
Panel A: Remaining TVPI (RTVPI)									
DPI	–0.108	0.334	0.431**	0.275	0.173	0.207	0.159	0.180	0.395*
Fund dry powder	1.584**	–1.629*	–1.229	–0.289	0.308	1.635	2.064	–0.722	1.488
Previous DA rank	0.005	0.039	0.054	0.108*	0.072	0.069	0.069	0.053	0.018
US dummy	0.009	0.288	0.038	0.123	0.281	0.362	0.204	0.141	0.135
Fund size	0.483***	0.446***	0.482***	0.341***	0.341***	0.325***	0.283**	0.319***	0.260**
Fundraising dummy	0.544*	0.496	–0.369	0.583	–0.588	0.000	0.000	–3.705***	3.127***
Market dry powder	–16.22***	–18.26***	–20.74***	–18.76***	–9.08**	6.153	–7.013*	–4.74	–5.557
Public market return	–0.812	0.433	–0.661	–2.134**	–3.120***	2.013**	–2.043**	0.108	–0.217
S&P 500 P/E ratio	0.002	0.019	0.041	0.089**	–0.05	–0.048	0.001	–0.010	0.003
Rel. regional return	3.436***	1.454**	0.583	0.26	1.475*	0.961	1.11	0.771	–0.308
BAA spread	0.015	–0.315**	–0.108	0.368**	–0.548***	–0.003	–0.202	–0.168	–0.063
FAS 157 dummy	–2.348***	–2.184***	–2.490***	–1.846***	–1.474***	0.251	–0.781*	–0.981**	–0.736
Intercept	0.472	0.499	0.409	1.485	1.486	–3.49	0.889	–0.121	0.861
Observations	739	739	737	735	733	730	711	685	647
Adjusted R^2	0.205	0.178	0.160	0.102	0.062	0.039	0.031	0.030	0.026
Panel B:Remaining IRR (RIRR)									
DPI	–0.001	0.422*	0.416**	0.201	0.082	0.144	0.067	0.118	0.378*
Fund dry powder	–2.404***	–2.107**	–1.836	–0.935	0.131	1.175	1.015	0.364	2.189
Previous DA rank	–0.017	0.039	0.035	0.131**	0.068	0.102	0.058	0.031	0.010
US dummy	0.092	0.431	0.115	0.090	0.395	0.405	0.302	–0.199	–0.200
Fund size	0.471***	0.435***	0.504***	0.347***	0.309***	0.268**	0.283**	0.348***	0.200
Fundraising dummy	0.575**	0.415	–0.333	0.252	–0.449	0.000	0.000	–3.750***	4.165***
Market dry powder	–16.80***	–19.07***	–21.84***	–19.98***	–11.94***	4.562	–6.864	–5.834	6.064
Public market return	–0.202	0.734	–0.766	–1.824*	–3.666***	1.977**	–1.913**	0.010	–0.315
S&P 500 P/E ratio	–0.019	0.032	0.053	0.123***	–0.029	–0.025	0.008	–0.002	0.013
Rel. regional return	3.558***	1.799**	0.785	0.572	1.781**	1.009	1.512	0.522	–0.395
BAA spread	0.074	–0.242*	–0.171	0.418**	–0.679***	0.021	–0.200	–0.199	–0.073
FAS 157 dummy	–2.291***	–1.961***	–2.317***	–1.751***	–1.691***	0.084	–1.004**	–1.283***	–0.704
Intercept	1.389	0.499	0.122	1.027	2.624	–2.478	0.895	0.167	2.263
Observations	734	732	731	728	724	720	703	674	637
Adjusted R^2	0.226	0.200	0.174	0.116	0.076	0.039	0.029	0.034	0.023
Panel C: Remaining Direct Alpha (RDA)									
DPI	–0.113	0.369	0.294	0.222	0.118	0.269	0.250	0.433**	0.564***
Fund dry powder	–0.639	–1.173	–1.043	–0.132	–0.350	1.294	0.923	0.125	1.648
Previous DA rank	–0.014	0.009	0.043	0.121**	0.061	0.101	0.022	–0.050	–0.028
US dummy	0.063	0.314	0.202	0.001	0.568*	0.523*	0.306	–0.087	–0.206
Fund size	0.553***	0.575***	0.602***	0.476***	0.385***	0.363***	0.362***	0.404***	0.319***
Fundraising dummy	0.662**	0.281	0.133	0.675	–0.760	0.000	0.000	–3.625***	2.996***
Market dry powder	–8.214***	–9.118***	–13.39***	–6.125*	2.662	11.38***	–2.284	4.097	5.894
Public market return	0.890	1.997**	0.406	1.351	–0.327	4.172***	0.846	2.663***	2.183**
S&P 500 P/Eratio	0.042	0.011	0.083**	0.077*	–0.064	0.018	0.053	0.017	0.050
Rel. regional return	2.038***	1.302*	–0.739	–0.529	0.247	–0.244	0.177	0.298	–1.730
BAA spread	0.056	–0.166	0.091	0.592***	–0.045	0.376**	0.312*	0.307*	0.214
FAS 157 dummy	–2.403***	–2.485***	–2.525***	–1.605***	–1.426***	0.251	–0.749*	–0.752*	0.134
Intercept	–4.241**	–4.408**	–4.732**	–4.692**	–2.678	–7.192***	–2.795	–4.175	–4.157
Observations	735	736	733	733	731	726	710	682	643
Adjusted R^2	0.131	0.135	0.122	0.11	0.092	0.098	0.054	0.086	0.071

NOTES: This exhibit reports regressions of venture capital fund remaining performance on fund-specific and market-wide factors. Panel A reports results for remaining TVPI ranking, Panel B reports results for remaining IRR ranking, and Panel C reports results for remaining direct alpha (DA) ranking. In each panel, remaining performance ranking is measured in deciles within fund age across funds of all vintages. Results are reported for funds age 4 to 12. The sample characteristics and definitions for all variables are the same as in Exhibit 5. *, **, *** designate coefficient values that are statistically different from zero at the 10%, 5%, and 1% level, respectively, in a two-tailed test.

after the end of the quarter. To see if this delay in reporting effects or inference, we reestimate the analysis in Exhibits 5 and 6 with lagged NAVs. We do this reestimation with both one-quarter lags and two-quarter lags.[7] We find results that are very similar to those reported, and in more cases than not, stronger in so far as the estimated coefficients are greater in magnitude. Overall, the lagged reporting of NAVs does not affect inference.

CONCLUSIONS

This article provides a first look at the private equity performance over the life cycle of funds. With our sample of 1,400 mature buyout and VC funds spanning three decades, we find that performance (relative to reported NAVs) of both the typical buyout and VC fund tends to decline after a fund is seven or eight years old. For example, the median buyout fund's remaining direct alpha switches from positive to negative when the fund is seven years old. However, the decline in subsequent performance is evident for both (median) buyout and VC funds across all three performance measures. This result implies that older funds should tend to transact at larger discounts in the secondary market. We also document substantial cross-sectional variation in fund performance across all fund ages, both on an absolute and relative basis.

We also examine the determinants of future fund returns and find that several fund-specific and market-wide factors are important for both absolute and market-adjusted performance. Different factors are important for buyout and VC funds, and the importance of specific factors changes over a typical fund's lifetime. Our results suggest the following:

i) Fund performance tends to decline, and cross-sectional heterogeneity in performance tends to increase after funds are about seven years old; this is true for both buyout and venture funds;
ii) Buyout funds with high distributions to date perform better subsequently;
iii) Larger buyout funds have better performance later in fund life, and larger VC funds have consistently better performance on both an absolute and relative basis;
iv) Delegating timing of investments to GPs improves performance, on average;
v) High market-wide dry powder generally hurts young funds, presumably because it is associated with more competition for deals, but is beneficial for older funds exiting investments, presumably because selling into a tight market allows for better exit valuations;
vi) There is more ability to predict future buyout fund performance than VC fund performance.

Future research could extend our analyses to other asset classes, such as real estate funds, private credit, and infrastructure funds. All of our performance analysis is based on the assumption of current fund value being represented by NAVs, but, of course, these do not represent true prices at which transactions occur. With the growth of the secondary market in recent years, it would be interesting to repeat our analysis with fund values obtained from actual transaction prices to determine how many of the effects we document are reflected in market pricing.

[7] The results are not tabulated here but are available from the authors upon request.

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