



Considering the Alternatives: A Practical Look at Enterprise Risk Analysis and Alternative Investments

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CONTENTS

Abstract

1

Introduction

2

Constructing Sample Portfolios

4

Individual Manager Risk Analysis

5

Illiquid Investments

22

Total Fund Analysis

23

Conclusions and Best Practices

31

Appendix

32

ABSTRACT

Enterprise risk analyses, such as stress testing and scenario analyses are increasingly popular with institutional investors. Alternative investments, such as hedge funds, private equity and real estate present challenges to enterprise risk analysis.

- As institutional investors are increasing allocations to alternative investments, how are they addressing the challenges of incorporating illiquid or non-transparent investments into enterprise risk analysis?
- How do different approaches to data management affect the resulting risk analysis?
- What are the benefits and risks of different approaches to this challenge?

In this white paper, BNY Mellon's Global Risk Solutions and HedgeMark Risk Analytics, a BNY Mellon company, explore these issues and offer examples of possible solutions.

Key Observations and Insights to Best Practices Include:

- Different approaches to data management can lead to different potential conclusions about the risks within an investment portfolio.
- Use a consistent approach across the most granular detail available to evaluate investment risks. Obtaining position-level information for all asset classes is generally considered the best practice.
- Consider hedge fund structures that can provide position-level transparency, liquidity and control. Hedge fund managed accounts and liquid alternative funds are increasingly popular structures that offer such features.
- Using a single vendor to pull together an institution's total investment data enables a more uniform approach in calculating enterprise-wide risk and exposure, whereas data across multiple platforms adds to the complexity and likelihood of errors.
- Evaluate volatility-based measures like Value-at-Risk (VaR) as just one element of a broader risk management framework that considers other factors such as exposure. Consider VaR for portfolios relative to the total composite, as a benchmark, or over time, rather than as an absolute value.



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INTRODUCTION

ENTERPRISE RISK ANALYSIS DEFINED

Risk management can mean different things to different people. Enterprise Risk can include all the many aspects of risk that affect an organization including but not limited to market risk, reputational risk, regulatory risk, compliance risk, operational risk, and legal risk.

Enterprise Risk Analysis can also mean forward-looking (“ex-ante”) risk calculations that estimate investment risks across multiple asset classes. This paper focuses on the definition of Enterprise Risk Analysis that estimates ex-ante risks of an investment program with multiple asset classes owned by a single organization, such as a pension plan or a charitable foundation. Ideally, this risk management discipline should be a component of a larger “enterprise-wide” risk management framework that also considers risks other than investment risk.

HISTORICAL PERSPECTIVE

Over the past decade, institutional investors have become more aware of the importance of risk management across asset classes. Since the advent of modern portfolio theory, portfolio managers have understood risk to be important in selecting and monitoring investments within a single portfolio strategy. Evaluating risk across investment strategies has become common practice more recently. It used to be that reviewing a few risk measures based on the volatility of monthly return streams such as a Sharpe Ratio or Information Ratio would be considered an effective risk management process.

With the continuing increased focus on risk by regulators and other stakeholders, many institutional investors require a more comprehensive understanding of how risk operates across investments within an entire investment program. Some regulators require reporting pertaining to stress testing and scenario analysis, such as through Form PF for U.S. investment advisers to hedge funds, and pursuant to Solvency II for insurance companies and UCITS for European investment funds. These new risk reporting requirements have generated the need for sophisticated risk calculation tools and services to help address these changing requirements. Many firms are establishing a separate Chief Risk Officer function to supplement the risk management responsibilities inherent within the investment management functions. These new risk management functions require a significant amount of data to enable evaluation of investment risks across asset classes.

EXPOSURE AND VOLATILITY

In considering investment risk, two common approaches to risk management are based on the definition of risk as return volatility or the definition of risk as exposures.

EXPOSURES

Exposure-based risk analysis identifies the relevant risk factors for each investment, enabling the preparation of summaries of portfolio allocations to various categories of exposures or factors, or investment characteristics.

Investment strategies or broad asset classes have characteristics that may be more relevant to one strategy than another. For example, duration is a key risk characteristic for fixed income investments but less relevant for common stock. Some characteristics can be relevant across asset classes. Credit ratings are often associated with bonds but may also be associated with the issuers of common stock. Economic sectors are most often associated with common stock, but corporate debt and private equity investments can also be associated with economic sectors.

With increased focus on risk by regulators and other stakeholders, many institutional investors require a more comprehensive understanding of how risk operates across investments within an entire investment program.

Currency or country exposure is relevant for most investments, and liquidity is also a consideration for all investments. Each of these measures provides insights into different aspects of investment risks, but the estimation and aggregation of these risks requires transparency into portfolios.

VOLATILITY

A covariance matrix enables an understanding of the volatility of the total fund relative to the correlations of each of the component asset classes and sub-strategies or investments. This approach enables an understanding of which investments contribute to the total risk of the fund and which investments help off-set some of the risks of other investments.

The covariance matrix is generally based on historical returns to estimate how investments move in relation to each other, so ex-ante risk is also based on ex-post returns. Often, risk systems generate covariance matrices based on several months or several years of daily returns of each of the specific securities. Some risk systems also calculate covariance matrices based on monthly returns of the investments.

ALTERNATIVE INVESTMENTS

Covariance matrices based on daily or monthly returns makes sense in evaluating the relative risk profile of publicly traded liquid investments that are priced frequently. Many institutional investors have been increasing their allocations to alternative investments such as private equity, real estate and hedge funds, which often do not provide sufficient liquidity or transparency to facilitate ex-ante analysis. Real estate and private equity investments are often priced quarterly, so the apparent risk of these investments based on daily volatility alone could underestimate the actual risk of losing money in the event an investor wanted to sell. The typical return profile of private equity includes an initial period of negative returns followed hopefully by a prolonged period of growth, resulting in an initial public offering and payouts to investors. This return profile is appropriately measured by long-term internal rate of returns rather than independent monthly or daily time-weighted rates of return. Private equity investments will often provide transparency into the underlying companies, but these companies are not valued frequently and detailed cash flow information generally is not provided for specific underlying companies. Real estate investments often provide transparency about underlying investments as well on a quarterly frequency.

Hedge funds may be constructed with liquid or illiquid investments, but hedge fund managers often share limited information periodically with investors. Hedge fund managers that provide descriptions of exposures and characteristics in manager letters often define summary categories differently. For example, one manager's definition of Europe might include the United Kingdom and all countries in the European continent, while another manager might define Europe to mean only those countries in the European Economic and Monetary Union. Investors with large allocations to alternatives often spend a significant amount of resources and time finding ways to normalize summary data so exposures can be aggregated across managers and asset classes.

APPROACHES TO INCORPORATING ALTERNATIVE INVESTMENTS INTO ENTERPRISE RISK ANALYSIS

Institutional investors that want to incorporate alternative investments into ex-ante risk analysis have to make some assumptions. These assumptions come with different levels of data management requirements that could lead to different levels of confidence about the reasonableness of the potential conclusions.

Ex-ante risk calculations estimate the volatility of each investment's return stream in absolute terms and relative to other investments and benchmarks.

Risk aggregators can provide calculated risk exposures using the underlying holdings to the investors without revealing the underlying holdings in detail.

THIRD-PARTY RISK AGGREGATORS

Where detailed holdings are available, taking the time to incorporate the most detailed information enables the most flexibility in viewing different slices of data, and the most confidence in the accuracy of the calculations. This is particularly important with hedge funds or any portfolio containing derivatives, because derivatives may move in non-linear ways that can only be captured if the detailed terms and conditions of the derivatives have been modeled. Where hedge funds may not be willing to provide full transparency to investors, they may be willing to provide transparency to third-party risk aggregators using non-disclosure agreements. These risk aggregators can then provide calculated risk exposures using the underlying holdings to the investors without revealing the underlying holdings in detail.

Where detailed holdings are not available even to third party risk aggregators, managers will often provide summary exposures. Where detailed holdings are available but the investments are illiquid, or where summary exposures only are available, it is necessary to proxy these summary exposures with relevant indexes that represent relevant factors of interest to the investor.

Some investors with smaller allocations to alternative investments may choose to assume that an entire portfolio or even asset class is not worth the trouble of estimating detailed factor exposures. In this case, it is possible to proxy an investment or asset class to an index with various factor adjustments that is intended to mimic the performance of the asset.

CHOICES AND RISK ANALYSIS

How do these different choices affect the resulting risk analysis? Does detailed data management matter? To help evaluate these questions, we constructed sample portfolios using the most detailed data available. We next compared the apparent risk these detailed portfolios reveal when we repeated the analysis on the same portfolios using summary exposures or top level approximations.

CONSTRUCTING SAMPLE PORTFOLIOS

OUR QUANTITATIVE APPROACH

Here we will compare the risk assessments on hedge funds using a mix of available data. Working with a few large institutional investors, BNY Mellon was able to obtain full positions, monthly manager statements, and historical returns for 17 hedge funds across a mix of strategies. In this way, each hedge fund would have risk results calculated using the three methodologies, allowing for more direct comparison on the similarities and differences across the three transparency levels. The 17 funds were comprised as follows:

- Long/Short Equity – 7 Funds
- Event Driven – 4 Funds
- Global Macro – 3 Funds
- Relative Value – 2 Funds
- Multi-Strategy – 1 Fund

The following approach was then used to model the risk for each fund utilizing the three types of data:

Positions: A snapshot of all positions held in the portfolio at 12/31/2014. The risk was calculated using a full revaluation – security level approach. Every security was linked to an asset type specific pricing model. Monte Carlo simulation, using 1,000 paths, was then used for each security and then aggregated to the fund and other reporting levels.

Exposures: For each of the funds, a 12/31/2014 manager newsletter was obtained. The information from those letters was then extracted and mapped into indices or other risk factors to create a “hypothetical” replicating portfolio that could also be processed in the risk model under the same approach and methodology as the funds’ actual positions.

Hedge Fund Index: Each fund was mapped to a major Hedge Fund Index based upon the strategy of the fund and a beta calculated using the monthly returns of the fund. An alternate approach for hedge funds with a consistent strategy is to incorporate the actual fund returns as an input into the risk model.

INDIVIDUAL MANAGER RISK ANALYSIS

When assessing the risk for an individual hedge fund manager there are a number of types of information that are helpful for understanding the risk, including:

Exposures: Details on the size, type and country of the investment.

Value at Risk (VaR): A statistical measure of downside risk that captures the potential loss of the portfolio given a time horizon (i.e., 1 Month), and confidence interval (i.e., 95%). Conditional VaR, also known as expected tail loss, is a different form of VaR that estimates the average loss given a breach of the VaR confidence interval. Conditional VaR does a better job of capturing the risk of fat tail strategies, or those that have fewer but higher loss events.

Sensitivities or Betas: A measure of how a portfolio would change in value given a pre-defined move in a specific index or risk factor.

Historical Stress Tests: An estimate of the portfolio’s performance under the market conditions of a prior historical period, typically one where the markets moved significantly. Stress Tests are helpful to understand how a fund will behave in more extreme market conditions. Stress Tests are also more helpful at estimating how big a loss a fund may experience.

Too often, investors interpret VaR as the maximum amount they might lose, whereas, VaR is a measure of loss under normal market conditions and based upon the time horizon and confidence interval, a loss amount that investors may often realize. Stress tests can do a better job of capturing worst case loss amounts and can also be helpful at identifying market conditions for which the portfolio might be more susceptible to a loss. Almost all of these types of risk information can be calculated using the different levels of transparency. Full positions obviously offer the most flexibility and completeness in calculating the risk statistics. One big challenge with manager newsletters is the high variation among the type and quality of that data. For example, Figures 1 and 2 are examples of the types of data provided by two different equity long-short funds and two different event driven funds.

Figures 1 and 2 show varying geographic exposures provided by two different long/short funds. Note the disparate levels of granularity, with Figure 2 providing a much more useful set of country allocation statistics.

Figure 1

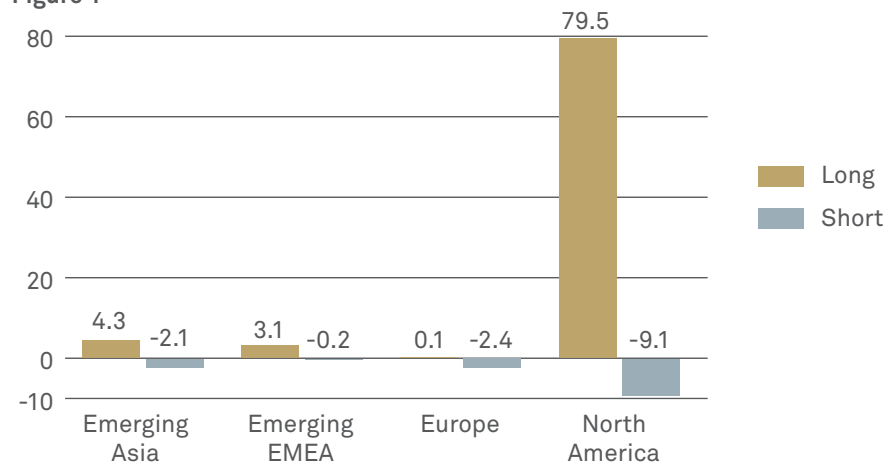


Figure 2

Geographic Exposure					
Region	Country	Long %	Short %	Gross %	Net %
Asia Pacific	Australia	3.74	(0.10)	3.84	3.64
	China	14.44	0.00	14.44	14.44
	Hong Kong	2.13	0.00	2.13	2.13
	Japan	5.37	0.00	5.37	5.37
	Thailand	2.55	0.00	2.55	2.55
Central America	Mexico	5.21	0.00	5.21	5.21
Europe	Belgium	5.32	0.00	5.32	5.32
	Britain	21.73	(0.10)	21.83	21.63
	Denmark	2.23	(0.40)	2.63	1.83
	European Countries	2.02	(0.30)	2.32	1.72
	France	13.21	0.00	13.21	13.21
	Germany	11.46	0.00	11.46	11.46
	Greece	2.52	0.00	2.52	2.52
	Ireland	5.07	0.00	5.07	5.07
	Netherlands	3.43	0.00	3.43	3.43
	Norway	3.55	(0.20)	3.75	3.35
	Sweden	4.22	0.00	4.22	4.22
Switzerland	10.05	0.00	10.05	10.05	
Mid East And Africa	South Africa	2.02	(0.10)	2.12	1.92
North America	Canada	8.63	0.00	8.63	8.63
	United States	7.33	0.00	7.33	7.33
South America	Brazil	6.89	0.00	6.89	6.89
	Chile	2.95	0.00	2.95	2.95

Figures 3 and 4 show varying industry and sector exposures provided by two different event driven managers. Note that one fund reports across ten sectors, while the other reports across 31 industry types. The latter is obviously more granular. Furthermore, combining datasets such as these is no small data management task, especially considering the high probability for numerous formatting iterations among scores of funds within a well-diversified hedge fund portfolio.

Figure 3

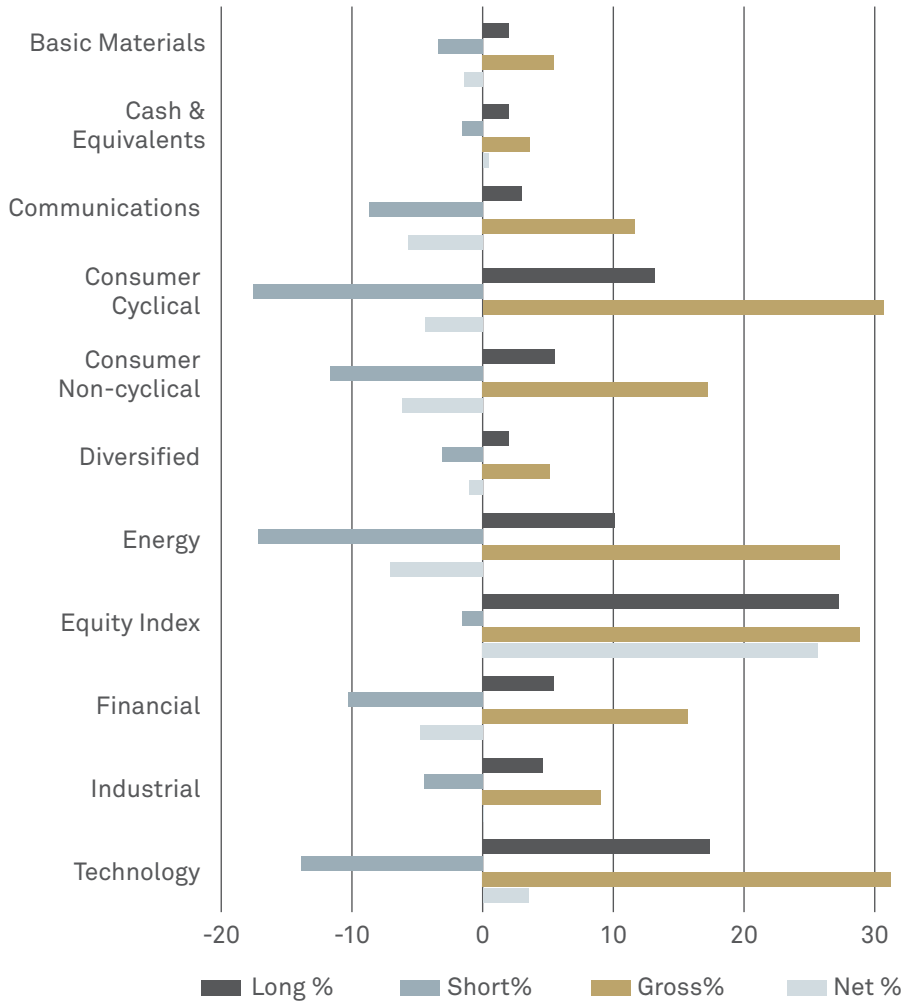


Figure 4

Industry Exposure				
Sector	Long %	Short%	Gross%	Net %
Aerospace/Defense	4.57	(1.60)	6.17	2.97
Airlines	2.38	0.00	2.38	2.38
Apparel	3.77	(2.62)	6.39	1.14
Auto Manufacturers	3.79	(3.17)	6.96	0.62
Auto Parts&Equipment	2.04	(2.66)	4.70	(0.62)
Banks	4.41	(5.84)	10.25	(1.43)
Beverages	3.28	(4.47)	7.76	(1.19)
Cash & Equivalents	0.00	(1.60)	1.60	(1.60)
Coal	0.00	(3.97)	3.97	(3.97)

Figure 4 cont

Industry Exposure				
Sector	Long %	Short%	Gross%	Net %
Commercial Services	0.00	(8.80)	8.80	(8.80)
Computers	5.38	(8.83)	14.21	(3.46)
Consumer Cyclical	3.55	(1.60)	5.15	1.95
Diversified Finan Serv	0.00	(2.50)	2.50	(2.50)
Energy-Alternate Sources	3.49	(3.53)	7.03	(0.04)
Equity Index	27.28	0.00	27.28	27.28
Food	4.30	0.00	4.30	4.30
Holding Companies-Divers	0.00	(1.50)	1.50	(1.50)
Internet	0.00	(7.89)	7.89	(7.89)
Lodging	0.00	(5.28)	5.28	(5.28)
Machinery-Constr&Mining	0.00	(2.02)	2.02	(2.02)
Mining	0.00	(1.83)	1.83	(1.83)
Oil&Gas	7.26	(12.89)	20.14	(5.63)
Oil&Gas Services	3.48	0.00	3.48	3.48
Private Equity	3.08	0.00	3.08	3.08
Real Estate	0.00	(5.13)	5.13	(5.13)
Retail	7.81	(7.12)	14.93	0.69
Semiconductors	4.27	(4.05)	8.32	0.22
Software	11.81	(4.19)	16.00	7.63
Telecommunications	2.99	(2.40)	5.39	0.59
Toys/Games/Hobbies	0.00	(3.09)	3.09	(3.09)
Transportation	0.00	(2.49)	2.49	(2.49)

RESULTS

As expected, the results of the analysis across the different funds using different levels of transparency produced a wide range of output and conclusions.

Using a monthly return stream to estimate risk factors provides very limited information about exposures within a fund. Without positions or more detailed information on the manager's strategy, the monthly returns provide no information on the types (credit, IR, equity) or region/country of exposure. However, monthly returns of the actual fund or an appropriate Hedge Fund Index can be reasonable in assessing the risk of the manager, as the volatility of the returns can be a reasonable assessment of the future potential volatility of the fund. However, as every mutual fund prospectus will tell you, past returns are no indication of future performance. This can be especially true for hedge funds.

It is possible to calculate VaR for funds based only on monthly return data, provided a sufficient number of return observations are available. This approach has the advantage of being faster, easier and cheaper than modeling position level detail, but some types of analysis may be unavailable or less useful. Returns-based analysis assumes a consistent style over time, which may not be true for many hedge fund opportunistic or Global Macro strategies. It is not best practice to combine returns-based and holdings-based analysis in the same comparison.

VAR CALCULATION RESULTS

The results of the VaR calculation across the managers utilizing the different methodologies were as follows:

Figure 5

	Value at Risk (1 Month, 95%) Calculated Using:			
	Strategy	Positions	Exposures	Difference
Manager 1	Event Driven	-3.54%	-4.60%	1.06%
Manager 2	Event Driven	-2.40%	-1.34%	-1.06%
Manager 3	Event Driven	-2.28%	-1.72%	-0.56%
Manager 4	Event Driven	-0.74%	-3.38%	2.65%
Manager 5	Global Macro	-4.20%	-4.90%	0.70%
Manager 6	Global Macro	-3.08%	-3.00%	-0.08%
Manager 7	Global Macro	-2.50%	-2.19%	-0.31%
Manager 8	Long/Short Equity	-2.04%	-3.91%	1.87%
Manager 9	Long/Short Equity	-5.67%	-6.16%	0.49%
Manager 10	Long/Short Equity	-5.02%	-5.42%	0.39%
Manager 11	Long/Short Equity	-4.83%	-4.35%	-0.48%
Manager 12	Long/Short Equity	-4.73%	-3.55%	-1.18%
Manager 13	Long/Short Equity	-4.58%	-3.52%	-1.06%
Manager 14	Long/Short Equity	-3.25%	-3.60%	0.36%
Manager 15	Multi-Strat	-6.17%	-10.13%	3.96%
Manager 16	Relative Value	-1.16%	-2.00%	0.84%
Manager 17	Relative Value	-1.53%	-1.22%	-0.31%

A few observations from the results: 10 of the 17 funds had VaR measures calculated using positions that were within 1% of the VaR calculated using exposures.

Nine of the 17 funds had a position VaR less than the exposure VaR. As the portfolios modeled using exposures capture very little idiosyncratic risk, and exposures often do not allow for capturing possible gamma or convexity in the portfolio, it is not surprising that many VaR measures based on exposures would be higher than the corresponding VaR measures for the same funds modeled using actual positions.

In strategies that are long and short the same item on a manager's newsletter, it is not possible to capture the basis or idiosyncratic risk contained within their actual positions. As such, the long and short exposures will be offset in the VaR calculation, and the manager's risk will likely be understated.

Figure 6

Manager 13			
	Long	Short	Net
Basic Materials	\$900	\$(6,700)	\$(5,800)
Communications	\$10,603	\$(6,750)	\$3,853
Consumer Cyclical	\$12,504	\$(10,201)	\$2,303
Consumer Non-cyclical	\$31,910	\$(23,401)	\$8,509
Equity Index	\$0	\$(3,800)	\$(3,800)
Financial	\$7,802	\$(11,001)	\$(3,199)
Other	\$21,506	\$(19,501)	\$2,005
Technology	\$10,603	\$(6,750)	\$3,853
Utilities	\$0	\$(1,600)	\$(1,600)
	\$95,828	\$(89,704)	\$6,124

The smaller Net Positions make it harder to capture the true risk of the fund using exposures vs funds that have larger net long or net short sector bets.

When modeling the exposures, only the net long or short position will be modeled whereas when using positions, the actual securities are used and while the long and short positions will often offset much of the market risk, the stock specific risk will be captured.

Another summary of the results is that if the only goal were to estimate VaR for most hedge funds, utilizing exposures or returns would provide reasonable results. The issue is that VaR is quite limiting, especially when it comes to understanding a fund's strategy, or for assessing risk in non-normal market conditions.

PUTTING RISK INFORMATION TO USE IN THE REAL WORLD

There are many different questions and analysis that investors focus on within their portfolio, much of those often driven by what is occurring in the financial markets at the present time. Utilizing a few of those scenarios we can compare the effectiveness of positions and exposures to perform a detailed analysis.

CHINA AND WORLD MARKET EVENTS

On any given day, news about a particular country is quite common, and one of the first questions investors ask is "what is my exposure". Recently, we saw quite a bit of focus on a number of world events where a particular country became the focus for investors. Using China as an example, we can try to determine how much exposure each manager has to China. As many manager letters only provide detail at the region level, the first step would be to assess the exposure to the Asia region.

Out of 17 managers, based upon positions, all but one shows some exposure to Asia. Interestingly, two of the exposure managers show no Asia exposure even though there is a small short exposure based upon positions for both Manager 11 & 15. This is another observation from this exercise of comparing the analysis using both positions and the manager's newsletter. Managers will often use their own judgment to decide if something is material enough to put into their write-up and adjustments to exposures (Notional, Beta, Delta etc.), if done at all, are entirely at the manager's discretion, and often done quite differently fund to fund.

In analyzing how similar or different the exposures are between positions and manager provided summaries we find a wide range of outcomes. While a few, including Manager 13 show very similar exposures, many are quite different. Manager 7 has very big differences, especially when viewing on un-adjusted notional. The methodology used by managers will often be quite different across managers, and not always disclosed to the investor. Using positions, all managers can be compared using the same methodology. For Manager 7, using a 10 year duration adjustment factor, the Asia exposure on the long side becomes much closer to what the manager provided. The discrepancy on the short side might be attributed to manager interpretation of materiality, or differences in exposure definitions or calculations.

Figure 7

ASIA Exposure	Long Notional	Short Notional	Long 10yr Equiv	Short 10yr Equiv
Manager 1 Exposures	17.1%	(8.5%)	15.2%	(6.5%)
Manager 1 Positions	16.5%	(15.4%)	16.5%	(13.8%)
Manager 2 Exposures	0.3%	0.0%)	0.2%	0.0%)
Manager 2 Positions	0.4%	(0.1%)	0.4%	(0.1%)
Manager 3 Exposures	56.1%	(12.6%)	52.0%	(12.5%)
Manager 3 Positions	22.4%	(21.5%)	24.8%	(20.5%)
Manager 5 Exposures	65.9%	(59.0%)	55.2%	(53.0%)
Manager 5 Positions	121.8%	(121.0%)	117.0%	(110.7%)
Manager 6 Exposures	95.2%	(82.6%)	39.6%	(36.7%)
Manager 6 Positions	239.5%	(265.5%)	202.9%	(218.9%)
Manager 7 Exposures	31.7%	(1.2%)	31.5%	(1.2%)
Manager 7 Positions	156.5%	(25.1%)	35.6%	(17.8%)
Manager 8 Exposures	0.8%	(1.4%)	0.8%	(1.4%)
Manager 8 Positions	0.9%	(2.0%)	0.9%	(2.0%)
Manager 9 Exposures	3.0%	(1.0%)	3.0%	(1.0%)
Manager 9 Positions	3.0%	(1.5%)	3.0%	(1.5%)
Manager 10 Exposures	1.8%	(4.7%)	1.8%	(4.7%)
Manager 10 Positions	1.8%	(9.6%)	1.8%	(9.6%)
Manager 11 Positions	0.0%	(1.6%)	0.0%	(1.6%)
Manager 12 Exposures	3.1%	(3.1%)	3.0%	(3.1%)
Manager 12 Positions	5.1%	(5.0%)	5.1%	(5.0%)
Manager 13 Exposures	16.6%	(17.7%)	16.6%	(17.7%)
Manager 13 Positions	22.0%	(18.0%)	22.0%	(18.0%)
Manager 14 Exposures	10.2%	(2.9%)	10.2%	(2.9%)
Manager 14 Positions	10.1%	(10.3%)	10.1%	(10.3%)
Manager 15 Positions	0.0%	(1.1%)	0.0%	(1.1%)
Manager 16 Exposures	122.9%	(3.0%)	102.9%	(2.7%)
Manager 16 Positions	04.4%	(7.2%)	2.3%	(6.4%)
Manager 17 Positions	14.0%	(28.6%)	6.2%	(13.8%)

While Asia exposure is a good start and might provide insight as to a worst case exposure to China, drilling down to country allows the investor to know exactly what their Asia exposure represents.

Figure 8

China Exposure	Long Notional	Short Notional	Long 10yr Equiv	Short 10yr Equiv
Manager 1 Positions	4.7%	(1.1%)	4.7%	(1.1%)
Manager 3 Positions	3.5%	(1.2%)	3.5%	(1.2%)
Manager 5 Positions	17.7%	(10.1%)	18.1%	(7.5%)
Manager 6 Positions	44.4%	(33.5%)	43.7%	(33.5%)
Manager 7 Positions	3.8%	0%	3.8%	0%
Manager 8 Positions	0%	(0.4%)	0%	(0.4%)
Manager 9 Positions	3.0%	(0.5%)	3.0%	(0.5%)
Manager 10 Exposures	0.3%	(1.9%)	0.3%	(1.9%)
Manager 10 Positions	0.3%	(1.9%)	0.3%	(1.9%)
Manager 12 Positions	0.1%	0.0%	0.1%	0%
Manager 13 Exposures	5.9%	(2.0%)	5.9%	(2.0%)
Manager 13 Positions	5.9%	(2.9%)	5.9%	(2.9%)
Manager 14 Exposures	4.7%	(1.0%)	4.7%	(1.0%)
Manager 14 Positions	4.7%	(3.3%)	4.7%	(3.3%)
Manager 15 Positions	0%	(0.1%)	0%	(0.1%)
Manager 17 Positions	0.5%	(0.2%)	0.5%	(0.2%)

When drilling into the country China, only three manager letters (Managers 10, 13 & 14) provided any detail of the fund's direct exposure to China. Interestingly, in each of those three cases, while there were greater discrepancies between positions and exposures at the region level, the China exposure is much closer. Also, at this stage, it is now clear that in terms of China exposure, the focus should be on Manager 5 and Manager 6. However, if we were dependent upon just the manager's monthly letter, we would have no knowledge of the China exposure for these funds. Only by modeling the positions is it clear that much of their Asia exposure is from China.

UNDERSTANDING THE TYPE OF EXPOSURE

The next level would be to understand the type of exposure (FX, Equity, FI, Credit etc.). This is rarely possible with exposures. However, using positions, this next drill down is quite easy. For the two managers with significant exposure, the drill down can now be done to the asset exposure level and security type level to assess what type of exposure is being held by the managers. Manager 5 has a reasonably sized exposure to China, with most of that coming from Equity. Manager 6 on the other hand has a very large exposure to China, and almost exclusively on FX. Given the similar sizing on both long and short FX exposure, one can also surmise that the fund is making more of a basis play on different maturity dates within the forward contracts. This level of detail and analysis is not possible without the ability to model the fund using positions.

Figure 9

China Exposure	Long Notional	Short Notional	Long 10yr Equiv	Short 10yr Equiv
Manager 5	17.7%	(10.1%)	18.1%	(7.5%)
Cash & Equivalents	0%	0%	0%	0%
Equity	15.5%	(7.0%)	15.5%	(7.0%)
Equity	10.7%	(6.0%)	10.7%	(6.0%)
ETF	1.6%	0%	1.6%	0%
Futures	.7%	0%	.7%	0%
Options	.3%	(0.1%)	.3%	(0.1%)
Rights-Warrants	.4%	0%	.4%	0%
Swaps	1.8%	(0.9%)	1.8%	(0.9%)
FX	1.6%	(0.2%)	1.6%	(0.2%)
Interest Rate	0%	(2.3%)	.4%	0%
Interest Rate & Credit	.3%	(0.5%)	.3%	(0.3%)
Private Equity	.3%	0%	.3%	0%

Figure 10

China Exposure	Long Notional	Short Notional	Long 10yr Equiv	Short 10yr Equiv
Manager 6	44.4%	(33.5%)	43.7%	(33.5%)
Equity	.2%	(2.1%)	.2%	(2.1%)
FX	38.4%	(31.4%)	38.4%	(31.4%)
Forward contracts	24.6%	(26.5%)	24.6%	(26.5%)
Options	13.8%	(4.9%)	13.8%	(4.9%)
Interest Rate & Credit	5.8%	0%	5.1%	0%

More sophisticated drill down analysis can include shocking the CNY currency to understand the impact of the options and futures and how the fund is positioned against movements in the USD/CNY FX rate. In this case, the fund is mostly taking a bullish position on the CNY currency and their downside risk is quite modest.

Figure 11

Manager 6	CNY Up 10%	CNY Down 10%
FX	1.8%	(0.2%)

The China example highlights the benefits of a position based risk analysis versus relying solely on manager provided summary data. Importantly, in a portfolio of multiple managers, when position information is used for risk analysis, investors have the added advantage of being able to aggregate and understand total exposure at the portfolio level.

UNDERSTANDING HEDGE FUND CONVEXITY

Many hedge fund strategies are structured in such a way that the payouts from an up or down market move are asymmetrical. This is especially true in funds that contain a high number of options or derivatives.

Manager 16 presents an interesting scenario for analysis. Both the positions and exposures show equity exposure of about \$25MM long and \$20MM short.

Figure 12

		Long Notional	Short Notional
Manager 16 – Positions	Equity	\$23,763,379	(\$20,015,335)
Manager 16 – Exposures	Equity	\$25,022,893	(\$20,043,093)

Without the position detail, the best that can be extrapolated when estimating the fund’s expected P&L under a range of equity shocks would be small linear equity sensitivity. Examining the potential P&L for Manager 16 under a ladder of equity market moves from -50% to +50% highlights this issue. While the exposure analysis shows that small linear sensitivity, viewing the same analysis based upon positions shows a very different story. The positions contain options, and other derivatives and in this particular strategy, provide good downside protection on an equity drop, and offer the investor much more significant upside on a large equity increase.

POSITIONS VS. EXPOSURES

Figure 13: Manager 16 - Positions, Equity Sensitivity

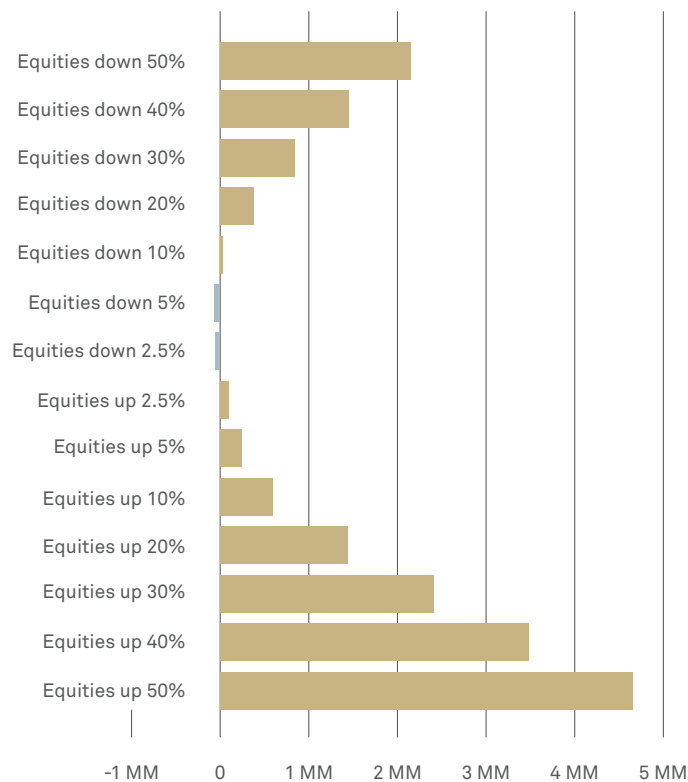
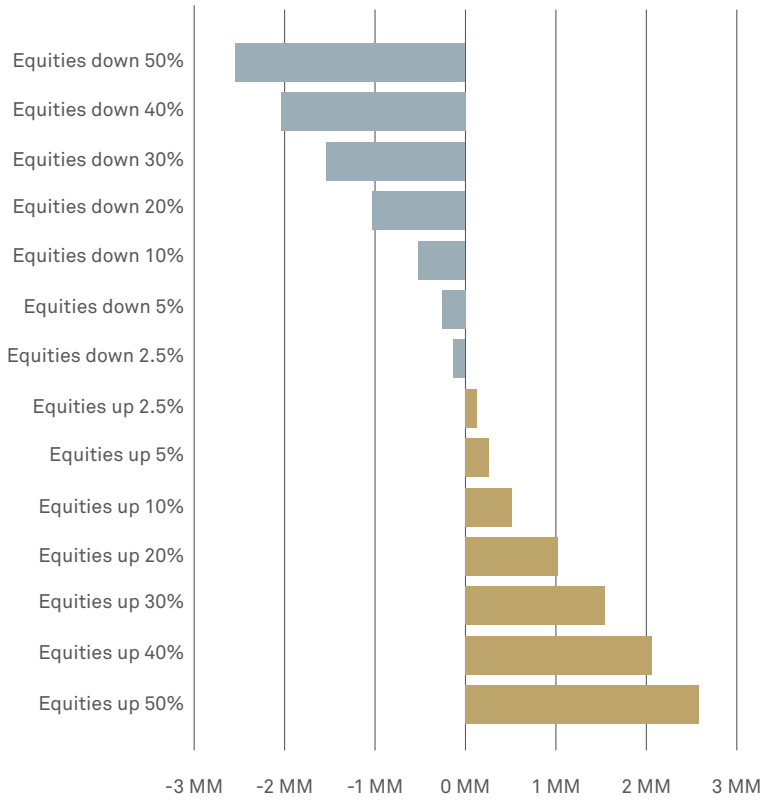


Figure 14: Manager 16 - Exposures, Equity Sensitivity



THE ROLE OF FX RATES AND HEDGING ON THE PORTFOLIO

One of the more difficult assessments for investors is understanding the role of FX rates on the risk of their investments. Across hedge funds, there is a range of those that fully hedge, those that never hedge and those that are a mix. While some manager letters will discuss the manager’s preference, most are silent and the investor is unable to ascertain their exposure to different currencies.

Figure 15

	USD Strengthening 10%	USD Weakening 10%
Manager 1 Exposures	3.7%	-3.7%
Manager 1 Positions	-0.5%	1.1%
Manager 2 Exposures	1.4%	-1.4%
Manager 2 Positions	0.3%	-0.3%
Manager 3 Exposures	5.2%	-5.2%
Manager 3 Positions	0.4%	-0.4%
Manager 4 Exposures	10.4%	-10.4%
Manager 4 Positions	0%	0%
Manager 5 Exposures	-4.4%	4.4%
Manager 5 Positions	-0.1%	5.2%
Manager 6 Exposures	-3.3%	3.3%
Manager 6 Positions	0.4%	1.9%
Manager 7 Exposures	-1.0%	1.0%

Figure 15 cont

	USD Strengthening 10%	USD Weakening 10%
Manager 7 Positions	-2.6%	2.6%
Manager 8 Exposures	-0.2%	0.2%
Manager 8 Positions	-0.1%	0.2%
Manager 9 Exposures	0.3%	-0.3%
Manager 9 Positions	-0.2%	0.2%
Manager 10 Exposures	0.2%	-0.2%
Manager 10 Positions	-4.2%	4.2%
Manager 11 Exposures	-0.4%	0.4%
Manager 11 Positions	-1.1%	1.1%
Manager 12 Exposures	1.8%	-1.8%
Manager 12 Positions	0.3%	-0.3%
Manager 13 Exposures	0.2%	-0.2%
Manager 13 Positions	-0.5%	0.6%
Manager 14 Exposures	2.1%	-2.1%
Manager 14 Positions	0.3%	-0.3%
Manager 15 Exposures	5.7%	-5.7%
Manager 15 Positions	-0.2%	0.2%
Manager 16 Exposures	7.6%	-7.6%
Manager 16 Positions	-0.2%	0.4%
Manager 17 Exposures	3.6%	-3.6%
Manager 17 Positions	-0.2%	0%

CURRENCY EXPOSURE

Exposures provide little guidance on a manager's currency exposure. Most often, it is not possible to know if the manager is hedging their FX risk unless the full positions are obtained with all the FX hedges. While most funds are more hedged than the exposures would indicate, a few do show greater FX risk with the positions fully modeled, including managers 7, 11 & 13. As such, investors should be careful when evaluating the FX sensitivity for managers analyzed using exposures. It is best to ascertain the manager's stance on hedging directly from the fund, or use positions if a truly accurate assessment of a fund's FX risk is required.

HISTORICAL STRESS TESTING

Stress testing is a staple of any risk management program and involves assessing how a fund or portfolio would likely behave under a variety of more extreme market conditions. One of the most popular stress testing approaches is to use past historical market events as the scenario under which to assess the current portfolio. In this way, the volatilities and correlations from a historical event (for example, 2008) can be used to see how a portfolio might behave if that market scenario were to repeat. While we know that no future event will ever be quite the same as a particular historical event, utilizing a range of past stress events provides a spectrum of market conditions to help gauge potential weaknesses or areas of high risk for particular portfolios.

ESTIMATED RETURNS OR A MIX OF HISTORICAL STRESS TESTS

This analysis was completed using portfolio modeling on all positions as well as the model portfolio built using exposures from the manager's newsletter.

Utilizing a range of past stress events provides a spectrum of market conditions to help gauge potential weaknesses or areas of high risk.

Figure 16

	2002 BEAR MARKET RALLY	2002 CREDIT CRUNCH	2008 CREDIT SEIZE	1992 ERM CRISIS	1999 EQUITY DOWN/ IR UP	2000 EQUITY DOWN/ IR UP	2008 LEHMAN FAIL POST BAILOUT	1998 RUSSIAN DEBT CRISIS	2007 FINANCIAL SUMMER CRISIS
Manager 1 Exposures	17.6	(14.3)	(14.7)	2.0	(3.9)	(1.0)	(16.1)	(4.7)	(6.4)
Manager 1 Positions	16.8	(20.9)	(45.2)	(2.2)	(6.1)	(7.0)	(31.4)	(10.7)	(10.7)
Manager 2 Exposures	7.2	(8.0)	(19.0)	1.7	(2.1)	(2.3)	(11.9)	(3.9)	(3.6)
Manager 2 Positions	4.0	(5.5)	(14.5)	(0.0)	(2.0)	(2.0)	(10.4)	(4.0)	(2.6)
Manager 3 Exposures	9.5	(5.8)	(11.4)	2.0	(0.7)	(4.8)	(6.5)	3.7	(2.2)
Manager 3 Positions	4.6	(6.9)	(21.5)	(4.9)	(1.0)	(2.9)	(15.0)	(1.2)	(4.8)
Manager 4 Exposures	2.7	6.6	10.2	1.1	3.3	2.4	7.9	4.1	(0.2)
Manager 4 Positions	5.5	(1.4)	(40.5)	(23.5)	1.1	(7.4)	(26.5)	(1.9)	(5.6)
Manager 5 Exposures	17.5	(14.2)	(21.5)	11.0	(6.7)	(5.3)	(11.2)	(9.8)	(2.4)
Manager 5 Positions	14.1	(18.7)	(30.2)	10.5	(7.5)	(4.6)	(15.1)	(11.8)	(6.4)
Manager 6 Exposures	1.1	(4.8)	(19.2)	0.8	(3.6)	(1.4)	(12.2)	(8.2)	(2.5)
Manager 6 Positions	(1.1)	0.2	7.4	6.8	(0.6)	1.6	5.9	(0.3)	1.9
Manager 7 Exposures	7.9	(7.8)	(13.7)	5.1	(5.6)	(2.1)	(7.8)	(7.9)	(2.4)
Manager 7 Positions	5.1	(10.4)	(9.4)	7.4	(3.0)	(0.3)	(6.8)	(2.8)	(3.2)
Manager 8 Exposures	5.7	(5.9)	(10.7)	0.6	(2.9)	(1.9)	(8.2)	(3.5)	(2.6)
Manager 8 Positions	4.4	(5.5)	(9.8)	0.4	(2.7)	(1.4)	(7.3)	(4.6)	(2.2)
Manager 9 Exposures	20.8	(21.8)	(35.5)	7.1	(10.0)	(12.4)	(28.0)	(16.8)	(9.1)
Manager 9 Positions	20.1	(21.4)	(36.8)	7.1	(9.5)	(10.3)	(23.8)	(16.5)	(7.5)
Manager 10 Exposures	16.8	(12.5)	(12.9)	16.0	(13.4)	(6.0)	(2.2)	(19.0)	(1.0)
Manager 10 Positions	8.1	(7.9)	(20.9)	4.2	(5.8)	(7.6)	(8.3)	(6.1)	(2.0)
Manager 11 Exposures	7.8	(11.1)	(16.7)	(1.9)	(5.5)	(0.8)	(17.4)	(5.7)	(5.8)
Manager 11 Positions	7.8	(10.7)	(16.6)	3.3	(4.4)	(0.9)	(10.6)	(5.5)	(3.0)
Manager 12 Exposures	10.7	(14.3)	(29.8)	1.9	(4.6)	(4.0)	(20.6)	(12.1)	(6.6)
Manager 12 Positions	12.7	(12.4)	(28.1)	2.6	(3.7)	(5.2)	(17.6)	(7.3)	(5.6)
Manager 13 Exposures	(3.0)	5.1	25.7	(4.3)	0.8	5.5	11.2	6.2	3.4
Manager 13 Positions	(0.6)	0.1	2.0	(0.4)	(0.9)	(0.4)	1.3	(1.5)	0.8
Manager 14 Exposures	17.4	(16.2)	(30.3)	2.1	(6.6)	(6.5)	(20.6)	(6.4)	(6.8)
Manager 14 Positions	14.2	(15.4)	(32.6)	1.0	(5.0)	(6.5)	(21.6)	(7.6)	(7.0)
Manager 15 Exposures	22.1	(19.0)	(24.7)	2.7	(5.8)	(5.8)	(24.6)	(2.9)	(8.2)
Manager 15 Positions	9.4	(10.2)	(35.4)	(12.9)	(2.2)	(7.2)	(23.8)	(7.7)	(7.5)
Manager 16 Exposures	0.6	(0.6)	1.4	(0.7)	1.5	2.9	(2.4)	3.2	(1.8)
Manager 16 Positions	(2.4)	0.5	(5.8)	(2.1)	1.1	0.2	(4.8)	2.6	(1.0)
Manager 17 Exposures	0.2	(1.4)	(8.4)	(0.5)	0.2	0.2	(7.8)	0.5	(1.8)
Manager 17 Positions	(0.2)	1.6	(11.5)	(8.2)	1.4	(1.7)	(7.6)	0.7	(1.0)

ESTIMATED GAINS AND LOSSES

Interestingly, in many cases, and for many stress events, the estimated gains or losses for the funds are reasonably similar for many funds modeled using the positions and that same fund's exposures. The issue is that there are often some events and some funds where the differences can be quite dramatic, especially on a directional change. Manager 4 is the most extreme, where clearly the makeup of the portfolio and expected behavior cannot be accurately modeled using just the data provided by the manager's newsletter.

A view of the data on Manager 4 highlights that in this case, it is not possible to estimate how the derivatives will behave in different market events, especially large moves based upon just the data in the manager newsletter.

Figure 17

Account Name	Security Type Level 2	Long Notional	Short Notional	10 Yr Equiv Long Notional	10 Yr Equiv Short Notional
Manager 4 - Positions		178,954,453	-49,257,294	76,081,199	-28,695,145
	Alternative Investments	4,204,080	0	4,204,080	0
	Derivatives	10,921,440	-36,560,156	10,921,440	-24,294,122
	Equity	7,989,928	0	7,989,928	0
	Fixed Income	155,839,003	-12,697,137	52,965,750	-4,401,022
Manager 4 - Exposures		122,009,999	-17,000,000	95,946,666	-14,783,333
	Derivatives	3,979,999	-2,540,000	3,979,999	-2,540,000
	Equity	39,839,999	-7,810,000	39,839,999	-7,810,000
	Fixed Income	78,189,999	-6,650,000	52,126,666	-4,433,333

MISCONCEPTIONS ABOUT EXPOSURES

Another important take away is that while many investors would suspect that using exposures to model the fund would likely lead to an overestimation of losses that would occur in a stress event, this is not always the case. As can be seen in the data, many events show a higher expected loss when the positions are modeled. Manager 10 during the Russian Debt Crisis and the 1999 interest rate hike are two good examples. As such, investors would be wise to remember that when using exposures, care should be taken in remembering that the maximum loss predicted in different stress events might be low.

THE SUBTLETIES OF INTEREST RATE RISKS

When assessing a fund's interest rate sensitivity, having position level information is critical. Many hedge funds provided limited information on fixed income risks within investor letters and exposure reports.

When curve shifts are not perfectly parallel, exposure to various key rates along the yield curve matters a great deal. Unfortunately, such exposure information is rarely robust enough within investor letters to be helpful. As a result, those doing the modeling are forced to infer exposures to various points on the curve from fund level statistics like average duration. This approach might be described by the saying, "If your head is in the oven and your feet are in the freezer, your average temperature may be just fine!"

Looking at our data set, we can see significant sensitivity to the short and long portions of the curve for several of the 17 funds. One manager in particular had a significant bet against the long bond, which was more than offset by a bullish stance on the belly of the curve and thus obscuring the bet to a large extent. This scenario is readily detectable for an investor benefiting from position level transparency. Note the contrast between Figures 18 and 19 below, which illustrate the key rate sensitivities attainable from exposure based and position based risk reporting, respectively.

Additionally, for instruments with both credit and interest rate risks like corporate or convertible bonds, a sophisticated risk engine will ingest position level detail and assess the appropriate sensitivities of each security. Investor letters and exposure reports will often divide allocations between "rates" and "credit", leaving investors to wonder about their risks. Modeling the funds based solely on this information becomes more art than science. Note the contrast between Figures 20, 21, 22 and 23 below, which illustrate the credit spread sensitivities attainable from exposure based and position based risk reporting, respectively.

Figure 18: The key rate durations based on limited exposure level information compiled from monthly manager statements. The below results are measured across a portfolio of hedge funds.

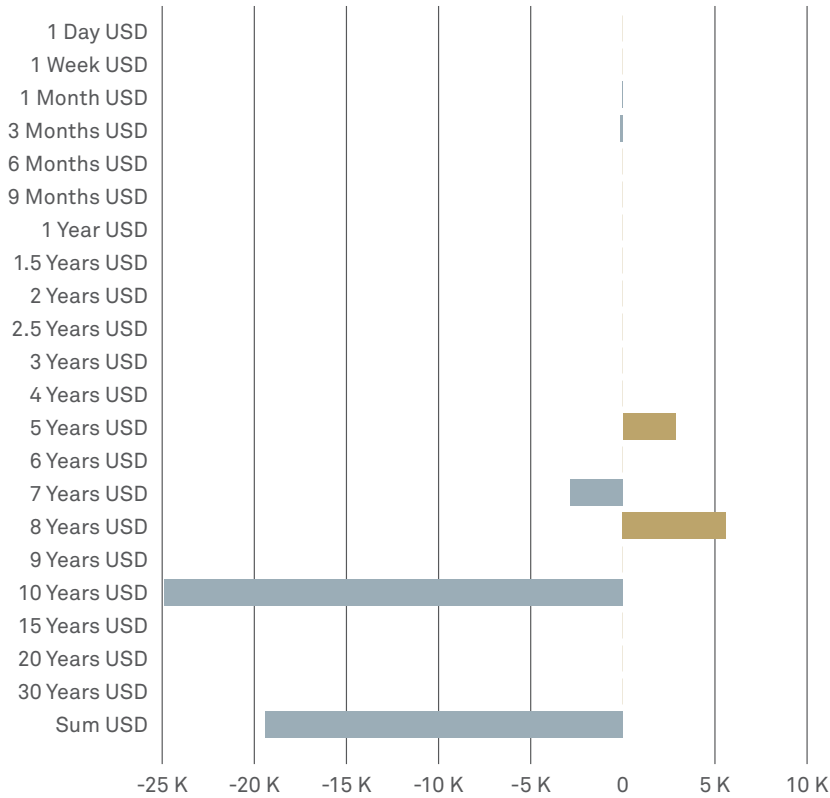
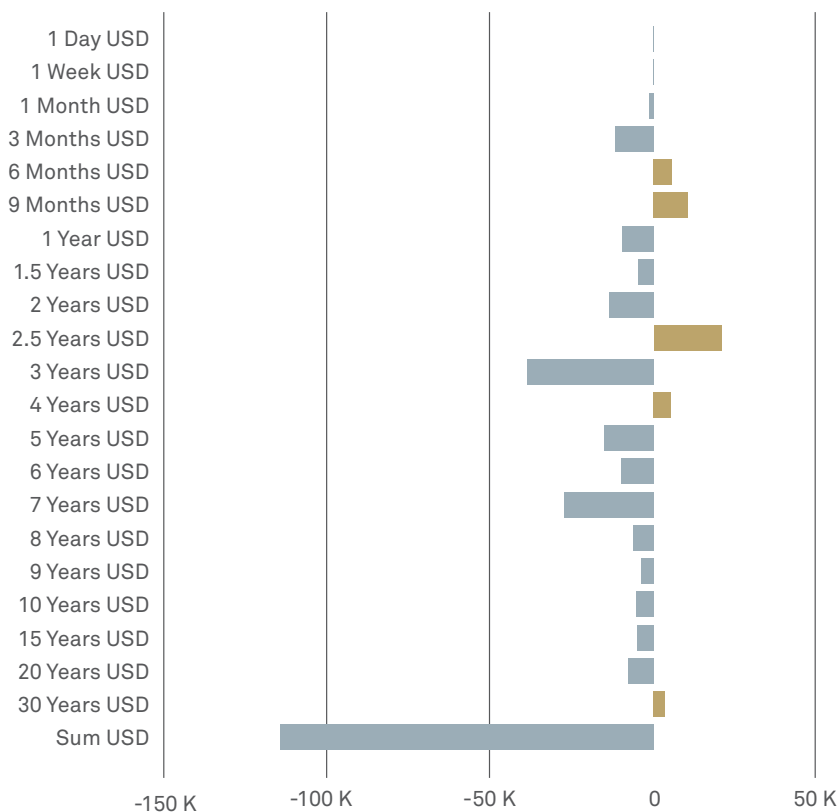


Figure 19: The key rate durations based on position level information across the same portfolio of hedge funds. Note the higher level of granularity.

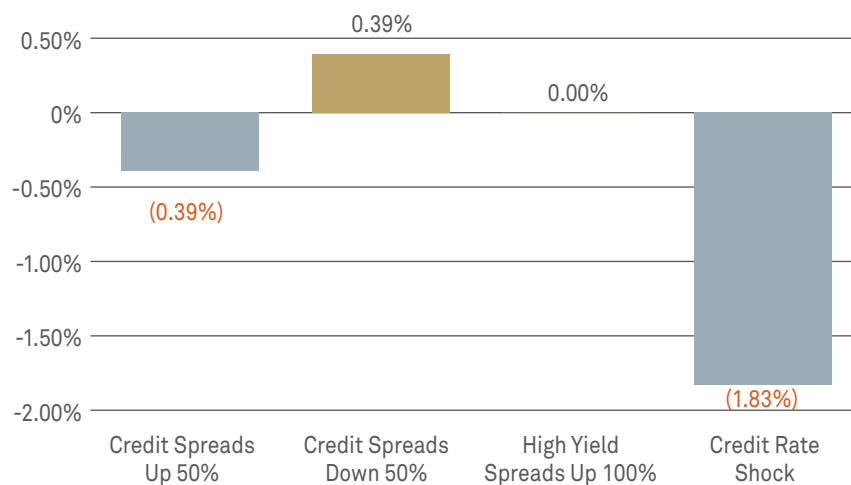


Credit Spread sensitivity results based on limited exposure level information compiled from monthly manager statements. The below results are measured across a portfolio of hedge funds, decomposed by asset class.

Exposures: Sensitivity Analysis [Notional]

Data as of December 31, 2014

Figure 20: P&L % Change - Total Scenario



We define 'Credit Rate Shock' as a 100 basis point parallel shift applied to all credit spreads including rating, industry and CDS spreads.

Figure 21: P&L Value Change – Group by Asset Exposure

Asset Exposure	Market Value	Notional Value	Credit Spreads Up 50%	Credit Spreads Down 50%	High Yield Spreads up 100%	Credit Rate Shock
Total	1,700,000,000	1,602,695,145	(6,566,426)	6,566,426	0	(31,031,258)
Cash & Equivalents	791,279,268	791,279,268	0	0	0	0
Commodity	0	(10,708,000)	0	0	0	0
Credit	0	(8,031,500)	93,737	(93,737)	0	809,295
Equity	626,734,597	598,981,546	0	0	0	0
FX	0	(181,597,100)	0	0	0	0
Interest Rate	0	(29,978,100)	0	0	0	0
Interest Rate & Credit	273,486,456	434,249,352	(6,660,162)	6,660,162	0	(31,840,553)
Private Equity	8,499,679	8,499,679	0	0	0	0

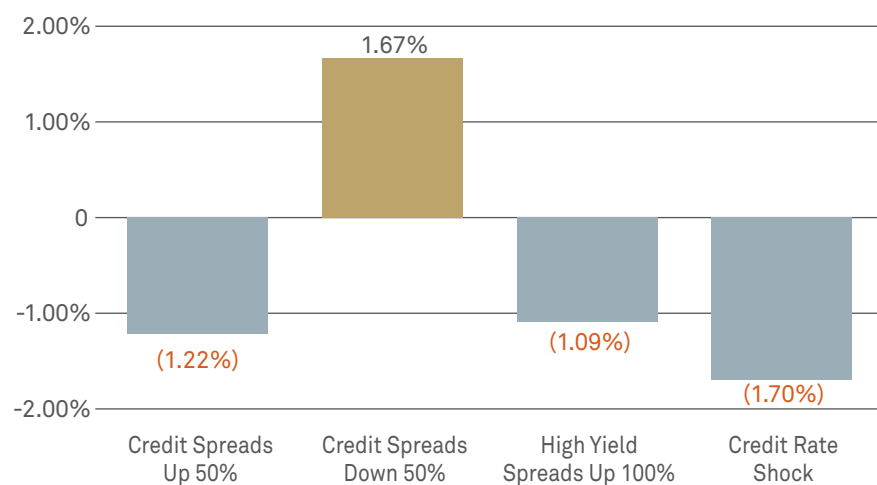
We define 'Credit Rate Shock' as a 100 basis point parallel shift applied to all credit spreads including rating, industry and CDS spreads.

Credit Spread sensitivity results position level information across the same portfolio of hedge funds, again decomposed by asset class. Note the revelation of the increased sensitivity to credit spread changes.

Positions: Sensitivity Analysis [Notional]

Data as of December 31, 2014

Figure 22: P&L % Change - Total Scenario



We define 'Credit Rate Shock' as a 100 basis point parallel shift applied to all credit spreads including rating, industry and CDS spreads.

Figure 23: P&L Value Change – Group by Asset Exposure

Asset Exposure	Market Value	Notional Value	Credit Spreads Up 50%	Credit Spreads Down 50%	High Yield Spreads up 100%	Credit Rate Shock
TOTAL	1,700,000,000	2,619,374,904	(20,768,950)	28,372,682	(18,584,315)	(28,929,957)
Cash & Equivalents	517,090,627	517,090,627	0	0	0	0
Commodity	1,310,499	(10,497,902)	0	0	0	0
Credit	(1,508,965)	(86,386,647)	1,375,349	(1,669,350)	748,071	3,193,340
Equity	567,330,757	601,464,031	(497,517)	204,747	(410,126)	(978,066)
FX	11,808,036	(295,287,774)	0	0	0	0
Interest Rate	2,699,562	1,174,181,079	0	0	0	0
Interest Rate & Credit	579,928,315	697,470,320	(21,646,782)	29,837,285	(18,922,260)	(31,145,231)
Other	388,456	388,456	0	0	0	0
Private Equity	20,764,622	20,764,622	0	0	0	0
Real Estate	188,091	188,091	0	0	0	0

We define 'Credit Rate Shock' as a 100 basis point parallel shift applied to all credit spreads including rating, industry and CDS spreads.

ILLIQUID INVESTMENTS

Private investments present a problem in calculating ex-ante risk. Private investments are rarely valued on a daily basis, and funds generally report their underlying holdings on a lagged (often quarterly) basis. To understand the risk of the entire fund we need to incorporate the private investments in some manner. The typical approach is to proxy the funds to an equity index. Although lagged valuations, the difficulty of valuing private holdings, and the infrequency of the valuations generally lead to the conclusion that public and private equity are not highly correlated given traditional correlation methods.

PUBLIC MARKET PROXY FOR PRIVATE EQUITY

Intuitively many investors consider private equity to be more like public equity than anything else to which it can be compared. In absence of greater knowledge about the private investments utilizing a public market proxy makes sense. Many investors do get additional information such as sector and country on private equity holdings. With that additional information more granular analysis can be done. From an exposure standpoint, being able to incorporate the private equity sectors with the public sector does provide a more complete exposure picture. With the additional information we can also proxy individual sectors to a public market sector benchmark. The assumption is that a private equity information technology stock will be more like a public information technology stock than the broad index. An analysis of that assumption is further explored in Appendix A.

In absence of greater knowledge about the private investments utilizing a public market proxy makes sense.

So does it make a difference if you proxy against a single index or go deeper and proxy against country/sector indices? To explore this question, we analyzed an actual private equity investment program for an institutional investor that uses a detailed proxy process. The private equity portfolio consisted of over 70 limited partnerships with hundreds of underlying positions. Utilizing the look-through capabilities of the Burgiss Group's Private Informant* service we receive each limited partnership's prorated shares of each private (as well as public) company that is held by the partnership. Any cash held in the portfolio is also captured. Each company is assigned a sector and a country. We then proxy each company to a similar sector/country or region public market index. We compare that detailed sector/country proxy analysis to an alternative model using a high level proxy for the entire private equity portfolio. The table below clearly indicates a different VaR and conditional VaR for the two different approaches.

Figure 24

	Value At Risk	Conditional Value At Risk
Private Equity Sector/Country Proxy	4.59%	5.59%
Private Equity Portfolio Broad Market Proxy	9.56%	12.38%

The sample private equity portfolios do have a fairly diverse sector and country mix. This diversification reduces the risk of the portfolio but is only captured through the more detailed proxy methodology. A significant factor in the lower VaR numbers for this sample is the detailed proxy method captures the underlying cash held in the private equity portfolios whereas the broad market proxy assumes a zero cash position.

* Burgiss is a global provider of investment decision support tools for the private capital market. Private Informant is a service of the Burgiss Group that provides transparency, providing continuously-updated, detailed information on company holdings within private capital funds, including private equity, venture capital, real estate, distressed debt, energy and fund-of-funds.

SAMPLE REAL ESTATE PORTFOLIO

We also went through the same process with our sample real estate portfolio. In this case we only went down to the country/region level for the more detail process. Once again we compared the same portfolio to a single real estate public market index. As the table indicates even taking the minor step of getting the proxy in the correct region produces a different risk number.

Figure 25

	Value At Risk	Conditional Value At Risk
Real Estate Country/Region Proxy	5.23%	6.38%
Real Estate Single Market Proxy	7.95%	9.88%

This sample real estate portfolio is 90% U.S. thus the impact to expanding the proxies to countries or regions is not a significant change. Expanding the detailed proxy process to real estate types such as office, residential, etc. presumably would highlight the same diversification benefits we saw with private equity.

The results of this exercise have shown a more detailed proxy methodology for private investments does produce different risk statistics. In this analysis the calculated risk is less for the more detailed proxy methodology than the single equity market index. The diversification of the different benchmarks as well as the inclusion of cash in these funds lowers the risk statistics.

TOTAL FUND ANALYSIS

Most of this paper thus far has discussed some of the differences of looking at risk on funds in isolation. In order to evaluate the impact that different levels of transparency can have when looking at the total plan (e.g. including all of the plan assets including traditional stock and bond funds with alternative assets), we created two synthetic plan allocations.

A sample Conservative Portfolio has allocations as follows:

- US Core Bond at 30%,
- International Equity at 20%
- US Equity at 30%
- Alternatives at 20% with allocations to real estate, private equity/venture capital, and hedge funds at 5, 5, and 10% respectively.

A sample Aggressive Portfolio includes the same underlying funds but with the following weights:

- US Core Bond at 10%
- International Equity at 20%
- US Equity at 25%
- Alternatives at 45% with allocations to real estate, private equity/venture capital, and hedge funds at 5, 15, and 25% respectively.

We then created three different versions of each one of these portfolios, so there were six in total. The first used all position level information for all investments including all of the alternative funds. Position level information is used for hedge funds while private equity and real estate using the underlying company level information which is then modeled to a factor based on the region and sector and a random beta to that factor usually in the .9 to 1.2 range, but averaging around 1. The second iteration used exposure information for the hedge funds, public market information for the long positions, and a single factor (e.g. the S&P 500 for the PE/VC and REITs Exposure information being defined as investor letters, Open Protocol Enabling Risk Aggregation (OPERA) Reports and the like) for other alternative positions. The third version used the same position based funds for the long funds, but modeled all the alternatives to a single factor based on the pertinent asset class. In most cases, the incorporation of alternative investments into a total plan analysis will usually be undertaken through a combination of the above methodologies, but for purposes of the analysis we look at each approach separately to demonstrate some of the inherent differences.

DIFFERENT LEVELS OF TRANSPARENCY

The ability to calculate and decompose the risk and review exposures is greatest when position based portfolios are used. Different levels of transparency impact the fundamental exposure based reporting, as well as more sophisticated measures such as VaR based statistics, historical stresses, and shocks. The accuracy of the underlying data becomes even more important and difficult to manage the more opaque the assets that are held in the portfolio. The collection, aggregation, and synthesis of alternative data with the traditional holdings of the portfolio have traditionally been a manual process supported by institutional investors. To do it well takes a significant amount of operational alpha and the process is often fraught with issues due to the completely manual nature (e.g. input errors, interpretive differences of staff over time, spreadsheet errors, etc.).

EVALUATING OUR FINDINGS

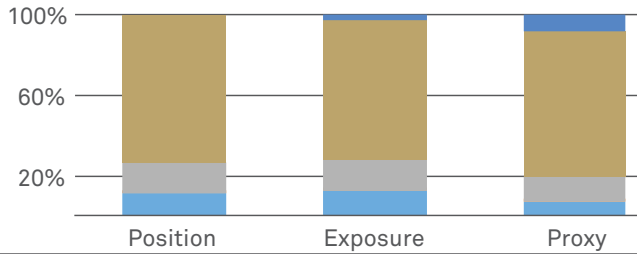
One of the most fundamental ways plan sponsors continue to evaluate risk is by looking at their exposures to regions, countries, and sectors. Due to the rapid expansion into alternatives this provides some challenges. An example of this is shown below by looking at the apparent differences in regional exposures using different level of transparency. One common question may be what is our overall exposure to a country such as China, and what type of instruments (stocks, bonds, etc.) are included in that exposure. If full position level transparency is available on all of the funds, this can be easily determined, but if the only information available is exposure information, country level exposure may be limited to an estimated exposure based on the collective conversations with the relevant managers with Asian exposure. Furthermore, Figures 26 and 27 show 4% greater exposure to Asia Pacific in the proxy portfolio compared to the position based portfolio, and this difference holds true for the market value allocations and the notional value allocations. It is interesting that the exposure based portfolios show higher allocations to Asia Pacific for both notional and market values than the position level analysis would suggest.

Also when loading exposures or using proxies, some data is classified in a general exposure to Global or Other, because of the variety of categories and levels of detail reported by different managers. For example, Figures 26 and 27 show the different apparent weights of the Global bucket using the proxy compared to using the position level detail. Almost 9% of the book is in Global with the proxy analysis, but on a position basis this drops to almost zero as those instruments are classified into their respective regions. This type of impact is apparent in all topologies (e.g. sector, industry, country, instrument type, etc.) the more position level data available.

The most critical component is the veracity of the underlying data. This becomes even more important and difficult to manage the more opaque assets that are held in the portfolio.

Figure 26: Market Value Regional Allocations

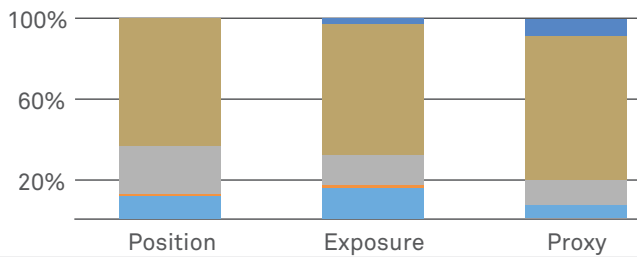
Data as of December 31, 2014



	Position	Exposure	Proxy
Global	0%	3.7%	8.8%
North America	73.3%	68.8%	71.8%
Europe, Mid East, Africa	14.7%	14.2%	11.6%
Central/South/Latin	1.0%	1.0%	0.7%
Asia Pacific	11.1%	12.3%	7.0%

Figure 27: Notional Value Regional Allocations

Data as of December 31, 2014



	Position	Exposure	Proxy
Global	0%	2.7%	8.9%
North America	63.8%	65.3%	71.6%
Europe, Mid East, Africa	23.8%	15.0%	11.7%
Central/South/Latin	1.5%	1.2%	0.7%
Asia Pacific	11.0%	15.9%	7.1%

IMPACT ON VALUE AT RISK

The Value at Risk statistics shown are calculated using a one month Monte Carlo analysis at a 95% confidence level, unless otherwise specified.

In both model portfolios (Aggressive and Conservative) we see the VaR as a % of the market value is lowest for the position based version and highest for the proxy versions, and have a minimal impact on the Conditional VaR as a % of market value. This may indicate a benefit from diversification impact when detailed positions enable the analysis to capture idiosyncratic risk at its maximum level. This result appears generally consistent across all of the VaR based statistics for the six model portfolios analyzed.

Figure 28

	VaR % MV	Conditional VaR % MV
AGGRESSIVE- POS	(3.31)	(4.33)
AGGRESSIVE- EXP	(3.33)	(4.33)
AGGRESSIVE - PXY	(3.53)	(4.37)
CONSERVATIVE - POS	(2.98)	(3.77)
CONSERVATIVE - EXP	(2.99)	(3.78)
CONSERVATIVE - PXY	(3.03)	(3.77)

SHOCKING THE PORTFOLIO

In addition to VaR, there are other ways to evaluate the risk of the portfolio. Two of the more frequently used ex-ante approaches are looking at historical scenarios to see how the current portfolio would react if that same scenario were to replay itself and shocking the portfolio based on the user's view of what is going to happen in the market. The treatment of the alternative assets will materially impact the results and it is helpful to consider the impact and or limitations that can occur when using exposure and or single factor proxies.

Below are some results of a variety of popular historical scenarios. The below table uses a green, yellow, orange scheme to denote loss/gain levels within the respective Aggressive and Conservative portfolios.

- Allocations to alternative assets and the level of available incorporated in the risk system (position level, exposures, or proxies) continue to have a meaningful impact on the results. The higher the allocation to alternatives the more aware you need to be of the impact they have on the results that are generated.
- In almost all cases all of the Aggressive portfolios show more risk (greater expected loss) in down scenarios and more upside (expected gain) in up scenarios when compared to the Conservative portfolios.
- In a vast majority of the scenarios both the Conservative and Aggressive Proxy versions show lower risk in a down scenario and a smaller expected gain in an up scenario when compared to the Exposure and Position based iterations. However, there are some cases where the Proxy version shows more risk than both the position and exposure versions.
- The differences between the results (spread between the 3) are more dramatic on the Aggressive portfolio and due to the higher allocation to the alternatives, and moreover, the treatment of those alternatives (proxy, exposures, and positions).

Figure 29

Historical Event Name	AGG POS	AGG EXP	AGG PXY	CON POS	CON EXP	CON PXY
2008 Credit Seize - P&L % MV	(37.2 %)	(38.9 %)	(38.1 %)	(32.8 %)	(33.5 %)	(33.1 %)
2008 Lehman Fail Post Bailout - P&L % MV	(25.1 %)	(25.8 %)	(25.6 %)	(22.8 %)	(23.1 %)	(23.0 %)
2002 Dotcom Hangover - P&L % MV	(18.4 %)	(18.2 %)	(16.4 %)	(15.4 %)	(15.3 %)	(14.5 %)
2008 Lehman Fail Pre Bailout - P&L % MV	(18.2 %)	(18.6 %)	(19.4 %)	(16.6 %)	(16.8 %)	(16.9 %)
2002 Credit Crunch - P&L % MV	(16.4 %)	(16.4 %)	(14.9 %)	(14.0 %)	(14.0 %)	(13.4 %)
2001 Equity Correction - P&L % MV	(13.9 %)	(14.4 %)	(12.5 %)	(12.1 %)	(12.3 %)	(11.5 %)
2001 Dot Bomb - P&L % MV	(12.0 %)	(12.9 %)	(11.3 %)	(10.4 %)	(10.7 %)	(10.0 %)
2001 Equity Down/ IR Down - P&L % MV	(12.0 %)	(12.4 %)	(10.8 %)	(10.3 %)	(10.4 %)	(9.8 %)
1998 Nasdaq Correction - P&L % MV	(10.1 %)	(10.2 %)	(9.1 %)	(8.4 %)	(8.5 %)	(8.1 %)
2006 May - June Sell Off - P&L % MV	(8.2 %)	(8.3 %)	(8.7 %)	(7.4 %)	(7.5 %)	(7.6 %)
1998 Russian Debt Crisis - P&L % MV	(7.9 %)	(8.0 %)	(7.0 %)	(6.4 %)	(6.4 %)	(6.2 %)
2008 June Correction - P&L % MV	(7.9 %)	(8.0 %)	(7.1 %)	(6.8 %)	(6.9 %)	(6.5 %)
2002 Equity Meltdown - P&L % MV	(7.7 %)	(7.0 %)	(6.8 %)	(6.0 %)	(5.7 %)	(5.6 %)
2007 Financial summer Crisis - P&L % MV	(7.7 %)	(7.8 %)	(9.7 %)	(7.0 %)	(7.1 %)	(7.8 %)
2004 Credit Scare - P&L % MV	(6.9 %)	(7.1 %)	(6.7 %)	(6.6 %)	(6.7 %)	(6.6 %)
2000 Equity Down/ IR Up - P&L % MV	(6.4 %)	(6.7 %)	(5.4 %)	(5.7 %)	(5.8 %)	(5.3 %)
1998 Technology Correction - P&L % MV	(5.5 %)	(5.7 %)	(4.9 %)	(4.7 %)	(4.8 %)	(4.6 %)
1999 Equity Down/ IR Up - P&L % MV	(5.3 %)	(5.1 %)	(4.8 %)	(4.6 %)	(4.5 %)	(4.4 %)
1994 Bond Crash - P&L % MV	(4.4 %)	(4.1 %)	(3.6 %)	(4.1 %)	(4.0 %)	(3.7 %)
2001 Sep 11th - P&L % MV	(4.0 %)	(4.0 %)	(3.3 %)	(3.4 %)	(3.4 %)	(3.1 %)
2007 Shanghai Surprise - P&L % MV	(2.0 %)	(2.0 %)	(2.2 %)	(1.6 %)	(1.6 %)	(1.7 %)
2003 No Deflation Rally - P&L % MV	(0.1 %)	0.3 %	0.1 %	0.5 %	0.6 %	0.5 %
2004 Bond Sell Off - P&L % MV	(0.1 %)	(0.3 %)	(0.2 %)	(0.8 %)	(0.9 %)	(0.9 %)
2003 No Deflation Market Drop - P&L % MV	0.2 %	0.0 %	0.3 %	(0.3 %)	(0.4 %)	(0.2 %)
1999 Fed Tightening - P&L % MV	2.4 %	2.4 %	1.1 %	1.3 %	1.2 %	0.8 %
1997 Asian Market Crisis - P&L % MV	3.0 %	2.8 %	2.6 %	2.9 %	2.8 %	2.7 %
1992 ERM Crisis - P&L % MV	3.1 %	2.2 %	2.5 %	2.6 %	2.3 %	2.6 %
1997 Japan Market Crash - P&L % MV	4.1 %	3.7 %	3.9 %	3.6 %	3.4 %	3.5 %
2000 Equity Up/ IR Down - P&L % MV	5.4 %	5.2 %	5.0 %	5.0 %	4.9 %	4.8 %
1995 Flat Tax - P&L % MV	6.5 %	6.0 %	5.3 %	5.7 %	5.5 %	5.3 %
2008 Bear Market Rally - P&L % MV	6.7 %	6.7 %	6.5 %	5.8 %	5.8 %	5.8 %
1999 Emerging Mkt Rally - P&L % MV	6.8 %	6.5 %	6.2 %	6.1 %	6.0 %	5.9 %
1999 Nasdaq Rally - P&L % MV	6.8 %	6.1 %	5.3 %	5.9 %	5.6 %	5.2 %
1998 Technology Rally - P&L % MV	11.6 %	11.2 %	9.6 %	9.6 %	9.4 %	8.7 %
2001 Equity Rally - P&L % MV	15.7 %	14.9 %	13.1 %	13.7 %	13.3 %	12.6 %
2002 Bear Market Rally - P&L % MV	16.8 %	16.2 %	14.5 %	14.6 %	14.4 %	13.7 %
1999 Equity Up/ IR Up - P&L % MV	17.7 %	16.6 %	14.1 %	14.0 %	13.6 %	12.5 %

Investors want the ability to stress the portfolio based on what they think will happen next or come up with a nightmare scenario and see how the portfolio would react.

FURTHER DECOMPOSING RESULTS

Historical shocks are an interesting illustration of how a current portfolio would react if that exact scenario repeated, but almost everyone will agree that history is highly unlikely to exactly repeat. There are simply too many variables in the market for them to converge again, so investors want the ability to stress the portfolio on what they think will happen next or come up with a nightmare scenario and see how the portfolio would react. This is often referred to as shocking the portfolio. The treatment of alternatives has a material impact on the results.

Using the same model portfolios we have throughout this section we stressed the portfolios assuming the follow scenario:

- Credit Spreads Widen + 25%
- Continued Strengthening of USD – a 3% move
- Plus 30 BP Parallel move to the Yield Curve
- A 20% decrease in the Equity markets

The position based portfolios show less of a loss than the proxy versions in both the Aggressive and Conservative portfolios. This is again exacerbated in the Aggressive portfolio compared to the difference in the Conservative portfolio. The loss in Aggressive Position is 14.96% while the loss in the same Aggressive Proxy version is 18.21%, however in the Conservative Position you see an expected loss of 13.35% compared to a loss of 14.61% in Conservative Proxy. This is due to the treatment of the alternative assets.

Figure 30

Portfolio	Total	Credit Spreads Up 25%	FX Shock - Up 3%- USD	Equity down 20%	Curve Shifts - Prl +30bps- ALL
AGG POS	(14.96)	(0.21)	(0.63)	(13.86)	(0.26)
AGG EXP	(15.26)	(0.10)	(0.85)	(14.08)	(0.23)
AGG PXY	(18.21)	(0.05)	(0.57)	(17.42)	(0.16)
CON POS	(13.35)	(0.23)	(0.61)	(11.99)	(0.52)
CON EXP	(13.47)	(0.18)	(0.70)	(12.08)	(0.51)
CON PXY	(14.61)	(0.16)	(0.58)	(13.38)	(0.48)

As mentioned above, the ability to drill into the results in multiple dimensions is enhanced by greater transparency. One example of evaluating this at a lower level would be by asset class or instrument type. In the chart below you can see that the Proxy Portfolios have 5 basic asset classes (alternative investments, cash & equivalents, derivatives, equity and fixed income). This is a typical way things may be aggregated when a lack of better transparency exists. As we go up the transparency continuum we start adding asset classes which help to better explain the risk. In the exposure buckets we add Commodities as an asset class and finally when we get to position based we add FX and Other. The position based methodology is a bottom up approach that looks at every asset and categorizes accordingly vs. a top down approach that assumes portfolios match the investor's defined investment hierarchy. More often than not assets in the Alternative Investments get a broad market index proxy and sometimes these get a beta adjustment to that proxy. When assuming a broad market index or indices you lose the idiosyncratic risk that you capture when you do this at the position level and it explains much of the difference between the position and exposure portfolios. The exposure based results fall in the middle due to the diversification impact (using multiple factors with respective weights per fund) achieved versus using a single proxy for investments without any level of transparency.

Further analysis could consider sectors, duration bands, or other categories relevant to the investments. One common way to look at this is in historical stresses, sensitivities or VaR based reports to compare a bottom up approach (as shown above) to a top down approach. Often this will highlight an exposure to an asset class that was not intended. A great example of this occurred in 2008 when well diversified investors were unaware of their exposure to the equity market. Hedge funds and other alternatives were often included in an absolute return bucket and investors were surprised by their exposure and the corresponding losses. In fairness when correlations go to one and there is a liquidity crisis there may not be a safe place to invest, but better information might have helped them avoid some of the surprises with the losses incurred.

Figure 31

AGGRESSIVE – POSITION							
Security Type Level 1	Market Value	Notional Value	Total	Credit Spreads Up 25%	FX Shock - Up 3%-USD	Price Shifts - Price down 20%	Curve Shifts - Prl +30bps-ALL
Total	1,000,000,000	1,135,202,192	(14.96)	(0.21)	(0.63)	(13.86)	(0.26)
Alternative Investments	198,300,768	198,300,768	(4.10)	0.00	(0.11)	(3.99)	0.00
Cash & Equivalents	87,146,098	87,146,098	(0.02)	0.00	(0.02)	0.00	0.00
Commodity	91,417	91,417	0.00	0.00	0.00	0.00	0.00
Derivatives	4,340,828	138,525,138	0.25	0.01	0.12	0.16	(0.04)
Equity	523,035,876	524,053,758	(10.54)	(0.00)	(0.59)	(9.95)	(0.00)
Fixed Income	186,649,513	186,649,513	(0.55)	(0.22)	(0.04)	(0.07)	(0.22)
FX	46,895	46,895	(0.00)	0.00	(0.00)	0.00	0.00
Other	388,605	388,605	(0.00)	0.00	0.00	(0.00)	0.00
CONSERVATIVE – POSITION							
Security Type Level 1	Market Value	Notional Value	Total	Credit Spreads Up 25%	FX Shock - Up 3%-USD	Price Shifts - Price down 20%	Curve Shifts - Prl +30bps-ALL
Total	1,000,000,000	1,054,080,877	(13.35)	(0.23)	(0.61)	(11.99)	(0.52)
Alternative Investments	107,365,031	107,365,031	(2.22)	0.00	(0.05)	(2.17)	0.00
Cash & Equivalents	37,510,642	37,510,642	(0.01)	0.00	(0.01)	0.00	0.00
Commodity	36,567	36,567	0.00	0.00	0.00	0.00	0.00
Derivatives	1,753,797	55,427,521	0.10	0.00	0.05	0.06	(0.02)
Equity	517,842,550	518,249,702	(10.43)	(0.00)	(0.58)	(9.86)	(0.00)
Fixed Income	335,317,213	335,317,213	(0.79)	(0.23)	(0.03)	(0.03)	(0.51)
FX	18,758	18,758	(0.00)	0.00	0.00	0.00	0.00
Other	155,442	155,442	(0.00)	0.00	0.00	(0.00)	0.00
AGGRESSIVE – EXPOSURE							
Security Type Level 1	Market Value	Notional Value	Total	Credit Spreads Up 25%	FX Shock - Up 3%-USD	Price Shifts - Price down 20%	Curve Shifts - Prl +30bps-ALL
Total	1,000,000,000	985,690,462	(15.26)	(0.10)	(0.85)	(14.08)	(0.23)
Alternative Investments	196,698,004	196,698,004	(4.07)	0.00	(0.11)	(3.96)	0.00
Cash & Equivalents	127,467,957	127,467,957	(0.02)	0.00	(0.02)	0.00	0.00
Commodity	0	(1,360,000)	0.00	0.00	0.00	0.00	0.00
Derivatives	29,110	(34,757,420)	0.07	0.00	0.07	0.00	0.00
Equity	534,221,439	530,246,108	(10.80)	0.00	(0.68)	(10.12)	0.00
Fixed Income	141,583,490	167,395,814	(0.45)	(0.10)	(0.11)	(0.00)	(0.23)
CONSERVATIVE – EXPOSURE							
Security Type Level 1	Market Value	Notional Value	Total	Credit Spreads Up 25%	FX Shock - Up 3%-USD	Price Shifts - Price down 20%	Curve Shifts - Prl +30bps-ALL
Total	1,000,000,000	994,276,185	(13.47)	(0.18)	(0.70)	(12.08)	(0.51)
Alternative Investments	106,723,926	106,723,926	(2.21)	0.00	(0.05)	(2.16)	0.00
Cash & Equivalents	53,639,385	53,639,385	(0.00)	0.00	(0.00)	0.00	0.00
Commodity	0	(544,000)	0.00	0.00	0.00	0.00	0.00
Derivatives	29,110	(13,885,502)	0.03	0.00	0.03	0.00	0.00
Equity	522,316,775	520,726,643	(10.54)	0.00	(0.61)	(9.92)	0.00
Fixed Income	317,290,804	327,615,734	(0.75)	(0.18)	(0.06)	(0.00)	(0.51)

Figure 31 cont

AGGRESSIVE – PROXY							
Security Type Level 1	Market Value	Notional Value	Total	Credit Spreads Up 25%	FX Shock - Up 3%-USD	Price Shifts - Price down 20%	Curve Shifts - Prl +30bps-ALL
Total	1,000,000,000	1,000,000,000	(18.21)	(0.05)	(0.57)	(17.42)	(0.16)
Alternative Investments	459,906,734	459,906,734	(9.22)	0.00	0.00	(9.22)	0.00
Cash & Equivalents	7,228,328	7,228,328	(0.00)	0.00	0.00	0.00	0.00
Derivatives	16,923	16,923	(0.00)	0.00	0.00	(0.00)	0.00
Equity	432,928,780	432,928,780	(8.77)	0.00	(0.57)	(8.20)	0.00
Fixed Income	99,919,236	99,919,236	(0.22)	(0.05)	(0.00)	0.00	(0.16)
CONSERVATIVE – PROXY							
Security Type Level 1	Market Value	Notional Value	Total	Credit Spreads Up 25%	FX Shock - Up 3%-USD	Price Shifts - Price down 20%	Curve Shifts - Prl +30bps-ALL
Total	1,000,000,000	1,000,000,000	(14.61)	(0.16)	(0.58)	(13.38)	(0.48)
Alternative Investments	209,906,734	209,906,734	(4.22)	0.00	0.00	(4.22)	0.00
Cash & Equivalents	8,673,369	8,673,369	(0.00)	0.00	(0.00)	0.00	0.00
Derivatives	16,923	16,923	(0.00)	0.00	0.00	(0.00)	0.00
Equity	481,645,266	481,645,266	(9.73)	0.00	(0.57)	(9.16)	0.00
Fixed Income	299,757,708	299,757,708	(0.66)	(0.16)	(0.01)	0.00	(0.48)

We could continue to drill down on the above in a myriad of ways (reviewing sectors, duration bands, etc.), but a very common way to look at this in historical stresses, sensitivities or VaR based reports is to compare a bottom-up approach (as shown above) to a top-down approach. Often this will highlight an exposure to an asset class that was not intended.

CONCLUSIONS AND BEST PRACTICES

As the examples above illustrate, the assumptions that are used in incorporating alternative investments into enterprise risk analysis matter. Different approaches to data management can lead to different potential conclusions about the apparent risks within an investment program.

The analyses discussed earlier, and discussions with institutional investors about their experiences in using enterprise risk analyses, suggest the following best practices:

1. Use the most granular detail available in order to evaluate investment risks. If holdings detail is not available to the investor, request holdings detail to be made available to a third party risk provider. If no holdings detail is available, use investment-specific exposures to incorporate into the risk management process.
2. Detailed investment information is necessary for an investor's ongoing due diligence process, so consider the availability of necessary information as a factor in selecting investment managers. Institutional investors often have leverage with prospective managers.
3. Evaluate volatility-based risk measures such as VaR as one element of a broader risk management framework that also considers other measures such as exposures.
4. VaR is an estimate that is more useful in relative analysis than as an absolute value. Compare VaR of a total fund over time to help identify changing market conditions, or compare VaR of a single portfolio relative to an asset class, total fund or benchmark to gain insights into how components interact within an overall investment program.
5. Consider hedge fund investment structures that provide additional transparency, liquidity and control. Hedge fund managed accounts or liquid alternative funds are increasingly popular with institutional investors that are interested in hedge fund investing without the information and liquidity constraints common to traditional hedge fund structures.
6. Understand the assumptions that have been used in incorporating illiquid investments into ex-ante risk when reviewing the results of specific scenario analysis or stress tests.
7. Compare ex-ante risk measures to ex-post risk measures. Illiquid investments will show lower ex-post risk statistics based on observable quarterly returns than ex-ante risk measures using daily-priced market index proxies based on relevant factor exposures. Volatility based risk measures for illiquid investments will tend to understate the risk of losing money if compared to volatility measures for liquid investments.

Risk management as a function is necessary whenever there is the desire to take and understand risks. The practice of risk management has changed significantly over time, but it continues to be a discipline without definitive standards. The best practices discussed herein are intended to help others address the challenges presented by opaque or illiquid alternative investments.

APPENDIX

A DEEPER ANALYSIS ON WHETHER PRIVATE EQUITY BEHAVES LIKE PUBLIC EQUITY

Unlike the hedge fund examples earlier in this paper, there is a legitimate question in the context of Private Equity Funds as to whether the more transparent analysis really provides a more accurate picture of risk. It does seem more intuitive that a private equity holding would behave more like a public market sector holding than a generic market holding. To prove that intuition is problematic. Private equity companies are infrequently priced and tracking transactions at the company level is difficult with the inconsistent and often opaque reporting from general partners. Relying on prices reported by the general partner is problematic given the illiquidity in the market place. Nevertheless, we did attempt to see if we could glean anything from any available data that does exist. Since we cannot rely on prices, if we only looked at private company activity that has been sold or distributed as public stock and tried to compare those companies to the public market sectors we considered whether we could determine that they behaved more like public market sectors than a broader market index. Once again we utilized Burgiss's work tracking private equities. Burgiss tracks thousands of private equity companies as reported by the general partners. For our analysis, we used a sample of the Burgiss data that included 153 securities that had been liquidated or disposed of. 33 of those securities lost all of their value resulting in a 100% loss. With the 120 securities that remained we calculated a public market equivalent return (Kaplan-Schoar PME). This calculation takes the cash flow activity and "grows" that investment as if one invested in the public markets. If our sample reflects what our intuition was suggesting, then if we calculate a PME with the sector level index returns compared to an overall index returns, we would expect the sector level returns to track the returns of our companies more closely. With our sample of 120 securities we calculated a PME "growing" the investments in the private companies by the returns of sector indexes over the life of the investment. The average PME for the sector analysis generated a ratio of 1.76 indicating that surviving companies returned 76% more than they would have returned had they been invested passively in small cap sector funds matching the sector of the company. When we recalculated the PME using the 120 securities "growing" the investments in the private companies by the return of a broad growth index, the average PME was 1.74, indicating that the companies in this sample produced a return 74% greater than had the investments in the private companies been invested passively in a broad growth index. Using sector benchmarks produced a PME that was slightly less predicative than using a broad index. Even more telling, comparing each company's PME to the different indices, there is no consistency of which one generates a greater PME. Of the 120 companies 49 of the company's sector PME was greater than the broader index and 55 had the broader index having a greater PME with 16 returning the same PME. Although 153 securities is hardly a definitive study on how well private companies correlate with public companies it is not particularly surprising in this small study that private equity company returns seem to march to their own drumbeat.

AUTHORSHIP

We would like to acknowledge the contribution made by our collaborators. Please find a listing of the experts who made this paper possible:

BNY MELLON

Frances Barney, CFA, Managing Director

Head of Global Risk Solutions Consulting Americas

Andrew Lapkin, CEO

HedgeMark International LLC, a BNY Mellon Affiliate

Guy M. Holappa, CFA, Managing Director

Global Risk Solutions Consulting

Derek R. van Vliet, Vice President

Senior Risk Consultant, Global Risk Solutions

Jim Nevola, CFA, FRM, CAIA, CIPM, Vice President

Senior Risk Consultant, Global Risk Solutions

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