Contrary to the prevailing trend of investors seeking to concentrate their private markets portfolios with a few, select managers, our detailed quantitative analysis suggests that broad diversification both across and within asset classes may produce better risk-adjusted returns than a less diversified portfolio.

Manager selection is nevertheless very important in an asset class with a highly dispersed return distribution, but our research highlights that allocation should remain a foundational component of private markets portfolio construction.

Increasing numbers of private markets investors have sought to ‘rationalize’ their portfolios over recent years, concentrating more capital with fewer managers in pursuit of greater operational efficiency, supported by arguments claiming that ‘over-diversification’ reduces returns. This has led to a greater concentration of capital with major private markets managers. The largest 10 funds raised in 2017 accounted for 38% of all capital committed – the highest proportion ever recorded – while 76% of follow-on funds were larger than their predecessors.\(^1\)

However, our research suggests that the concept of over-diversification is a myth. Furthermore, while proponents of more concentrated portfolios argue that the only way to improve returns from private markets is through manager selection, we argue that asset allocation and manager selection are both essential and complementary elements of portfolio construction.

\(^1\) PitchBook, PE & VC Fundraising Report 2017
Skillful manager selection is critical in an asset class that has historically produced a much wider dispersion of returns than public markets (see Chart 1), and a portfolio concentrated with top-quartile managers might well generate higher absolute returns in a positive market environment. However, investors following this strategy may be greatly underestimating the risk it poses.

HarbourVest’s detailed quantitative analysis suggests that diversification is a prerequisite for effectively managing downside risk in a private markets portfolio. Indeed, the conclusion presented by the data is that to both minimize risk and maximize expected returns, an investor should build an appropriately diversified set of exposures to the various private markets sub-asset classes and, within each, invest with a diversified group of high-performing managers. The optimal degree of diversification within an asset class is determined by the return dispersion and will vary by asset class.

Diversification remains, in the words of Nobel laureate Harry Markowitz, “the only free lunch in finance”.

ANALYTICAL FRAMEWORK

Our analysis is based on 23 years of private markets fund performance data. This encompasses more than 4,000 mature funds across strategies and geographies, drawn from HarbourVest’s proprietary historical data set of investment and due diligence data, supplemented by several publicly available data sources.

Using this historical return data, we conducted 10,000 Monte Carlo Simulations to assess the likelihood of different risk and return outcomes from model portfolios with varying degrees of diversification. These model portfolios were simulated as evenly-paced allocations over consecutive three-year periods to take into account the impact of the macroeconomic environment across different cycles. This analysis produced probability estimates of the likely Distributed to Paid-In Capital (“DPI”) Multiple at maturity for each strategy. In addition, we calculated the median expected return and risk-adjusted return (for more details, see “Better risk measures for private markets” on page 10) and compared the risk characteristics for each portfolio.
DIVERSIFICATION WITHIN ASSET CLASSES

GLOBAL VENTURE FUND PORTFOLIOS

Modeling using the performance of mature global venture funds with vintage years from 1995 to 2017 found that both risk-adjusted returns (as expressed via the Sortino Ratio) and median DPI improved as the number of funds invested in increased (see Chart 2).

CHART 2: Greater fund diversification in a global venture fund portfolio improves the chances of achieving or exceeding a Minimum Acceptable Return (“MAR”) of 1.5x

Modeled risk and returns from global venture fund portfolio, by number of funds invested in over three-year period

HarbourVest proprietary data set; Vintage years 1995 – 2017; Funds with residual value <20%; Residual Value = 1 – (∑ Cumulative Distributions) / Total Value; Even allocation over 3 consecutive vintage years; Venture portfolio 36 funds, 80% US, 10% Europe, 10% Asia; Returns net of limited partner fees and expenses. Expected Shortfall 95% represents the average expected return in the lowest 5% of modeled scenarios. The graphic and data above are based on a Monte Carlo simulation. MAR = Minimum Acceptable Return. Sortino Ratio annualized for 15 years using the square root of time rule. See Appendix for more information on the construction of this simulation. Past performance is not a reliable indicator of future results.

Sortino Ratio = \( \frac{E[R - MAR]}{DD} \), where \( E \) = expected; \( R \) = expected return; \( MAR \) = minimum acceptable return; \( DD \) = downside deviation
A significant part of this modeled improvement stemmed from the sharp decline in downside risk as fund-count rose. The predicted return in the worst 5% of modeled scenarios, represented by the expected shortfall at the 95th percentile level, increased to above break-even (1.02x) in the 36-fund model. For a three-fund portfolio, the expected shortfall is a multiple of 0.42x – in other words a potential capital loss of 58% over the portfolio’s life.

The overall chance of significant outperformance (return multiples exceeding 2.5x) stayed relatively even across the varying levels of diversification, but the probability of meeting or exceeding an assumed minimum acceptable return (“MAR”) of 1.5x – represented by the green areas on Chart 2 – increased in lockstep with the number of venture funds invested in. For example, our analysis found that with a three-year evenly-paced model portfolio of 36 funds, the chance of a global venture fund portfolio delivering a DPI multiple greater than 1.5x was 63.4%. For an equivalent three-fund model portfolio that probability was just 46.9%.

We acknowledge that the performance of a global venture fund portfolio can be significantly improved through manager selection, given the much wider dispersion of returns within this asset class. While this is not the focus of this paper, we hope to explore this topic further in a future thought piece.

**US BUYOUT FUND PORTFOLIOS**

Most investors will understand the necessity of diversifying venture exposures and are unlikely to find these results too surprising. Yet our analysis shows that diversification also improves the risk-return profile of a US buyout portfolio.

Applying the same modeling technique to mature US buyout funds with 1995 to 2017 vintages found improved risk-adjusted returns as the number of funds increased (see Chart 3). Adding more funds to a US buyout fund portfolio, invested in evenly over three consecutive years, reduced the risk of losing capital and improved the expected shortfall level.
Modeling a concentrated US buyout fund portfolio, allocating to one fund per year over three consecutive years, found an expected shortfall of 0.93x – denoting an average loss of 7% of invested capital in the worst 5% of scenarios. However, a modeled diversified US buyout fund portfolio, investing in eight funds per year over three consecutive years, reduced the statistical chance of capital loss to zero. It should be noted that capital loss is always possible when investing, but the diversified strategy produced no simulated runs in our modeling in which an investor lost capital. The expected shortfall also rose in the diversified portfolio to 1.37x. In simple terms, even in the poorest 5% of scenarios this level of diversification means an investor could still expect to receive a 37% return on invested capital at maturity.

The diversified strategy produced no simulated runs in our modeling in which an investor lost capital.

The diversified model portfolio therefore has less downside risk. Indeed, the chance of attaining a DPI multiple below or equal to 1.5x is just 9.9% in the diversified model portfolio, against 30.1% in the concentrated one. However, this risk reduction is not achieved at the expense of expected returns. The probability of returns exceeding a DPI multiple of 2.0x is lower in the diversified US buyout fund portfolio – 5.0% compared to 24.7% for the concentrated portfolio. However, based on our model results, which assumed an MAR of 1.5x, an investor in a concentrated portfolio would be more likely to fail to meet that minimum target (30.1%) than to achieve a DPI multiple of 2.0x.

Some investors seeking higher absolute returns might still be inclined towards the concentrated portfolio, giving a disproportionate value to the chance of outperformance despite the higher downside risk. Such an investor may believe that the fund managers with which they intend to invest are skilled and will beat an MAR of 1.5x. Yet even looking exclusively at this higher-performing cohort, our data suggests the rational approach remains investing in a diversified portfolio.
We calculated the weighted expected return from portfolios that exceeded a 1.5x DPI by multiplying the average returns from portfolios in this range by the probability of returns actually falling in that range (see Chart 4). This calculation revealed that the expected average return in the 1.5x to 2.0x bucket is the same for both model portfolios, while the average return from a concentrated portfolio exceeding 2.0x is higher. However, once you factor in the much lower probability of the funds in a portfolio of that size actually generating a return between 1.5x and 2.0x, the probability-weighted expected return for a concentrated portfolio exceeding the 1.5x MAR was inferior to that of the diversified portfolio.

As demonstrated in Chart 3 by the lower Sortino Ratio for a concentrated US buyout fund portfolio, investors would not be adequately compensated for the additional risk they would assume in pursuit of higher absolute returns. Indeed, our modeling across both buyout and venture strategies clearly suggests that, while strong absolute returns are achievable with a more concentrated exposure, the level of downside risk involved – when correctly modeled – is much higher than many investors think.

<table>
<thead>
<tr>
<th>CHART 4: Weighted expected returns from US buyout fund portfolios exceeding 1.5x MAR are higher in a diversified portfolio than in a concentrated one</th>
<th>Concentrated US Buyout</th>
<th>Diversified US Buyout</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5x &lt; Average Return &lt;=2.0x</td>
<td>1.74x</td>
<td>1.74x</td>
</tr>
<tr>
<td>Average Return &gt; 2.0x</td>
<td>2.29x</td>
<td>2.07x</td>
</tr>
<tr>
<td>1.5x &lt; Probability &lt;=2.0x</td>
<td>45.2%</td>
<td>85.1%</td>
</tr>
<tr>
<td>Probability &gt; 2.0x</td>
<td>24.7%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Weighted Expected Return &gt; 1.5x</td>
<td>1.35x</td>
<td>1.58x</td>
</tr>
</tbody>
</table>

HarbourVest proprietary data set; Vintage years 1995 – 2017; Companies with residual value < 20%; Residual Value = 1 – (∑ Cumulative Distributions) / Total Value

Diversified portfolio: 100% US Buyouts; 24 funds; Concentrated portfolio: 100% US Buyouts; 3 funds; Even allocation over 3 consecutive vintage years; Returns net of limited partner fees and expenses. The data above is based on a Monte Carlo simulation. See Appendix for more information on the construction of this simulation. Past performance is not a reliable indicator of future results.
DIVERSIFICATION ACROSS ASSET CLASSES

We would argue that a better way to improve portfolio performance is to diversify across asset classes within private markets.

As previously noted, the dispersion of returns within global venture funds is broader than for US buyout funds, and the downside risk is also greater. Investors looking to minimize risk may therefore conclude that allocating to US buyout funds alone would be the optimal approach. However, our modeling suggests that supplementing a US buyout fund portfolio with a diversified global venture fund exposure may actually improve the risk-adjusted returns of the combined portfolio (see Chart 5).

Analysis of our proprietary data found that adding a diversified global venture fund exposure (30% of the total) to a diversified US buyout fund portfolio resulted in a combined portfolio with a higher Sortino Ratio. This improvement in risk-adjusted returns is due to venture and buyout assets operating in different market cycles, responding to economic stimuli in different ways. In basic terms, returns from the two asset classes vary markedly from each other year-to-year and over time. Chart 6 clearly illustrates the different cycles in which they have operated.

![Chart 5: Combined portfolio of US buyout and global venture funds offers better risk-adjusted returns than each individual exposure. Modeled probability density of return outcomes, by portfolio type.](image-url)

<table>
<thead>
<tr>
<th></th>
<th>US Buyout</th>
<th>Global Venture</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected DPI</td>
<td>1.72x</td>
<td>1.69x</td>
<td>1.71x</td>
</tr>
<tr>
<td>% &lt;= 1.0x</td>
<td>0.0%</td>
<td>1.5%</td>
<td>0.0%</td>
</tr>
<tr>
<td>1.0x &lt; % &lt;= 1.5x</td>
<td>9.9%</td>
<td>35.1%</td>
<td>6.4%</td>
</tr>
<tr>
<td>1.5x &lt; % &lt;= 2.0x</td>
<td>85.1%</td>
<td>33.0%</td>
<td>83.3%</td>
</tr>
<tr>
<td>% &gt; 2.0x</td>
<td>5.0%</td>
<td>30.4%</td>
<td>10.3%</td>
</tr>
<tr>
<td>Sortino Ratio</td>
<td>1.81</td>
<td>0.54</td>
<td>3.19</td>
</tr>
<tr>
<td>Expected Shortfall</td>
<td>1.37x</td>
<td>1.02x</td>
<td>1.43x</td>
</tr>
<tr>
<td>Sharpe Ratio</td>
<td>2.60</td>
<td>0.66</td>
<td>2.09</td>
</tr>
</tbody>
</table>

HarbourVest proprietary data set; Vintage years 1995–2017; Funds with residual value <20%; Residual Value = 1 − (∑ Cumulative Distributions) / Total Value

US Buyout portfolio: 24 funds, US; Global Venture portfolio: 36 funds, 80% US, 10% Europe, 10% Asia; Combined portfolio: 30% Global Venture/70% US Buyout, 60 funds. Even allocation over 3 consecutive vintage years. The graphic and data above are based on a Monte Carlo simulation. Sortino Ratio and Sharpe Ratio both annualized for 15 years using the square root of time rule. See Appendix for more information on the construction of this simulation. Past performance is not a reliable indicator of future results.
While Cambridge Associates data shows that US venture funds formed in 2000 – in the wake of the dotcom bubble bursting – recorded 0% net IRR on a pooled basis, US and European buyout funds of the same vintage produced annualized returns of 17.4% and 21.8%, respectively. The inverse scenario played out for funds of the 2010 vintage: US venture funds returned a net pooled IRR of 23.5%, against 14.6% from US buyout funds and 8.6% from European buyouts.

More broadly, Chart 6 vividly illustrates the importance of diversification across private markets asset classes. Indeed, as this paper has aimed to demonstrate, an appropriate level of diversification both across and within asset classes can be highly beneficial to a private markets portfolio in terms of helping to maximize risk-adjusted returns. Furthermore, our analysis has highlighted that asset allocation can contribute to meaningful improvements in expected returns. Asset allocation and manager selection are both essential to effective portfolio construction in private markets.

HarbourVest does not believe investors should be overly concerned with over-diversification. Instead, our research suggests that the optimal approach to building a private markets portfolio is to allocate across a broad range of strategies and then to select a broad range of funds within each of those strategies.

**Chart 6: Returns from different private markets sub-asset classes respond to different economic stimuli**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>104.4%</td>
<td>83.1%</td>
<td>16.7%</td>
<td>21.8%</td>
<td>32.6%</td>
<td>29.9%</td>
<td>22.1%</td>
<td>20.3%</td>
<td>11.6%</td>
<td>9.3%</td>
<td>13.7%</td>
<td>17.3%</td>
<td>20.5%</td>
<td>23.5%</td>
<td>24.6%</td>
<td>19.7%</td>
<td>18.2%</td>
<td>21.4%</td>
</tr>
<tr>
<td>2</td>
<td>15.9%</td>
<td>16.5%</td>
<td>17.7%</td>
<td>10.2%</td>
<td>17.4%</td>
<td>23.4%</td>
<td>26.5%</td>
<td>20.2%</td>
<td>17.3%</td>
<td>11.1%</td>
<td>8.3%</td>
<td>11.5%</td>
<td>14.8%</td>
<td>19.2%</td>
<td>19.4%</td>
<td>19.8%</td>
<td>18.7%</td>
<td>17.2%</td>
</tr>
<tr>
<td>3</td>
<td>13.3%</td>
<td>14.1%</td>
<td>11.5%</td>
<td>9.5%</td>
<td>16.6%</td>
<td>22.6%</td>
<td>22.5%</td>
<td>17.9%</td>
<td>13.2%</td>
<td>8.9%</td>
<td>8.0%</td>
<td>9.8%</td>
<td>13.2%</td>
<td>15.4%</td>
<td>16.0%</td>
<td>18.6%</td>
<td>17.5%</td>
<td>15.9%</td>
</tr>
<tr>
<td>4</td>
<td>6.9%</td>
<td>10.4%</td>
<td>8.0%</td>
<td>9.2%</td>
<td>13.3%</td>
<td>20.2%</td>
<td>18.5%</td>
<td>15.9%</td>
<td>12.4%</td>
<td>8.6%</td>
<td>7.9%</td>
<td>9.7%</td>
<td>12.1%</td>
<td>15.2%</td>
<td>15.0%</td>
<td>18.5%</td>
<td>16.3%</td>
<td>15.6%</td>
</tr>
<tr>
<td>5</td>
<td>5.9%</td>
<td>10.0%</td>
<td>5.1%</td>
<td>8.9%</td>
<td>13.1%</td>
<td>13.4%</td>
<td>17.8%</td>
<td>15.7%</td>
<td>6.8%</td>
<td>7.3%</td>
<td>7.6%</td>
<td>9.1%</td>
<td>11.3%</td>
<td>12.5%</td>
<td>14.6%</td>
<td>18.4%</td>
<td>15.5%</td>
<td>15.2%</td>
</tr>
<tr>
<td>6</td>
<td>4.8%</td>
<td>9.8%</td>
<td>2.3%</td>
<td>2.7%</td>
<td>7.9%</td>
<td>9.9%</td>
<td>5.4%</td>
<td>12.2%</td>
<td>4.5%</td>
<td>6.6%</td>
<td>6.7%</td>
<td>7.8%</td>
<td>11.2%</td>
<td>11.5%</td>
<td>8.6%</td>
<td>16.3%</td>
<td>15.2%</td>
<td>14.7%</td>
</tr>
</tbody>
</table>
| 7    | -12.7% | -0.7% | 0.0% | 3.5% | 12.2% | 8.4% | -0.6% | 6.6% | 5.2% | 6.3% | 9.6% | 8.1% | 10.3% | 9.9% | 6.4% | 9.5% 

3 Year IRR | 5 Year IRR | 10 Year IRR
---|---|---
20.1% | 16.2% | 12.2%
14.9% | 15.7% | 11.7%
13.2% | 15.3% | 10.8%
12.0% | 14.8% | 10.2%
10.9% | 14.0% | 9.6%
8.7% | 12.2% | 9.5%

**Legend**
- Asia
- European Buyout
- Global Secondaries
- US Buyout
- US Growth
- US Venture
- US Credit

Source: Cambridge Associates. Net LP pooled returns as of March 31, 2018

Note: US Credit includes Credit Opportunities and Subordinated Capital composites
APPENDIX

BETTER RISK MEASURES FOR PRIVATE MARKETS

No investor is agnostic to risk, and any practical approach to private markets portfolio construction must include an accurate appraisal of risk.

Standard approaches use the standard deviation of returns to measure risk, but this relies upon the assumption of a symmetrical return distribution. This therefore penalizes upside and downside deviations equally – failing to differentiate between harmful volatility and the positive volatility that generates investor returns. The distribution of returns from private markets investments is not normal, exhibiting a significant positive skew. As such, a portfolio with a larger proportion of higher returning assets will actually tend to have a higher standard deviation and erroneously appear riskier.

Furthermore, methodologies that employ standard deviation use the mean return as a target return, which means they do not necessarily reflect an investor’s return needs.

As such, a more appropriate measure of risk for illiquid private markets investments is downside deviation, which focuses on the volatility of returns that fall below a defined minimum acceptable return. This addresses the issues with using standard deviation, as it does not rely on the faulty assumption of symmetrical return distributions or substitute average return for the investor’s target return.

The Sortino Ratio is a modification of the oft-deployed Sharpe Ratio that uses downside deviation as the measure of risk, allowing us to compare risk-adjusted returns for assets with non-symmetrical return distributions, such as private markets.\(^8\) The higher the Sortino Ratio the more attractive the investment’s risk-adjusted return. Using this method allows us to approach portfolio assessment more effectively, by calculating returns in relation to the amount of bad risk assumed rather than penalizing an investment equally for negative and positive performance.

\(^8\) Sharpe Ratio = \(\frac{\text{Expected Return} - \text{Risk-free Rate}}{\text{Return Deviation}}\)
Chart 4 clearly illustrated the advantages of the Sortino Ratio. If an investor had looked at the performance data through the lens of return volatility and the Sharpe Ratio, they may have unwisely chosen to exclude venture funds from their portfolio entirely. The Sharpe Ratio was higher for the modeled US buyout fund portfolio than for the combined one, yet our analysis shows that the combined portfolio has both higher upside and lower downside risk. The lower Sharpe Ratio for the combined portfolio stemmed entirely from the higher probability density in its upside “tail” than the US buyout portfolio: put simply, the Sharpe Ratio worsened for the combined portfolio due to increased incidence of better returns.

**THE SORTINO RATIO**

\[
Sortino\ \text{Ratio} = \frac{E[R - MAR]}{DD}
\]

**THEORY**

Expected Return is the annual rate of return an investment is expected to generate.

Minimum Acceptable Return ("MAR") is the minimum acceptable return or target against which that investment is to be assessed.

Target Downside Deviation ("DD") is the calculation of downside risk. It is determined by first effectively eliminating positive returns from the calculation by treating them as underperformance of zero. Then you take the realized returns’ underperformance relative to the MAR and calculate their deviations. Finally, you calculate the root-mean-square of these figures.

\[
DD = \sqrt{\frac{1}{N-1} \sum_{i=1}^{N} (\min(0,x_i - MAR))^2}
\]

where \(x_i = i^{th}\) return and \(N = \text{total number of returns}\)

**ADDITIONAL IMPORTANT INFORMATION**

Model performance results are inherently limited and should not be considered a reliable indicator of future results. No investor received the indicated model performance. Certain assumptions have been made for modeling purposes. No representation or warranty is made as to the reasonableness of the assumptions made. Changes in the assumptions may have a material impact on the hypothetical returns presented. Different model scenarios will provide different results.

**Monte Carlo Simulations**

These model (hypothetical) portfolios are intended for illustrative purposes only. Performance information for each hypothetical portfolio utilized a Monte Carlo Simulation and are based on the actual cash flows of a proprietary data set that includes partnership investments made by funds managed by HarbourVest, along with partnership data from external sources. The capital calls and distribution data are based on historic partnership investment cash flows, but does not represent the actual experience of any investor or fund. The results of the simulation are impacted by an uneven representation of funds with different vintage years, sizes, managers, and strategies, and a limited pool of investment cash flow data. The actual pace and timing of cash flows is likely to be different and will be highly dependent on the underlying partnerships’ commitment pace, the types of investments made by the fund(s), market conditions, and terms of any relevant management agreements. The results presented are based entirely on the output from numerous mathematical simulations. The simulations are unconstrained by the fund size, market opportunity, and minimum commitment amount, and do not take into account the practical aspects of raising and managing a fund. The simulated hypothetical portfolio results should be used solely as a guide and should not be relied upon to manage your investments or make investment decisions.
HarbourVest is an independent, global private markets investment specialist with more than 35 years of experience and more than $50 billion in assets under management. The Firm’s powerful global platform offers clients investment opportunities through primary fund investments, secondary investments, and direct co-investments in commingled funds or separately managed accounts. HarbourVest has more than 400 employees, including more than 100 investment professionals across Asia, Europe, and the Americas. This global team has committed more than $34 billion to newly-formed funds, completed over $19 billion in secondary purchases, and invested over $8 billion directly in operating companies. Partnering with HarbourVest, clients have access to customized solutions, longstanding relationships, actionable insights, and proven results.