AMP Capital Investors Limited
ABN 59 001 777 591 AFSL 232497

> Hedging Handbook

// Multi Asset Group - Portfolio Management Team

JUNE 2017

Contents

Background

The Multi Asset Group (MAG) Portfolio Management team, within AMP Capital, manages large multi asset class investment portfolios (mostly superannuation and pension funds). These investment exposures are primarily achieved through asset class-specific managed funds and some direct investments. We dynamically manage the asset allocations within portfolios with a process that includes valuation, sentiment, liquidity, cycle and technical factors. As a global institutional investor AMP Capital has access to a variety of derivatives that can be used to implement dynamic views and protect the capital of our investment portfolios. Idea generation is sourced both externally and internally. In addition guidance and execution support is provided by the AMP Capital Protected Growth team who are experts in option derivative instruments and markets.

Approach

Hedging Philosophy

Fundamentally our view is that returns are generated by carrying risk, but we hedge (reduce risk) when it's appropriate; this incurs a cost but may be appropriate at times, as investors are not always rewarded for bearing risk. We may also find that a derivative structure can deliver a more favourable payoff than holding a direct exposure. Finding the right risk to reward trade-off for each portfolio is at the core of our hedging decision making process.

Hedging Checklist

There are various elements in our approach to hedging:

1. Fundamental reason why we think that there will be a market correction, derived from our dynamic asset allocation (DAA) process (e.g. the valuation of the market is high and sentiment is strongly positive, which is a negative).
2. A catalyst that will trigger the correction (e.g. during the lead up to the 2016 US presidential election there were market dips in relation to the polling of the two presidential candidates).
3. Utilise the most efficient approach to hedge the foreseen risk: we can use natural hedges, options/derivative strategies or simply reduce the exposure.

Options Rules

A. Options are only used to gain exposure to underlying assets or to hedge risk, therefore selling naked options (that do not cover a physical market position) is not allowed as this would increase risk (rather than hedge it).
B. There must be a known outcome (cost), this may include an opportunity cost. The downside risk must be understood and limited.
C. Each option position must have pre-defined exit triggers so that we crystallise the benefit (or loss) in a disciplined manner.
D. Each portfolio has an annual option premium budget (over a rolling 12 month period).
E. Positions and cost are managed appropriately, relative to peer funds.

Natural Hedges

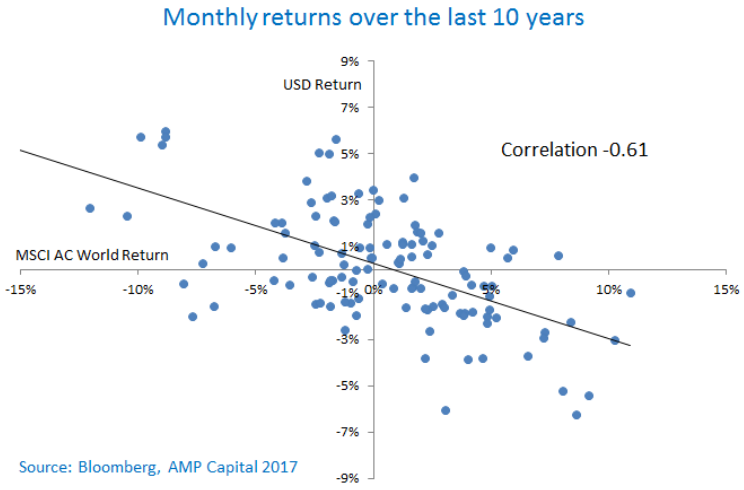
Natural hedges are exposures that will increase in value when the perceived risk event occurs; this increase in value should offset (to some degree) the loss in other exposures in the portfolio as a result of the risk event.

Diversification

Multi asset class portfolios already have a level of risk protection as they hold a diversified portfolio of assets; this diversification benefit is heightened by our extensive institutional investment capacity. We are able to invest in assets as diverse as direct infrastructure, unlisted bank loans, venture capital/private equity, quantitative hedge funds, as well as traditional asset classes such as equity and fixed income.

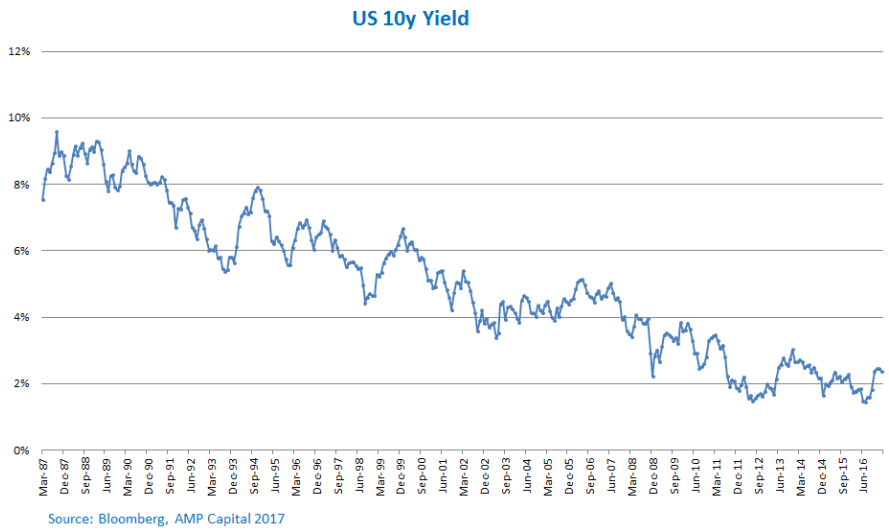
Defensive assets (US Dollar)

When equities perform poorly, the US dollar tends to perform strongly. This is because as global asset managers move their exposures to 'safe' assets, such as US Treasures and gold, which are both denominated in US dollars, the demand for US dollars increases and drives up its price. The below chart shows this relationship between negative global equity returns (MSCI All Country World Index) and US dollar returns against a basket of major world currencies (Bloomberg code DXY). The top left quadrant shows that in months when equities are down, the US dollar is up; this is a negative correlation, indicating that it is a good natural hedge.



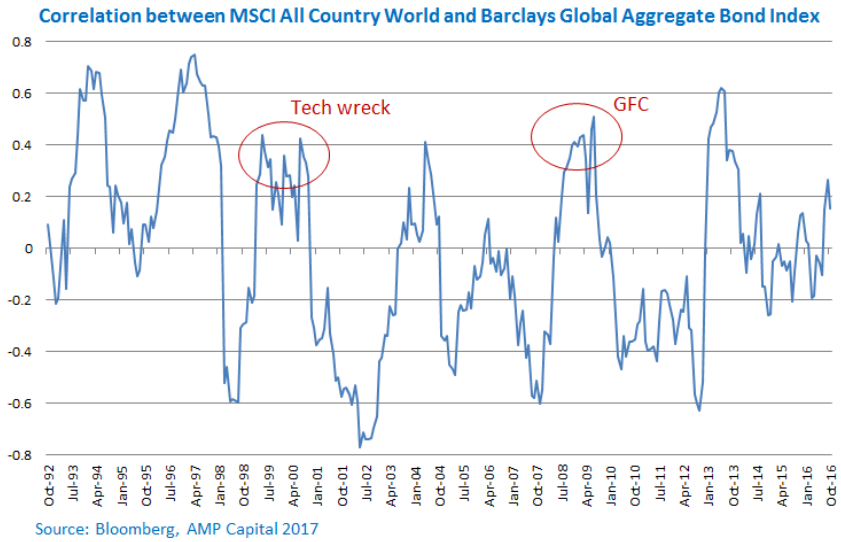
Defensive assets (Equity & Fixed Income)

Fixed income securities (bonds), are the classic defensive assets relative to equities. They provide a predictable income and returns uncorrelated to equities at times when share markets are falling. In today's environment this classic hypothesis is challenged for a couple of reasons. Firstly bond yields are at historic lows, so their returns are more stable than equities, however returns are low. The following chart shows a 30-year trend of declining 10-year US Treasury bond yields.



Source: Bloomberg, AMP Capital 2017

Secondly, it is generally thought that bond prices are negatively correlated with equities, but when we look at the historical record this isn't always the case. In key stress situations such as the tech wreck and the global financial crisis (GFC) they were actually positively correlated, i.e. they both lost value at the same time. So we can't always rely on this natural hedge.



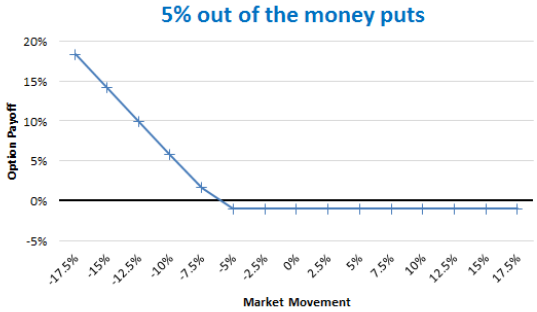
Source: Bloomberg, AMP Capital 2017

Options Hedging Strategies

Protective Puts

Put payoff

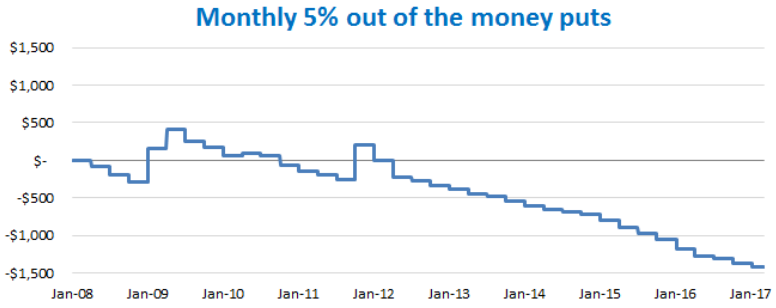
Buying protective put options (out of the money puts) is comparable to buying classic insurance, we pay a premium up front but it pays a positive return when the market declines. The chart below shows this relationship between market movement and the options payoff at expiry. The put contract has a strike price that is 5% below the current market level. If the market falls by 10% the contract will provide a 6% return. The premium is 1.3%, so if the market goes up, or doesn't fall by 5%, our option will expire with no value (we forgo the premium). The blue line on the chart below is the payoff at expiry (vertical axis) for a given level of market movement (horizontal axis).



Source: Bloomberg, AMP Capital 2017

Premium return drag

The premium cost accumulates over time. The below chart is the cumulative return of holding 5% out of the money put options rolled monthly, on a notional $10,000 portfolio. It shows that there are positive returns to the left of the graph, which refers to the period towards the end of the GFC, but generally they are a drag on overall performance. Therefore we do not run a continual put strategy; however put options may be used as a hedging tool that can be used as part of our DAA process.



Source: Bloomberg, AMP Capital 2017

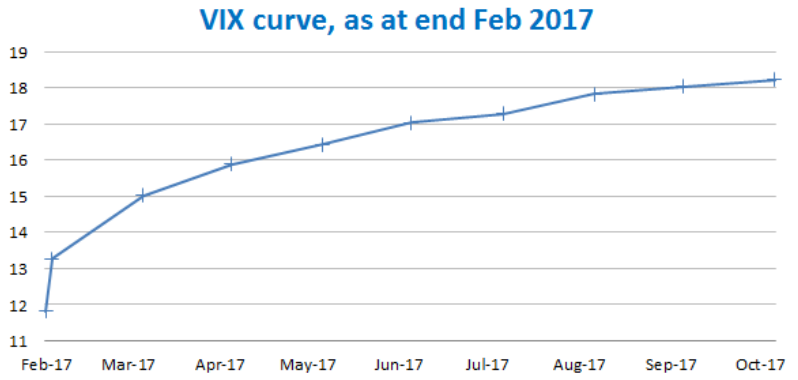
Buy when volatility is cheap

The premium (or price) paid for options changes over time based on market expectations of volatility. If the market is expecting higher volatility in the future, participants will buy more options, pushing up the price. Therefore the option price provides an indication of the market-implied level of volatility. The VIX is an index which measures the implied level of volatility, based on short dated (1 month to expiry) options prices. If the VIX is low, options are cheap. We think of 'cheap' as when the VIX level is below 12. As shown on the chart below, we prefer to buy options when volatility is relatively low and therefore option prices are relatively cheap.

Source: Bloomberg, AMP Capital 2017

VIX cost of carry

It is a common strategy to buy VIX futures as a hedge against negative events, as market volatility will increase in times of market stress. However there is a steep curve in the term structure of VIX futures. If an investor bought VIX futures three months before expiry, they will experience significant roll down. Roll down is the reduction in the value of a contract as it reaches expiry as you "roll down" the curve below. We don't buy VIX futures for this reason, the cost of carry is generally not appropriate to our portfolios. The cost of carry is the cost of holding a contract, there are notional costs associated with using futures which are baked into the price, some of these costs show up as roll-down.

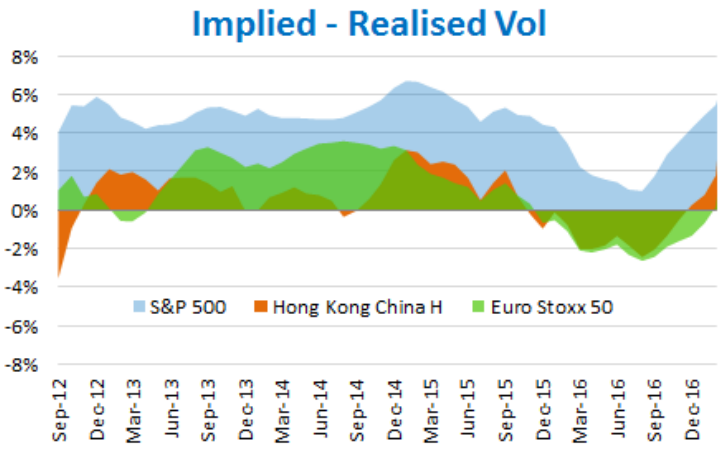


Source: Bloomberg, AMP Capital 2017

Implied v realised volatility

So far we have focussed on the US S&P 500, but puts are also used in other markets. In the US, insurance companies need to comply with the US Solvency II regulation, essentially forcing them to buy put options on their equity market exposures (which are mostly S&P 500). This pushes up the price of put options on the S&P 500, so we look at protective puts in other markets and the reverse collar strategy in the following sections.

The below chart show the option implied volatility less the actual realised market volatility. The implied volatility is from 5% out of the money put options on three markets: the US, Hong Kong and Europe. Theoretically this should be 0% (implied volatility = realised volatility), the higher the number the less attractive are the put options as they are more likely to expire out of the money (at no value). We used a monthly six-month volatility horizon, and then smoothed the monthly results over six months to create the following chart. It shows that US put options trade at a sustained premium relative to the other markets.



Source: Bloomberg, AMP Capital 2017

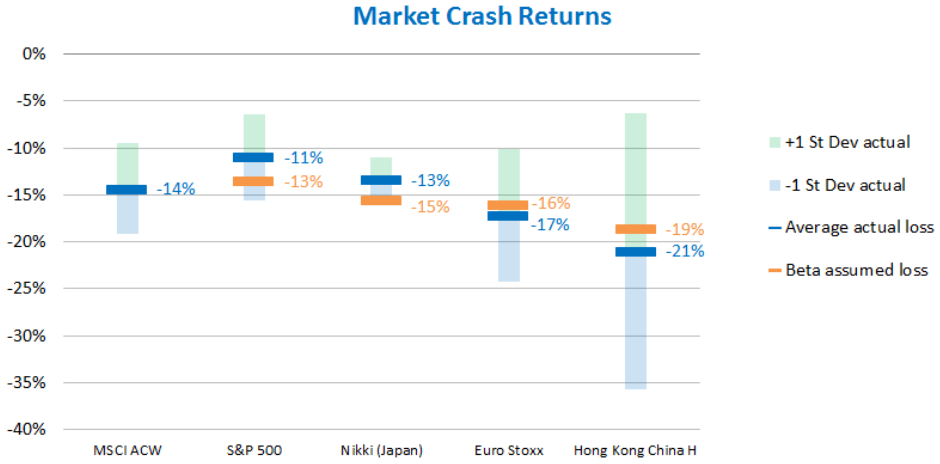
Crash Beta

Beta is the sensitivity of an equity asset to the broader market, in this case single market index (e.g. Euro Stoxx) sensitivity to variation in the MSCI All Country World Index (Bloomberg code MASC ACWI). This gives a sense of how much a particular market will move in relation to the global equity market. Crash Beta is the sensitivity during market stress scenarios; we find that the normal characteristics become exaggerated; beta decreases for low beta markets and increases in high beta markets. We calculated the average market return in periods when the MSCI ACWI fell more than 10%. This occurred 4 times in the last 7 years.

	S&P 500	Nikki (Japan)	Euro Stoxx	Hong Kong China H
Current Beta*	0.94	1.08	1.12	1.30
Crash Beta	0.77	0.93	1.20	1.46

*as at 6/03/2017 from Bloomberg calculated over 2years

The impact can be seen on the chart below, where we model the expected return, given the current market beta, then we show the historic average actual loss. Markets such as Europe and China fall further, whereas the US and Japan fall less than would have been expected using the current market beta. Also the variation in the higher beta markets is greater, in this data set two of the four crashes in Hong Kong led to losses in excess of 30%.



Reverse Collar

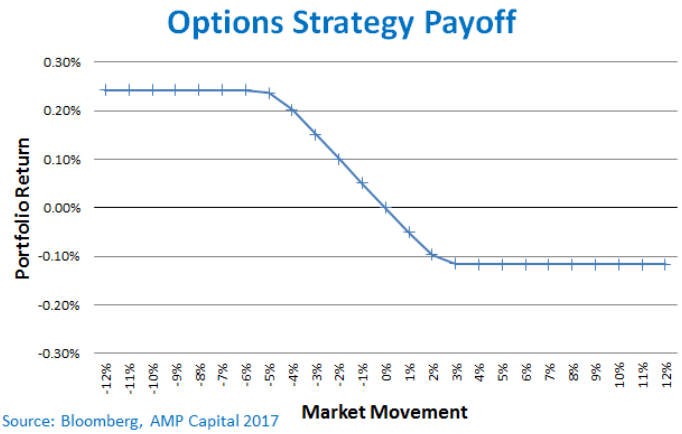
Strategy

A reverse collar protects against a modest market correction without incurring the cost of selling a large physical equity position. A reverse collar is when an investor sells (shorts or writes) a put option while simultaneously buying (establishing a long position in) the call option on the same index. To cover the short put we also short index futures, to

provide protection against any negative market movement. This is particularly effective because of the pricing skew in the options market for the S&P 500, namely that put option prices are more expensive then calls. In the US, insurance companies must comply with the US Solvency II regulation, essentially forcing them to buy put options to protect their equity market exposures (which are mostly the S&P 500). This creates a skew in the price of puts compared to the price of call options on the S&P 500.

This skew historically can be as much as three to one (for contracts with less than three months to maturity), i.e. a put option that is 5% below the market price costs three times more than a call option that is 5% above the market. We normally sell the put options at a level approximately 5% below the market price but buy call options at approximately 2% above the market price. Taking advantage of the skew, the options premium is normally cost neutral, and thereby reduces the performance drag if the market remains stable.

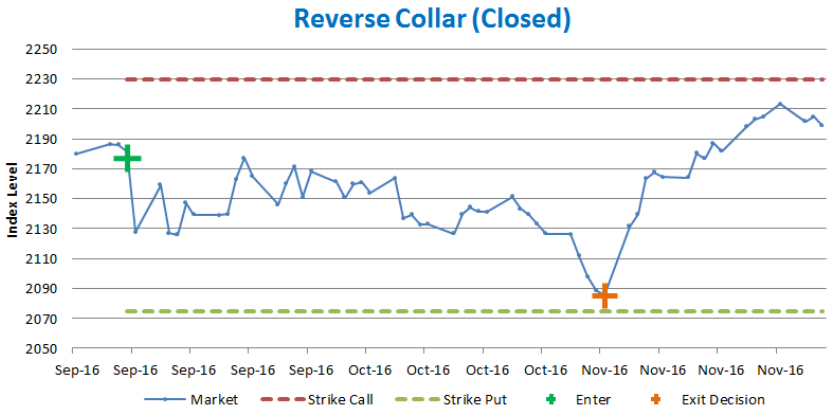
The reverse collar (with a short index futures position) has the payoff profile shown below. It provides protection (i.e. a positive payoff) when the market falls by the first 5%, but if the market rallies there will be an opportunity cost in terms of the foregone upside gain. It's important to remember that our funds naturally hold large positions in developed market equities so that they still capture most of the gains in a rally.



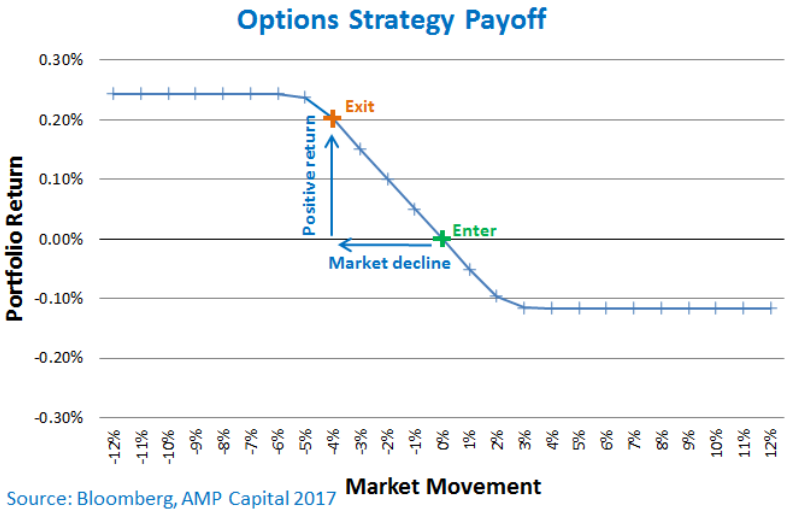
Source: Bloomberg, AMP Capital 2017

Actual Example

In September 2016, our DAA process showed record low yields, high valuation levels in the S&P 500 and the US presidential election could be seen as a catalyst for a market correction. We also saw the high skew in the options market for puts and calls on the S&P 500, so we established a reverse collar position on the appropriate portfolios. As shown in the following chart, its establishment (green +) in early September was well-timed as the market continued to be trend downwards in line with opinion polling. The position was exited (orange +) when the majority of the potential gain from the strategy had been captured. The second chart shows the same transactions but from the traditional option profit and loss payoff diagram perspective.



Source: Bloomberg, AMP Capital 2017



Source: Bloomberg, AMP Capital 2017

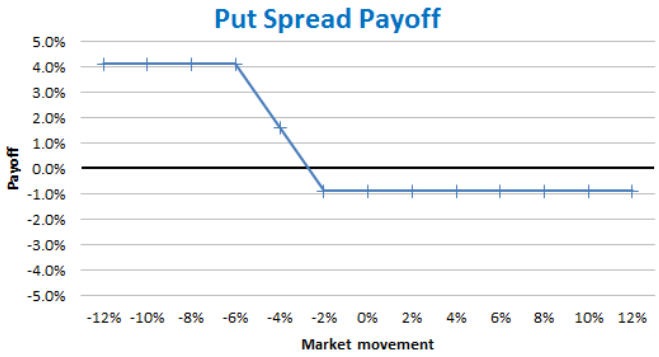
Reverse collar back test

We back tested a 95% and 102% reverse collar position that was rolled monthly, (selling a put 5% below market level and buying the call option at 2% above the market level) , using Bloomberg data, to view the monthly payoff of the strategy since 2008 against key indicators within our process. As shown there is a strong relationship between positive sentiment and a positive payoff from such a hedging strategy; a sentiment score above 1.5 is considered extreme optimism (a bearish signal in our process), highlighted in purple on the table. This is consistent with behavioural economics and bubble theory; where there is "irrational exuberance" we think it a good time to hedge an equity portfolio. Given the short-term nature of option positions, a faster moving signal such as sentiment tends to be a superior indicator of market stress, whereas value is a longer term measure. Therefore it is prudent to always look for a catalyst for a reversal in market direction, in conjunction with value, when reviewing option protection strategies.

US Market	High			Sentiment					Low
	Z Score	3	2	1.5	1	0.5	0	-0.5	-1	-1.5
Expensive	1								-3%	-3%
	0.5						-1%		-2%	-3%
Value	0				-3%	2%	2%	-2%	-3%	-3%
	-0.5			5%	1%	0%	-1%	-1%	-2%	-2%
	-1	7%	6%	8%	0%	1%	-3%	-1%	-2%	-3%
Cheap	-1.5		3%			-1%	0%	-3%		
	-2				4%		-2%			
	-2.5					4%				

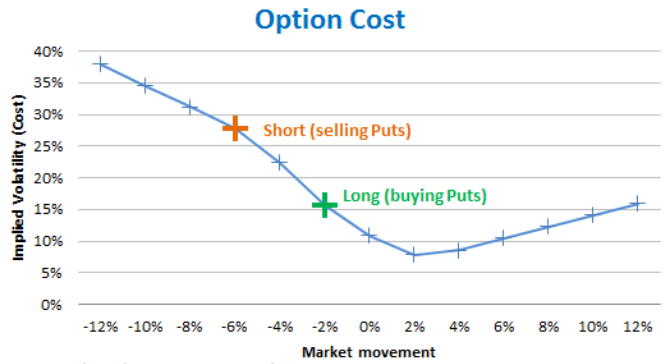
Put Spread

A put spread strategy is one that purchases an out of the money put option, but then sells a put option that is further out of the money, i.e. at a lower strike price. The benefit of this strategy is that it reduces the premium cost (compared to a simple out of the money put option) yet still delivers a positive payoff if the market corrects downwards. The below chart shows the payoff profile of a 2% & 6% put spread (selling puts 6% below the market level and buying puts 2% below the market level). Under this strategy a (more expensive) put option may be purchased at a higher strike price, i.e. one that is closer to the current market price, (which will thus offer more downside protection), than a simple out of the money put option. This is because the sale of the put option will raise premium that may be used to offset some of the cost of the put option purchase. This is especially effective if an investor is only expecting a moderate market correction.



Source: Bloomberg, AMP Capital 2017

The put spread also benefits from the same US market skew as the reverse collar. The below chart shows the difference in option premium that is payable for options with different strike prices relative to the current market index price level. The implied volatility derived from the cost of the option premium is almost twice as expensive at a strike price 6% below the market compared to a strike price 2% below the market (analysing an option that is three months from maturity).



Source: Bloomberg, AMP Capital 2017

Options Monitoring

Position Dashboard

Each option position is monitored from a dashboard. Key details such as the hedging strategy and rules are documented in the first section, along with exit triggers etc. The second section is normally a chart that visualises the entry point and exit trigger relative to the underlying market. The third section shows the specifics of the trades that have been executed and the positions' profit and loss status. The fourth section shows the portfolio exposure and the profit and loss value at the portfolio level.

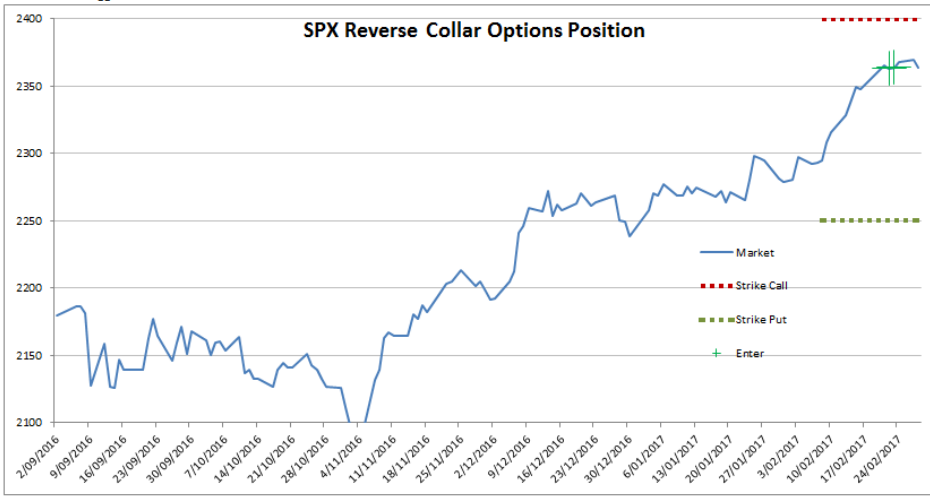
Position Dashboard: SPX Reverse Collar Options Position

Fundamental Picture: Post Trump election equity markets have run hard on the optimism (and up beat growth outlook), further into high valuations, but seem not to have fully accounted for possible trade war & increasing real yields (and therefore relative discount rates) forcing a correction into the equity markets.

Catalyst: French elections could signal risk off environment or a fed hike could trigger another tapper tantrum

Efficiency: Reverse collar takes advantage of skew in the US options market caused by structured pension products. This is effective for peer relative funds as the initial cost is almost neutral the upside opportunity cost is known & the funds still participate with their other holdings.

Exit triggers: Market falls close to the put strike, maximising the payoff, otherwise hold to maturity



TRADE_DATE	SECURITY_NAME	SECURITY_CODE	Trade	MATURITY	trade price	last price	P/L	Delta
23-Feb-17	June 17 Calls on SPX	SPX 06/16/17 C2400 Index	Buy	16-Jun-17	42.05	43.00	0.04%	0.28
23-Feb-17	June 17 Puts on SPX	SPX 06/16/17 P2250 Index	Sell	16-Jun-17	33.65	36.25	-0.11%	0.40
23-Feb-17	S&P500 EMINI FUT Mar17	ESH7 Index	Sell	17-Mar-17	2,365.31	2,362.75	0.11%	-1.00
						Total	**0.04%**	**-0.33**
22-Feb-17	June 17 Calls on SPX	SPX 06/16/17 C2400 Index	Buy	16-Jun-17	37.85	43.00	0.22%	0.28
22-Feb-17	June 17 Puts on SPX	SPX 06/16/17 P2250 Index	Sell	16-Jun-17	34.25	36.25	-0.08%	0.40
22-Feb-17	S&P500 EMINI FUT Mar17	ESH7 Index	Sell	17-Mar-17	2,357.64	2,362.75	-0.22%	-1.00
						Total	**-0.08%**	**-0.33**

Code	Name	Size	Trade Date	P/L
wdrf	AMP Capital Diversified Retirement Fund	3%	22-Feb-17	0.00%
wfdc	Future Directions Conservative Fund	2%	22-Feb-17	0.00%
wfdf	Future Directions Balanced Fund	5%	22-Feb-17	0.00%

Option Premium Budget

Each portfolio has an options premium budget, which is monitored on a rolling 12 month basis.

2017	
Budget	0.35%
Premium spent	0.27%
P/L	0.07%
Gross Available premium	**0.08%**
Net Available Premium	**0.42%**

As of	27/02/2017

Position	Theme	Open	Maturity	Status	Year	Target Price	Net (P/L %)	Cost	Value	(P/L AUD)	Spend
S&P reverse collar	Risk reversal	Jul 16		Closed	2016		0.08%				-0.01%
ASX puts	Tail option	ep/Oct 2016		Closed	2016		0.07%				0.12%
SPI Put 4800	Tail option	Nov 16	Mar 17	Open	2017		-0.01%	$ 11,488	$ 10,625	-$ 863	0.07%
SPI Put 4800	Tail option	Nov 16	Jun 17	Open	2017		-0.01%	$ 10,750	$ 9,675	-$ 1,075	0.08%
SPX Call 2400	Risk reversal	Feb 17	Jun 17	Open	2017	2,250	-0.06%	$ 9,852	$ 10,572	$ 720	0.07%
SPX Put 2250	Risk reversal	Feb 17	Jun 17	Open	2017	2,250		-$ 8,915	-$ 9,035	-$ 120	-0.06%
S&P500	Risk reversal	Feb 17	Mar 17	Open	2017	2,250	0.01%	$ 306,845	$ 307,610	$ 765	0.00%

Profiles

Multi-Asset Group Portfolio Management Team

Debbie Alliston, BBus (Finance), CFA

Head of Multi-Asset Portfolio Management

Debbie Alliston is the Head of Multi-Asset Portfolio Management and Chief Investment Officer, Corporate Super. In her role she is responsible for managing a team of portfolio managers who are responsible for a range of diversified funds including LifeCycle, institutional, and goals-based funds. In addition Ms Alliston is the Portfolio Manager for AMP's default Corporate Super offerings. Prior to joining AMP Capital, she was with Apostle Asset Management as an Investment Director (since 2007), where she was responsible for the management of the ongoing affiliate program including investment due diligence and manager selection and review. From 1991 to 2007 she was with BT Financial Group (formerly Rothschild Asset Management) in a range of roles, including Head of Investments where she was charged with the management of the BT investment team. Ms Alliston held a range of other positions with BT over the 16-year period, including Chief Operating Officer, Investment Management and Director - Head of Portfolio Management. For the last five years of her tenure she had portfolio management responsibility for BT's complete range of diversified products. She has also held roles with Bankers Trust Investment Management in the UK and Equitilink Australia.

Darren Beasley, BCom (Finance & Actuarial Studies), FIAA

Senior Portfolio Manager *(contributor to this paper)*

Darren Beesley is a Senior Portfolio Manager in the Multi-Asset Group with responsibility for a range of diversified funds including Retirement and Life portfolios. He also contributes to research, portfolio construction and asset allocation across the group's broader set of multi-asset funds. Prior to joining AMP, Mr Beesley was Portfolio Manager for Perpetual's Diversified Strategies Team where he was responsible for the Perpetual Diversified Real Return Fund and other multi-asset portfolios. In his role he focused on dynamic asset allocation, portfolio management, implementation and asset class research. Mr Beesley has also worked as portfolio manager and dealer at Ankura Capital (WestAM), a quantitative Australian equities firm, and as an Investment Analyst at Willis Towers Watson. He is qualified as a Fellow of the Institute of Actuaries of Australia (FIAA) and sits on the Actuaries Institute Retirement Income Working Group. He completed a degree in Commerce at UNSW majoring in Finance and Actuarial Studies, and was awarded the UNSW Co-op scholarship in Actuarial Studies.

Heath Palos, BBus (financial risk management), CFA

Assistant Portfolio Manager *(author of this paper)*

Heath Palos joined the Multi-Asset Group in July 2016. He contributes to research, portfolio construction and asset allocation across the group's multi-asset Funds. Prior to joining AMP, he was a Portfolio Manager at Macquarie Wealth, where he was responsible for the strategic asset allocation and fund manager selection for model portfolios. He was also a member of the Macquarie Wealth Investment Committee that set tactical asset allocations based on market valuations and macroeconomic analysis. Heath also designed, built, ran and sold The Agile Fund, a quantitative hedge fund which generated significant alpha. Heath has completed a Bachelor of Business majoring in Financial Risk Management and is a CFA charterholder.

Protected Growth Team:

Steve Hafey, BEc (Hons), AIAA, FFin
Head of Protected Growth

Steve Hafey's primary portfolio management duties involve the implementation of customised derivative strategies across a range of domestic and international markets. In previous roles within AMP Capital, Mr Hafey has been Head of Enhanced Funds where he was responsible for the Enhanced and Absolute Return team, encompassing portfolio management, client servicing and business development for a suite of index, enhanced index, market neutral and long/short equity portfolios. He also has quantitative experience from an earlier role as a Quantitative Analyst, mainly in the areas of market valuation and pricing analysis. In his initial position at AMP, he was an Actuarial Analyst valuing corporate superannuation funds. Prior to joining AMP in 1991, Mr Hafey received a First Class Honours degree and a University Medal in Actuarial Studies from Macquarie University.

Alexson Lee, BCom (Hons)
Portfolio Manager, Protected Growth
Alexson Lee joined AMP Capital in June 2006, as a Portfolio Manager in the Structured Products team (now Protected Growth team). In this role, he is mainly responsible for managing the existing funds, in particular International Protected Growth, and is also involved in developing new products for the Protected Growth team. Prior to joining AMP Capital, Mr Lee worked with Westpac Banking Corporation as an Equity Derivative Trader, involved in the market making, hedging and risk management of Westpac equity warrants. Prior to this, Mr Lee worked as a Quantitative Analyst and a Risk Analyst for Westpac. Mr Lee holds a Bachelor of Commerce with Honours in Actuarial and Applied Finance.

Kathryn Greguric, BAcc, CFA
Portfolio Manager, Protected Growth
Kathryn Greguric joined AMP Capital in 2002. In her current role, Ms Greguric is responsible for the management of derivative overlay portfolios. Prior to her current role, Ms Greguric was an Investment Analyst within AMP Capital's Investment Analytics team. This role involved performance analytics, performance attribution, and quantitative and competitor analysis. Before joining AMP Capital, Ms Greguric worked with Qantas as an Internal Auditor. In this role she conducted operational audits of processes and risk areas of various Qantas departments. She was also responsible for the development and maintenance of databases during the implementation of a new revenue accounting system. Ms Greguric has a Bachelor of Accounting from the University of Technology, Sydney and is a CFA charterholder.