PEI Alternative Insight

PRIVATE EQUITY INTERNATIONAL

PRIVATE EQUITY MATHEMATICS

SECOND EDITION

Applied analytics and quantitative methods for private equity investing

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1 Private equity as part of your portfolio

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Introduction

It is generally agreed on that investment portfolios undergo the classic life cycle of construct, nurture and harvest.[1] Most of the extant research on investing expound on the general principles articulated by Harry Markowitz in his 1952 paper that serves as the foundation of modern portfolio theory (MPT). Markowitz's research assumes that a portfolio is comprised of assets that are, among other things, fungible, transparent, readily quoted and easily transferable. These elements contribute towards understanding the risk-reward trade-offs among investment choices, thereby allowing the portfolio manager to build an appropriate portfolio given his/her individual utility function.

Private equity as an investment option raises unique challenges, including:

- ***Construct phase*** – lack of unitised/clean data; non-uniform access with generally large minimums, cash flow uncertainty and multi-year commitments; qualitative aspects (for example, talent, relationships) and other such elements.
- ***Nurture phase*** – lack of ability to actively manage or assert influence could vary from being completely passive for limited partners (LP) to being active for general partners (GP). However, post-portfolio construction (or when making an acquisition), even the most active GPs can do little other than continue to be active in the individual portfolio companies themselves.
- ***Harvest phase*** – lack of multiple or defined exit options imply realisations could be suboptimal or span many years. The continuing development of the secondary markets, structured products and listed private equity funds notwithstanding, exit options are quite limited which make the asset class illiquid.

Further, the private equity industry as a whole is not known to maintain robust data sets, due to issues such as lack of depth, lag in information, lack of true price discovery, as well as selection and self-reporting biases. Reported returns are not normally distributed and they are also capital weighted, which makes uniform, unitised allocation analysis very difficult. It can also be generally agreed on that possibly the most important aspect of private equity portfolio management is upfront selection, whether an LP making an investment in a GP or an investment a GP makes in a portfolio company.

Therefore, given the uniqueness of private equity, its data issues and the overlay of multiple non-quantifiable elements, private equity portfolio management is as much an art as a science. Even if it is not possible to clearly articulate the exact methods of portfolio management, it may be possible to identify some general parameters, principles and metrics

[1] Depending on trading or maturity strategies, the portfolios may be with or without composition churn during the holding period.

(herein collectively called 'private equity tools'). The potential application of private equity tools in managing private equity portfolios is unique to the type of participant:

- GP focus on industry sub-sectors[2] (for example, IT, industrial)
- Fund of funds focus on various types of GPs (for example, buyout, secondary)
- LP focus on types of investments (for example, private equity, public equity, fixed income)

This chapter aims to demonstrate methods of estimating private equity metrics as well as highlight illustrations and presentation styles specific to each private equity participant (that is, GPs, funds of funds and investors). We begin by presenting select private equity metrics and then performing sample analyses from the perspective of each private equity participant. At the onset, it is also equally important to remind the readers of the numerous concerns highlighted above; therefore, the results should be used with extreme caution and more so as relative anchor points are used with some degree of freedom.

Private equity metrics

As with all market practitioners, private equity participants have their own preferences about the metrics they use for portfolio management. Although the metrics, exact formulae and their utility may vary across practitioners, the analysis itself can be grouped into three general categories: (1) return-related, (2) risk-related, and (3) at the portfolio level. This section presents select private equity metrics and their estimation formulae for each of the three general categories.

Return-related

Expected return is a mathematical expectation of return from a single holding or portfolio of holdings. It is generally based on the expected probability of each return. In quantifying the expected return, it is important to establish the parameters around the expected return or whether it is: (a) relative or absolute, and (b) cash-on-cash or in percentages (that is, a 2x multiple return is 41 percent IRR if cash is returned in year 2 versus 10 percent IRR if cash is returned in year 7).

Mean return is the arithmetic average of the return. *Weighted average mean return* would include an additional set of information along with the return for the holding (for example, assets, number of holdings, capital invested).

Quartile is the measure of the relative ranking of the holding (for example, return). The K^{th} quartile of population X can be defined as the value 'x' such that:

$$P(X \leq x) \leq p \text{ and } P(X \geq x) \geq 1 - p$$

where:

$$p = \frac{k}{4}, \text{ for } k = 1,\ldots, 4$$

[2] For the purposes of this chapter, the focus is on the industry sub-sector as a whole, rather than unique opportunities within the sub-sector.

Risk-related

Standard deviation is the measure of the deviation of values from their mean. It can be used as a measure of *risk appetite* or the tolerance of volatility on a single and/or a portfolio of investments. The more recent accounting pronouncements (for example, FASB ASC Topic 820) to mark holdings to market would create further intra-period valuation fluctuations.

Variance is a related measure of dispersion around a value, defined as the square of the standard deviation.

Semi-deviation is the measure of volatility of values that occur below a target return.

$$\sqrt{\sum_{i=1}^{n} \frac{[\max(0, T - x_i)]^2}{n}}$$

where:

T is the target return
For this chapter, the target return is assumed to be 8 percent.

Loss probability is the measure of the probability of loss in the portfolio. *Some loss probability* (SLP) is the ratio of results whose return is negative to the total number of returns. Assuming M possible results from a simulation, and S of them have negative returns, then the SLP is $100(S/M)$ percent. Similarly, *total loss probability* (TLP) is the ratio of total loss occurrences to the total number in the portfolio.

Portfolio level

Correlation is the measure of relationship between two values. Estimates range from -1 (exact opposite relationship) to +1 (exact relationship).

Intra-portfolio correlation is the measure of diversification within a portfolio or the degree of correlation of holdings within the portfolio.

$$Q = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} X_i X_j P_{ij}}{\sum_{i=1}^{n}\sum_{j=1}^{n} X_i X_j}$$

where:

X_i, X_j are the fraction invested in asset i, j
P_{ij} is the correlation between asset i and j

Skewness is the measure of symmetry of the holdings within the portfolio. Positive means an elongated right tail and negative means an elongated left tail.

Kurtosis is the measure of the peakedness of the holdings within the portfolio. High kurtosis implies a distinct peak with rapid decline. Low kurtosis implies a flat top with slow decline.

Sharpe ratio is a measure of the derived risk premium per unit of risk. Higher Sharpe ratios imply greater relative risk-adjusted values.

$$r_3 = \frac{E(R - R_f)}{\sqrt{Var(R - R_f)}}$$

where:

R_f is the risk-free rate
For this chapter, the risk-free rate is assumed to be 3 percent.

Sortino ratio is a measure of the risk-adjusted return of the portfolio. As a modification of the Sharpe ratio, it measures the derived risk premium over a target return.

$$r_4 = \frac{E(r) - T}{Semi\text{-}deviation}$$

where:

T is the target rate
For this chapter, the target return is assumed to be 8 percent.

The subsequent sections in this chapter use these private equity metrics to evaluate the benefits of diversification using defined data sets for each of the private equity participants. The data set can be analysed either on a stand-alone or on a simulated basis. Stand-alone analysis would mean that the data set itself is used for estimating these metrics. Simulation would mean that the data set is used as a reference point by a random process that consequently builds a distribution of results that is used for estimating the metrics. For this chapter, MATLAB software has been used for simulating the expected return distributions from the sample data sets of over 200,000 iterations. Thereafter, the expected return distributions were used to calculate the metrics based on the aforementioned formulae. For simplicity purposes, it is assumed that the data sets are perfectly unitised with the ability to make equal allocations on each iteration.

General partner perspective

The previous section identified select private equity metrics that can be used for portfolio management. This section looks at their application from a GP's perspective. GPs use a top-down (driven by macroeconomic factors or themes), bottom-up (opportunistic development) or a combination approach to manage their private equity portfolios. Overall, portfolio management techniques will anchor around the composition of the

GP's talent pool, which includes: (a) investment access, (b) ability to add value, (c) amount of disposable capital, (d) breadth and depth of team, and (e) incremental capital need/access. For example, GPs managing larger funds may devote resources to develop sector-specific teams/themes but, given their fund size, they generally do not participate in smaller deals. On the other hand, GPs managing smaller funds can remain specialists but they may trade-off on the size of the deal or on control. Therefore, 'portfolio' means different things to different GPs; there can be various quantifiable as well as non-quantifiable reasons for allocating capital across and within the different companies/sectors in the portfolio.

The private equity tools can help GPs perform quantitative sector analysis. To conduct this analysis, given the previously articulated data issues, the author supplemented the private market data set with public market sector data as a proxy. For this section, the two data sets have (i) only included sectors where both data sets had more robust information and (ii) been organised into the following four sector groups to be better aligned:

- ***Industrial:*** energy-related, chemicals, construction materials, metals, packaging materials, capital goods, including aerospace and defence, construction, engineering and building products, industrial machinery.
- ***Consumer:*** food and beverage, personal products, supermarkets, retail, apparel, hotels and restaurants, media production and services, durable and non-durable household goods.
- ***Healthcare:*** healthcare product providers, healthcare facility services and providers, R&D, marketing, pharmaceutical and biotechnology production.
- ***IT:*** software, hardware, database management, IT consulting and services, Internet, telecom (fixed and wireless), semiconductors.

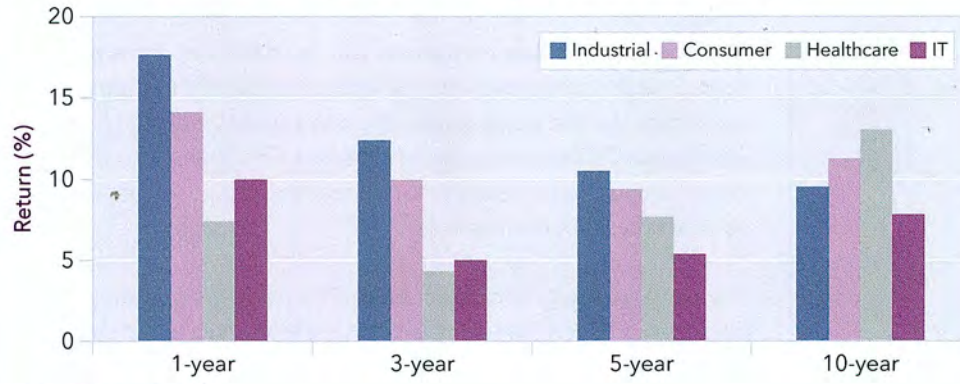
It is possible to use different data sets or time periods to organise data into smaller or larger groups, as well as to include other sectors or groupings. For the illustrations below, the information included in the one, three, five, ten, 15 and 20 year sector returns were sourced from both the private and public markets.

- ***Private market*** returns of US pooled industry net IRRs from Thomson Financial (beginning in 2002), which includes the information housed by Thomson Financial on all private equity transactions (for example, buyouts, mezzanine and venture capital) as sourced in November 2013.
- ***Public market*** returns of US industry indices from MSCI (beginning in 2002). The three, five and ten year cumulative industry returns provided by MSCI were annualised.

Return-related

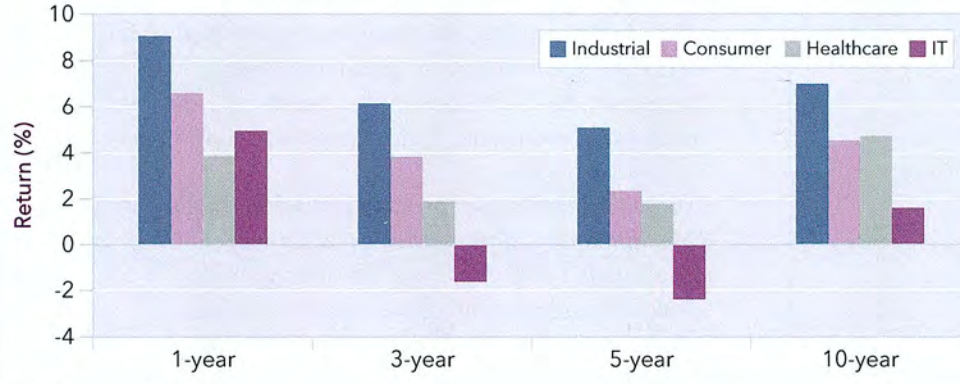
Return-related analysis generally varies across sectors, time diversification and economic cycles. It is not unusual for certain sectors to have significant relative over-performance over certain periods of time. Figures 1.1 and 1.2 show the one, three, five and ten year historical returns across the four predefined sectors. For example,

Figure 1.1: **Mean returns of private market portfolios (2002 vintage)**



Source: Thomson Financial.

Figure 1.2: **Mean returns of public market portfolios (since 2002)**



Source: Thomson Financial.

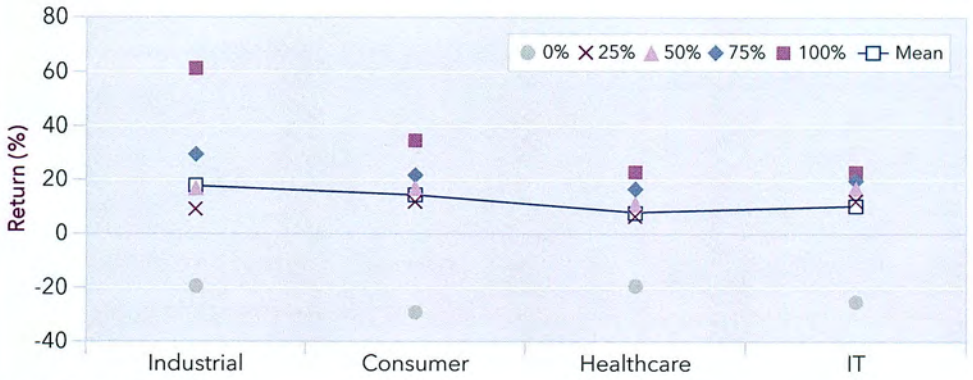
healthcare initially underperforms (one-year returns) and then catches up, leading returns for all sectors at the ten-year return point.

Figures 1.3 and 1.4 show that there is significant dispersion in the returns and that top-quartile returns exhibit high over-performance when compared to the mean returns.

Figure 1.5 shows that the expected return distribution takes on a more familiar or defined profile as more sectors are included in the portfolio. This assumes equal capital allocation across all sectors.

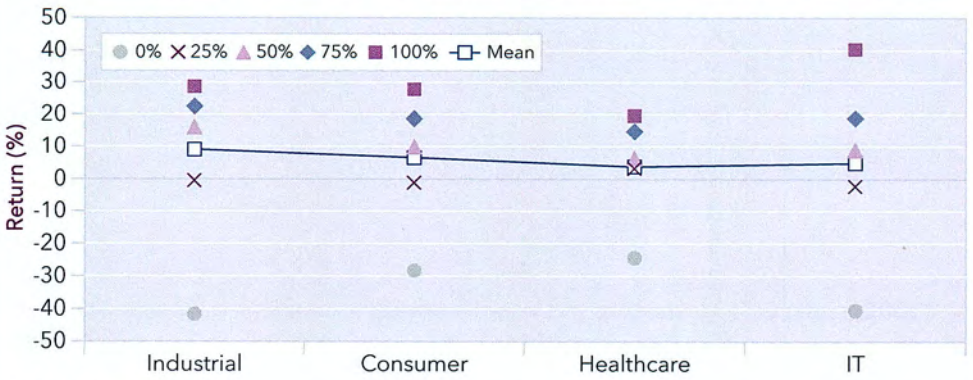
The expected return distributions can be constructed by either (a) random sector selection, or (b) anchoring the first sector and then introducing one additional sector at a time. The results of the second approach should gradually approach the results of the first approach as more sectors are included. The deviation within the approaches will generally depend on the correlation between the sectors.

Figure 1.3: **Quartile returns of private market portfolios – 1-year (2002 vintage)**



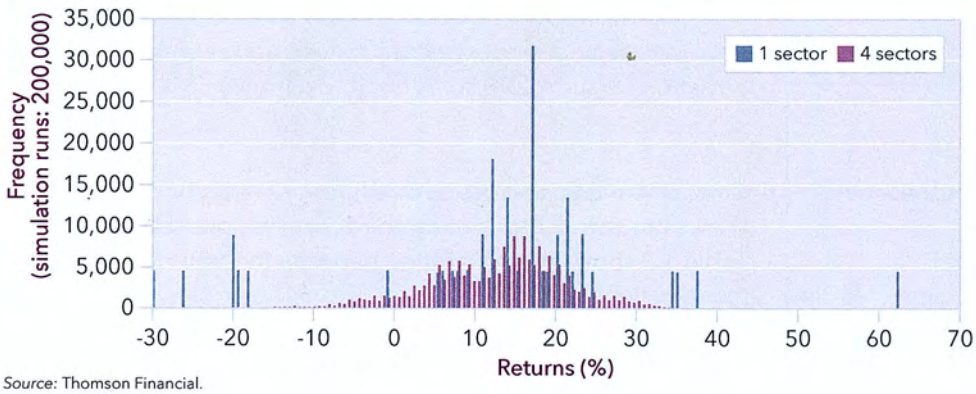
Source: Thomson Financial.

Figure 1.4: **Quartile returns of public market portfolios – 1-year (since 2002)**



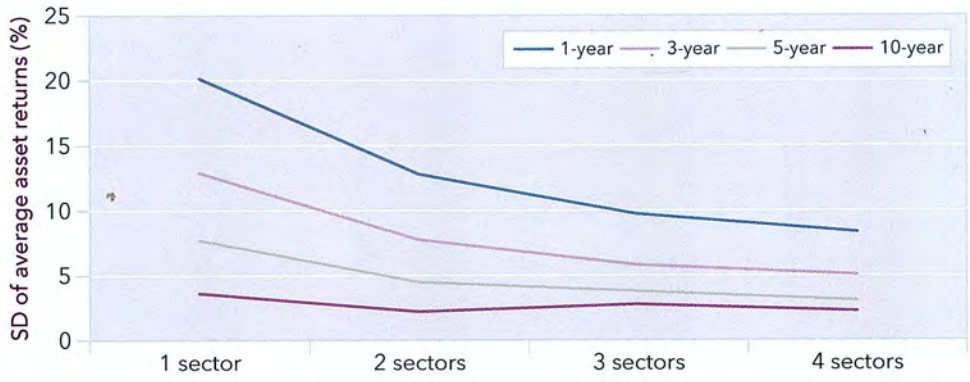
Source: MSCI.

Figure 1.5: **Expected return distribution of private market portfolios – 1-year (2002 vintage)**



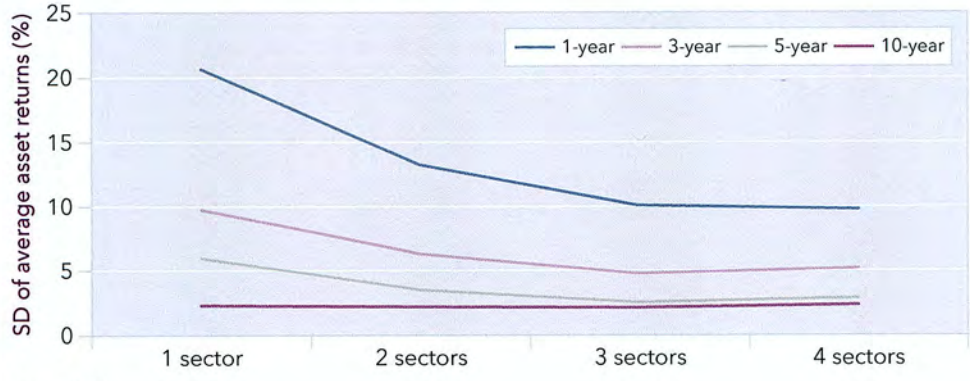
Source: Thomson Financial.

Figure 1.6: **Standard deviation of private market portfolios (2002 vintage)**



Source: Thomson Financial.

Figure 1.7: **Standard deviation of public market portfolios (since 2002)**



Source: MSCI.

Risk-related

Standard deviation generally reduces as more sectors are included in the portfolio and the portfolio becomes more diversified. Figures 1.6 and 1.7 show that this is true for both private market and public market portfolios. However, diversification benefits are not limitless and it is important to be cognisant of the marginal impact of standard deviation versus return so as not to over-diversify and return to the mean.

Portfolio level

Correlation varies across sectors, time periods/horizon as well as vintages. Table 1.1 shows the correlation among the 1-year returns of various private equity sectors while Table 1.2 shows the correlation between the returns of the various holding periods for the industrial sector.

Using public market and private market data sets, Table 1.3 shows the correlation between the sectors within each group.

Table 1.1: **Correlation between 1-year returns of various private equity sectors (2002 vintage)**

	Industrial	Consumer	Healthcare	IT
Industrial	1.00	0.81	0.75	0.79
Consumer	0.81	1.00	0.77	0.88
Healthcare	0.75	0.77	1.00	0.95
IT	0.79	0.88	0.95	1.00

Source: Thomson Financial.

Table 1.2: **Correlation of returns between industrial sector holdings (2002 vintage)**

	1-year	3-year	5-year	10-year
1-year	1.00	0.67	0.29	0.38
3-year	0.67	1.00	0.81	0.76
5-year	0.29	0.81	1.00	0.69
10-year	0.38	0.76	0.69	1.00

Source: MSCI.

Table 1.3: **Correlation between private and public sectors – 3-year (since 2002)**

		Public			
		Industrial	Consumer	Healthcare	IT
Private	Industrial	0.90	0.57	0.70	0.76
	Consumer	0.95	0.74	0.81	0.87
	Healthcare	0.78	0.47	0.74	0.79
	IT	0.89	0.73	0.82	0.93

Source: Thomson Financial, MSCI.

Table 1.4 measures the intra-portfolio correlation and shows that the individual sectors provide some level of diversification to each other.

Other metrics also vary across sectors, time periods/horizon as well as vintages. Tables 1.5 and 1.6 show that both data series have some kurtosis, indicating 'fat tails' with the possibility of both extreme positive and negative returns. Further, the Sharpe and Sortino ratios generally become better as more sectors are added.

Table 1.4: **Intra-portfolio correlation of private market portfolios (2002 vintage)**

	1-year	3-year	5-year	10-year
1 sector	1.0000	1.0000	1.0000	1.0000
2 sectors	0.4983	0.5002	0.5009	0.4985
3 sectors	0.3322	0.3339	0.3327	0.3326
4 sectors	0.2503	0.2512	0.2493	0.2500

Source: Thomson Financial.

Table 1.5: **Kurtosis in private market portfolios - 1-year (2002 vintage)**

# sectors	Semi-dev (%)	Skewness	Kurtosis	Sharpe	Sortino
1	6.05	0.37	3.34	0.74	0.72
2	3.54	-0.21	3.53	1.02	2.28
3	2.97	-0.27	3.33	1.05	1.76
4	2.90	-0.34	3.21	1.14	1.53

Source: Thomson Financial.

Table 1.6: **Kurtosis in public market portfolios - 1-year (since 2002)**

# sectors	Semi-dev (%)	Skewness	Kurtosis	Sharpe	Sortino
1	13.79	-1.32	3.74	0.29	0.08
2	7.16	-0.82	3.25	0.37	-0.01
3	5.33	-0.68	3.18	0.36	-0.26
4	5.13	-0.49	3.01	0.33	-0.34

Source: MSCI.

The Sortino ratio is not negatively affected by a few large outlying returns on the upside, unlike the Sharpe ratio.

Fund of funds portfolio perspective

The previous sections looked at select private equity tools, their estimation formulae and their application for GPs. This section looks at the application of private equity tools for funds of funds or investors looking into developing private equity programmes (for example, private equity allocations across many GPs). We will estimate the private equity tools across the three previously articulated categories (that is, return-related, risk-related and portfolio level).

Instead of looking at the profiles of individual funds of funds to estimate the private equity tools, this section uses underlying GP return information as a proxy for constructing/evaluating funds of funds. For this illustration, the data set includes the individual final fund net IRRs for the 2002 to 2012 vintages. The data set is sourced from Preqin in November 2013 and organised into the following investment types:

- ***Buyout:*** 697 data points for US and 1,128 data points for global
- ***Secondaries:*** 75 data points for US and 106 data points for global
- ***Expansion/venture capital:*** 829 data points for US and 1,155 data points for global
- ***All components:*** 1,601 data points for US and 2,389 data points for global

It is possible to use different data sets and time periods to organise this data into smaller/larger categories of investment type, as well as to include other investment types.

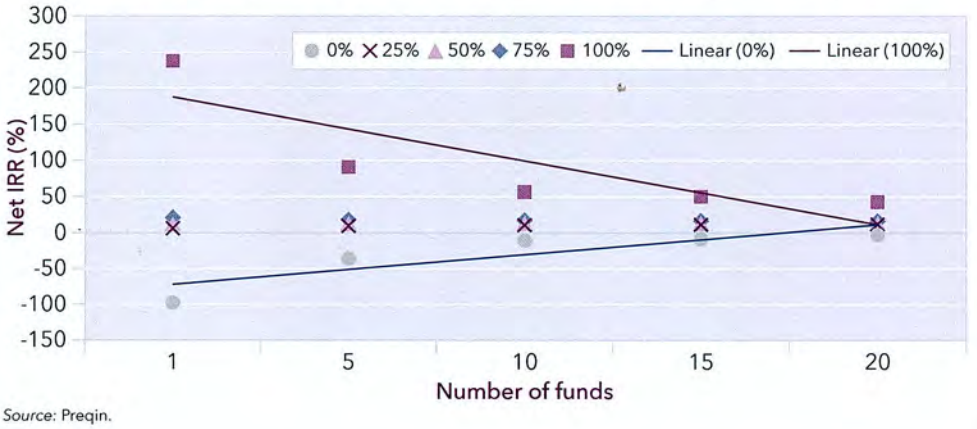
Return-related

Returns have a high degree of dispersion and vary across vintages, investment types and number of fund allocations. Figure 1.8 shows that the dispersion of returns is greatly reduced as the number of funds is increased (as long as the funds do not have a high degree of positive correlation). *All charts assume an equal-weighted return across funds.* Figure 1.9 shows that the dispersion within the categories of investment type is even more pronounced with expansion/venture capital exhibiting the highest level of dispersion.

Figure 1.10 shows that fund vintage plays a major role in portfolio performance. Although fund investment periods provide a high degree of flexibility for investors to allocate capital over larger time horizons, funds of the same vintage will generally have some biases including macroeconomic conditions, credit conditions and opportunity set. Conversely, allocating capital across vintages increases the odds of capturing vintage-performance biases.

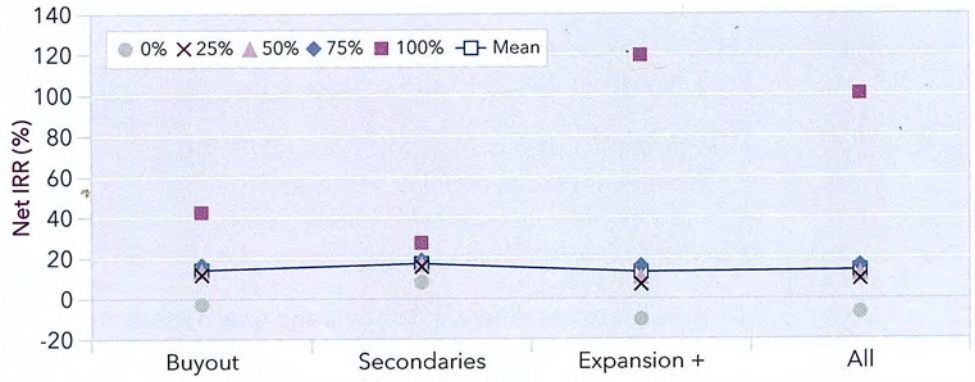
Figure 1.11 shows that the expected return distribution takes on a more familiar or defined profile as more funds are added.

Figure 1.8: **Average quartile IRR based on number of funds - global buyout**



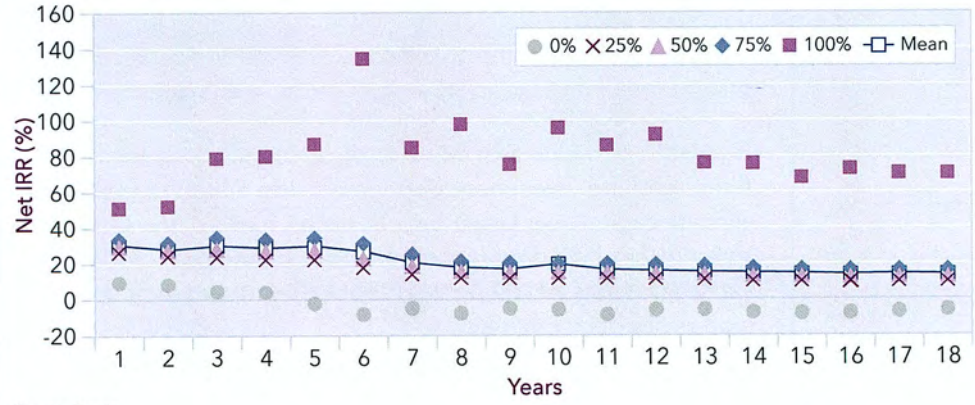
Source: Preqin.

Figure 1.9: **Return dispersion between investment types – global**



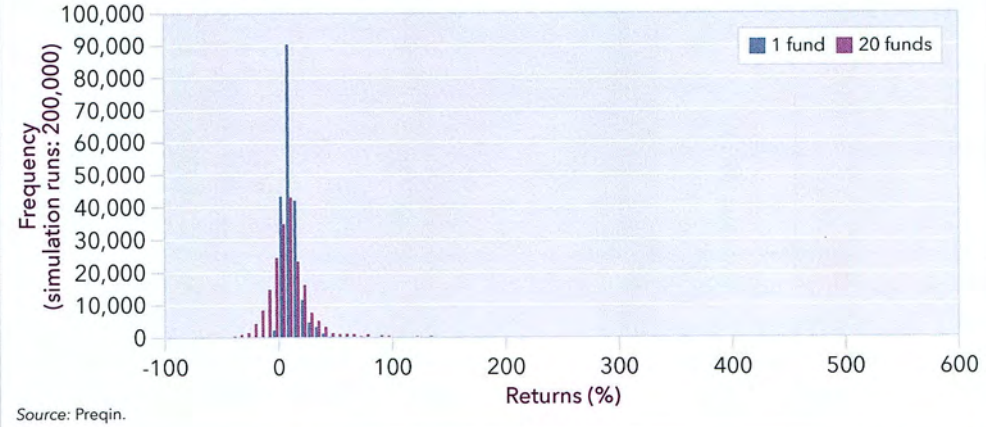
Source: Preqin.

Figure 1.10: **Returns of 1993 vintage funds – global**



Source: Preqin.

Figure 1.11: **Expected return distribution of 2010 vintage US funds**



Source: Preqin.

Risk-related

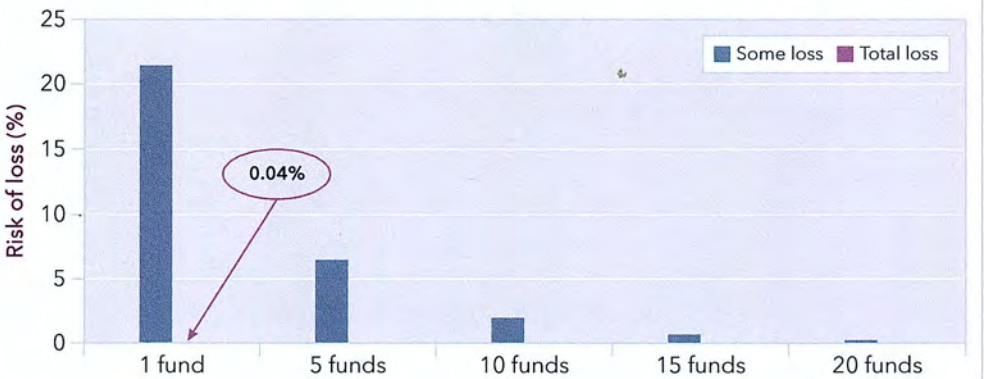
Standard deviation decreases as more funds are included in the portfolio. As illustrated in Figure 1.12, standard deviation falls, but its marginal impact becomes less pronounced beyond approximately 20 funds. Given that most funds have between ten and 20 companies within their portfolio, at a 20-fund level a fund of funds is expected to be diversified across 200 to 400 companies. Optimal management would focus on ensuring that the fund of funds' composition has built-in diversification across its allocations so as not to over-diversify or, conversely, be misled into believing in diversification because of sheer volume (for example, total allocation to generalist funds that in the end have a high sector bias due to the prevailing opportunity set). Further, making too many fund allocations always poses the risk of bringing the expected return of the portfolio to the mean expected return of the market, which is substantially lower than the top-tier return.

Figure 1.13 shows that the risk of loss decreases as more funds are included. This is in line with the estimates provided in Figure 1.12, and as such also highlights the relative higher risk profile of the GP versus a fund of funds investment.

Figure 1.12: **Standard deviation among investment types by number of funds – global**

Source: Preqin.

Figure 1.13: **Risk of loss by number of funds – global**



Source: Preqin.

Portfolio level

Other metrics also vary across investment types, return periods and vintages. Table 1.7 shows that the data series have a positive skew, suggesting more upside potential than downside risk, and some investment types display a more pronounced level of kurtosis. Further, the Sharpe and Sortino ratios improve as more funds and investment types are added.

Table 1.7: **Impact on metrics with the addition of funds and investment types**

# funds	Semi-dev (%)	Skewness	Kurtosis	Sharpe	Sortino
Buyout - US					
1	5.34	1.5653	14.8465	0.6373	0.8961
5	2.55	0.6887	5.3171	1.4385	1.8674
10	2.32	0.4747	4.0960	2.0250	2.0349
15	2.04	0.3880	3.7093	2.4978	2.3131
20	1.77	0.3356	3.4994	2.8921	2.6772
Secondaries - US					
1	2.58	0.7620	3.2885	1.1988	3.0839
5	1.20	0.3194	2.9891	2.7594	6.6298
10	0.38	0.1969	2.9329	4.0535	21.0324
15	0.12	0.1441	2.9293	5.1506	68.9922
20	0.017	0.0898	2.9191	6.2072	467.3100
Expansion + Venture capital - US					
1	8.96	6.4093	64.4357	0.2162	0.4261
5	3.67	2.8247	14.7687	0.4897	1.0619
10	3.11	1.9762	8.6751	0.6929	1.2532
15	3.09	1.6022	6.7188	0.8504	1.2509
20	3.12	1.3793	5.7208	0.9839	1.2266
All - US					
1	7.33	7.3256	95.5677	0.3049	0.5926
5	3.24	3.3042	21.5346	0.6810	1.3497
10	3.04	2.3352	12.1944	0.9641	1.4423
15	3.00	1.8778	8.8993	1.1864	1.4681
20	2.96	1.6426	7.4753	1.3670	1.4984

Source: Preqin.

Investor portfolio perspective

This section looks at private equity tools for investors that are evaluating whether to diversify their portfolio outside the traditional asset classes (for example, equities, bonds) into private equity. This section estimates the private equity tools' pre/post inclusion of private equity within a portfolio from the three previously articulated categories (that is, return-related, risk-related and portfolio level). The basic private equity tools and therein their limitations afforded to the GPs and funds of funds remain the same as to the other investors.

For this analysis, one, three, five and ten year return data are sourced from:

- Private equity returns of pooled industry net IRR from Thomson Financial sourced in November 2013.
- MSCI World Index returns exclude the US market and are based on data from MSCI Barra.
- Dow Jones Industrial Average returns are based on data from Dow Jones Indexes.
- S&P 500 Total Return Index data from Bloomberg.
- Barclays Aggregate Bond Index returns are for US and global and are based on data from Barclays Capital. The three, five and ten year data were extrapolated from the one-year returns.

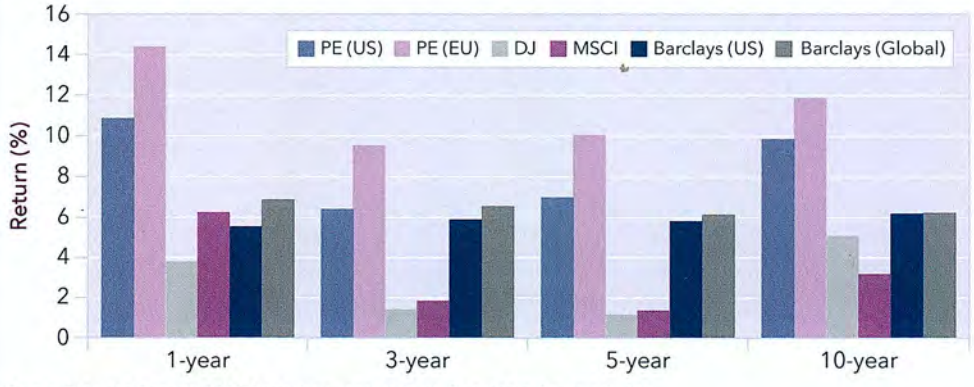
It is possible to use different data sets, proxies and time periods, to organise this data into smaller/larger data sets as well as to include other asset classes or indices.

Return-related

Returns vary over time and economic cycles. Figure 1.14 shows the historical return profile of the selected asset classes, with private equity generally over-performing the other classes. Figure 1.15 shows the impact on the private equity return when other asset classes are included in the portfolio.

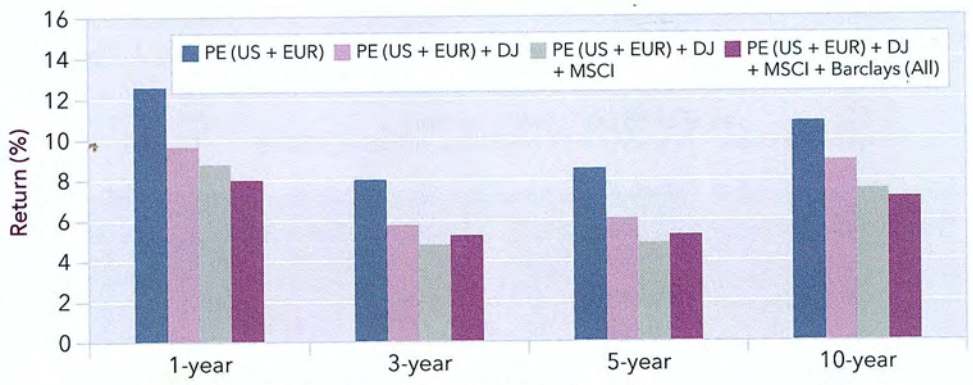
Figure 1.16 shows the historical time series of one-year returns. Private equity display on average better returns compared to equity market indices, such as Dow Jones and

Figure 1.14: **Mean private equity returns compared to other asset classes (since 2002)**



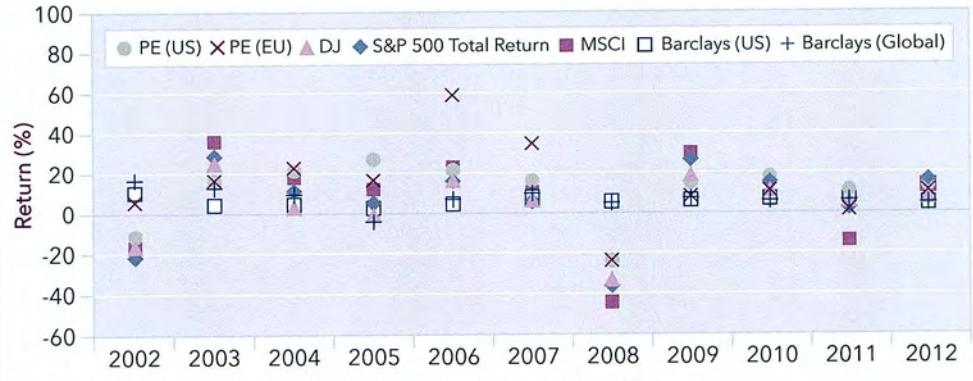
Source: Thomson Financial, MSCI Barra, Dow Jones Indexes, Bloomberg, Barclays Capital.

Figure 1.15: **Impact on mean returns with the addition of other asset classes (since 2002)**



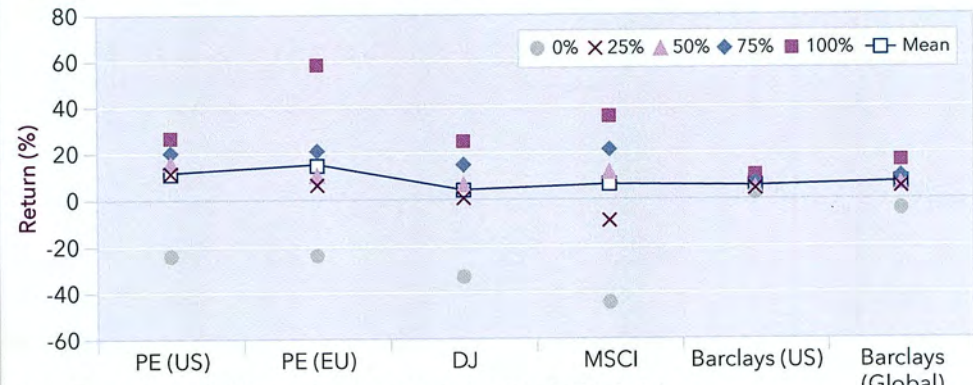
Source: Thomson Financial, MSCI Barra, Dow Jones Indexes, Bloomberg, Barclays Capital.

Figure 1.16: **Historical returns of various asset types – 1-year (since 2002)**



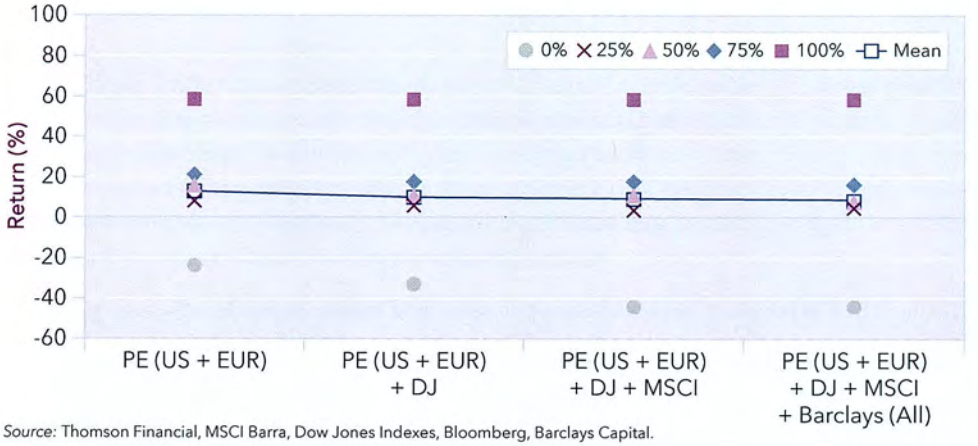
Source: Thomson Financial, MSCI Barra, Dow Jones Indexes, Bloomberg, Barclays Capital.

Figure 1.17: **Dispersion of returns of various asset types – 1-year (since 2002)**



Source: Thomson Financial, MSCI Barra, Dow Jones Indexes, Bloomberg, Barclays Capital.

Figure 1.18: **Dispersion of returns with the addition of other asset classes - 1-year (since 2002)**



Source: Thomson Financial, MSCI Barra, Dow Jones Indexes, Bloomberg, Barclays Capital.

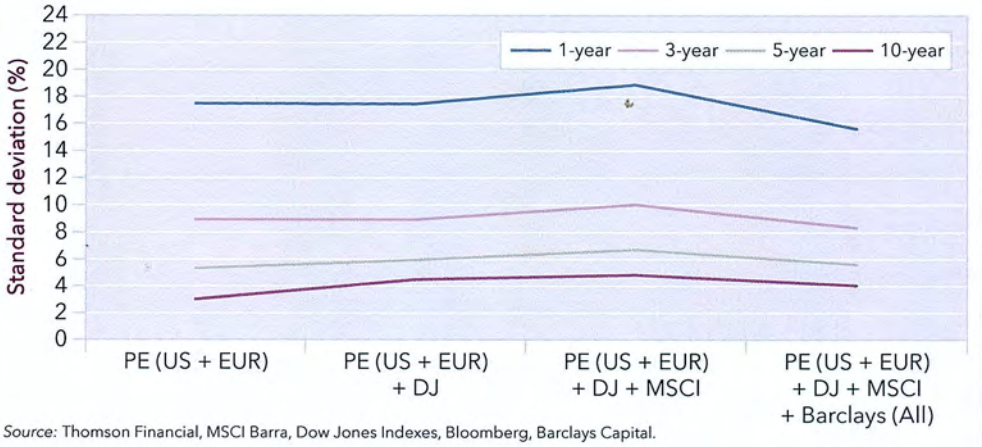
S&P 500 but, at the same time, greater volatility. On the other end of the risk/return spectrum, the bond markets display low and steady returns.

Figure 1.17 shows the dispersion of returns. Bond markets are more tightly distributed, followed by the public equity markets and then the private equity markets. Figure 1.18 shows the impact on dispersion of returns as more asset classes are included in the portfolio.

Risk-related

Standard deviation generally reduces as more asset classes are added to the portfolio. This is shown in Figure 1.19. Standard deviation generally does not reduce as public equities are added to the private equity portfolio since both are equity investments.

Figure 1.19: **Standard deviation of returns with the addition of other asset classes (since 2002)**



Source: Thomson Financial, MSCI Barra, Dow Jones Indexes, Bloomberg, Barclays Capital.

Fixed income is the true diversifier, and its addition to the portfolio does lower the portfolio's risk. Some care must be taken in accounting for the standard deviations in private equity since the pooled IRR series may not be updated very frequently.

Portfolio level

Correlation varies between asset classes and return periods, as shown in Table 1.8. As expected, private equity markets are more closely correlated with the public equity markets than bond markets. An additional item to further evaluate would be that the pooled IRRs used to estimate the private equity market returns are generally event-based realisations, which would tend to correlate with the public markets.

Table 1.8: **Correlation between asset classes and return periods – 1-year (since 2002)**

	PE (US)	PE (EU)	DJ	MSCI	Barclays (US)	Barclays (Global)
PE (US)	1	0.6951	0.8174	0.8323	-0.5001	-0.3374
PE (EU)	0.6951	1	0.6105	0.6685	-0.2352	0.0704
DJ	0.8174	0.6105	1	0.9108	-0.2793	0.0386
MSCI	0.8323	0.6685	0.9108	1	-0.4546	0.0226
Barclays (US)	-0.5001	-0.2352	-0.2793	-0.4546	1	0.6402
Barclays (Global)	-0.3374	0.0704	0.0386	0.0226	0.6402	1

Source: Thomson Financial, MSCI Barra, Dow Jones Indexes, Bloomberg, Barclays Capital.

Table 1.9: **Metrics across asset classes and return periods – 1-year (since 2002)**

	Semi-dev (%)	Skewness	Kurtosis	Sharpe	Sortino
PE (US)	8.20	-1.45	3.86	0.55	0.37
PE (EU)	7.88	0.41	3.80	0.59	0.84
DJ	11.91	-1.06	3.55	0.06	-0.35
MSCI	15.38	-0.91	3.09	0.15	-0.11
Barclays (US)	5.17	0.68	2.97	1.28	-0.45
Barclays (Global)	4.44	-0.36	3.74	0.80	-0.22
PE (US + EUR)	8.04	-0.04	4.41	0.56	0.60
PE (US + EUR) + DJ	9.53	-0.24	4.40	0.39	0.19
PE (US + EUR) + DJ + MSCI	11.30	-0.58	4.18	0.31	0.08
PE (US + EUR) + DJ + MSCI + Barclays (All)	9.58	-0.52	5.81	0.32	0.01

Source: Thomson Financial, MSCI Barra, Dow Jones Indexes, Bloomberg, Barclays Capital.

Other metrics vary across asset classes and return periods. The analysis captures the basic portfolio management essence of commingling assets that tend to behave differently. Table 1.9 shows that private equity, when included, tends to positively impact the portfolio's return.

Conclusion

With a cautionary nod towards the theoretical purists, the multitude of data issues, qualitative overlay and other non-fungible holdings aspects make private equity metrics estimation challenging. However, data analysis from three different perspectives reveals that in spite of the aforementioned shortfalls, every result highlights the benefits of portfolio diversification from three perspectives:

- ***Return-related*** have a high degree of dispersion and vary across holdings (for example, sectors, funds, vintages). Top-quartile performers significantly outperform mean returns.
- ***Risk-related*** diversification across lesser correlated assets tends to reduce portfolio volatility as well as risk of loss.
- ***Portfolio level*** private equity investments generally tend to enhance returns and on a risk-adjusted basis inclusion of private equity in the portfolio seems to imply greater value.

Some participant-based observations from the private equity metrics analysis include:

- ***For GPs:*** year-on-year sector performance is disparate and impacted by macroeconomic events, credit conditions, market sentiment and prevailing opportunity set. Diversification across sectors generally increases the possibility of a balanced risk-return profile.

- ***For funds of funds:***
  - Dedicated programmes (for example, in-house or third-party) with clear strategies should be able to push the portfolio to achieve top-tier returns.
  - Diversification across approximately 20 managers balances the risk-return profile and also significantly reduces the risk of loss. However, the programme should account for the company-level diversification attained by the underlying GP investments to ensure that the fund is not over-diversified to drive returns to the sector or private equity market's mean return.
  - It may not be possible to time private equity market performance but generally, multi-year allocations, diversification across investment types and backing historic alpha generators all increase the odds of top-tier performance.

- ***For investors:*** inclusion of private equity with other asset classes should diversify the portfolio and increase the potential for higher returns.

In conclusion, although a blind, highly quantitative approach to private equity management may not be the most appropriate, a general application of the private equity tools demonstrated in this chapter provides some useful insights. The illustrated private

equity tools, data sets, analysis and assumptions should be used as building blocks by readers to create various permutations. □

The opinions expressed in this chapter are those of the author and may not be representative of the institutions at which he works.

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