Effective downside risk management: Distinguishing between core protection and tail risk strategies
There is an increasing demand for protection against falls in markets and there is a wide range of instrument and strategies that can be used for downside risk management.

We find that:

» In order to decide on the appropriate approach to managing downside risk, investors need to be clear about their risk tolerance for different outcomes.

» Downside risk management is complex and involves understanding the nature of volatility and the costs involved.

» Improved diversification is the first step in any downside risk management programme. Layers of protection can then be added that are consistent with the investor’s risk tolerance.

» Dynamic management is necessary for some instruments given the high cost of holding them for an extended period.

» An approach that combines core protection with hedging tail risks is more adaptable to changing conditions.
The aim of this paper is to understand the benefits and the drawbacks of downside risk management techniques within a portfolio context.

After 2008 the desire to avoid significant losses is at the forefront of investors’ minds, evidence of which can be seen in a sharp rise in the demand for volatility-based instruments. The approach to managing downside risk, however, is not the same for every investor. It is determined by a number of key decisions, made either at the plan or portfolio level, on issues that include:

» The level of risk tolerance
» The time horizon
» The likely cost
» The anticipated trade-off between risk and return
» The assets to which these strategies should be applied.

Effective portfolio construction is essential in managing downside risk and the evolution of more sophisticated diversification methodologies has helped to reduce risk without materially compromising expected return. Traditional balanced portfolios have become better diversified over time through the addition of new asset classes. However, increased globalisation and the interdependence of asset classes have led to an increase in their correlation at times of crisis. A focus on risk weighting rather than capital weighting, and risk premia rather than asset classes, should lead to better diversified portfolios that are less susceptible to drawdowns. Risk premia are, however, still subject to mispricing and a liquidity shock can cause a dramatic increase in their correlation. Consequently, additional levels of downside risk management are still required by some investors.

Rules-based strategies offer protection that is permanently embedded and that can insure against severe market falls. These strategies involve trading decisions that are not based on active judgment but on the signal from a rule that is conditioned on the prior performance of the asset. They can be suitable for investors who prefer approaches in which cause and effect can be easily identified. The rules-based approaches that we examine are volatility cap strategies, momentum strategies and Constant Proportion Portfolio Insurance (CPPI). Although these strategies can be successful in meeting their objectives, each has its drawbacks such as a limited participation in market rallies or the overfitting of a model. Unlike these rules-based approaches, Tactical Asset Allocation (TAA) is dynamic and usually dependent on the skill of the manager supported by fundamental or quantitative inputs. The rationale for its success lies in the need to respond to changing financial and economic conditions but persistence of returns can be difficult to achieve.

As well as overall strategies for managing downside risk, there are specific instruments to do this of which options are the most commonly used. Experience shows that the systematic purchase of put protection can be costly so a tactical approach is inherently appealing. However, the time available to make a profit through the tactical management of options or volatility futures can be very short since, by its very nature, a crisis does not tend to endure and may reverse quickly. We have devised a framework for distinguishing between core protection, with a low cost of carry, and tail strategies that must be opportunistically applied. A framework for when to apply tail protection is, therefore, essential.

We propose a more rigorous and diversifying approach to downside risk management through effective portfolio construction and the use of core protection and tail risk strategies. This requires the constant monitoring of the investor’s objectives and downside risks, as well as the market environment, so as to be able to utilise the most appropriate and cost effective strategies available. The manager must be aware of the cost of running these strategies, how to access them, their hidden risks and have in place robust risk management systems and an effective operational platform. Different strategies are suitable for different scenarios and investment time horizons. This requires that the manager understands and controls multiple parameters such as time, price and volatility, as well as other considerations such as risk budgeting and the portfolio beta to systematic risk.
1. The demand for downside risk management

“Rule No.1: Never lose money. Rule No.2: Never forget rule No.1.” This saying from Warren Buffett emphasises the importance of managing downside risk when investing. Tversky and Kahneman defined loss aversion as the tendency to prefer avoiding losses to making gains and judged that any losses are psychologically twice as powerful as similar gains. Since the market crisis in 2008, demand for strategies that protect against ‘left tail’ events, or significant negative returns, has increased substantially. It was Nassim Taleb\(^1\) who helped draw attention to ‘black swans’ which are highly improbable and unpredictable events but that nonetheless have a massive impact on markets and which appear less random and more predictable on subsequent analysis.

However, 2008 was only the catalyst for this increased interest in downside risk management strategies. The global financial crisis is part of an extended debt cycle that began in 1980. Over the next thirty years, helped by the disinflationary tailwinds of globalisation, deregulation and technology-led productivity gains, central banks were able to cut rates each time there was a recession without the fear of inflation. This cycle allowed, and even rewarded, the accumulation of debt and it culminated in the ‘sub-prime crisis’ that led to the global financial crisis and the collapse of Lehman Brothers. The media has increasingly taken to referring to the period from the bursting of the tech bubble to the present day as the ‘lost decade’ in conscious reference to Japan where interest rates reached their zero bound, equity markets de-rated and deflation set in. It is partly the fear that we are in an environment that is unfamiliar to most market participants, with limited policy options and with uncertain outcomes, that has led to this interest in downside protection. Meanwhile the bond yields of safe-haven government bond markets so low, there is no obvious diversifying asset.

Confronted by greater volatility in markets, investors found that diversification out of equities into other asset classes did not protect portfolios as they had expected and instead found correlations rising as depicted in Figure 1.

**Figure 1: The historical drawdown for equities, a traditional balanced and a diversified portfolio**

It is partly the fear that we are in an environment that is unfamiliar to most market participants, with limited policy options and with uncertain outcomes, that has led to this interest in downside protection.

According to a survey from Tower Group\(^3\) institutional investors and pension funds are looking for new means of limiting risks as they face greater pressure from stakeholders to be better protected in the event of a repeat of the 2008 crisis. This increase in demand for risk management is demonstrated by an exponential increase in the demand for volatility-based instruments (Figure 2). For example, since March 2009, the open interest on VIX futures contracts (the first and second month) and the number of shares outstanding of the largest volatility ETF had each increased fivefold as of April 2012.

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2. We modelled this using the following asset allocation: 40% fixed income, 17.5% real assets, 16% private equity, 13.5% absolute return, 7.5% overseas equity and 5.5% domestic equity. The equity component of the reference portfolio (60%) has been replaced with the endowment model. The endowment model is predicated on the ability of long-term institutions such as Yale to receive an illiquidity premium.
Not only has the demand for options increased but they are now positioned for more extreme outcomes. The realised probability of a fall of at least 50% in the S&P500 index over the next twelve months has only been 2.9% since 1929. In 2007 the percentage of open interest or put options on the S&P500 (with a six month maturity) with strikes at least 50% below the spot price was less than 2.5% as shown in Figure 3. However, in April 2012 more than 25% of the open interest of December put options on the S&P500 were at strikes at least 50% below the spot price (as shown in Figure 4). The relatively high proportion of put options with significantly out-of-the-money strikes may be driven by:

» an increasing demand for volatility hedging activities
» the need for cheaper deep out-of-the-money protection (since protection at levels closer to the market can be very expensive)
» the increasing use of the S&P500 as a proxy to hedge the risk deriving from exposure to other equity or credit markets.


Source: Schroders, Bloomberg. Data as of 20 April 2012. Open interest by strike on listed S&P500 index put options maturing in December 2012 taken as a percentage of total open interest.

Source: Schroders, Bloomberg. Open interest on listed 50% out-of-the-money S&P500 December put options, 6 months before expiry with the exception of the open interest on the December 2012 put option, as at the 20 April 2012. Period from June 2007 to April 20, 2012.
2. Issues that investors should consider

The approach to managing downside risk, however, is not the same for every investor. It is determined by a number of key decisions, made either at the plan or portfolio level, on issues that include:

- The level of risk tolerance
- The time horizon
- The likely cost
- The anticipated trade-off between risk and return
- The assets to which these strategies should be applied.

**Risk tolerance**

It is critical to be able to assess risk aversion in terms of an investor’s tolerance of the failure to achieve his or her objectives, such as a target return, and the ability to cope with a large loss. This will then help define how much downside protection an investor requires. Additionally, an investor needs continually to reassess his or her tolerance for risk in the light of market movements. For example, does an investor who can tolerate a 10% fall in markets retain the same tolerance after the markets have already fallen 10%?

**Time horizon**

One of the most important considerations for investors is the length of their time horizon. For example, downside risk strategies may not be appropriate if investors are comfortable with the volatility that can come from marking positions to market over a given time period. A Constant Proportion Portfolio Insurance (CPPI) strategy, for example, is sensitive to the maturity as well as to the yield of the bonds that are used to set the floor value. Similarly, the decision to hedge a risky asset may be tactical and apply only to a particular time period.

**Cost of downside management**

Investors need to assess how much they are willing to pay for protection against an adverse event affecting their portfolio given the probability of that event occurring. Downside risk strategies have a cost and work like insurance policies; investors pay a premium that is either fixed or that, by capping their upside returns, could even increase their opportunity cost if the insured event does not occur. As part of the process it is important to assess any costs (whether realised or opportunity) so as to understand better how these strategies are likely to behave and to recognise any hidden risks (such as credit or liquidity).

The increased demand for hedging strategies has led to an increase in their cost. The cost of volatility futures and options can be assessed by analysing: the size of the roll yield, the difference between forward and spot implied volatility; and the difference between implied and realised volatility. Since 2008, these costs have been increasing sharply as demonstrated in Figure 5.

**Figure 5: The cost of investing in volatility instruments**

![Figure 5: The cost of investing in volatility instruments](image)

*Sources: Schroders, Bloomberg. Data from 31 December 2004 to 30 March 2012, monthly data, 30 days realised volatility of the S&P500 Index (Bloomberg), VIX Index as spot implied volatility (Bloomberg), 1st forward is the futures contract on the VIX index maturing in one months time (UX1 Index, Bloomberg), 2nd forward is a generic VIX index 2nd maturity (UX2 Index, Bloomberg).*
The trade-off from using downside risk management

Investors need to assess the trade-off between the potential gains from the successful application of a downside risk management strategy and the potential losses they face from its misuse. In a low return and high volatility environment they are forced to reassess their investment process and their approach to risk control so that they can better understand, and therefore manage, downside risks. Moreover, the constant pressure to outperform means that this has to happen without significantly capping upside returns.

The assets to which downside risk management should be applied

While this paper focuses, in the interests of clarity, on how downside protection strategies can be applied to specific asset classes, we believe such strategies are more robust when applied at the overall portfolio level across all asset classes. Even though downside risk management is often thought to apply primarily to equity markets, in the recent liquidity crisis most asset classes became highly correlated (with the exception of some high quality bond markets). This happened just when diversification was most needed and demonstrates that risk management should be thought of at the portfolio level.

3. Effective Portfolio Construction

Although diversifying across different asset classes should result in a narrower spread of returns, portfolios may still be exposed to systemic risk from a collapse in markets precipitated by a severe, economy-wide downturn or to hidden risks across asset classes. This was demonstrated in 2008 when liquidity risk was not adequately diversified away for most investors.

In this section, we analyse the limits of diversification starting with a representative 60/40 portfolio and show how this can be improved, to some extent, through diversification. The diversified multi-asset strategy is aimed at improving the quality of the growth engine by replacing the equity portfolio with alternative assets that deliver equity like returns but with lower volatility. We then highlight a further evolution using a risk premia-based approach that improves on this diversification model.

Based on our analysis, the representative portfolio that we shall use for reference throughout this paper (comprising 60% US equity and 40% US Global Aggregate fixed income) has a 22.6% historical probability of losing capital in any one year, a volatility of 9.6% per annum and a CVaR of -15.8%. Its maximum drawdown was -30.3% in 2008. The portfolio is not well diversified since 86% of its risk comes from the equity risk premium and exposure to the term premium diversifies away only 8% of the total risk, as shown in Figure 6. When we apply the same analysis to the diversified portfolio we find that the portfolio has a higher volatility (11.5%) but a lower CVaR of -13.7%, and a maximum drawdown of -30.4%.

Traditional portfolios that have a capital allocation of 60% equities and 40% bonds have a risk allocation more consistent with 90% equities and 10% bonds. One remedy for this would be to create a risk-weighted portfolio that aims to have a more balanced allocation to risk. Although more diversified, such a strategy would have a much lower expected return as it would have to allocate more of its capital to bonds.

In order to achieve an expected return commensurate with the 60/40 portfolio, some of the lower return assets, for example high quality bonds, would have to be leveraged. This is the essential idea behind a risk parity approach to multi-asset investing: that risk-weighting is more important than capital-weighting when building portfolios. However, whereas risk parity, as traditionally implemented, attempts to equalise risk across assets, a more robust approach is to allocate instead to ‘risk factors’ or ‘risk premia’ which are the common drivers of asset class returns. These risk premia can be grouped into categories depending on their factor sensitivities. These factor sensitivities could represent long-term fundamental return drivers like inflation or growth. A highly diversified portfolio can be obtained by risk weighting inflation and growth sensitive risk premia over time. Based on long-term estimates of the risk profiles of risk premia we formed a strategic portfolio aiming to maximise the risk/return trade-off subject to risk and concentration limits. This resulted in a portfolio with a return target which is similar to a 60/40 reference portfolio but with a lower volatility (5.9%), a lower CVaR of -12.1% and one that is better diversified (Figure 5) with a lower historical maximum drawdown of -12.8%.

4 The calculations of Conditional Value at Risk (CVaR) and volatility have been performed using five years of monthly data. All risk analysis uses a start date of 31 March 2007 and an end date of 31 March 2012. The 60/40 reference portfolio used throughout this paper comprises 60% S&P500 and 40% the Merrill Lynch US Corporate and Government Master Index.

5 CVaR is the Conditional Value at Risk. We have used a 95% confidence interval in our modelling. The CVaR is the average loss when the loss is located in the 5% of cases outside this confidence interval (i.e. a worst case loss) whereas Value at Risk looks at the likely loss ignoring this 5% (i.e. a best case loss). Maximum drawdown calculated as peak to trough fall over the period 31 March 2007 – 31 March 2012.
The recent financial crisis reminded investors that asset allocation is more important than stock selection in driving returns but that conventional approaches to asset allocation often produce disappointing results. There has consequently been a renewed emphasis on effective risk diversification as the central goal in portfolio construction. All three portfolios that we analysed targeted the same level of total return with volatility below 10%. However, as can be seen from Figure 7, both the reference 60/40 and diversified portfolios have a high beta to the S&P500, whereas the risk premia portfolio shows a lower sensitivity to equity risk. Additionally, the risk premia portfolio would have experienced significantly lower drawdowns in 2008 (as shown in Figure 8).

Figure 7: A comparison of twelve month rolling betas

Source: Bloomberg, Schroders, the Yale Endowment 2011. The rolling twelve month beta of each portfolio against the S&P500 index. The balanced portfolio comprises 60% S&P500 index and 40% Merrill Lynch US Corporate and Government Master Index. For the diversified portfolio we have replaced the equity allocation with a diversified growth engine using the average physical allocation of the Yale Endowment Fund between December 2006 and December 2011 as a proxy. The risk premium portfolio is the result of a back-test for the strategic beta portfolio managed by the multi-asset team. The model back-test performance shown above is hypothetical (not actual) and no representation is made that the particular combination of investments would have been selected at the commencement date, held for the period shown, or that the performance would have been achieved. The performance period extends from 30 March 1997 to 30 March 2012. Performance shown is past performance. Past performance is not necessarily a guide to future performance. The value of investments can go down as well as up and is not guaranteed. Performance is presented gross of fees.
Effective portfolio construction is essential in managing downside risk and the evolution of diversification methodologies has helped to reduce risk without materially compromising expected return.

Rules-based strategies offer protection that is permanently embedded and that can insure against severe market falls.

4. Rules-based approaches to managing downside risk

Rules-based strategies offer protection that is permanently embedded (core protection) and that can insure against severe market falls (tail risk). These strategies involve trading decisions that are not based on active judgment but on the signal from a mathematical rule that is conditioned on the prior performance of an asset. They can be suitable for investors who prefer approaches in which cause and effect can easily be understood and explained. The rules-based approaches that we examine are:

- Volatility caps driven by signals based on the prior volatility of the asset
- Momentum strategies driven by signals based on the prior price levels of the asset
- CPPI involving a dynamic allocation between a growth portfolio and risk-free assets.

Effective downside risk management: Distinguishing between core protection and tail risk strategies

Figure 8: Historical drawdowns of the 60/40 portfolio, the diversified portfolio and the risk premia portfolio

Source: Schroders, Bloomberg, the Yale Endowment 2011. The balanced portfolio represents 60% S&P500 index/40% Merrill Lynch US Corporate and Government Master Index. For the diversified portfolio we have replaced the equity allocation with a diversified growth engine using the average physical allocation of the Yale Endowment Fund between December 2006 and December 2011 as a proxy. The risk premia portfolio is the result of a back-test for the strategic beta portfolio managed by the multi-asset team. The model back-test performance shown above is hypothetical (not actual) and no representation is made that the particular combination of investments would have been selected at the commencement date, held for the period shown, or that the performance would have been achieved. The performance period extends from 30 March 1997 to 30 March 2012. Performance shown is past performance. Past performance is not necessarily a guide to future performance. The value of investments can go down as well as up and is not guaranteed. Performance is presented gross of fees.
Tactical Asset Allocation (TAA)

In this section we have focused on rules-based approaches but tactical asset allocation is also a market timing strategy that allocates actively between different asset classes. The rationale of increasing or decreasing the exposure of a portfolio to various asset classes is supported by the need to respond to changes in economic and financial conditions measured by growth, inflation, monetary or valuation cycles. TAA is usually driven by a combination of quantitative and fundamental inputs but ultimately depends on the skill of the manager, and on the efficacy of his or her process, so as to enable a quick and accurate response to changing financial conditions.

The success of TAA is heavily reliant on skill and data and is affected by survivorship bias since those managers that are not skilful fall by the wayside. However, research by Arnott, Robert, and Todd Miller supports the success of TAA, as does an Estrada study on fifteen equity markets over the last century, which showed that if an investor had missed the ten best days, this would have resulted in a poor performance while if he had missed the ten worst days, his performance would have been exceptional.

TAA can add flexibility to a strategic portfolio and can potentially limit some of the downside risk in a prolonged cyclical downturn and reduce the risk of being exposed to extremely expensive valuation levels. Persistence in returns, however, can be difficult to achieve.

4.1 Volatility cap strategies

Volatility cap strategies set a maximum ‘acceptable’ volatility level and reduce market exposure when the actual volatility of the portfolio exceeds this level. Volatility caps are often used as a tool to reduce, or give more certainty to, the hedging costs associated with guaranteed products.

We have simulated a simple volatility cap strategy. The annualised volatility of the 60/40 reference portfolio is capped at 11% on a daily basis. As volatility reaches 11%, we gradually hedge the portfolio by moving the portfolio into less risky assets. Such a strategy resulted in a slight reduction in portfolio risk to 9.2% compared to a 60/40 reference portfolio which has a volatility of 9.6% but the CVaR was higher at -17.4% relative to -15.8% for the 60/40 reference portfolio (as shown in Figure 8).

Figure 9: Simulation of the historical performance of a volatility cap strategy overlaid on the reference portfolio

Source: Bloomberg, Schroders, volatility cap compared to reference 60/40 portfolio using monthly data from 31/03/2007 to 31/03/2012. Portfolio composed of 60% S&P500 Index, 40% Merrill Lynch US Corporate and Government Master Index. Strategy consists of capping the volatility of the portfolio at 11% by selling equities and buying bonds when the volatility cap is reached. The simulated results must be considered as no more than approximate representation of the strategy’s potential performance. They are the result of quantitative back-testing which are based on a number of assumptions such as market liquidity and transaction costs. There are a number of limitations on the retroactive reconstruction of any performance results based on simulations. Past performance is not a guarantee of future results.

Volatility cap strategies have typically been successful in meeting their objective of limiting volatility. Additionally, they may result in reduced drawdowns because, in the case of repeated waves of selling, exposure may be reduced after the first stage of the sell-down and prior to the occurrence of subsequent waves. Although market exposure is unlikely to be fully restored during any rebound, the volatility-capped portfolio will typically start from a higher valuation base than a portfolio that lacks this mechanism for derisking.

4.2 Momentum strategies

The rationale for momentum strategies has its roots in concepts from behavioural finance10 such as investor herding, confirmation bias and overreaction. The success of managed futures funds, otherwise known as Commodity Trading Advisors (usually shortened to CTA), helped support the theory but their success may have been driven as much by diversification, risk management and P&L management, as by their signal generation. Momentum strategies have been the subject of numerous studies and this research provides significant evidence of their effectiveness11. Faber (2007)12 showed that, in comparison to a buy-and-hold strategy, it was possible to reduce the downside risk and volatility of a multi-asset portfolio while improving returns by using a simple momentum strategy.

We have created a simple momentum strategy for the 60/40 reference portfolio. It aggressively allocates +/-20% of equity around the neutral strategic allocation of the portfolio by allocating to bonds when the twelve month momentum of equities is negative and by allocating to equities when it is positive. In our simulation, this simple strategy would have enhanced returns on average from 3.7% to 4.9% per annum. At the same time, the portfolio volatility increased to 11.3% as the strategy allocated more into equities but its CVaR was reduced to -14.0% with a lower drawdown of -21.4% as shown in Figure 10.

Figure 10: Simulation of the historical performance of a momentum strategy overlaid on the reference portfolio

Source: Bloomberg, Schroders, momentum strategy compared to reference 60/40 portfolio using monthly data from 31/03/2007 to 31/03/2012. The volatility cap is set at 11%. Portfolio composed of 60% S&P500 Index, 40% Merrill Lynch US Corporate and Government Master Index for 40%. Strategy consists of holding 80% of S&P500 and 20% of Merrill Lynch US Corporate and Government Master Index when the momentum of the S&P500 over the last 12 months is positive and holding 40% of S&P500 and buying 60% of Merrill Lynch US Corporate and Government Master Index when the momentum of the S&P500 over the last 12 months is negative. The simulated results must be considered as no more than approximate representation of the strategy’s potential performance. They are the result of quantitative back-testing which are based on a number of assumptions such as market liquidity and transaction costs. There are a number of limitations on the retroactive reconstruction of any performance results based on simulations. Past performance is not a guarantee of future results.

There are pitfalls associated with momentum strategies of which probably the most significant is that the choice of parameters used may overfit a particular market pattern and that this pattern may not reoccur. In addition, there is always a compromise between the responsiveness of the signal chosen, allowing an investor to capture or exit a trend more quickly, and the degree to which that sensitivity generates ‘noise’ leading to false signals and costly turnover.

11 Chan, Hameed, Tong (1999), ‘Profitability of Momentum strategies in the international equity markets’.
4.3 Constant Proportion Portfolio Insurance (CPPI)

CPPI involves dynamically allocating between a growth portfolio and risk-free assets in order to target a guaranteed minimum level of return. We consider here two CPPI approaches applied to the 60/40 reference portfolio with a capital guarantee equal to 80% of the highest level achieved over the last ten years. Both CPPI approaches have a ten year maturity, four times leverage and the volatility of the growth asset is capped at 10%. The first CPPI approach started 10 years ago (and therefore is currently maturing) and the second started six years ago (and has four years still to run). This allows us to compare the volatility of a CPPI strategy close to its maturity with that of a CPPI strategy earlier in its life.

Over this period the first CPPI approach outperformed a buy-and-hold portfolio during the 2008 market crash but lagged in 2009 and afterwards as the CPPI mechanism automatically reduced exposure to equity when approaching maturity in order to protect the high-water mark, as shown in Figure 11.

At a 95% confidence level, the five year volatility is 6.2% and the CVar is -12.7% which compares to 9.6% and -15.8% for the 60/40 reference portfolio. The equity risk premium remains the main driver of returns.

The second CPPI approach, outlined above, and with four years to run, delivered similar returns to a buy-and-hold strategy but with a lower volatility and drawdown risk. The volatility was 7.9% and the CVar was -16.3%.

Figure 11: Simulation of the historical performance of a 10 year CPPI strategy overlaid on the reference portfolio

Source: Schroders, Bloomberg. Weekly data from 30 April 2002 until 30 April 2012. The simulated results must be considered as no more than approximate representation of the strategy's potential performance. They are the result of quantitative back-testing which are based on a number of assumptions such as market liquidity and transaction costs. There are a number of limitations on the retroactive reconstruction of any performance results based on simulations. Past performance is not a guarantee of future results.

In summary, these results illustrate that CPPI can deliver some exposure to a growth strategy as well as capital protection. However, the cost of this capital protection can be that participation in any capital growth is limited. The outcome of a CPPI strategy can be affected by several factors including: 1) the degree of leverage to the growth asset, 2) the time to maturity, 3) changes in interest rates, 4) a deterioration in the quality of the safe asset. Costs are associated with rebalancing, managing the gap risk and the quality of the bond portfolio used to construct the floor. The collapse of some government bond markets in the Eurozone which had been previously considered as risk free assets provides a good example of the hidden risks associated with these strategies.
5. The use of volatility-based instruments

As well as overall strategies for managing downside risk, there are specific volatility-based instruments such as options and volatility futures. In its simplest form the put option provides protection against a possible loss at a cost referred to as the premium outlay. The idea behind buying put options is to protect a portfolio against falls in a market beyond a particular level (in other words to provide tail risk protection). The use of options, therefore, results in truncating the distribution of returns. There are times when a buy-and-hold option strategy is an appropriate approach for an investor. If, for example, a pension plan needs to limit any potential future loss to a defined limit on the next valuation date, a buy and hold option strategy can provide a useful means to achieve this objective. Experience has shown that the systematic purchase of put protection can be costly so a tactical approach might prove more beneficial. However, as we show below, the time available to make a profit through tactical option management can be very short in a crisis. By its very nature, a crisis does not tend to endure and reverses quickly.

It is up to the investor to choose, the most appropriate strategy based on his or her risk appetite and portfolio objectives. Dynamic hedging processes (including the rapid monetisation of option strategies) may become more commonplace as awareness of the mark-to-market risk increases. It is important to understand that as the price and the volatility of the underlying evolves so too does the protection afforded by the option strategy. In other words, maturities and strikes matter.

Volatility futures can be added to a portfolio to dampen equity volatility. However, the use of these volatility derivatives is relatively new. In 1993 the Chicago Board Options Exchange introduced the VIX as the first volatility index. It was developed by Whaley based on the implied volatility of a basket of ATM (at-the-money) options on the S&P100. In 2003 a new methodology was introduced defining the VIX as an average of the implied volatility of OTM (out-of-the-money) options on the S&P500. Whaley called the VIX Index “the investors’ fear gauge index.” Futures were introduced in March 2004 and options in February 2006.

Since its introduction in 1986 until 2012, the VIX (and before that the VXO) moved above 30 for more than one week on only thirteen occasions and remained above this level on average for just 39 days. It stayed above 40 on seven different occasions for a period of 35 days on average (Figure 12). This shows that the time available to make a profit during a crisis is relatively short. It was only when the VIX managed to stay above 40 for 245 consecutive days between September 2008 and May 2009 that volatility instruments became so popular. This period was long enough to provide the opportunity to buy it and then to sell it at a profit.

Figure 12: The duration in days when the S&P500 volatility index has remained above 40

Volatility futures are exposed to a significant cost of carry which can detract from performance with the roll cost most destructive at the short end. In addition their mean reverting nature can lead to sharp reversals that make a long position costly over time. A dynamic approach is required to help prevent this attrition in value.
6. Using effective portfolio construction in combination with core and tail downside risk management

The ideal portfolio protection instrument should provide large absolute gains during severe market corrections and allow upside participation in positive markets, thereby creating a positive skew in the distribution of investment returns. In practice such an outcome is extremely difficult to achieve since hedging strategies are not costless. The long run performance of a hedge is a function of the losses incurred during calm markets and the gains made during a crisis event. The main reason for the divergence in performance lies with the cost of the hedge. Certain strategies face a high cost either as an upfront premium (put options) or cost of carry (volatility instruments). These costs can eat away at returns. But at the same time, these strategies can offer the highest level of protection during severe market corrections and should not be ruled out altogether. Instead we recommend adopting a dynamic approach to identifying the most appropriate hedge by taking into consideration the benefits and limitations we have identified.

For this reason we recommend that, in addition to effective portfolio construction using risk premia, investors should distinguish between core protection and tail risk hedges. Core protection is designed for normal market conditions and provides a positive payoff in moderate corrections. Tail risk hedges are designed to provide significant absolute gains during extreme market corrections and as a result these strategies tend to be more expensive. Investors need to decide what risks they are concerned about: whether it is the risk of moderate but persistent drawdowns (and therefore a core protection strategy is required) or the risk of very large drawdowns (in which case tail risk protection is more appropriate). Or perhaps they are sensitive to both risks in which case investors might consider allocating a portion of their risk budget to a basket of conditioned strategies to hedge tail-risks, thereby improving diversification, and allocating another part of their risk budget to core protection strategies.

Figure 13: Three levels of risk management

Source: Schroders.
Core protection explained

Core strategies are designed to provide low cost protection; as a result they are useful for a moderate correction. To reduce the cost, core protection typically uses spread strategies which involve buying one instrument and selling another instrument simultaneously to lower the cost of carry of the hedge. The most common examples of core strategies are detailed below.

**Put spread** – a put spread involves buying a put and simultaneously selling another put with a lower strike. For the purpose of this analysis, we are using a twelve month 95%-80% put spread. Selling the deeper out of the money put (80% of the underlying spot price) reduces the premium and the resulting performance drag. The strategy will provide protection for falls above the short put strike and will offer no additional support for much deeper corrections. Put spreads should be considered in situations where volatility has already spiked but where there is a risk that the market continues to sell off. The put spread offers the investor the opportunity to add protection at a lower cost, while the already elevated levels of volatility suggest that the probability of a more pronounced downturn is limited. The biggest risk is a more severe correction where markets fall below the short put strike. The gains on the long leg can therefore be eliminated by the loss on the short leg and the strategy offers no protection.

**Collar** – this involves buying a put and selling a call to fund the protection. For the purpose of this analysis, we are using a twelve month 95%-105% collar (in other words buying the put at 95% of the underlying spot price and selling the call at 105% of the price). The strategy is outright long protection and will outperform during a crisis, however, the capped upside can cause severe underperformance if the market rallies sharply. Collars should be considered when equities appear expensive and large upside gains are believed to be limited. The strategy will do well at the beginning of a correction and when the trend to the downside is strong although the upside cap makes collar strategies more sensitive to bear market rallies.

**Rolling calendar collar** – the strategy is designed to capitalise on the differences in the pricing of options across different maturities. In its simplest form the rolling calendar collar involves buying a long dated put option and funding the purchase by selling a succession of short dated call options. For the purpose of this analysis, we are using a twelve month 95%-one month 105% rolling calendar collar. By selling short dated call options the strategy benefits from the time decay on the call since this effect becomes more pronounced as it approaches expiry. Additionally, the probability that the call is exercised over the one month time frame is low reducing the risk of losses on the upside cap. Rolling calendar collars are useful in a normal market environment where the risk of a sharp rally is low.

**Put spread collar** – a combination of a long put, a short put with a lower strike and a short call. For the purpose of this analysis, we are using a twelve month 95%-80%-105% put spread collar (in other words the same as the collar but in addition selling a put at 80% of the underlying spot price). The investor anticipates a small correction but believes that the risk of a sharp reversal is limited. Put spread collars are useful when volatility is expected to remain contained and the risk of extreme moves on either side is limited. Here the investor looks to benefit from the premium gained from selling the call and the deeper out of the money put option. The biggest risk is a tail event either to the downside or to the upside.

We have assessed the effectiveness of three of the option strategies described above in combination with the reference 60/40 portfolio and comparing the results to that portfolio without any protection strategies:

» A twelve month put option at 95% of the spot price
» A twelve month put spread
» A twelve month rolling calendar collar.
As can be seen from Figures 14 and 15, the option strategies offer an improvement in the volatility and drawdown characteristics of the portfolio which translates into a higher information ratio. With the exception of the calendar collar strategy, we observe no improvement in returns. In other words, a buy and hold investment via a naked put option or put spread would have underperformed the main portfolio.

**Figure 14: The risk and return characteristics for a sample of option strategies**

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Annual Return</th>
<th>Annual Risk</th>
<th>Maximum Drawdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>60/40 Reference portfolio</td>
<td>3.7%</td>
<td>9.6%</td>
<td>-34.2%</td>
</tr>
<tr>
<td><strong>Option Strategies</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portfolio + Put option</td>
<td>3.2%</td>
<td>4.1%</td>
<td>-10.3%</td>
</tr>
<tr>
<td>Portfolio + Put spread</td>
<td>3.2%</td>
<td>7.2%</td>
<td>-23.7%</td>
</tr>
<tr>
<td>Portfolio + Rolling calendar collar</td>
<td>6.1%</td>
<td>4.2%</td>
<td>-3.6%</td>
</tr>
</tbody>
</table>

Source: Schroders, Bloomberg. Assumes a 100% notional exposure to the option strategies and buying or selling 12 month option contracts on the S&P500 that are held to maturity and rebalanced at expiry. Data from March 2007 to February 2012. Performance shown is past performance. Past performance is not necessarily a guide to future performance. The value of investments can go down as well as up and is not guaranteed.

**Figure 15: Simulation of the historical performance of a sample of option strategies (shown as overlays to the portfolio return)**

Source: Schroders, Bloomberg. Assume a 100% notional exposure on the option strategies. Buying 12 month option contracts that are held to maturity and rebalanced at expiry. Data from March 2007 to February 2012. The simulated results must be considered as no more than approximate representation of the strategy’s potential performance. They are the result of quantitative back-testing which are based on a number of assumptions such as market liquidity and transaction costs. There are a number of limitations on the retroactive reconstruction of any performance results based on simulations. Past performance is not a guarantee of future results.

Taking a closer look at Figure 15, it is clear that during a crisis period, such as the 2008 credit crunch, these strategies offer a significant level of protection by limiting downside losses although these gains are subsequently eroded by the costs associated with maintaining the position. This serves to emphasise the drawback of a buy-and-hold strategy using options. Additionally, the outperformance of the rolling calendar collar was a function of the premium earned from the sale of the calls which more than offset the losses from the puts over this period.

Our analysis shows that option strategies can limit downside losses but that the costs of maintaining the position can erode the benefits.
Effective downside risk management: Distinguishing between core protection and tail risk strategies

**Figure 16: Average performance of hedging strategies by bear market regime (excess return relative to S&P500 index)**

<table>
<thead>
<tr>
<th>Bear Market Regime</th>
<th>0% to -10%</th>
<th>-10% to -20%</th>
<th>-20% to -30%</th>
<th>&gt; -30%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1M Variance</td>
<td>10%</td>
<td>5%</td>
<td>0%</td>
<td>-5%</td>
</tr>
<tr>
<td>VIX 2nd</td>
<td>5%</td>
<td>10%</td>
<td>15%</td>
<td>20%</td>
</tr>
<tr>
<td>Put Spread collar</td>
<td>0%</td>
<td>5%</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>95% Put</td>
<td>5%</td>
<td>10%</td>
<td>15%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Source: Schroders, Bloomberg. Bear market regime represented by the magnitude of the drawdowns on the S&P500 index from February 2005 to February 2012 and the average excess return for each hedging strategy is measured over the entire period. Assume a 100% notional exposure on the option strategies that is held to maturity and rebalanced at expiry. The notional exposure on the volatility strategies adjusted to a standard deviation of 16%. A representation of the long term expected volatility of the S&P500 index. Shown for illustrative purposes only. Past performance is no guarantee of future results, performance is shown gross of fees. The value of investments can go down as well as up and is not guaranteed.

The option strategies we have investigated offer different risk and return profiles in different environments (Figure 16). An investor should buy put protection if he expects a sharp drop in the price of the underlying early in the life of the option (generally the first third), preferably when volatility is low in absolute terms and when implied volatility is low compared to realised volatility. A put spread should be favoured when the investor expects a limited drop without having any insight into when this might occur since the put that has been sold helps to offset the cost of the strategy. However, the put spread does not protect the portfolio if the price falls below the strike of the deep out-of-the-money option that has been sold. Finally, a collar strategy offers unlimited downside protection at a lower cost than a put option in isolation although it caps the upside of the underlying asset and in bull markets can provide a performance drag which, over the short term, can be four to five times larger than for a put spread.

**Tail risk strategies explained**

Tail risk strategies are designed to offer large gains during a severe market fall. In stressed environments risk assets often become correlated leading to large drawdowns at the portfolio level. Tail risk strategies exhibit a negative correlation to risk assets; consequently these assets have gained popularity amongst investors as an alternative source of diversification. However, the biggest drawback for tail risk strategies is the cost of maintaining the exposure. Put simply these strategies offer portfolio insurance but the upfront premium can be significant. The most common examples of tail risk strategies are explained below:

**Long put options** – put options are the most common tail risk strategy and provide a large payoff during a crisis event. The disadvantage is the upfront premium which can lead to a meaningful performance drag for a buy and hold strategy. Moreover, put options are sensitive to the movements in the underlying equity index and the time to maturity. The value of the option erodes with the passage of time and a significant fall in the underlying may be required to offset the losses incurred as the option approaches expiry.

**Volatility (VIX) futures** – exchange traded futures on implied volatility indices such as the VIX index are the most commonly traded volatility instrument. Periods of market stress are often associated with a spike in volatility and, as a result, volatility futures exhibit a negative correlation with risk assets. It is this that makes them a natural hedge against a market correction. But there are also limitations to holding these instruments. In order to maintain a constant exposure to volatility, the futures contracts are rolled at expiration. During calm markets the volatility futures curve is upward/positively sloping where the price of long dated volatility is higher than short dated volatility and as a consequence the investor is exposed to a roll cost. This cost can be significant and damaging to returns. Additionally, volatility is mean reverting and high levels of volatility cannot be sustained for an extended period.
We have investigated and assessed the effectiveness of adding volatility futures to the 60/40 reference portfolio. The allocation to the futures has been calculated so as to be volatility neutral to the reference portfolio. As can be seen in Figures 17 and 18, volatility strategies offer an improvement to the volatility and drawdown characteristics of the portfolio.

**Figure 17: The risk and return characteristics of volatility instruments**

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Annual Return</th>
<th>Annual Risk</th>
<th>Maximum Drawdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>60/40 Reference portfolio</td>
<td>3.7%</td>
<td>9.6%</td>
<td>-34.2%</td>
</tr>
<tr>
<td>Volatility instruments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portfolio + VIX short term future</td>
<td>2.5%</td>
<td>8.1%</td>
<td>-16.9%</td>
</tr>
<tr>
<td>Portfolio + VIX Mid-term future</td>
<td>7.3%</td>
<td>8.4%</td>
<td>-13.8%</td>
</tr>
</tbody>
</table>

Source: Schroders, Bloomberg. The notional exposure on the volatility strategies is adjusted to a standard deviation of 11%. A representation of the historical volatility for a balanced portfolio of 60% equities and 40% bonds. VIX short-term future represents the performance of the CBOE VIX 2nd month contract, VIX mid-term contract represents the performance of a daily rolling position in the 4th, 5th, 6th and 7th month CBOE VIX futures contracts. Data from March 2007 to February 2012. Performance shown is past performance. Past performance is not necessarily a guide to future performance. The value of investments can go down as well as up and is not guaranteed.

**Figure 18: Simulation of the historical performance of volatility instruments (shown as overlays to the portfolio return)**

Source: Schroders, Bloomberg. The notional exposure of the volatility strategies is adjusted to achieve a standard deviation of 11%. VIX short-term future represents the performance of the CBOE VIX 2nd month contract, VIX mid-term contract represents the performance of a daily rolling position in the 4th, 5th, 6th and 7th month CBOE VIX futures contracts. Data from March 2007 to February 2012. Performance shown is past performance. Past performance is not necessarily a guide to future performance. The value of investments can go down as well as up and is not guaranteed. The simulated results must be considered as no more than approximate representation of the strategy’s potential performance. They are the result of quantitative back-testing which are based on a number of assumptions such as market liquidity and transaction costs. There are a number of limitations on the retroactive reconstruction of any performance results based on simulations. Past performance is not a guarantee of future results.

There are other means of accessing volatility which can help alleviate some of the problems with investing in volatility futures: that they provide good tail risk protection but that the costs of holding them in a normal market environment can be very high.

**Volatility ETFs** – exchange traded funds that replicate a passive exposure to volatility futures.

The ETFs are designed to provide a constant exposure to a specific point along the volatility futures curve. For example the iPath Short-Term VIX futures ETN offers exposure to the 1st and 2nd month contracts while the Mid-Term Futures ETN offers exposure to the 4th, 5th, 6th and 7th month VIX futures contracts. The short dated contracts are more sensitive to changes in implied volatility but are also more vulnerable to the roll cost which can be severe at the short end of the curve. The medium term contracts face a lower roll cost but at the same time they are less sensitive to changes in the levels of implied volatility. On average the medium term contracts offer the better risk-adjusted returns but during periods of market stress the short dated futures clearly outperform. As such, a trade-off between cost and protection is required.
Volatility options (VIX Options) – these are option contracts on volatility futures. A long volatility position is established by buying a call option. The maximum loss is limited to the premium outlay; however, this outlay can be high and reflects the slope of the volatility futures curve as well as supply and demand dynamics for the options.

Third party indices – to overcome the high costs of holding volatility instruments a number of third party indices have been developed to provide exposure to volatility at much lower costs. These indices are based on a set of rules that determine the allocation to volatility futures.

Variance swaps – these provide exposure to future realised variance (volatility squared) and like volatility futures exhibit a negative correlation with risk assets. In addition, variance swaps offer positive convexity in returns that can magnify the returns during periods of market stress. The main drawback is the spread between implied and realised variance since a long position in a variance swap involves buying implied variance in exchange for realised variance at maturity. Typically, implied variance trades at a premium to realised variance and the higher the premium the greater the cost which accounts for the return profile of the variance swap in Figure 18. Moreover, variance swaps are OTC instruments that expose the investor to counterparty risk; a risk that increases at exactly the point when the investor may wish to monetise the gain on the hedge.

The cost of tail strategies over any meaningful period of time means that it is critical to be able to construct signals to identify when tail strategies should be bought and sold and to apply a core and tail approach within a dynamic framework for managing downside risk.

8. Momentum and conditioning: a dynamic approach to managing protection

Experience shows that the systematic purchase of put protection can be costly (as discussed earlier) and that a tactical approach might prove more beneficial. However, as we demonstrate below, the time available to make a profit through tactical option management can be very short in a crisis. Investing in a put option on the S&P500 in January 2011 may initially have appeared a wise choice given the volatility over the year. However, history showed that active management was required either to reset the option in the first quarter, then again in June-July or opportunistically to take profit during the turmoil of the 3rd quarter, as shown in Figure 19. If the buyer did not take some or all of these actions, the portfolio would have absorbed the full expense of the premium expense since the S&P500 finished the year flat.

Figure 19: Simulation of the performance of an S&P500 put option in 2011

Source: Bloomberg, Schroders. Cumulative return of a 12 month 5% out of the money S&P500 put option held from 31 December 2010 until 31 December 2011. Combined risk the performance of the S&P500 (Prime index). The simulated results must be considered as no more than approximate representation of the strategy’s potential performance. They are the result of quantitative back-testing which are based on a number of assumptions such as market liquidity and transaction costs. There are a number of limitations on the retroactive reconstruction of any performance results based on simulations. Past performance is not a guarantee of future results.
To provide an example of the added value possible from an active approach, we have devised a simple strategy that takes a view on options based on the twelve month momentum of the S&P500. Here, the objective is to add protection when the momentum turns negative and remove protection when the momentum is positive. The results are displayed in Figure 20 alongside the buy-and-hold strategy. This illustrates that an active approach can provide a meaningful improvement to performance.

Figure 20: Performance characteristics of a buy and hold approach relative to a dynamic process for managing volatility strategies

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Annual Return</th>
<th>Annual Risk</th>
<th>Maximum Drawdown</th>
<th>Annual Return</th>
<th>Annual Risk</th>
<th>Maximum Drawdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>60/40 Reference portfolio</td>
<td>3.7%</td>
<td>9.6%</td>
<td>-34.2%</td>
<td>4.9%</td>
<td>6.6%</td>
<td>-10.7%</td>
</tr>
<tr>
<td>Option Strategies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portfolio + Put option</td>
<td>3.2%</td>
<td>4.1%</td>
<td>-10.3%</td>
<td>4.5%</td>
<td>6.6%</td>
<td>-11.2%</td>
</tr>
<tr>
<td>Portfolio + Put spread</td>
<td>3.2%</td>
<td>7.2%</td>
<td>-23.7%</td>
<td>3.8%</td>
<td>8.5%</td>
<td>-24.5%</td>
</tr>
<tr>
<td>Portfolio + Rolling calendar collar</td>
<td>6.1%</td>
<td>4.2%</td>
<td>-3.6%</td>
<td>7.0%</td>
<td>6.8%</td>
<td>-9.4%</td>
</tr>
</tbody>
</table>

Source: Schroders, Bloomberg. The notional exposure on the volatility strategies are adjusted to a standard deviation of 11%. The 60/40 reference portfolio is a balanced portfolio of 60% equities and 40% bonds. VIX short-term future represents the performance of the CBOE VIX 2nd month contract, VIX mid-term contract represents the performance of a daily rolling position in the 4th, 5th, 6th and 7th month CBOE VIX futures contracts. Data from March 2007 to February 2012. Performance shown is past performance. Past performance is not necessarily a guide to future performance. The value of investments can go down as well as up and is not guaranteed.

Options do not provide a free lunch. The effectiveness and cost of an option strategy are also a function of the skew (the difference between the volatility of puts and calls), the volatility regime, the term structure of the implied volatility and the underlying market trends. Time decay can also significantly reduce the effectiveness of a strategy. The payment of a premium means that for this not to expire worthless, the required price movement needs to occur during the life of the policy. However, few people would wish to see their house burn down just because they have paid for their home insurance.

Although volatility can also be seen as an asset class it should not be used in a buy-and-hold strategy because of the decay in its value due to the cost of rolling the long volatility position. It is evident from Figure 5 that the cost of tail risk strategies is significant and in extreme cases these costs can completely eliminate the potential benefits of the hedge. Therefore the timing of an investment in a tail risk strategy is critical. The earlier the crisis event occurs the lower the impact of the cost on performance. To address these concerns, we recommend a dynamic approach to tail risk management that takes into consideration a market view. For example, tail risk strategies are effective when the risk of an imminent correction is high. At this point the potential gains on the hedge significantly outweigh the cost. In the recent crisis, the best time to monetise a long volatility position was mid 2008. It is, however, unlikely that investors who held a long OTC volatility exposure with Lehman Brothers as the counterparty would have reached the same conclusion. We believe that active management is required to invest in volatility derivative strategies. Investors should consider the expected changes in volatility compared to the cost of rolling the strategy and should understand the impact of a decline in volatility, as well as counterparty and liquidity risks.
Although rules to condition the decision to enter and exit positions are necessary, the success of these strategies will be a function of the reactivity of the parameters used to the underlying, the consistency and accuracy of the signals and even the future pattern of volatility itself and the underlying assets’ price movements.

We decided not to include variance swaps and forward variance swaps within this paper since data is more difficult to obtain. Variance swaps are, by the nature of their construction, expensive instruments in which to invest. They aim at delivering the payoff of the realised variance and benefit from the price asymmetry between realised and implied volatility. Their cost of carry is important because of the structural premium that investors pay for receiving realised volatility compared to implied volatility.

9. Downside risk – Putting it all together

Warren Buffet stated that “Risk comes from not knowing what you’re doing”. We have shown that the demand for downside risk management has increased with the pressure to avoid missing return objectives. Meanwhile increased fiduciary duties require that investment managers and investors understand downside risk management techniques and know when and how best to apply and control them.

In constructing a portfolio for an investor, the risk tolerance of the investor, with respect to core and tail risk, must be clearly understood in order build a suitable portfolio. As we have shown, downside risk protection strategies can incur significant cost and this cost needs to be incorporated into the expected risk/return profile of the portfolio.

Improving diversification by using risk premia that are lowly correlated is the first step to improving drawdowns. However, even a well diversified portfolio is likely to be exposed to the equity risk premium or other systematic risks.

Downside risk management is necessary to minimise exposure to systematic risk. The ideal portfolio protection strategy should be designed to provide large gains during severe market corrections and allow upside participation in positive markets, thereby creating a positive skew in the distribution of investment returns. In practice, such an outcome is extremely difficult to achieve since hedging strategies are not costless.

The information presented in Figures 22-24 suggests that there is a large dispersion in the payoff profile of the different hedging strategies over time. This highlights the importance of understanding the characteristics of each hedging strategy and identifying the levels of risk that a hedge will and will not protect against. The long run performance of a hedge is a function of the losses incurred during calm markets and the gains made during a crisis event. The main reason for the divergence in performance lies with the cost of the hedge. Certain strategies face a high cost either as an upfront premium (put options) or via the cost of carry (volatility instruments). These costs can eat away at returns. However, these strategies can offer the highest level of protection during severe market corrections and should not be ruled out altogether, instead we recommend adopting a dynamic approach to identify the most appropriate hedge by taking into consideration the benefits and limitations we have explored. For this reason, we recommend distinguishing between core protection and tail risk hedges.
Figure 21: For active management of the downside risk, distinguish between core and tail strategies

Core strategies are designed to provide low cost protection; as a result they are useful for a moderate correction. To reduce the cost, core strategies are typically ‘spread’ strategies that involve buying one instrument and simultaneously selling another instrument.

Tail risk strategies are designed to offer large gains during a severe market correction. However, as we have shown, the biggest drawback for tail risk strategies is the cost of maintaining the exposure. Therefore, these strategies need to be actively managed and the risk budget needs to be carefully monitored.

Good downside risk management is difficult. The investment manager must apply a rigorous methodology for downside and hedging strategies and be capable of allocating between actively managed core and tail risk strategies. The manager must also be aware of the cost of running these strategies, how to access them, their hidden credit and liquidity risk (OTC or listed) and have a robust risk management approach, operational framework and measurement system. Additionally, different strategies are suitable for different scenarios and investment time horizons. This, therefore, requires that the manager understands and controls not one, but multiple, parameters such as time, price and volatility as well as other considerations such as risk budgeting, insurance premium and the portfolio beta to systematic risk.

Source: Schroders.
Appendix I

In the tables below we have compared all of the approaches that we have evaluated in this paper, outlining when each approach is effective together with statistics on the historical volatility, CVaR and maximum drawdowns.

### Figure 22: Strategic portfolio construction

<table>
<thead>
<tr>
<th>Strategy Name</th>
<th>Instruments</th>
<th>Core or Tail</th>
<th>When Effective</th>
<th>Risks</th>
<th>Volatility</th>
<th>CVaR</th>
<th>Max Drawdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference Portfolio</td>
<td>Equity and bonds</td>
<td>Core</td>
<td>When bonds exhibit a low correlation to equities, allowing gains on bonds to offset losses on equities</td>
<td>Dominated by equity risk. Bonds can exhibit a positive correlation to equities</td>
<td>9.6%</td>
<td>-15.8%</td>
<td>-30.3%</td>
</tr>
<tr>
<td>Endowment Model</td>
<td>Diversify into alternative asset classes to reduce sensitivity to equity risk</td>
<td>Core</td>
<td>If any sell off is concentrated in a specific asset class</td>
<td>Equity specific risk is retained. Correlation increases during crisis period, exposed to liquidity risk</td>
<td>11.5%</td>
<td>-13.7%</td>
<td>-34.4%</td>
</tr>
<tr>
<td>Risk Premia Portfolio</td>
<td>Diversification across risk factors. Equal contribution to risk</td>
<td>Core</td>
<td>Stable correlation across risk premia allows for more consistent return profile</td>
<td>A regime shift that leads to a structural breakdown in correlations across risk premia</td>
<td>5.9%</td>
<td>-12.1%</td>
<td>-12.8%</td>
</tr>
</tbody>
</table>

Source: Bloomberg, Schroders.

### Figure 23: Rules based dynamic asset allocation

<table>
<thead>
<tr>
<th>Strategy Name</th>
<th>Instruments</th>
<th>Core or Tail</th>
<th>When Effective</th>
<th>Risks</th>
<th>Volatility</th>
<th>CVaR</th>
<th>Max Drawdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volatility Cap on reference portfolio</td>
<td>Algorithm-based dynamic allocation between growth portfolio and risk free component</td>
<td>Core</td>
<td>Trending market</td>
<td>Model parameters need to be adapted for regime shifts</td>
<td>9.2%</td>
<td>-17.4%</td>
<td>-27.2%</td>
</tr>
<tr>
<td>Momentum strategy on reference portfolio</td>
<td>Algorithm-based tactical allocation between growth portion and risk free component</td>
<td>Core</td>
<td>Trending market</td>
<td>Sharp reversal in the market direction and trend can be costly.</td>
<td>11.3%</td>
<td>-14.0%</td>
<td>-21.4%</td>
</tr>
<tr>
<td>CPPI strategy on reference portfolio</td>
<td>Algorithm-based dynamic allocation between growth portfolio and risk free component</td>
<td>Core</td>
<td>Trending market</td>
<td>Monetisation as the fund approaches the bond floor</td>
<td>6.2%</td>
<td>-12.7%</td>
<td>-23.8%</td>
</tr>
</tbody>
</table>

Source: Bloomberg, Schroders.

### Figure 24: Overlay protection and derivatives

<table>
<thead>
<tr>
<th>Strategy Name</th>
<th>Instruments</th>
<th>Core or Tail</th>
<th>When Effective</th>
<th>Risks</th>
<th>Volatility</th>
<th>CVaR</th>
<th>Max Drawdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downside Put</td>
<td>Invest in a put option to protect the portfolio against a fall in equity prices</td>
<td>Tail</td>
<td>The closer the investment in the put option is to the crisis event the better</td>
<td>At expiry, the cost is limited to the premium paid. Holding all else constant the value of the option deteriorates with the passage of time</td>
<td>4.1%</td>
<td>-13.0%</td>
<td>-10.3%</td>
</tr>
<tr>
<td>Put Spread</td>
<td>Buy a put option (i.e. a 12m 95% put) and simultaneously sell another put with a lower strike (i.e. a 12m 85% put)</td>
<td>Core</td>
<td>When volatility has already spiked and the risk of more aggressive sell off is low</td>
<td>A severe correction where the price of the underlying falls below the strike on the put sold</td>
<td>7.2%</td>
<td>-12.5%</td>
<td>-23.7%</td>
</tr>
<tr>
<td>Rolling Calendar Collar</td>
<td>Buy a long dated put option (i.e. 12m 95% put) and sell a succession of short dated call options (i.e. 1m 105% call)</td>
<td>Core</td>
<td>At the start of a correction when the trend to the downside is strong</td>
<td>A sharp rally that leads to losses on the sale of the call option. Vulnerable to bear market rallies</td>
<td>6.1%</td>
<td>-11.0%</td>
<td>-3.7%</td>
</tr>
<tr>
<td>Volatility Futures</td>
<td>Futures contracts on implied volatility indices such as the VIX index (i.e. VIX short-term contract)</td>
<td>Tail</td>
<td>Severe correction expected in the near term</td>
<td>Cost of rolling the contracts can be significant. A tendency for volatility to mean revert means that high levels are not sustainable and sharp reversal can be painful</td>
<td>8.1%</td>
<td>-13.0%</td>
<td>-16.9%</td>
</tr>
<tr>
<td>Variance Swaps</td>
<td>Variance swaps or forward variance swaps. Exposure to future realised variance</td>
<td>Tail</td>
<td>Severe correction expected in the near term</td>
<td>Exposed to actual market volatility (variance squared) cost of rolling, high premium</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Source: Bloomberg, Schroders.

As Tactical Asset Allocation is a function of skill and timing we have not shown additional analysis for these strategies.
Appendix II: Glossary

**Collar:** A derivative strategy that offers the investor a limited profit potential if the underlying asset rises and a limited loss if the underlying falls. The strategy is constructed through the combination of holding the underlying asset, a long put and a short call. Generally the put and the call are both out-of-the-money when the trade is established and have the same expiry date. It is often used by investors who wish to protect the value of an asset but are willing to give up some upside return for a reduced premium cost. Sometimes the cost is nil in which case this is known as a zero-cost collar.

**Conditional Drawdown (CDaR):** The average of the worst drawdowns experienced over a period of time based on a confidence parameter.

**Conditional VaR (CVaR):** This is a measure of the expected losses that exceed the VaR limit. CVaR calculates the average of the worst losses and is therefore more sensitive to the shape of the loss distribution in the tail of the distribution. It was created to meet some of the shortcomings of the Value at Risk approach such as the indifference to losses below the VaR confidence level, that VaR is non-additive and the assumption of normality in the distribution.

**Constant Proportion Portfolio Insurance (CCPI):** A strategy providing portfolio insurance whereby the manager dynamically allocates between safe assets (typically cash or government bonds) and a risky asset (such as equities) using a set of pre-defined rules.

**Derivative:** A financial instrument that derives its value from another asset or product. While derivatives can be used for speculative purposes they serve a vital role in risk management with a substantially deeper, more liquid and flexible market than exists for traditional assets such as equities and bonds.

**Downside risk:** The potential loss that could be sustained as a result of a market decline. The standard deviation of returns below a target (minimum acceptable return) weighted or not by the probability of occurrence or exponentially weighted in order to embed some memory of recent market events.

**Drawdown and conditional drawdown:** The peak-to-trough decline in an investment over a certain period of time. Usually expressed as a percentage.

**Futures contract:** An exchange traded binding agreement to buy or sell a financial instrument at a specified price on a stated delivery date. The underlying asset may be a financial instrument, commodity, currency or market index. The standardisation of exchange traded futures differentiates them from forwards.

**Gain Loss Spread:** In 2008, Estrada presented the Mean Gain-Loss Spread framework (GLS) that considers the probability of a loss, the average loss and the average gain of an investment. The GLS is the difference between the expected gains and expected losses of a distribution.

**Hedge:** A transaction that offsets the exposure of an asset or portfolio to fluctuations in price or some other risk. Usually engineered through a derivative instrument.

**Lower Partial Moment:** The LPM is defined as the average of the squared deviations below a target return. The lower partial moment (LPM) of return distributions helps investors better describe their risk aversion.

**Option:** Confers upon the holder the right but not the obligation to buy (call) or sell (put) an underlying asset, currency, commodity at an agreed price on or before a specified date (American style) or on a given date (European style).

**Put option:** An instrument which gives the option buyer the right but not the obligation to sell an underlying asset, currency, commodity at an agreed price on or before a specified date (American style) or on a given date (European style). The option seller has an obligation to take delivery of the underlying should the holder exercise their right.

**Swaps:** A swap is a derivative in which counterparties exchange certain benefits of one party’s financial instrument for those of the other party’s financial instrument. The benefits in question depend on the type of financial instruments involved. The five most common types of swaps are: interest rate swaps, currency swaps, credit swaps, commodity swaps and equity swaps. There are also many other types.

**VaR:** An estimate of the probability of portfolio losses based on the statistical analysis of historical price trends and volatilities. VaR95 is a commonly-used measure to express a maximum loss 95% of the time.

**VIX Index:** This is the ticker for the Chicago Board of Options Exchange Market Volatility Index. It provides a measure of the implied volatility of options on the S&P500 index and is expressed in percentage points to give the 30 day annualised expected volatility of the S&P500.

**Volatility:** Volatility is a measure of the uncertainty of an investment. This is usually calculated using standard deviation of returns on an annual basis and is also a measure of risk.
Thanks to:

Aymeric Forest – Fund manager, Multi-Asset
Remi Ajewole – Fund manager, Multi-Asset
Matthias Scheiber – Fund manager, Multi-Asset
Justin Simler – Head of Product Management, Multi-Asset
Nicolaas Marais – Head of Multi-Asset and Portfolio Solutions
Lesley-Ann Morgan – Senior Strategist, Global Strategic Solutions
Andy Connell – Acting Head of Portfolio Solutions and Head of LDI
Fakhreddine Chaabani – Structurer, Structured Solutions
Lakha Shezad – Quantitative Fund Manager, Structured Funds
Mike Hodgson – Head of Structuring, Structured Solutions
John McLaughlin – Head of Portfolio Solutions, Portfolio Solutions

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