# Adjusting Private Equity Returns Using Strategy-Level Betas

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**Investors have traditionally assessed investment track records in private equity by simply comparing overall portfolio performance against benchmarks and competitors without making adjustments for differences in the mix of strategies and the level of risk being taken. Performance comparisons, unadjusted for varying risk of different private equity strategies, are likely to exaggerate the benefits of certain higher risk-reward strategies in periods like we find ourselves in today, when the markets are at the back end of a long expansionary cycle that have buoyed higher beta strategies, venture capital in particular. We thus believe that accurate assessments of private equity outperformance can only be made on a risk or beta-adjusted basis[1]. Similarly, on the back of strong increases in valuations of the riskiest assets, it is important for asset owners to know how much the risk of the overall portfolio has increased in order to rebalance the overall multi-asset class portfolio's risk levels to within policy ranges.**

Measuring investment risk is itself a controversial topic in our industry. The expected future volatility of an investment's return is one of most common proxies for measuring investment risk. But when we are evaluating the risk of, say venture capital, we care about the risk that is being added to the overall portfolio, not just the stand-alone volatility of the asset class. Given public equities are the largest component of a typical institutional portfolio, we care most about the volatility that venture capital adds to a portfolio of global public equities. If public equities have an expected future annual volatility of 16% and venture capital ("VC") returns have an assumed volatility twice that of public equities at 32%, the impact on the overall portfolio's volatility is not simply the new weighted average volatility, but rather the volatility reflecting a less than perfect correlation between public equity returns and venture capital returns[2]. If the correlation is 50%, then venture capital adds no incremental risk to the overall portfolio.

Beta is the measure that captures the product of volatility and correlation, which is why this paper seeks to arrive at estimates of private equity strategy betas in order to adjust return streams being compared and to adjust overall portfolio risk estimates. Here, betas are portrayed in the form of factors or ratios of public equity performance moves. So a venture capital beta of 1.5 implies that if public equities go up 10%, we would expect venture capital rises 15% over the same period.

While adjusting private equity performance for sub-strategy beta is conceptually straightforward, it is not easy to implement due to the lack of widely agreed private equity betas. Private equity reported performance is widely believed to understate the volatility as reported figures are smoothed, in part as a result of conservative accounting practices. Correlations of private equity returns to public equities are likely also understated for the same reason. Accordingly, betas calculated from regressions of reported private equity valuations against public equity valuations are likely to be understated as both inputs to the calculation of betas, volatility and correlations, are likely to be understated. There is no investment industry agreement on the right betas to use at the overall private equity level nor when considering individual PE/VC sub-strategies such as large cap vs. lower middle-market ("LMM") buyouts, early vs. late-stage venture, etc.

**[1,2] Hypothetical return expectations are based on simulations with forward looking assumptions, which have inherent limitations. Such forecasts are not a reliable indicator of future performance.**

A number of academic studies aimed at measuring PE/VC beta are available, however a) they generally do not evaluate sub-strategies (e.g., early state VC) separately, b) there are divergent views even among expert academics on the right methodology to use and c) the results differ widely from study to study with equity betas (relative to global developed market public equities) ranging from <1.0 to 2.0+ just for buyouts on their own, depending on the data source used, methodology adjustments and time period considered.

We can make three important observations that hold true across the various sources and build reasonably accurate estimates based on them.

— Early-stage Venture Capital has a higher beta compared to buyout and growth equity strategies, reflecting high loss rates and huge dispersion across VC firms. This translates into very high levels of return volatility, with the beta lowered by the weak correlation of VC returns with public equity returns.

— A healthy level of diversification will reduce the effective beta at the portfolio level, as much of the volatility at the individual deal or fund level cancels each other out when blended together. For example, the beta for buyouts when examined at the individual deal level was found in the two studies that adopted that methodology to be in excess of 2.0, but in studies that use a buyout fund as the base unit of measure, the beta range falls to 0.94-1.33[3].

— Although we could find no academic papers that studied separately buyout beta by deal size we believe that it is highly likely that lower middle market ("LMM") buyout strategies display a lower beta than larger-cap ones. This appears to be explained by lower levels of leverage and weaker correlations with public equity indices, than large cap buyouts[4].

[3] Some of the effect is due to diversification from uncorrelated deals, but academics surmise that the private equity fee structure also plays a dampening effect on volatility.

[4] LMM deals use meaningfully less leverage than large-cap buyouts, and are less often valued using direct public comparables.

[5] **Hypothetical return expectations are based on simulations with forward looking assumptions, which have inherent limitations. Such forecasts are not a reliable indicator of future performance.**

The table below shows our estimates for fund-level betas across the five core private equity sub-asset classes. This draws on third party and our own research analyzing reported index level PE performance, public equity proxy indices and detailed cash flow analysis at the deal and fund level. It is jarring for us to see growth equity categorized as a sub-strategy of buyouts, but this was very often the case in nearly all of the private equity research done on risk measures, so we have momentarily adopted this grouping, but solely for the purpose of this whitepaper.

**Exhibit 1: Recommended Forward Looking Betas for Five Private Equity Sub-Asset Classes[5]**

| Strategy | Beta to S&P 500 |
|---|---|
| Lower to Middle Market Leveraged Buyouts | 1.0 |
| Large Cap Leveraged Buyouts | 1.2 |
| Growth Equity | 1.3 |
| **All Buyouts (assume 20/50/30 weighting)** | **1.2** |
| Venture Capital (Early Stage) | 2.3 |
| Venture Capital (Late Stage) | 1.2 |
| **All Venture (assume 35/65 weighting)** | **1.6** |

**Source: Partners Capital**

**We estimate the market weight of early-stage vs late-stage VC to be approximately 35% early stage and 65% late stage, pointing to a 1.6 beta for VC overall.** This is in line with the findings of Ang, A. Chen, B. Goetzmann, W.N and Phalippou, L (2004) *Estimating Private Equity Returns from Limited Partner Cash Flows* as described below.

**For Partners Capital client portfolios, which are generally biased toward middle-market buyouts, we typically budget for an average beta of 1.0 for the buyouts portion of the portfolio.** For private equity indices such as the State Street index, we would assume that performance reflects predominantly large buyouts and propose to risk adjust the buyout sector benchmarks using a 1.1 to 1.2 beta. Towards the

end of the paper, we illustrate beta-adjusting the Partners Capital private equity historical track record in order to compare that performance against the State Street PE benchmark on an apples-to-apples basis.

## Private Equity Risk Measurement Methodology

The purpose of this research exercise is to arrive at beta estimates for these five PE sub-asset classes in order to calibrate the risk any investor is taking with private equity in various mixes of buyouts, growth equity, early-stage venture and late-stage venture capital. In the most simplistic terms, we want to know how much our private equity portfolio will decline in value in the face of a given equity market decline. It is important to underscore that the nature of the losses for public vs private equity in a market correction are qualitatively different, to the extent that private equity can experience significant permanent losses. A diversified public equity portfolio can decline in value by 20% but very few, if any, companies disappear in the process. In most cases, there is a bounce back in part because the decline had elements of investor panic overcorrecting valuations. In contrast, a 20% public equity market correction related to some economic or financial crisis (or even health crisis such as the current pandemic) can cripple private companies to the point of failure and write off. In particular, highly leveraged buyouts and early-stage venture capital financed companies are the casualties. In contrast, it can be argued that private companies have more aligned and nimble management teams contributing to lower risk in a crisis as we witnessed in the recent pandemic as PE GPs dove in rapidly to reposition companies for the new environment. Beta measurement is intended to capture such leverage, technology, financing and management risks. Private equity valuations may be slower to incorporate the full impact of potential permanent losses, but eventually they are written off with valuations and returns reflecting the result of these risks that tend to be higher in private companies.

With that qualitative explanation of relative risks of public and private equity, what does the historical data tell us about beta of each asset class and the underlying core five PE sub-asset classes?

There would have been no need for this whitepaper if we had been successful in our efforts to find a reliable piece of analytical research estimating betas for our five PE segments (small buyouts, large buyouts, growth equity, late-state venture capital and early-stage venture capital). We have included several pieces of tangential research on the topic in the form of historical volatility measures and smoothed earnings track records. Hence, we were compelled to conduct our own research to arrive at useful private equity risk metrics. Our analysis went down three logical paths to arrive at our beta estimates recommended in the summary above:

1) Beta estimates using published historical private equity indices

2) Public equity proxies for growth equity and venture capital

3) Cash flow analysis on the PE deals or funds that sit inside the PE indices

In the end, we chose to use output from all three of these approaches to estimate forward looking betas for our five PE sub-asset classes. We summarize our findings from each of the three paths below.

### Path #1: Beta estimates using published historical private equity indices

In this section we summarize the results of third-party research (CAIA, Burgiss, HarbourVest) combined with our own index level analysis focused on PE return standard deviations. We are particularly interested in the relative scale of risk being taken investing in venture capital relative to leveraged buyouts. There are huge limitations to using private equity indices which are the sum of individual PE fund reported returns. Such returns will not be directly comparable to the volatility of public equities for at least two major reasons: 1) valuations are only partially referencing public equity comparable companies and sectors and there is a smoothing bias which has GPs and their accountants anchoring valuations on the previous quarter's valuation or indeed toward cost in the early years of a new PE holding; and 2) there is less sentiment, or perhaps even irrational influences, that contribute to more extreme levels of public market equity volatility. Academics and Partners Capital analysts can attempt to adjust for the first, but not the second.

Beta is calculated in a number of different ways. To help us translate standard deviations into betas, we use the formula which first divides the security's standard deviation of returns by the benchmark's standard deviation of returns. The resulting value is then multiplied by the correlation coefficient (R) of the security's returns with the benchmark's returns. Below we illustrate the math by calculating the beta for Apple stock relative to the S&P 500.

Based on recent five-year data, the correlation between Apple and S&P 500 returns is 0.65. Apple has a standard deviation of returns of 30.3% and SPY has a standard deviation of returns of 15.0%. This results in a beta for Apple stock of 1.31.

Before we get to estimating different betas for VC vs buyouts, we start with estimating the annualized standard deviation for private equity as an overall asset class including venture capital.

$$\text{Beta of Apple} = 0.65 \left( \frac{0.303}{0.150} \right) = 1.31$$

CAIA Review (2016) research using 1Q 2004 – 1Q 2014 Raw Cambridge Associates PE index IRRs, arrive at an annual standard deviation of 9.9% over this period. From 1 Jan 2000 – 31 Dec 2017, HarbourVest calculated an 11.4% annualized standard deviation for the Burgiss All PE Index, which is similar to the CAIA figure of 9.9%. Our own analysis of standard deviations are shown below over a longer time frame of nearly 20 years.

**Exhibit 2: Private Equity Standard Deviations (1 January 2000 to 31 March 2020)**

| Index | Standard Deviation |
|---|---|
| State Street Private Equity Index TR USD | 10.7% |
| State Street Buyout PE Index | 10.1% |
| Preqin Private Equity Index | 8.4% |
| Preqin Buyout Index | 9.0% |
| Russell 3000 TR USD | 15.5% |
| MSCI AC World TR | 14.2% |

**Source: Partners Capital**

We can confidently conclude that the standard deviation of reported private equity returns is in the range of 10-11%, in contrast to public equities at 15-16% standard deviation. It is well recognized that these are apples and oranges given the volatility of public equities includes the effects of market sentiment and these simplistic private equity volatility statistics embed the smoothing effects of the judgmental accounting valuations made by PE management teams and embed serial correlation. Serial correlation arises in private equity pricing because investment managers use the previous price as an input for their estimation of current price, thereby biasing empirically derived volatility figures downwards. Many researchers including JP Morgan and CAIA have devised methods to desmooth returns in an attempt to arrive at something closer to a apple and apple comparison.

CAIA arrive at a more accurate volatility figure of 18.4% by de-smoothing returns using statistical techniques. De-smoothing is a mathematical process to remove serial correlation in the return stream of assets that experience infrequent appraisal pricing, such as private equity.

The formula used for de-smoothing is:

$$r_D(t) = (r(t-1)^* p)/(1-p)$$

**where:** $r_D(t)$ **= de-smoothed return for period t**
**r(t) = the return for period t**
**p = the autocorrelation**

Wherein, *p* the serial correlation factor, or de-smoothing coefficient takes a value between 0 and 1 and represents the weighting in current valuations of new market evidence (as opposed to the previous valuation). A positive serial correlation value for p increases the volatility of the adjusted series.

**In 2020, JP Morgan's desmoothing analysis** arrived at an estimate of 20.2% volatility for private equity for the long-term future, based on 13 years of historical private equity index data. Their methodology also utilizes risk forecasts that represent the underlying economic volatility of owning the assets, instead of simply the assets' reported accounting volatility.

A 20% standard deviation for the overall private equity asset class makes sense to us on the simple assumption that these private companies generally have more stable earnings and cash flows than the average public company and then can support leverage to the point that it brings the risk back broadly in line with public companies' risk. We do tend to invest in funds that deploy lower levels of leverage (average 50% debt/enterprise value) which may support the case for a lower volatility assumption, but our 20% standard deviation estimate for PE applies to our estimate for the average PE industry risk, which is further supported by the third-party research sources above.

We turn now to translating various sub-asset class de-smoothed PE standard deviations into beta assumptions for each of the sub-asset classes. Below, we use March 2001 to January 2020 quarterly PE returns, but from a slightly different data set time frame for each private equity index than that used above. We have intentionally started after the tech bubble burst, included the great financial crisis, but stopped before the effects of the pandemic. It is our opinion that this period of time better approximates the future environment, rather than one with the two extremes for venture capital. Including these end points results in much higher risk measures for VC. After adjusting for serial correlation based on the de-smoothing formula shown above, the new de-smoothed returns are used in place of the original returns for calculating the volatility of the series to arrive at annualised de-smoothed standard deviations.

Exhibit 3 below summarizes our math arriving at beta estimates for the overall PE asset class and for each sub-strategy excluding growth equity. The beta for early-stage VC is 30% higher than for large cap buyouts (0.76 vs 0.58), and nearly three times higher than the beta of small cap buyouts.

You will note above that there is no growth equity index for us to use over this period of time. They do exist for recent years. But as such, we have left growth equity out of this analysis and will rely more on public equity proxies in the next section to provide us with beta estimates for growth equity.

The final beta estimates shown here from published PE indices, even with the adjustment for de-smoothing, leave us with what appear to

**Exhibit 3: Private Equity Volatility and Beta Estimates from Desmoothed Performance**

| Private Equity Index[1] | Proxy for | Average Return 2001-2020 (Jan) | Std Dev | De-Smoothed Std Dev[2] | Ratio of De-Smoothed Std Dev to S&P500 Std Dev | Correlation to S&P 500 ($R^2$) | Beta to S&P500[3] |
|---|---|---|---|---|---|---|---|
| **State Street Private Equity Index** | Overall PE | 8.40% | 9.6% | 16.8% | 1.12 | 0.74 | 0.83 |
| **Preqin Private Equity Index** | Overall PE | 9.20% | 8.4% | 15.9% | 1.06 | 0.79 | 0.84 |
| **Preqin Venture Late Stage** | Late Stage VC | 7.00% | 10.2% | 12.5% | 0.83 | 0.60 | 0.50 |
| **Preqin Venture Early Stage** | Early Stage VC | 2.60% | 9.7% | 21.4% | 1.43 | 0.53 | 0.76 |
| **Preqin Buyout – Small Index** | Specialist LMM Buyouts | 11.40% | 7.4% | 10.3% | 0.69 | 0.38 | 0.26 |
| **Preqin Buyout – Large Index** | Large Cap Buyouts | 10.50% | 8.4% | 11.1% | 0.74 | 0.78 | 0.58 |

**Source: Partners Capital**

Notes:

1. Sample set is March 2001 - Jan 2020 for PE indices and uses quarterly data.
2. De-smoothed standard deviation adjusts for the serial correlation of private equity returns. If a sample has more serial correlation, this adjustment increases the standard deviation. There are many techniques for this adjustment. Specifically, we used an AR(1) adjustment described here: https://breakingdownfinance.com/finance-topics/alternative-investments/de-smooth-returns/
3. Beta is calculated as the ratio of the de-smoothed SD for PE indicies over the S&P 500 SD (15%), multiplied by the correlation to the S&P 500.

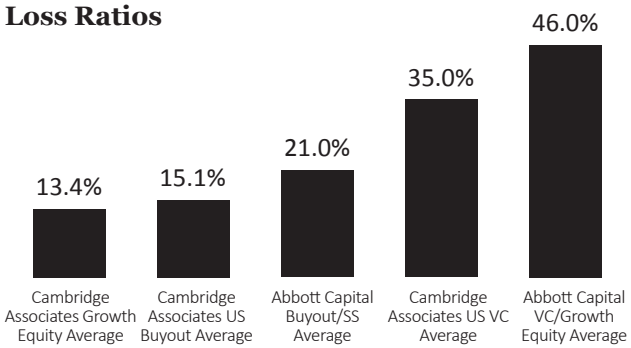
be unreasonably low betas (from 0.26 – 0.83). We attribute this to an understatement of the standard deviations relative to that for public equities due to the higher degree of diversification in the PE indices vs what is generally found in the average institutional PE portfolio. Desmoothed institutional portfolio returns will generally be explained by the top 30 – 40 funds held, while the indices generally have over 1000 fund holdings. Institutional public equity portfolios generally manifest volatility similar to that of public equity indices. As mentioned previously, PE volatility is also absent the effects of any investor sentiment which drives public equity prices to extremes in short periods of time. The cash flow approach discussed below will be the means by which we normalize for the sentiment or the illiquidity impact between public and private equity volatility. Here we will focus on the relative volatility and beta estimates across buyout and venture to guide us to the appropriate scale of any beta adjustment. What we care most about is the ratio of the betas in the final column in the table below.

Focusing on the relative betas, the key observations from this analysis are as follows:

The overall beta for private equity at 0.83 is higher than any underlying sub-sector's beta with early-stage venture coming the closest at 0.76. This is explained by the fact that when you combine all sub-sectors of PE, the PE portfolio becomes more highly correlated with public equities (e.g., 79% correlation for PE overall, vs 53% for early-stage venture capital).

The beta for small cap buyouts is the lowest which is explained by the more idiosyncratic nature of performance of smaller private companies. This is not explained by the beta being referenced against the large cap S&P 500 index vs a broader one which includes small cap equities. We get the same low beta vs the Russell 3000. Small cap private equity returns are quite simply the least correlated PE sub-asset class to public equities.

**Exhibit 4: Private Equity Sub-strategy Loss Ratios**




**Source: Partners Capital**

Buyouts, both large and small, have the lowest volatility measures before and after de-smoothing which makes sense given the focus on mature companies which have de-risked earnings streams which can sustain high levels of leverage. This suggests that the level of leverage does not create as risky a post-interest cost earnings stream as from early or late-stage venture.

### Path #2: Public equity proxies for buyouts, growth equity and venture capital

The rationale for looking at public equity indices as proxies for private equity risk is to try and approximate the "true risk" of private equity all relative to public equities. With private equity valuations, the owners have a tendency to report conservative valuations closely tied to previously reported valuations. As virtually all asset class risk is typically measured with reference to public equities, we are seeking to take out the conservative reporting habits and approximate what private companies' return volatility would be if they were thrown into a competitive marketplace. Additionally, public equity price volatility may better indicate what value would be realized at the time of a major market correction and owners were forced to sell.

We first share with you some third-party public equity historical return analysis which supports an overall 20% standard deviation assumption for private equity. Below, we share two different index proxies.

**a. Sector Weighted Proxy Index for PE:** CAIA argue, and we observe from our own investment experience, that private equity is skewed toward lower beta sectors and companies. To estimate the volatility of PE from public equity volatility

measures, CAIA adjust using the actual private equity net asset value sector weights from 1990 to 2009. CAIA then collected the S&P 400 midcap index performance figures for each sector from 1Q 2004 to 1Q 2014 to produce a PE-sector weighted set of overall market returns and arrive at volatility of **19.9%**. This exercise did not attempt to adjust for lower leverage of public equities which would perhaps point to a somewhat higher volatility measure.

**b. Russell 3000 index proxy:** Similarly, we looked at the historical annual volatility of the Russell 3000 index, which manifested a **15.5%** annualized standard deviation from 1-Jan-2000 – 31-Mar-2020. The Russell 3000 index includes the large cap Russell 1000 and the small-cap Russell 2000, encompassing a mix of market cap sizes that we believe approximates the private equity market today.

For **Growth Equities**, we have looked at the Nasdaq index and the Russell 2000 Growth index as the closest public equity closest proxies for this PE sub-strategy. The definition of Growth Equities includes small and large companies who are rapidly growing and in need of capital to do so. In 2022, consensus forecasts for Nasdaq 100 sales and earnings growth are 8.4% and 13.5%, respectively, versus the 5.3% and 9.7% expected from the S&P 500, according to Goldman Sachs. As you can see in Exhibit 5 below, both proxies for growth equity point to a 1.3 equity beta.

Our public equity proxy for **all venture capital** is the US Russell Microcap Index. This consists of the smallest 1,000 securities in the small-cap Russell 2000 Index, plus the next 1,000 smallest eligible securities based on a combination of their market capitalization and current index membership weight. This points to similar volatility and beta as our growth equity proxies, at 21% and 1.2, respectively. There are more tech-biased indices which could be examined, but none with a sufficiently long track record.

**Exhibit 5: Public Equity Indices as Proxies for Private Equity: Volatility and Beta Estimates**

| Public Equity Indices[1] | Proxy for | Average Return | Std Dev | Ratio of Proxy Index Std Dev to S&P500 Std Dev | Correlation to S&P 500 (R2) | Beta to S&P500[2] |
|---|---|---|---|---|---|---|
| **S&P 500 TR** | Public equities | 5.7% | 15.0% | 1.00 | 1.00 | 1.00 |
| **Russell 2000** | All Private Equity | 4.9% | 19.9% | 1.33 | 0.89 | 1.18 |
| **Russell 2000 Growth** | Growth Equity | 4.1% | 21.8% | 1.45 | 0.88 | 1.29 |
| **Nasdaq** | Growth Equity | 4.1% | 21.4% | 1.43 | 0.90 | 1.28 |
| **Nasdaq Biotech Index[5]** | Biotech VC, Early Stage VC | 6.9% | 24.6% | 1.65 | 0.65 | 1.07 |
| **XBI Biotech Index[3,5]** | Biotech VC, Early Stage VC | 12.4% | 27.5% | 1.84 | 0.67 | 1.24 |
| **Russell Microcap Index[4]** | All Venture Capital | 3.2% | 20.9% | 1.39 | 0.88 | 1.23 |

**Source: Partners Capital**

Notes:

1. Sample set is May 2001 – April 2021 for public indices and uses monthly data.
2. Beta is calculated as the ratio of index standard deviation to the S&P standard deviation, multiplied by the correlation to the S&P 500.
3. XBI biotech index performance data starts in 2006 and runs to April 2021, due to start date of index.
4. Russell Microcap calculations use November 2005 – April 2021 because of data availability.
5. Nasdaq Biotech Index includes large pharma companies, while the XBI does not.

Finally, we show below our proxy for **early-stage venture capital** in the form of the XBI biotech index. This index started in 2006 and includes approximately 200 biotech companies, equal weighted with less than 5% in pharmaceuticals. We estimate that nearly half of the companies are unprofitable and many with no revenue, which explains why we thought this may be the best proxy for early-stage VC. This does manifest the highest volatility of all of our proxy indices with a 27% annual standard deviation, but the beta sits in the mix with other PE beta estimates all hovering around 1.2 to the S&P 500, due to its relatively low correlation to the broader index. The Nasdaq Biotech Index manifests lower volatility, most likely due to the inclusion of large pharma companies and is therefore a less relevant proxy.

**We look to public equity proxies most for growth equity. Our conclusion from examining public equity proxies is primarily around growth equity. We do not have a good PE index for growth equity with a sufficiently long track record, and the cash flow-based analysis has shown unreliable results for growth equity (see below). Therefore, we draw on public equity proxies to arrive at our 1.3 beta for growth equities. This beta figure is supported by both the Russell 2000 Growth and Nasdaq indices as you can see in Exhibit 5.**

**There is also a valuable observation relating to the appropriate beta for venture capital, both early and late stage. While the volatility of the asset class is unsurprisingly high, the relatively low correlation to public equities brings the beta back in line with private equity overall at around 1.2. We may not have a useful public equity proxy for early stage VC however. Given the relatively high loss ratios (see Exhibit 4) for early stage VC vs late stage, we would expect a significantly higher beta for early stage VC.**

### Path #3: Cash flow analysis on the PE deals or funds that sit inside the PE indices

Using cash flows avoids the problem of conservative marks of portfolios before companies are sold, but rather focuses on all inflows and outflows of cash including the initial investment, top-ups for funding acquisitions, dividends, dividend re-caps and proceeds from ultimate exit. The variability of such cash flows across companies or funds which sit in different PE sub-strategies, captures a measure of their relative risk. Over the years, academics studying the risk and returns of these different sub-asset classes have done so looking at both deal level cash flows to the funds (GPs) and fund level cash flows to the underlying investors (LPs).

— **Deal level data:** the best research found included Buchner (2020) and Axelson (2013) which relied on transaction-level cashflows from proprietary GP-sourced information sources. Cochrane (2005), Ewens (2009), Korteweg (2010) used financing round-to-round valuations to estimate the beta of venture capital.

— **Fund level cashflow data:** the best research found included Franzoni (2011) using the proprietary CEPRES database, Ang (2014) using purchased data from Preqin, or Phalippou (2009) who used the Thompson Reuters / VentureXpert database. These looked at both gross or net of fee returns to LPs, as some academics argued that manager fees have a slight dampening effect on private equity betas.

One oddity observed in the academic data is that **the more granular the data, the higher the beta estimate**. The two studies (Buchner and Axelson) that use deal-level cashflows as their starting point concluded that buyout beta was in the 2.2-2.4 range. Contrast this with the studies that used fund-level cashflows, and not one of them found a buyout beta over 1.33[6]. If both data set levels had a similar number of PE deals on a look-through basis, we would not expect to see this deviation. We can only assume that sample size explains the difference, which is likely given the amount of work involved in tracking cash flows at the deal level. **For our intended purpose of evaluating the risk inherent in a relatively**

[6]Axelson in particular seemed to have had intuitively an issue with the lower beta figures from earlier studies as he felt they violated what the Modigliani-Miller theorem would imply and argues that because buyout deals are more levered than public companies their beta has naturally to be higher. He did concede that a possible explanation may be that the different governance structure of buyout deals may change or reduce their risk exposure compared to public firms. Nevertheless, it feels like Axelson set out as an objective to show that the "real" beta is higher than what previous studies imply.

**well diversified multi-manager PE/VC portfolio, we focus on the results somewhere between the fund level betas and the index level betas - more diversified than a single fund but less so than the index - and this is reflected in which type of study results we consider most applicable.**

There are significant alternative models used to arrive at a comparable set of betas from PE cash flows, with the most popular ones being single factor models (CAPM), 3 factor models (Fama-French) and the 4-factor models (Pastor and Stambaugh – "P&S"). It is beyond the scope of this document to describe these in detail, but some of the additional factors these model refinements introduced (e.g., small cap bias or illiquidity premium) seem fairly relevant to private equity investments. **Thus, we would generally favor using the 3 or 4-factor models to calculate PE betas**[7].

The interested reader can refer to the full collection of research papers on the subject we have assembled and are listed in the Appendix B which is our bibliography at the end of this document. We believe this list represents the majority of the usable literature on the topic.

## Buyout Beta Estimate from cash flow-based research

The table below provides a summary of existing academic literature and their findings on US buyout and venture capital betas derived from cash flow analysis. This table was originally published in a 2016 CAIA Alternative Investment Analyst Review article called "Assessing Risk of Private Equity: What's the Proxy?" The various buyout and venture capital fund level betas are shown in the first column. We have updated this table for the 2020 Buchner research publication which updated their 2014 paper.

When interrogating each piece of research to find the most useful for arriving at betas for our five PE sub-asset classes, many were quickly dismissed in favor of those using fund level (vs. deal level) cash flows and 3 or 4 factor models. As such Buchner and Axelson are unsuitable. Phalippou and Gottschalg can safely be omitted as it did not arrive at the beta of 1 through calculation, rather it curiously assumed a beta of 1 for buyouts as the starting point of their work. Similarly, we should disregard Jegadeesh as it focused on listed PE vehicles; not private funds. Lastly some of the older papers (Kaplan and earlier) used very old datasets (pre-2000) that we would also tend to omit as they are probably too out of date given the substantial changes in the PE/VC industry over the past 20 years.

This leaves us with three studies worth considering for buyouts – Ang, Franzoni and Driessen, who derived betas for buyouts of 1.33, 1.30 and 0.94 respectively. Of these Franzoni seems to have had access to the highest quality data (from the proprietary CEPRES deal level database), but it is deal level data which tends to overstate the beta for the asset class. Oddly, Franzoni arrived at a 1.30 beta using deal based data. We have some doubts on Preqin as a PE data source, which is used by Ang. Partners Capital use these data on a daily basis and frequently observe that the NAV time series data is incomplete and unreliable, although it is possible that in the context of a large enough sample set, mistakes on specific funds matter little. Similarly, Driessen uses Thomson Venture Economics data, which we understand to be incomplete, having cashflows for only 19% of the included funds.

Sadly, no study stands out as clearly the most reliable. **In order to avoid having to rely on a single study, we propose to use the average beta between these three studies, 1.2, for our buyout beta estimate.**

## Venture Capital and Growth Equity Beta Estimates from cash flow based research

We continue the updated CAIA table of past academic studies on private equity risk measures to include those that covered venture capital in Exhibit 7 below. Comparing these betas to the table from the previous section, all the studies that studied both buyouts and venture capital show consistently that venture capital investments have the higher beta of the two. The Buchner study further separated out early vs. late-stage venture and found a large differential between the two (beta of 3.66 for early stage and 1.87 for late stage). We can thus be fairly

[7] In any case the 3-factor and 4 factor models seem generally to yield similar numbers based on the studies we've seen that calculate both.

## Buyout Fund Beta Estimates from Cash-Flow based Research

| Beta | Annual Alpha | Year | Authors / Paper | Data Source | Method |
|---|---|---|---|---|---|
| **Deal Level Research Studies** | | | | | |
| 2.25 | 7.0% | 2020 | **Buchner:** The Alpha and Beta of Private Equity Investments | Cepres deal level cash flows | Single factor (S&P 500), cash-flow based 1980-2007 |
| 2.20 | 1.0% | 2014 | Buchner: The Alpha and Beta Private Equity Investments | Cepres deal level cash flows | Single factor (S&P 500), cash-flow based, gross of fees |
| 2.20 - 2.40 | 8.3% - 8.6% | 2013 | **Axelson, Sorensen, Stromberg:** Alpha and Beta of Buyout Deals: A Jump CAPM for Long Term Illiquid Investments | 1 Large fund of funds | Single factor (S&P 500), cash-flow based, gross of fees |
| 1.30 | 0.0% | 2012 | **Franzoni, Nowak, Phalippou:** Private Equity Performance and liquidity Risk | Center for Private Equity Research (Cepres deal level) | 4-factor Pastor and Stambaugh model, cash-flow based, gross of fees |
| **Fund Level Research Studies** | | | | | |
| 1.33 | -2.0% | 2014 | **Ang, Chen, Goetzmann, Phalippou:** Estimating Private Equity Returns from Limited Partner Cash Flows | Preqin on 515 VC and buyout funds | 4-factor Pastor and Stambaugh model, cash-flow based, gross of fees |
| 0.94 | 1.6% | 2011 | **Driessen, Lin, Phalippou:** New Method to Estimate Risk and Return of Non-Traded Assets from Cash Flows: The Case of Private Equity Funds | Thompson Venture Economics fund level | 3-factor Fama French model, cash-flow based |
| 1.00 | -3.0% | 2009 | **Phalippou, Gottschalg:** The Performance of Private Equity Funds | Thompson Venture Economics fund level | Single factor, profitability index (beta is assumed to be 1), net of fees |
| 1.00 | -0.1% | 2009 | **Jegadeesh:** Risk and Expected Returns of Private Equity Investments | Publicly-listed private equity FoFs, Listed Private Equity Funds | Single factor, publicly traded funds (range of betas, but none statistically different from 1), alphas slightly negative |
| 0.41 | N/A | 2005 | **Kaplan, Schoar:** Private Equity Performance: Returns, Persistence, and Capital Flows | Thompson Venture Economics fund level | Single factor (S&P 500); 1980-2001 |
| 0.86 | 2.0% | 2004 | **Woodward:** Measuring Risk and Performance for Private Equity | Thompson Venture Economics fund level | Single factor, Lagged betas and recalculation vs. Wilshire 5000, 1988-2004 |
| 0.66 | 0.7% | 2003 | **Jones, Rhodes-Kropf:** The Price of Diversifiable Risk in Venture Capital and Private Equity | Thompson Venture Economics fund level | Single factor (S&P 500), GP estimates of NAV |
| 1.08 | N/A | 2003 | **Ljungqvist, Richardson:** The Cash Flow, Return, and Risk Characteristics of Private Equity | 1 Large LP | Single factor (S&P 500) |

Source: Assessing Risk of Private Equity: What's the Proxy?", A. Coupe, CAIA Alternative Investment Analyst Review, Q3 2016.
Teal shaded rows indicate studies that are most reliable as they are recent, use fund (vs. firm) level cash flows, and use a 3 or 4-factor regression model.
Light blue shaded lack one of these elements but were found to be useful for relative beta comparisons across sub-asset classes.

confident that the beta for venture (and especially early-stage venture) is materially higher than the beta for buyouts.

We have fewer estimates for venture beta than buyouts, and these estimates range from 1.6 (Ang) to 2.57 (Driessen). The range is wider than for buyout beta estimates, which we suspect is due to different definitions of what constitutes a venture fund (specifically whether late/growth stage funds are included[5]). From our own analysis, we also noticed that the 1999-2000 tech crash period was an extreme outlier and significantly impacted beta results depending on whether it is included or not.

[5] We know for instance that Preqin, which was used for the Ang study, classifies late-stage strategies as venture, so this could help explain why they derived a low beta.

To arrive at separate estimated betas for early and late-stage venture capital, we combine Ang's results for venture overall, using their 4-factor model applied to fund level data with the Buchner analysis which breaks out deal level betas for early and late-stage venture capital. Buchner's (2014/2020) research on approximately 11,000 individual deals over a period of 1980 to 2009 arrived at betas for our five separate private equity sub-asset classes. It is the only study that examined sub-strategy betas and confirms that early-stage venture has a particularly high beta. However, these betas were derived from deal level data, not fund level. To adjust the relatively high deal level betas down to estimated fund level venture betas, we rely on the 2014 Ang et al research which provides reliable estimates of the overall venture capital (early and late stage) beta at 1.6 and overall buyout (to include growth equity) beta at 1.33, all fund level data. By applying the ratios of the Buchner early/

**Exhibit 7: Venture Capital Beta Estimates from Cash-Flow based Research**

| Beta | Annual Alpha | Year | Paper | Data Source | Method |
|---|---|---|---|---|---|
| **Deal Level Research Studies** | | | | | |
| 2.57 | 8.9% | 2020 | Buchner: The Alpha and Beta of Private Equity Investments | Cepres deal level cash flows | Single factor (S&P 500), cash-flow based 1980-2007 |
| 2.60 | 3.5% | 2014 | Buchner: The Alpha and Beta of Private Equity Investments | Cepres deal level cash flows | Single factor, S&P 500, cash-flow based |
| **Fund Level Research Studies** | | | | | |
| 1.60 | 6.0% | 2014 | Ang, Chen, Goetzmann, and Phalippou: Estimating Private Equity Returns from Limited Partner Cash Flows | Prequin on 515 VC and buyout funds | 4-factor P&S model, cash flows to LPs from funds, 1992-2008 |
| 2.57 | -8.3% | 2008 | Driessen, Lin, Phalippou: New Method to Estimate Risk and Return of Non-Traded Assets from Cash Flows: The Case of Private Equity Funds | Thompson Venture Economics fund level (686 funds) | 3-factor Fama French Model, cash-flow based; Generalized Method of Moments estimation (GMM),funds raised between 1980 and 1993 with liquidation age by 2003. |
| 2.06 | -1.2% | 2004 | Woodward: Measuring Risk and Performance for Private Equity | Cambridge Associates venture funds | Single factor, 1985-2003, Lagged betas and recalculation |

Source: "Assessing Risk of Private Equity: What's the Proxy?", A. Coupe, CAIA Alternative Investment Analyst Review, Q3 2016. Green shaded rows indicate studies that are most reliable as they are recent, use fund (vs firm) level cash flows, and use a 3 or 4 factor regression model. Yellow shaded lack one of these elements but were found to be useful for relative beta comparisons across sup-asset classes.

late-stage venture betas to Ang's overall venture and overall buyouts betas, we end up with what we expect the fund level betas would be for early and late-stage venture capital below, applying a 4-factor model.

**Exhibit 8: Venture Capital Beta Estimates Combining Buchner and Ang Research**

| Private Equity Strategy | Buchner Deal Level Betas | Ang's VC betas with Buchner Sub-sector Ratios |
|---|---|---|
| Early-Stage Venture | 3.66 | 2.28 |
| Late-Stage Venture | 1.87 | 1.17 |
| All Venture Capital | 2.57 | **1.60** |

**Source: Partners Capital**

## Conclusion for Path 3 Cash Flow Analysis

The academic studies focused on deal level and fund level cash flows to estimate PE stub-strategy volatility and beta are frustratingly complicated and flawed in so many ways as discussed. However, a creative combination of Buchner's VC separate early and late-stage VC betas from deal level cash flows applied to Ang's more reliable overall VC beta estimate from fund level cash flows, leaves us with what we believe to be a reliable estimate of the difference between early and late-stage VC risk. Exhibit 8 shows our calculations combining these two separate pieces of research.

Our best beta estimate of beta for early-stage venture is ~2.0-2.5 and for late stage is ~1.1-1.25. We have elected to use point estimate betas of 2.3 and 1.2, respectively for risk adjusting early-stage venture capital and late-stage venture portfolios. In some cases, we may vary the betas used to reflect the mix of VC stages (e.g., seed and A-rounds at the riskier end (say 2.5 beta) and B and C-rounds demonstrating risk approaching that of late stage (say 1.5 beta).

[8]The institutional investor's performance data is illustrative and is not an indicator of actual performance. The State Street PE index also includes Private Debt in addition to Buyout and Venture strategies. For the purposes of this exercise we removed the PD element from the data.
[9]The institutional investor's performance data is illustrative and is not an indicator of actual performance.

## PE Sub-strategy Risk Conclusions from the Three Analytical Paths

The reason for torturing our readers down the three analytical paths of

1) Beta estimates using published historical private equity indices

2) Public equity proxies for growth equity and venture capital

3) Cash flow analysis on the PE deals or funds that sit inside the PE indices

Is that no one or two paths provided us with reliable answers for risk metrics for each of the five sub-strategies. Appendix A below pulls together in one table, the beta estimates from each of the three analytical paths for each of the five sub-strategies. The yellow highlighted cells in he table indicate where we found the most reliable analytical path for each strategy beta risk measure.

## Example Adjusting Private Equity Track Records for Varying Mixes of PE Sub-strategies

In Exhibit 9 below, we compare a 2004-17 illustrative institutional investor's PE/VC investment track record against the State Street PE benchmarks for the same years[8]. We divided the performance data into Buyouts and Venture Capital (combining early and late stages) and assigned an estimated beta of 1.0 for the buyouts benchmark and 1.6 for the venture capital benchmark. These betas are in line with those recommended from this research.

As can be seen in the first set of tables below, the overall split of buyout vs. venture was 82%/18% for State Street and 90%/10% for the illustrative institutional investor's. Both saw higher average returns from venture than buyouts (16.1% vs. 11.0% for State Street and 17.4% vs. 14.4% for the illustrative institutional investor's) over the period.[9] For simplicity, we have assumed that there is no growth equity in either the State Street benchmark or the institution's portfolio. But, in most risk adjustment efforts done today, we would strongly recommend breaking out portfolio performance for large-cap buyouts, middle-market (specialist) buyouts, growth equity, early-stage venture and late-stage venture

capital in order to make the most accurate apples-to-apples risk-adjusted performance comparison.

Prior to any risk adjustments, the illustrative institutional investor's average annual IRR% was 14.7%, 2.8% above the State Street benchmark of 11.9%.

In Exhibit 10, we show the unadjusted IRRs in the middle column for each year and the beta-adjusted figures in the third column. The IRR%s are adjusted down to show what the PE returns for each portfolio (State Street and the illustrative institutional investor's track record) would be for

**Exhibit 9: State Street Benchmark and Illustrative Institutional Investor's Performance Data by Year**[10]

| State Street Benchmark | Buyout Beta 1.0 | | VC Beta 1.6 | | |
|---|---|---|---|---|---|
| | Buyout | | VC | | Total |
| | $B | IRR | $B | IRR | $M |
| 2004 | 47 | 16% | 11 | 7% | 58 |
| 2005 | 113 | 9% | 17 | 13% | 130 |
| 2006 | 150 | 6% | 25 | 6% | 176 |
| 2007 | 228 | 10% | 54 | 13% | 282 |
| 2008 | 149 | 10% | 31 | 13% | 180 |
| 2009 | 36 | 13% | 13 | 14% | 49 |
| 2010 | 30 | 10% | 12 | 20% | 42 |
| 2011 | 96 | 13% | 24 | 21% | 119 |
| 2012 | 99 | 14% | 18 | 20% | 117 |
| 2013 | 99 | 10% | 20 | 19% | 119 |
| 2014 | 112 | 15% | 31 | 14% | 142 |
| 2015 | 112 | 11% | 27 | 21% | 139 |
| 2016 | 130 | 12% | 22 | 25% | 151 |
| 2017 | 148 | 11% | 35 | 20% | 183 |
| % of total by strategy | 82% | | 18% | | |
| Average Capital Weighted IRR | | 11.0% | | 16.1% | 11.9% |

| Illustrative Institutional Investor Track Record | Buyout Beta 1.0 | | VC Beta 1.6 | | |
|---|---|---|---|---|---|
| | Buyout | | VC | | Total |
| | $B | IRR | $B | IRR | $M |
| 2004 | 11 | 13% | 1 | 11% | 12 |
| 2005 | 26 | 14% | | | 26 |
| 2006 | 63 | 8% | 9 | 3% | 72 |
| 2007 | 87 | 9% | 18 | 7% | 105 |
| 2008 | 30 | 13% | 11 | 31% | 41 |
| 2009 | | | | | – |
| 2010 | | | 10 | 8% | 10 |
| 2011 | | | | | – |
| 2012 | 42 | 15% | 10 | 28% | 52 |
| 2013 | 155 | 8% | | | 155 |
| 2014 | 147 | 29% | 56 | 13% | 203 |
| 2015 | 84 | 12% | 16 | 43% | 100 |
| 2016 | 360 | 14% | 4 | 42% | 364 |
| 2017 | 466 | 14% | 20 | 12% | 486 |
| % of total by strategy | 90% | | 10% | | |
| Average Capital Weighted IRR | | 14.4% | | 17.4% | 14.7% |

[10] The institutional investor's performance data is illustrative and is not an indicator of actual performance.

**Exhibit 10: State Street Benchmark and Illustrative Institutional Investor's Performance Adjusted to Beta 1.0 to Global DM Equities**

| State street | Unadjusted IRR | Beta adjusted IRR |
|---|---|---|
| 2004 | 14.0% | 13.5% |
| 2005 | 9.5% | 8.9% |
| 2006 | 6.3% | 6.0% |
| 2007 | 10.1% | 9.2% |
| 2008 | 10.7% | 9.9% |
| 2009 | 13.7% | 12.3% |
| 2010 | 13.0% | 10.8% |
| 2011 | 14.3% | 12.8% |
| 2012 | 15.1% | 14.0% |
| 2013 | 11.8% | 10.6% |
| 2014 | 15.2% | 14.0% |
| 2015 | 12.7% | 11.1% |
| 2016 | 14.1% | 12.8% |
| 2017 | 13.2% | 11.7% |
| **Capital Weighted Avg** | **11.9%** | **10.8%** |

| Illustrative Institutional Investor Track Record | Unadjusted IRR | Beta adjusted IRR |
|---|---|---|
| 2004 | 13.1% | 12.7% |
| 2005 | 13.7% | 13.7% |
| 2006 | 7.4% | 7.2% |
| 2007 | 8.9% | 8.4% |
| 2008 | 18.0% | 14.8% |
| 2009 | – | – |
| 2010 | 8.1% | 5.0% |
| 2011 | – | – |
| 2012 | 17.5% | 15.5% |
| 2013 | 7.6% | 7.6% |
| 2014 | 24.5% | 23.2% |
| 2015 | 17.1% | 14.6% |
| 2016 | 14.6% | 14.4% |
| 2017 | 14.4% | 14.2% |
| **Capital Weighted Avg** | **14.7%** | **14.1%** |

a beta of 1.0 to public equities. The State Street benchmark return is adjusted down from 11.9% IRR on unadjusted basis to 10.8% once adjusted. The overall institutional investor's PE portfolio return was risk-adjusted from 14.7% to 14.1% for a beta of 1.0 private equity portfolio. This illustrates that the Illustrative Institutional Investor's alpha was originally understated at 2.8% pa. vs 3.3%, risk-adjusted. This example adjusts for a relatively minor difference between the index VC % at 18% vs our client example at 10% VC, yet arrives at a non-trivial adjustment to the alpha we have generated against the benchmark. More meaningful differences exist with performance comparisons relative to some of the endowments such as Yale, where VC is in excess of 50% of their private equity allocation today.

## Whitepaper Overarching Conclusions

In conclusion, we believe that the various sub-strategies of private equity do have sufficiently different risk and return characteristics such that any comparison of historical private equity performance across different investors should include an adjustment for the different levels of risk being taken on.

In Appendix B below, we further illustrate some of the implications of risk dispersion across PE sub-strategies. Beyond risk-adjusting PE track records, understanding these different risk levels should inform the investor's private equity strategy allocation. Over- and under-weighting a given PE sub-strategy should be guided by mean variance optimization modeling and/or where you think the greatest alpha opportunities lie. Appendix B shows the current market weights of the five PE sub-strategies today (substituting "specialist buyouts" for lower middle market buyouts) and shows an illustrative recommended strategy allocation based on alpha estimates, which in turn have been derived from sub-strategy beta risk attribution using the beta estimates produced from the research documented in this whitepaper.[11]

[11] The institutional investor's performance data is illustrative and is not an indicator of actual performance.

## Appendix A: Private Equity Betas from Three Alternative Pathways

| Private Equity Strategy | Pathway #1: PE Firm Reported Quarterly Performance - Desmoothed by Partners Capital[1] | Pathway #2: Public Equity Indices as Proxies | Pathway #3: Academic Research (based on cash flows in and out of a fund relative to a public market equivalent) | Chosen Beta with reference to betas at left | Basis Chosen |
|---|---|---|---|---|---|
| Early Stage VC | 1 yr: 0.76 (Preqin)<br>3 yrs: 0.92 (Preqin) | 1.07 NASDAQ Biotech<br>1.08 XBI Biotech ETF<br>1.23 Russell Microcap | 2.30 Buchner/Ang | 2.30 | Academics |
| Late Stage VC | 1 yr: 0.50 (Preqin)<br>3 yrs: 0.54 (Preqin) | | 1.17 Buchner/Ang | 1.20 | Academics (rounded) |
| All Venture Capital | | | 1.60 Ang 2014 | 1.60 | Academics |
| Growth Equity | | 1.28 NASDAQ<br>1.29 R2000 Growth | | 1.30 | Public Proxies |
| LMM Buyouts | 1 yr: 0.26 (Preqin)<br>3 yrs: 0.59 (Preqin) | | | 1.00 | The 3 year desmoothing data implies that LMM and Large Cap have similar betas using reported performance. |
| Large Cap Buyouts | 1 yr: 0.58 (Preqin)<br>3 yrs: 0.60 (Preqin) | 1.18 Russell 2000 | | 1.00 | Assumed to be same as all buyouts below. |
| All Buyouts | | | 1.30 Franzoni 2012<br>1.33 Ang 2014<br>0.94 Driessen 2011 | 1.00 | Interpolation looking at All PE and backing out VC at 10% (beta = 1.6) |
| All Private Equity | 1 yr: 0.58 (Preqin)<br>3 yrs: 0.60 (Preqin)<br>1 yr: 0.80 (State Street)<br>3 yrs: 0.79 (State Street) | 1.18 Russell 2000 | | 1.20 | Public Proxies |

Notes:
1. Preqin data was desmoothed looking at rolling one and three year average annual performance. Desmoothing effectively adjusts for serial correlation (the stickiness of PE valuations and a bias to cost basis in the early years. It is our view that desmoothing cannot fully adjust PE marks back to something comparable to public equity volatility.
2. Venture Capital has represented approximately 10% of all private equity by value invested over the last 20 years. 10% used to arrive at weighted average PE betas.
3. Betas are all calculated relative to the S&P 500 or MSCI ACWI as the "beta of 1." See main paper for reference for each beta.

Yellow highlighted cells indicates the primary research pathway used for each PE sub-asset class to arrive at the chosen beta.

## Appendix B: Private Equity Sub Strategy Definitions and Expected Future Returns

| Strategy | Definition of Sub-Strategy | Market Weight[1] | Horizon Net IRR[2] | Historic Loss Ratio | Expected Net Total Returns | Beta to MSCI ACWI[3] | Illiquidity Premium + Alpha[4] | Manager Examples | Strategic Asset Allocation |
|---|---|---|---|---|---|---|---|---|---|
| Generalist Large Buyout | Typically involve companies with a stable earnings stream, perhaps growing slowly where the assumption of 30% to 70% debt in the capital structure is expected to be a material contributor to the investment return. Investors generally have control positions and sit on the company's board. Value creation is from sourcing (cheap entry price), post-acquisition operating value added and financial engineering. | 44% | 13% | 15% | **12%** | 1.2 | 5.0% | Apollo, Carlyle, Blackstone, Genstar, HIG, IK, Audax, CD&R, Bain | **25%** |
| Specialist / Middle Market Buyout | Middle market buyouts are $500M total enterprise value deals or smaller. Fund AUM < $5B. Sector specialists are focused primarily on one broadly defined sector such as consumer, technology, healthcare, financial services, industrials and energy. This focus generally deepens the PE firm's ability to add value throughout the process from sourcing to exit. Investors will use high levels of leverage, although perhaps somewhat less than generalists who are larger and can command lower borrowing costs. Geographic specialists outside the US (eg., China, UK, Europe) are also included in this category along with distressed investors. Most emerging managers (newly formed from spinouts) are also included here. | 16% | 15% | 15% | **13%** | 1.0 | 7.0% | Vista, Thoma Bravo, L-Catterton, TSG, Roark, Hillhouse buyouts, Silverlake | **40%** |
| Early Stage Venture Capital | Development stage capital, which may include seed capital, but generally follows founders and angel investors who have provided the initial seed funding for a business. This stage of financing is usually larger in sum than the seed stage because new businesses need more capital to start operations once they have a viable product or service. Generally focused on Series A and Series B rounds of financing. Will be a minority stage, but VC GPs will often join the board to offer their experience and reduce start-up risk. Typically targets technology companies but may also include opportunities in consumer, life sciences, industrials, energy and business services. | 7% | 15% | 35% | **19%** | 2.3 | 5.0% | Sequoia, Accel, Benchmark, Craft, 8VC, Flagship, A16z, Felicis, Ribbit, Redpoint, Vida | **10%** |
| Late Stage Venture Capital | The later stage of venture capital funding targets more mature companies. These companies may or may not yet be profitable but have proven product market fit, are generating revenue and are growing at high rates. Generally associated with Series C all the way up to pre-IPO funding rounds. Such funds will often retain holdings of the public securities even beyond the post IPO lock-up period. | 14% | 17% | 13% | **12%** | 1.2 | 5.0% | Sequoia, Tiger Global, Jeneration China, DST, General Catalyst, Lightspeed, Dragoneer, Founders Fund Growth, Hedosophia | **15%** |
| Growth Equity | Established companies that can benefit from additional capital to accelerate growth by investing in new product development, geographic expansion, human capital, infrastructure, and M&A. Companies are usually still founder-owned with no prior institutional investment. They have proven business models (established product and/or technology and existing customers) expecting substantial organic revenue growth (usually in excess of 20%). EBITDA is positive or expected to be so within 12 to 18 months. Typically, minority stakes using little if any leverage at investment. They often have built-in safeguards for private equity investors as well, making their equity senior to common. Value added is from sourcing process, assisting management through the growth transition and finding the most attractive exits. | 19% | 17% | 13% | **13%** | 1.3 | 5.0% | General Atlantic, TA Associates, Summit, Hillhouse Growth, Insight Partners, Spectrum, TCV, TPG Growth, Accel-KKR | **10%** |

Notes:

1. Data was compiled based on Preqin Private Equity online sample of the average dollar-weighted commitments 2015-2020. We believe 19% Preqin growth equity weight miscategorises many late stage VC and EM buyout funds as growth equity and we expect the right definition would arrive at approximately 10%.
2. Historical Returns are 15 years of annual horizon net IRRs for State Street Private Equity Indices as of 30 June 2021.
3. See Partners Capital Whitepaper on Private Equity Risk Measures (Betas) published December 2021.
4. Assumes public equity returns of 6% per annum nominal for beta return. Eg, Early-stage VC beta return is 13.8% using a beta of 2.3 to MSCI World

## Appendix C: Research Sources on Private Equity Risk Measurement

**Buchner, A (2020)**
*The Alpha and Beta of Private Equity Investments*

**HarbourVest (May 2019)**
*Rethinking Risk: How Diversification Amplified Selection Skill*

**Coupe, A (2016)**
*Assessing Risk of Private Equity: What's the Proxy?*
PAAMCO

**Kraussl, R. Jegadeesh, N and Pollet, J.M (2014)**
*Risk and Expected Returns of Private Equity Investments: Evidence Based on Market Prices*
The LSF Research Working Paper Series No. 14-04

**Axelson, U. Sorensen, M and Stromberg, P (2014)**
*Alpha and Beta of Buyout Deals: A Jump CAPM for Long-Term Illiquid Investments*

**Franzoni, F. Nowak, E and Phalippou, L (2011)**
*Private Equity Performance and Liquidity Risk*

**Phalippou, L and Gottschalg, (2009)**
*The Performance of Private Equity Funds*

**Driessen, J. Lin, T.C and Phalippou, L (2008)**
*A New Method to Estimate Risk and Return of Non-Traded Assets from Cash Flows: The Case of Private Equity Funds*
NBER Working Paper Series No. 14144

**Woodward, S.E (2004)**
*Measuring Risk and Performance for Private Equity*
Sand Hill Econometrics

**Ang, A. Chen, B. Goetzmann, W.N and Phalippou, L (2004)**
*Estimating Private Equity Returns from Limited Partner Cash Flows*

**Jones, C. M and Rhodes-Kropf, M (2003)**
*The Price of Diversifiable Risk in Venture Capital and Private Equity*

**Kaplan, S and Schoar, A (2003)**
*Private Equity Performance: Returns, Persistence and Capital Flows*
MIT Sloan School of Management

**Ljungqvist, A and Richardson, M (2003)**
*The Cash Flow, Return and Risk Characteristics of Private Equity*

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