Risk aware investment

Mark Deans | UBS Global Asset Management | 31 July 2015

INTRODUCTION

Integrating risk management into the investment process can improve the choice and sizing of positions in a multi-asset portfolio. In this way, investment views can be implemented effectively, diversification is considered, and an appropriate balance is struck between risk and return potential.

A typical investment process can be represented as a cycle of idea generation and debate, portfolio construction, and monitoring.

Traditionally, risk management might have been considered as a monitoring activity only, with limits placed on portfolio risk or active risk relative to a benchmark, and portfolio managers choosing trades freely, provided they remain within the limits. Risk analysis, can, however, add value at the earlier stages of the investment process, and help the portfolio manager with:

- Transforming investment ideas into effective trades;

- Combining trades into a portfolio with a balance of risk and return potential;

- Improving diversification and understanding any dominant sources of risk; and,

- Testing the effects of downside protection or other option strategies.

This paper discusses how risk management can bring these benefits and gives a practical example in each case. The examples use USD as a riskless base currency, but the methods used and benefits are similar for any base currency.

Figure 1: A typical investment process

2. DESIGNING EFFECTIVE TRADES

Investment ideas are often formulated either as outright positive or negative views on a market, or as relative value views between two or more markets or securities. For an outright trade, the portfolio manager may well have a good idea of the appropriate size in percentage or duration terms. For relative value trades, however, the volatility of each leg of the trade, and the correlation between them affects the appropriate size. Relative value trades are often specified with equal weight or equal duration. Sometimes this approach leads to one leg of a relative value trade dominating the other.

2.1. Example – Short Japanese government bonds v emerging market debt

In a trade of short Japanese Government Bonds (JGB) versus Emerging Market Debt (EMD) with equal weight, the JGB leg has much lower volatility than the EMD leg. This means that the risk is dominated by the EMD position and very likely the return will be similar to that of a simple long EMD trade. The portfolio manager may reconsider the size of the EMD leg in the light of this information.
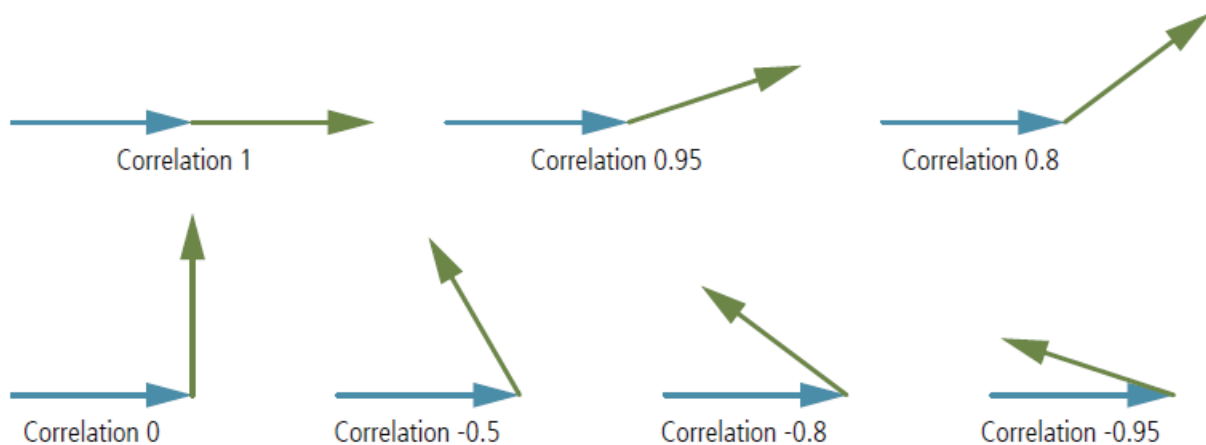
Figure 2: Example – short Japanese gov't bonds vs emerging market debt

Position	Duration (y)	Price volatility (%)	Contribution to risk (%)
JGB basket	−8.06	0.83	0.04
EMD basket	7.03	4.64	4.57
Total	−1.03	4.60	4.60

Source: Global Risk System. As of 20 October 2014. Total is a simple sum for duration and contribution to risk, but price volatility aggregation is not a simple sum because risk aggregation is affected by diversification and hedging effects. For illustrative purposes only. Not to be considered a recommendation to buy or sell a particular security.

We can visualise the trade using a risk triangle. In Figure 3, the length of the lines is proportional to the risk, and the angles between the lines represent correlation. Lines pointing in nearly the same direction show strong positive correlation, while lines at right angles show zero correlation. Lines in nearly opposite directions show strong negative correlation.

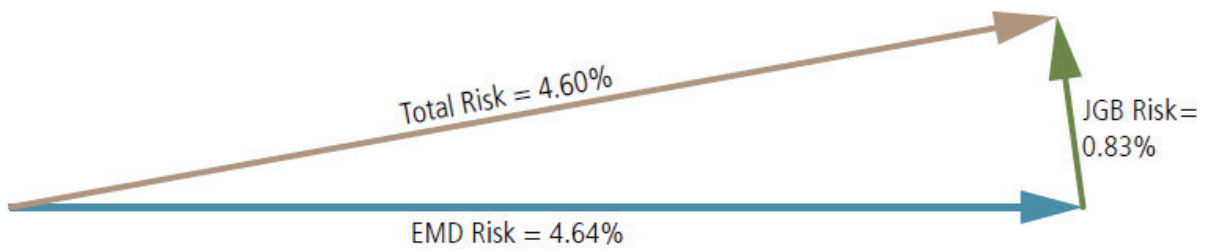Figure 3: Visualising the trade using a risk triangle

Source: UBS Global Asset Management

Looking at the angle at the bottom left of the triangle (Figure 4 below), you can see that the total risk is highly correlated with the EMD risk. Looking at the length of the lines, you can see that the total risk is almost the same size as the EMD risk. In this case, the short JGB position has a small negative correlation with the long EMD position, and reduces risk

slightly. The size and direction of the total risk line shows, that the total risk is dominated by the EMD position.
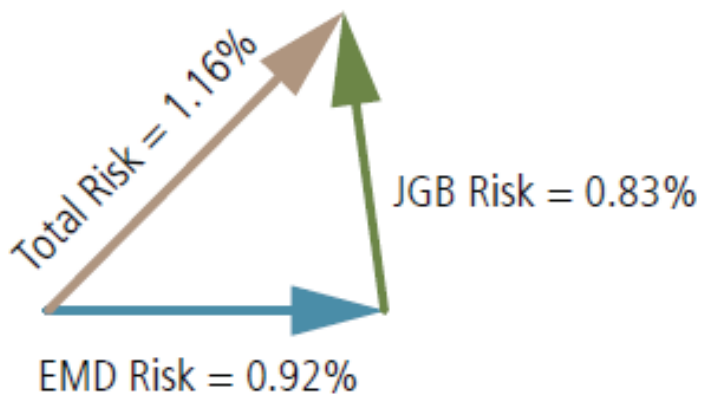
Figure 4: Example – short Japanese gov't bonds vs emerging market debt

Source: UBS Global Asset Management

Reducing the size of the EMD leg to a fifth of its original size makes the effect of each leg almost equal (Figure 5). The trade now has more of a cross-market character, rather than being dominated by one market. This can also help to contribute to diversification as discussed in the next section.

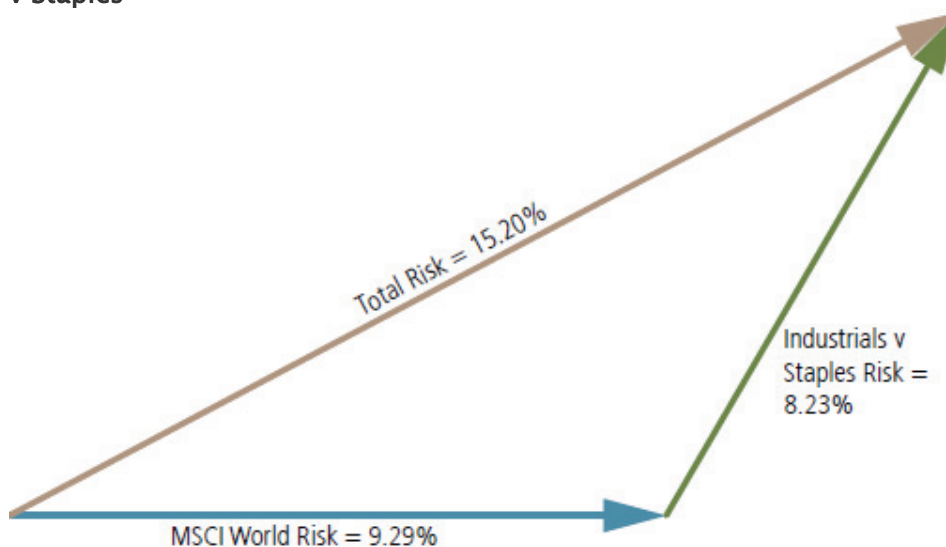**Figure 5: Example – reducing the EMD leg to a fifth of its original size**

Source: UBS Global Asset Management

3. COMBINING TRADES INTO A PORTFOLIO

A selection of what are believed to be attractive trades should be produced by the idea generation and debate phase of the investment process. The next step is to build these trades into an effective portfolio, balancing risk and return potential. Some trades may have returns that are expected to be highly correlated with each other. Often, these trades may express a theme like "risk-on", the idea that in a benign economic environment, where investors are seeking attractive returns and are not too worried about risk, prices of risky assets may increase. Equity, high yield debt, emerging market debt, and emerging market and commodity–related currencies may all increase in value, while safe haven currencies and high quality government bonds may decrease in value in relative or absolute terms.

For example, the directional trade long MSCI World, and the cross sector trade Industrials versus Staples could be seen as risk-on trades that would be expected to make a profit in such an environment. Figure 6 shows how their positive correlation gives only limited diversification benefit.

Figure 6: Example – Risk On – long MSCI World and cross sector trade Industrials v Staples

Source: UBS Global Asset Management. As of 20 October 2014.

Ideally, you would be able to combine a selection of trades with low correlations to form a portfolio, but in practice several potential trades may be highly correlated, all expressing a certain theme. It is helpful to construct a correlation matrix to identify clusters of highly correlated trades.

Figure 7 shows correlations using a short term and a long term risk model. The short-term model is calibrated using one year of historical data (1 September 2013 to 30 September

2014), and is a model used for assessing trades, as most trades have a life of less than one year. The long-term risk model is calibrated using seven years of historical data and includes the financial crisis of 2008. This gives a different perspective on correlations, and reminds us they can change over time. Correlation figures for the short-term model are shown in the lower left hand section below the diagonal, and correlation figures for the long-term model in the upper right hand section are above the diagonal.

Figure 7: Correlation matrix of trades

Risk Model Short Term\Long Term	Long MSCI World	Long Industrials v Staples	Short JGB v EMD	Short EUR v HUF	Short AUD v USD	Long JPY v G2
Long MSCI World	1.0	0.8	0.5	0.3	−0.6	−0.5
Long Industrials v Staples	0.5	1.0	0.3	0.3	−0.5	−0.4
Short JGB v EMD	0.4	0.1	1.0	0.2	−0.4	−0.3
Short EUR v HUF	0.1	0.0	0.2	1.0	−0.3	−0.1
Short AUD v USD	−0.2	0.0	−0.4	−0.5	1.0	0.4
Long JPY v G2	−0.6	−0.3	−0.2	−0.3	−0.1	1.0

Source: UBS Global Asset Management

A cluster of four trades are positively correlated with each other. These could be seen as risk-on trades. The other two – Short AUD vs USD and Long JPY vs G2 – could be seen as risk-off trades. G2 here represents an equal weighting to USD and EUR. The pattern of positive and negative correlations is mostly similar between the short- and long-term risk models, but there are a few exceptions.

This information can be used to help construct a portfolio. Other relevant information is the profit target and level of conviction for each trade.

3.1. Example – Equally-weighted trades

In this example, all the trades from Figure 7 are added in 10% weight to a sample portfolio containing the Global Securities Market Index (GSMI). This index consists of 65% MSCI AC World Index, 15% each of US and non-US Citigroup WGBI, and small amounts of high yield and emerging market debt. Cross market trades have a 10% weight in each leg.

Active risk is the risk of the portfolio containing the trades relative to the benchmark. Most of the risk comes from the equity trades. Currency risk is significant, but acts to decrease

the Assets Total Active Risk (the aggregate of equity and fixed income risk) by 10bp to get to the total active risk.

Figure 8: Equally-weighted trades

Summary	Total	Assets Total	Equity	Fixed Income	Alternative-	Currency
Active Risk	1.60%	1.70%	1.53%	0.46%	0.00%	0.85%
Portfolio Risk	7.09%	7.39%	7.17%	1.04%	0.00%	1.68%
Benchmark Risk	5.92%	5.83%	5.78%	0.73%	0.00%	1.65%
Beta w.r.t Benchmark	1.18	1.26	1.23	1.32	0.00	0.89
Correlation w.r.t Benchmark	0.99	0.99	1.00	0.92	0.00	0.87

Asset Class Weights			Equity	Fixed Income	Alternative-	Currency
Active Weight			10.00%	0.00%	0.00%	-10.00%
Portfolio Weight			75.19%	34.81%	0.00%	-10.00%
Benchmark Weight			65.19%	34.81%	0.00%	0.00%

Source: UBS Global Asset Management. As at 20 Oct 2014. For illustrative purposes only.

This can be seen as the equity and fixed income trades having a risk-on character, while the currency trades in aggregate tend to have a risk-off character. This becomes clearer when the trades are shown as building blocks (Figure 9 over page).
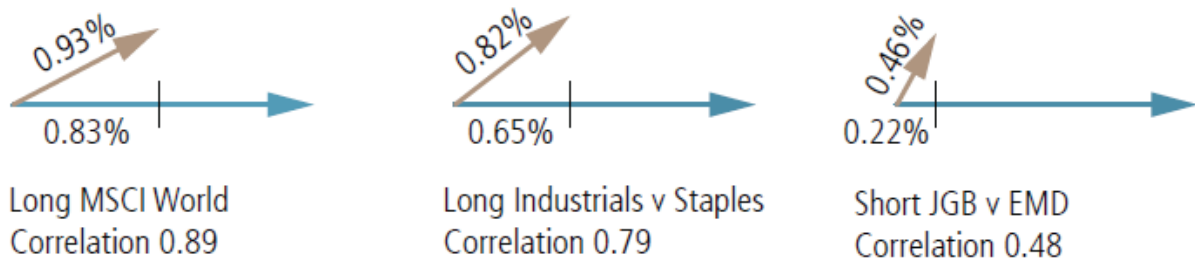
Figure 9: Trades as building blocks

Description	Active Position	Active Risk Exposure	Contribution to Active Risk	Mar. Contribution Active Risk
ROOT	0.00%	1.70%	1.70%	100.00%
Long MSCI World	10.00%	0.93%	0.83%	88.69%
Long Industrials v Staples	10.00%	0.82%	0.65%	79.15%
Short JGB v EMD	10.00%	0.46%	0.22%	48.30%
Passive Portfolio (GSMI)	0.00%	0.00%	0.00%	0.00%
Cash	−30.00%	0.00%	0.00%	0.00%

Source: UBS Global Asset Management. As at 20 October 2014. For illustrative purposes only. Not to be considered a recommendation to buy or sell any particular security.

The active risk exposure represents the volatility of each trade seen on its own. The Short JGB v EMD trade has a significantly lower volatility than the equity trades. This is common for fixed income trades. To have an equal risk, they usually need a larger nominal size. The contributions to risk are even more accentuated, as is always the case for any risk sources that are not perfectly correlated with the dominant risk source. The marginal contribution to risk can be interpreted as a correlation. The Long MSCI World trade is the largest source of risk, with a 0.89 correlation to the total assets risk.

Figure 10 (over page) shows the three asset allocation trades compared to the total assets risk. In each case, the number at the top, above the brown line shows the standalone risk of the trade, while the number at the bottom, below the blue line shows the risk contribution from the trade. The whole length of the blue line shows the total assets risk, with the thin vertical line showing the trade's contribution to risk.

Figure 10: Three asset allocation trades compared to total assets risk

UBS Global Asset Management. As at 20 October 2014

4. IMPROVING DIVERSIFICATION

Diversification can be improved by reshaping the sample portfolio to reduce its risk-on character. The risk information suggests:

- Rebalancing the legs of the fixed income trade so that the Short JGB leg plays a meaningful part, and increasing the overall size of the trade;

- Reducing the size of all the risk-on trades; and,

- Increasing the size of the risk-off currency trades.

After making these changes, the total risk has decreased by 16bp, with equity risk decreasing by 30bp, fixed income risk increasing by 24bp and currency risk increasing by 33bp. The sample portfolio has become more diversified, with a more even balance of risk between the asset classes. You can also see this in the building block view, where the contribution to risk from the three asset allocation trades (currency trades are not shown in this view) is more evenly distributed, and the marginal contribution from the Long MSCI World trade is somewhat reduced.

Figure 11: Rebalancing the fixed income trade, reducing the size of all risk-on trades and increasing risk-off currency trades
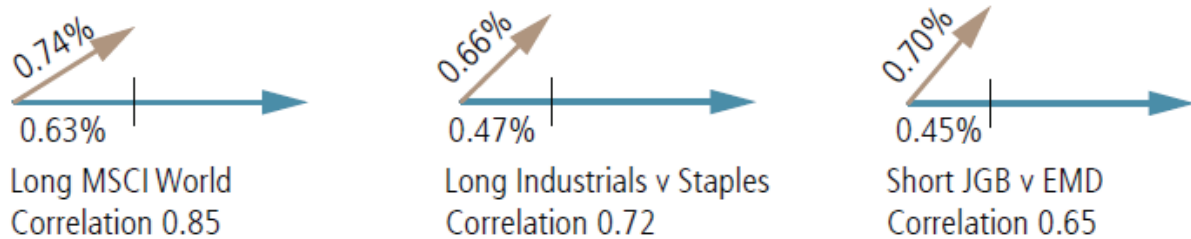
Sector	Total	Assets Total	Equity	Fixed Income	Alternative-	Currency
Active Risk	1.44%	1.55%	1.23%	0.70%	0.00%	1.18%
Portfolio Risk	6.65%	7.20%	6.89%	1.06%	0.00%	1.74%
Benchmark Risk	5.92%	5.83%	5.78%	0.73%	0.00%	1.65%
Beta w.r.t Benchmark	1.10	1.23	1.19	1.11	0.00	0.80
Correlation w.r.t Benchmark	0.98	0.99	1.00	0.76	0.00	0.76

Asset Class Weights			Equity	Fixed Income	Alternative-	Currency
Active Weight			8.00%	-48.00%	0.00%	40.00%
Portfolio Weight			73.19%	-13.19%	0.00%	40.00%
Benchmark Weight			65.19%	34.81%	0.00%	40.00%

Description	Active Position	Active Risk Exposure	Contribution to Active Risk	Mar. Contribution Active Risk
ROOT	0.00%	1.55%	1.55%	100.00%
Long MSCI World	8.00%	0.74%	0.63%	84.88%
Long Industrials v Staples	8.00%	0.66%	0.47%	71.72%
Short JGB v EMD	60.00%	-0.70%	0.45%	64.73%
Passive Portfolio (GSMI)	0.00%	0.00%	0.00%	0.00%
Cash	-76.00%	0.00%	0.00%	0.00%

Source: UBS Global Asset Management. As at 20 October 2014. For illustrative purposes only. Not to be considered a recommendation to buy or sell any particular security.

Figure 12: Reshaped sample portfolio

Long MSCI World
Correlation 0.85

Long Industrials v Staples
Correlation 0.72

Short JGB v EMD
Correlation 0.65

Source: UBS Global Asset Management

It is worth noting that although the risk from the currency trades has increased significantly, they still reduce the assets total risk, and even by a bit more than they did before. This shows that you may increase the possibility of returns and reduce risk by balancing the size of the various asset allocation and currency trades in a portfolio. The change in return expectations for the portfolio depends on the return expectation for each trade.

The value of diversification

For actively managed portfolios, the information ratio (as defined by Grinold and Kahn, Active Portfolio Management, 2nd Ed. McGraw-Hill 1999) is often used as a measure of risk-adjusted performance. The information ratio can be defined as the product of the square root of breadth and the information coefficient that represents skill. Breadth is defined as the number of independent investment decisions taken per year. If trades have a common theme like risk on, they are not independent. If they have a strong common theme, then the breadth is significantly reduced. This means that the expected return for a given level of risk is less if trades are highly correlated. Therefore, selecting trades that are not highly correlated with each other tends to improve the information ratio, and can lead to a better risk/return profile for the portfolio.

5. DOWNSIDE PROTECTION

As well as sizing the trades for an effective risk/return combination, you may be concerned about possible losses in an absolute sense (i.e. not relative to the benchmark). These can be seen using downside risk measures such as Value at Risk (VaR) and Expected Shortfall (ES). Using a stochastic volatility model that allows for fat tails in the distribution of returns, it's possible to see whether the tail of the distribution is fat – or, in other words, whether losses are likely to be larger than suggested by a normal distribution – by looking at the ratio of portfolio VaR and ES to risk. For a one-month time horizon used for tail risk measures, the ratio of VaR 1% to risk for a normal distribution would be 0.67, and for ES 1%, 0.76. In the sample portfolio, the ratios are 0.68 and 0.82. This means that larger losses are a little more likely than would be calculated using a normal distribution.

5.1. Example – downside protection with a put option

In this example, we buy a put on the S&P500 with strike 1600, and maturity December 2015 (about 14 months' time from the "as of" date 17 October 2014), and go long S&P500 futures to try to make the portfolio delta neutral. The level of the S&P500 on 17 October 2014 was 1887. The put has a nominal amount of 50% of the value of the sample portfolio, and a present value of 1.83% of the value of the sample portfolio.

Figure 13: VaR1% before downside protection

Summary	Total	Assets Total	Equity	Equity Fixed Income	Alternative-	Currency
Active VaR	1.01%	1.10%	0.87%	0.48%	0.00%	0.79%
Portfolio VaR	4.54%	4.94%	4.79%	0.70%	0.00%	1.17%
Benchmark VaR	4.07%	4.00%	3.98%	0.49%	0.00%	1.13%
Leverage w.r.t Benchmark	1.12	1.23	1.20	1.44	0.00	1.03

Asset Class Weights			Equity	Equity Fixed Income	Alternative-	Currency
Active Weight			8.00%	−48.00%	0.00%	40.00%
Portfolio Weight			73.19%	−13.19%	0.00%	40.00%
Benchmark Weight			65.19%	34.81%	0.00%	0.00%

Source: UBS Global Asset Management. As of 20 October 2014.

Figure 14: VaR1% with downside protection

Summary	Total	Assets Total	Equity	Equity Fixed Income	Alternative-	Currency
Active VaR	1.82%	1.77%	1.69%	0.48%	0.00%	0.79%
Portfolio VaR	3.14%	3.40%	3.12%	0.70%	0.00%	1.17%
Benchmark VaR	4.07%	4.00%	3.98%	0.49%	0.00%	1.13%
Leverage w.r.t Benchmark	0.77%	0.85%	0.78%	1.44%	0.00	1.03%

Asset Class Weights	Equity	Equity Fixed Income	Alternative-	Currency
Active Weight	8.98%	−48.00%	0.00%	39.02%
Portfolio Weight	74.17%	−13.19%	0.00%	39.02%
Benchmark Weight	65.19%	34.81%	0.00%	0.00%

Source: UBS Global Asset Management. As of 20 October 2014.

With downside protection, the portfolio VaR is reduced by 140bp, although portfolio risk actually increases by a small amount (9bp, screenshot not shown). The ratio of VaR to risk becomes 0.47, showing how the downside tail of the distribution has been reduced. You may notice how active risk is increased. This is because the large option position has significant volatility (Vega) risk. If volatility decreases, the value of the option decreases, and this is a potential source of underperformance relative to the benchmark.

It is also possible to look at downside protection using stress testing. Figure 15 and 16 show how the portfolio might have performed in a series of past events. The effects of the option position are most noticeable in the October 2008 whole-year scenario, where simulated losses are reduced by about 6%, and also in the 2009 Recovery Quarter scenario, where simulated gains are extended by about 3%.

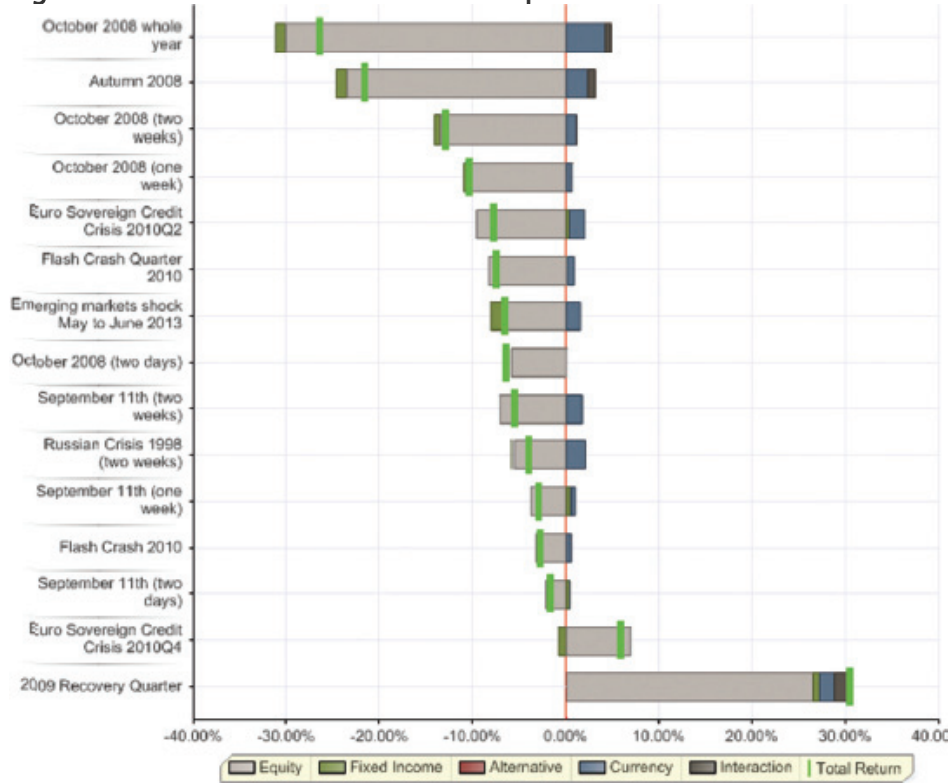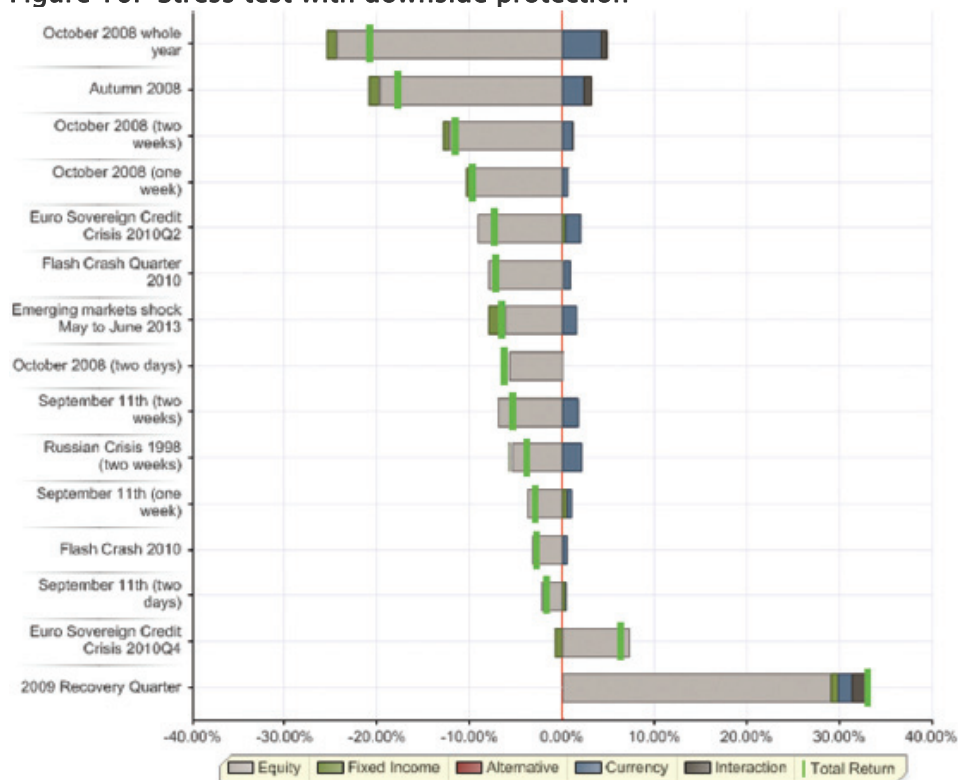Figure 15: Stress test before downside protection

Figure 16: Stress test with downside protection

6. CONCLUSION

When integrated into the investment process, risk management can help portfolio managers achieve a more attractive risk/return profile in portfolios. Diversification can be improved, and the characteristics of option strategies such as downside protection can be explored. In this way, portfolio managers' skills can be applied more effectively, and portfolios can be better adapted to clients' needs.

7. APPENDIX: STRESS TEST SUMMARY

The historical scenarios cover a range of past events. Most are crisis scenarios where risk assets decreased in value but, in some scenarios, risk assets increase in value, or different asset classes are affected in different ways. The scenario set focuses more on recent history rather than events in the distant past, as more reliable historical data is available, and more recent scenarios may be more relevant to current market conditions.

Figure 17: Scenario stress test summary

Scenario name	Start date	End date	Equity	Treasury rates	Credit spreads	EUR (v USD)	AUD (v USD)	MXN (v USD)
Russian Crisis 1998 (two weeks)	21–Aug–1998	03–Sep–1998	down	mixed	widen	strengthen	strengthen	weaken
September 11th (two days)	10–Sep–2001	12–Sep–2001	down	down, steepen	small changes	strengthen	strengthen	weaken
September 11th (one week)	06–Sep–2001	12–Sep–2001	down	down, steepen	narrow	strengthen	weaken	weaken
September 11th (two weeks)	06–Sep–2001	19–Sep–2001	down	mixed	widen	strengthen	weaken	weaken
October 2008 (two days)	08–Oct–2008	10–Oct–2008	down	up, steepen	widen	weaken	weaken	strengthen
October 2008 (one week)	06–Oct–2008	10–Oct–2008	down	up, steepen	widen	weaken	weaken	weaken
October 2008 (two weeks)	01–Oct–2008	15–Oct–2008	down	up, steepen	widen	weaken	weaken	weaken
Autumn 2008	09–Sep–2008	01–Dec–2008	down	down, steepen	widen	weaken	weaken	weaken
October 2008 whole year	03–Jan–2008	30–Dec–2008	down	down, steepen	widen	weaken	weaken	weaken

2009 Recovery Quarter	02–Mar–2009	02–Jun–2009	up	up, steepen	narrow	strengthen	strengthen	strengthen
Flash Crash 2010	05–May–2010	07–May–2010	down	mixed	widen	weaken	weaken	weaken
Flash Crash Quarter 2010	31–Mar–2010	30–Jun–2010	down	down, flatten	widen	weaken	weaken	weaken
Euro Sovereign Credit Crisis 2010Q2	02–Apr–2010	02–Jul–2010	down	down, flatten	widen	weaken	weaken	weaken
Euro Sovereign Credit Crisis 2010Q4	04–Oct–2010	04–Jan–2011	up	up, steepen	narrow	weaken	strengthen	strengthen
Emerging markets shock May to June 2013	21–May–2013	24–Jun–2013	down	up, steepen	mixed	strengthen	weaken	weaken

Source: UBS Global Asset Management. As at 20 October 2014.

7.1. Russian Crisis 1998

This scenario covers two weeks around the Russian default and rouble devaluation of August to September 1998. The most strongly affected assets are the rouble exchange rate and interest rates. Global equity process also decline, and credit spreads widen.

7.2. 11 September 2001

The terrorist attacks on the World Trade Centre in New York on 11 September 2001 led to market turmoil. This is captured in scenarios over two days, one week, and two weeks. All periods show a decline in equity markets, but developed market treasury rates initially decreased before later showing a variety of changes. Credit spreads first widened only slightly, then widened further.

7.3. The financial crisis of 2008 and recovery of 2009

The financial crisis of 2008 is often regarded as the worst financial crisis since the crash of 1929. This important event Is covered at five different time horizons, and a scenario for the strong recovery in equity markets in spring 2009 is also included. In these scenarios, the longer the period, the larger the decline in equity markets: around 40% over the whole year; 30% in the autumn of 2008; 20% in two weeks; 15% in one week; or, 9% in two days. High quality treasury bonds initially decreased in value, but after two weeks stabilised, and later

increased strongly in value. Credit spreads widened and risk assets generally reduced in value in a strong flight to quality type of scenario.

From March 2009, there was a strong recovery in equity prices. Government yields for longer bonds increased back to pre-crisis levels, but shorter term yields remained low. Credit spreads narrowed and risk assets generally increased in value.

7.4. Flash crash 2010

The flash crash of 6 May 2010 was a short, sudden intra-day dip in US equity prices. However, a significant decline occurred over a longer period – about a 5% decline in the S&P 500 index over two days, and about 12% over the quarter. The two scenarios capture a short- and a long-term view of this event and the surrounding period.

7.5. Euro sovereign credit crisis 2010

The Euro sovereign credit crisis lasted a long time, and different countries came under pressure at different times. The second quarter of 2010 saw the first strong rises in sovereign spreads as German yields fell around 50bp. Italian spreads widened by 75bp, and Spanish spreads by over 100bp. These spreads are measured relative to German government yields, which we consider to represent the base treasury rates for the Euro. Global equity markets declined with the S&P 500 falling by 13%, and the EuroSTOXX by 15%. The Euro weakened by about 7% against the dollar. Later on, in the fourth quarter of 2010, spreads widened further, with Irish and Greek credit spreads widening about 200bp, and Spanish spreads by 50bp. German yields increased by about 75bp during this period. French, Italian, and Portuguese spreads remained almost constant. Equity prices rose over this period, and credit spreads in markets other than the European sovereign market generally decreased. The Euro weakened by about 3% against the dollar. These two scenarios show contrasting behaviour of equity, high quality treasury yields, and spreads – other than European sovereign spreads, which widen in both scenarios.

7.6. Emerging markets shock summer 2013

Many emerging market currencies suffered significant declines in Summer 2013. This scenario looks at a one month period from 21 May to 24 June. World equity markets also declined, while treasury yields increased. The simultaneous decline of equity and high quality treasury bond prices is rather unusual, and makes this scenario distinct from more common flight to quality scenarios.

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