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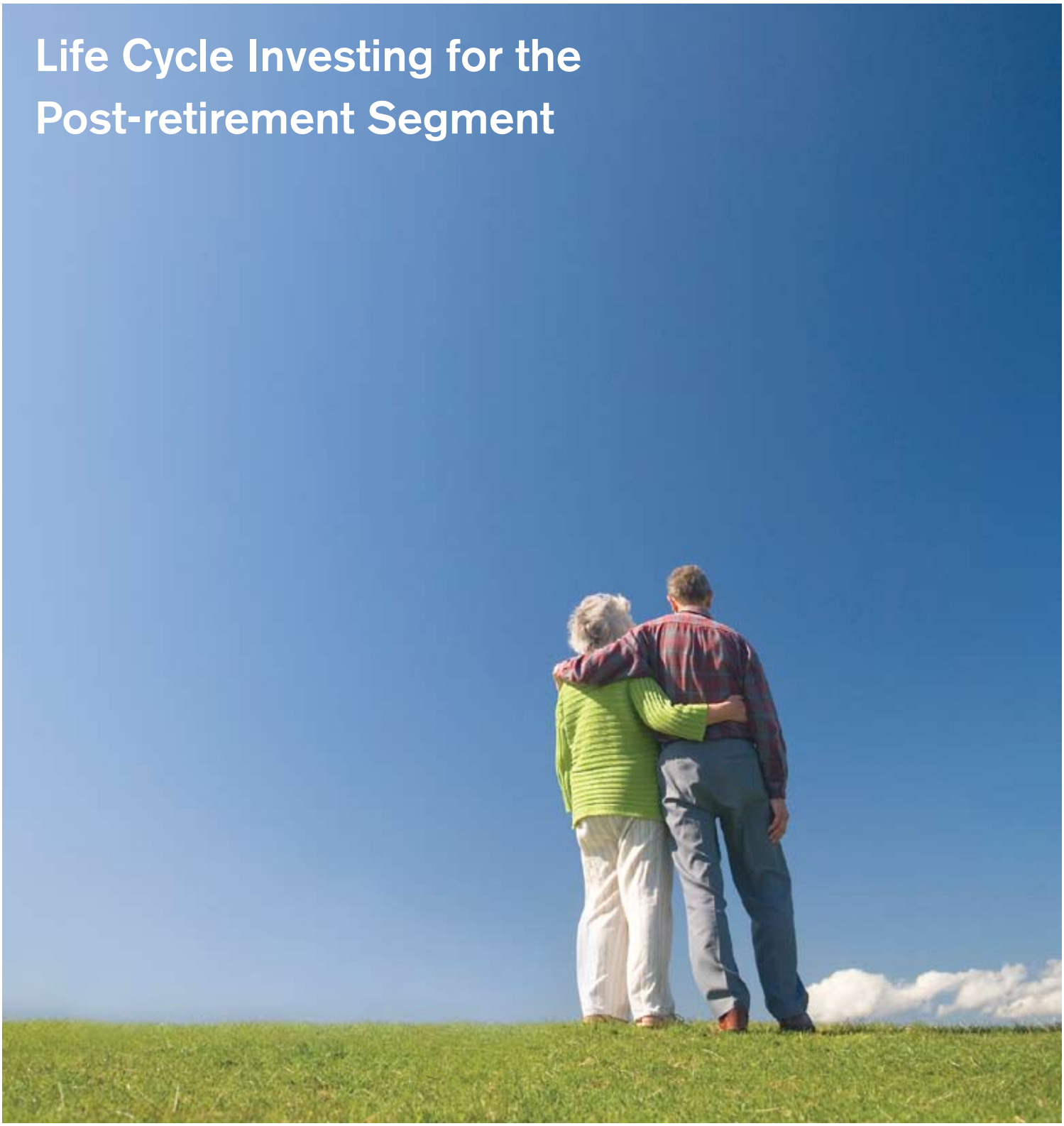
Milliman

Life Cycle Investing for the Post-retirement Segment

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EXECUTIVE SUMMARY

In the wake of the recent financial crisis, fund trustees, plan sponsors, and administrators have begun to reconsider traditional asset allocation strategies. As larger numbers of people approach the end of their working lives, defined contribution (DC) retirement plans in particular have come under increasing scrutiny because of their vulnerability to sustained market downturns.

The need to manage financial risks through more effective strategies is clear and urgent. As fund members inevitably shift from the accumulation of wealth to the generation of income, their needs and behaviour will fundamentally change. Debate in many markets has focused on the necessity for protecting fund member assets over the long term, looking hard at problems posed by such risks as increasing life expectancies (longevity risk), which in turn has rekindled the discussion of appropriate products and investment strategies for the post-retirement phase.

Fortunately, a number of promising approaches have emerged and become available that can help funds select, implement, and administer strategies appropriate to addressing these concerns. This paper examines a number of them, including target-date funds, target-volatility funds, continuous portfolio protection insurance (CPPI), bond plus call strategies, option budgets, and dynamic replication.

For our analyses, each strategy was projected over the last five years (2005-2010) based on Australian market returns, interest rates, and implied volatility. In order to capture the potential distribution of results for each strategy under a wide range of scenarios, a projection approach was used involving simulation over a set of 250 randomly generated 'real-world' scenarios of equity returns, interest rates, and implied volatilities calibrated to Australian market history.

Our research demonstrates that there are a variety of strategies and approaches available to funds seeking to provide risk management for their members' retirement savings and many are able to effectively address concerns about wealth protection, albeit often at the cost of reduced exposure to periods of dynamic growth. The adoption of a particular strategy will depend on a number of issues specific to individual funds and the legislative environment that they operate in.

Nevertheless, as more and more fund members move into retirement, where risk and exposure to major market downturns is magnified, the ability of DC retirement plans to meet a demand for more sophisticated investment strategies appears likely to create numerous incentives and opportunities for funds willing to innovate. This paper offers a detailed look at some of the more significant possibilities.

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INTRODUCTION

The recent financial crisis has prompted many questions about the security of retirement funds. With the importance of the retirement sector growing as larger numbers of people approach the end of their working lives, defined contribution (DC) retirement plans in particular have come under increasing scrutiny because of their vulnerability to sustained market downturns.

The steep market downturn between late 2007 and early 2009 exposed many flaws in traditional asset-allocation principles and risk-management techniques. Consequently, many DC plan administrators have begun to reassess their approaches, paying special attention to structures and strategies designed to manage risk more effectively.

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As fund members inevitably shift from the accumulation of wealth to the generation of income, their needs and behaviour will fundamentally change. Debate in many markets has centred on the problem posed by increasing life expectancies (longevity risk), which has rekindled the discussion of appropriate products and investment strategies for the post-retirement phase.

Unfortunately, the solution to longevity risk, or the risk of outliving one's savings, is not simple. While many tout the benefits of annuity-style products, there are a wide range of factors at play which must be considered, including:

- Overall levels of wealth, or whether individuals have sufficient assets to last a lifetime
- The ability to access alternative sources of income such as home equity or family support
- Changes to spending patterns throughout the phases of retirement (active, passive, and frail)
- Government provision of social security benefits
- The costs associated with private sector products
- Behavioural biases, an inability to make long-term decisions, and individual expectations of mortality

With the post-retirement problem increasing in importance, a substantial opportunity exists for institutions looking to develop solutions. Whilst traditional wealth management institutions such as insurance companies, banks, and fund managers have developed a variety of innovative offerings (see Figure 1 on page 4), retirement plans have been slow to move. This can be attributed to a number of factors, not least the long-term nature of many 'off-the-shelf' retirement products and their associated fees, together with counterparty management issues.

FIGURE 1: PRODUCT SOLUTIONS

PRODUCT	DESCRIPTION	ADMINISTRATION	ASSET ALLOCATION	CAPITAL
DRAWDOWN	Assets are invested across various asset classes and investors retain full liquidity, control, and ownership.	Generally pooled investment structures, with direct access by individuals.	As selected by plan sponsor, generally a combination of growth and defensive assets.	None required, no guarantees.
LONGEVITY INSURANCE	A portion of assets is invested in a longevity pool comprising many people and is distributed to those that survive beyond a defined age.		As per drawdown products, although the pooling mechanism results in exposure to the mortality / longevity of the pool.	None required. Longevity asset structured within pool.
FIXED ANNUITIES	Insurance company product guaranteeing a fixed return plus capital at the end of a defined term.	Administered individually.	Unknown to the investor, but usually invested in a combination of growth / illiquid assets to provide return commensurate with guaranteed yield and profitability requirements.	Generally required. Limited or no ability to supplement income.
LIFETIME AND DEFERRED ANNUITIES	Insurance company products guaranteeing lifetime income, either immediately or from a point in the future.			
VARIABLE ANNUITIES	Combination of traditional drawdown product plus a guarantee of income or capital for an extra fee.	Administered on an individualised basis and open-ended.	As per drawdown products, but guarantees may be provided and managed via derivatives.	
CAPITAL GUARANTEED PRODUCTS	Investments generally provided by an investment bank and guaranteed to provide a particular outcome—either simple or sophisticated.	Generally tranched in order to facilitate risk management by investment bank.	Underlying assets plus structured derivatives.	
OTHER STRUCTURED PRODUCTS				

As shown in Figure 1 on page 4, there are a variety of product-based solutions, with each requiring particular administration and investment expertise. All of these post-retirement products are based upon an underlying investment strategy and may be combined with a particular wrapper such as a life insurance contract to provide a guarantee or gain access to certain benefits–for example, a beneficial tax environment.

Capital may also be deployed to support these structures in order to provide a guarantee underwritten by the issuer, and requiring an additional return or profit to compensate.

The lack of a balance sheet and capital within many retirement funds makes it a difficult guarantee to be offered without significant support from a third-party institution. While opportunities exist for funds to purchase an 'off-the-shelf' solution or to work with partners to white-label a preexisting structure, this is not necessarily as simple as it seems. Funds looking to offer products in conjunction with third-party institutions will need to consider:

- Cost
- Control and flexiblity
- Portability
- Counterparty management

The financial crisis shook many people's confidence in the institutions that traditionally provided guarantees or insurance against such events. The high-profile corporate failures of institutions such as Lehman Brothers and American International Group (AIG) brought counterparty risk to the forefront.

Opportunities may exist for funds to replicate some of these investment strategies without a guarantee, resulting in a sustainable and lower-cost solution whilst providing much of the benefit of the original product but without a guarantee label.

This report analyses a variety of strategies and their performances historically as well as over a number of forward-looking simulations.

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MEMBER NEEDS AND STRATEGIES

MEMBER NEEDS/DRIVERS

The main objective of retirement planning for individual fund members is to ensure that sufficient income can be generated to provide an adequate standard of living after retirement. To date, the relative immaturity of global defined contribution (DC) systems has resulted in a focus on the accumulation of wealth which will change as increasing numbers transition into retirement.

Existing approaches have focused on the following strategies with little consideration for the income needs of members;

- Accumulation of wealth
- Generation of excess returns (alpha)
- Static or age-based asset allocation models
- Return benchmarks constructed relative to inflation (CPI + x%)
- Risk management via diversification

With increasing numbers approaching and entering retirement, the issues facing many retirement savings plans will undergo a fundamental change as member objectives shift inexorably from the accumulation of wealth to the generation of income.

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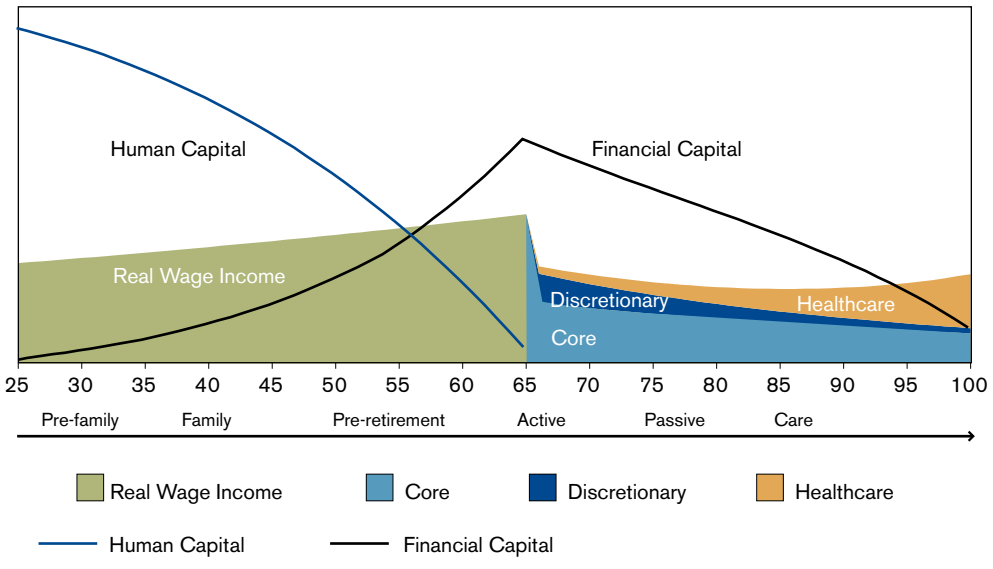
As outlined in the Milliman research paper 'A Holistic Framework for Life Cycle Financial Planning'[1] and illustrated in Figure 2, the maximisation of financial capital at the point of retirement, and the inability to replace it (human capital) in the face of a market downturn, poses a clear risk. As recent financial crises have demonstrated, poor returns in the years on either side of this retirement 'critical zone' can result in substantial changes to retirement plans.

FIGURE 2: HOLISTIC FINANCIAL PLAN (FINANCIAL LIFE CYCLE IN REAL MONETARY TERMS)



1 Corrigan, Joshua & Matterson, Wade (July 2009). A holistic framework for life cycle financial planning. Milliman Research Report. Retrieved July 13, 2010, from http://au.milliman.com/perspective/pdfs/holistic-framework-life-cycle.pdf.

As Figure 3 illustrates, the landscape for investment decisions in a post-retirement world is substantially different to that in accumulation. As many funds are discovering, members approaching retirement are more engaged with their circumstances and will consequently seek solutions tailored to their individual circumstances.

FIGURE 3: THE CHANGING STRUCTURE OF DEFINED CONTRIBUTION PLANS

DESCRIPTION	ACCUMULATION	RETIREMENT
GOAL	ABSOLUTE WEALTH	REGULAR INCOME
TIME HORIZON	FIXED (RETIREMENT AGE)	UNKNOWN (LIFETIME)
FINANCIAL CAPITAL	INCREASING	DECREASING
HUMAN CAPITAL	SOME ABILITY TO SUPPLEMENT SAVINGS	LIMITED / NO ABILITY TO SUPPLEMENT INCOME
LEVEL OF ENGAGEMENT	LOW, INCREASING TOWARDS RETIREMENT	HIGH
RISK TOLERANCE	HIGH	LOW

Appropriate life cycle strategies will need to consider these changing preferences and focus on the following objectives:

- Income
- Standard of living (i.e., income stability combined with management of inflation)
- Longevity (ability of assets to generate income over uncertain retirement horizon)—may incorporate social security and liquidation of home equity
- Provision for long-term care and health expenses
- Mitigation of retirement related risks
- Bequest

As outlined in Milliman's 2008 report 'Risk in Retirement.'[2] continued exposure to growth assets is necessary to provide access to excess returns and improve the sustainability of retirement funds. However, this increased exposure to growth assets—the central plank of many retirement plans—creates an increased sensitivity to 'fat tail' market events. Given the impact that the timing of returns can have on the sustainability of retirement savings, this exposure will need to be managed.

THE NEED FOR A NEW LIFE CYCLE INVESTING APPROACH

Consequently, we believe funds will increasingly look to more sophisticated investment strategies to meet the income and accumulation objectives of their members as they approach and enter retirement. These strategies will increasingly look to proactively manage risk as assets approach their peaks in and around retirement. Selecting the appropriate strategy will depend on a number of factors and potentially require systems and capabilities not necessarily available within fund structures as they exist today.

As recent market events have demonstrated, establishing an investment structure based on a mean/variance framework is not necessarily appropriate when considered alongside the extent of the financial risks to which members within the retirement 'critical zone' are exposed. As financial capital reaches its peak and retirement approaches, the sequence of returns becomes vitally important.

We believe funds will increasingly look to more sophisticated investment strategies to meet the income and accumulation objectives of their members as they approach and enter retirement.

Establishing an investment structure based on a mean/variance framework is not necessarily appropriate when considered alongside the extent of the financial risks to which members within the retirement 'critical zone' are exposed.

2 Matterson, Wade (July 2008). Risk in retirement: Impact of the market downturn and implications for retirees and product providers. Milliman Research Report. Retrieved July 13, 2010, from http://au.milliman.com/perspective/pdfs/risk-in-retirement-impact-07-31-08.pdf.

As noted in Milliman's May 2010 report 'Preparing for Change: Financial Planning for Retirees,' commissioned by Axa Australia:[3]

A sustained market downturn immediately before retirement or during retirement–i.e., in what is sometimes called the retirement "critical zone"–can be particularly destructive, as investors have limited time to recover or income to replace lost savings. The following table illustrates the importance that the sequence of returns can have on an individual's accumulated savings.

FIGURE 4: SEQUENCE OF RETURNS

RETURNS		ACCUMULATION		DRAWDOWN*	
SCENARIO 1	SCENARIO 2	SCENARIO 1	SCENARIO 2	SCENARIO 1	SCENARIO 2
		100,000	100,000	100,000	100,000
7%	-15%	107,251	86,071	101,888	81,767
10%	-9%	118,530	78,663	107,078	70,160
6%	6%	125,860	83,527	108,390	69,189
-9%	10%	115,027	92,312	94,492	70,940
-15%	7%	99,005	99,005	77,026	70,721
		Sequence of returns does not matter in accumulation.		Sequence of returns is important and can result in markedly different outcomes in drawdown.	

*Drawdown scenarios assume annual withdrawal of $5,000.

"The example above highlights the importance of sequencing, showing how the simple act of reversing the order of the returns results in two drastically different outcomes when withdrawals are taken into account."

Traditional approaches to risk management via diversification or asset allocation rely heavily on a number of concepts, each of which contains flaws that, under appropriate circumstances, can have a dramatic impact on the retirement savings of fund members.

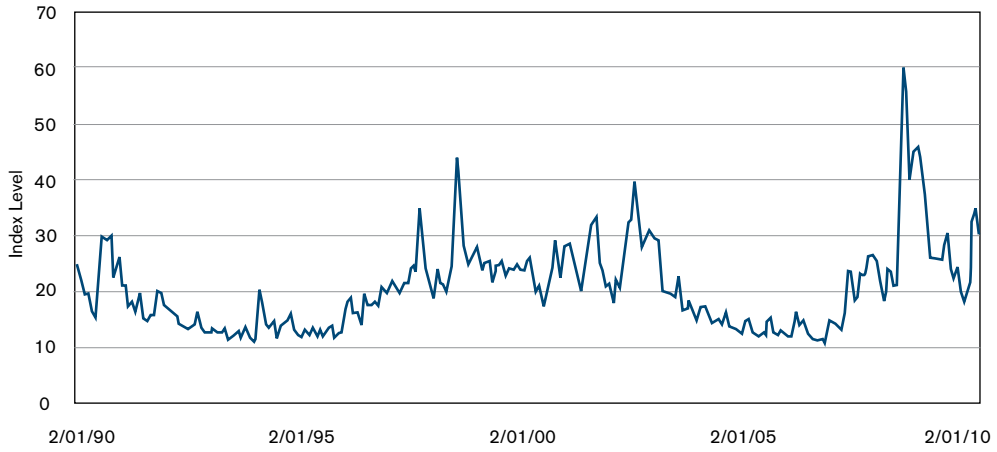
Traditional approaches to asset allocation rely heavily on a number of concepts, each of which contains flaws that, under appropriate circumstances, can have a dramatic impact on the retirement savings of fund members. These include:

- Volatility is stable.

The relatively static asset allocations utilised by many retirement plans assume that asset classes do not experience sudden shifts or changes in volatility. As Figure 5 illustrates, historical volatility as represented by the VIX index [4], changes considerably over time, especially during times of market crisis (i.e., the global financial crisis in 2008).

3 Referenced with permission by Axa Australia.
4 Implied volatility for short-term options on the S&P500 index.

FIGURE 5: HISTORICAL (US IMPLIED) VOLATILITY - VIX VOLATILITY INDEX 1990-2010



- Diversification benefits through low correlation.

Correlations between asset classes also exhibit a tendency to strengthen through periods of crisis, shown in the table in Figure 6. Such changes in correlation can eliminate the benefit of diversification when it is most needed.

Figure 6 contains estimated correlations between selected international equity markets[5] based on 10 years of monthly returns.

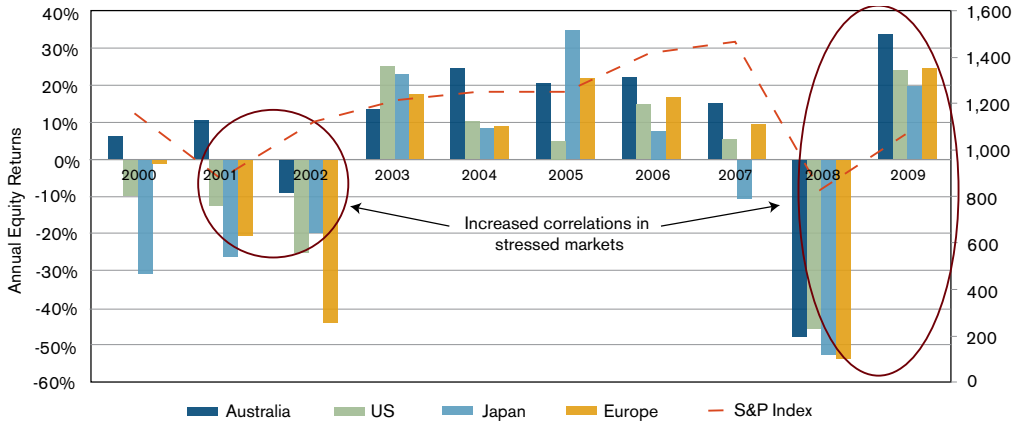
FIGURE 6: INTERNATIONAL EQUITY CORRELATION 1999-2009

	AUSTRALIA	US	JAPAN	EUROPE
AUSTRALIA	100%			
US	77%	100%		
JAPAN	67%	61%	100%	
EUROPE	74%	86%	58%	100%

The correlation statistics in Figure 6 indicate the existence of significant long-term diversification benefits[6] across the markets concerned. However, as mentioned above, short-term correlations may increase during times of market stress. This is reinforced in Figure 7, which illustrates the strong correlation across markets during the 2001-2002 and 2008-2009 periods.

5 ASX 200, S&P 500, Nikkei, DJ Eurostoxx, and FTSE indices.
6 All correlations significantly less than 1 ($N = 120$, $\alpha = 0.05$).

FIGURE 7: GLOBAL EQUITY MARKET RETURNS 1999-2009



- Investors with symmetric risk profiles

Investors have greater aversion to losses than appetite for positive returns, i.e., have an asymmetric risk profile. This is exacerbated as the assets and amount at stake increases through the 'critical zone.'

As many now know, investors have greater aversion to losses than appetite for positive returns, i.e., have an asymmetric risk profile. This is exacerbated as the assets and amount at stake increases through the 'critical zone.'

INTRODUCING RISK MANAGEMENT INTO THE PROCESS

As described above, we believe funds will increasingly look to more sophisticated investment strategies, with investment approaches that will explicitly consider risk in terms of individual member outcomes.

Risk-management Objective

As outlined in previous sections, the accumulation of risk as plan members approach retirement, combined with changing objectives requires a different approach. There are a variety of strategies that can potentially be employed.

- **Administrative strategies** rely on dynamically altering the underlying investment mix to achieve a smoother return or risk-management outcome. The three main administrative strategies are:
  — Target-date funds
  — Target-volatility funds
  — Continuous portfolio protection insurance (CPPI)

- **Derivative strategies** rely on the use of assets that directly facilitate risk management. Derivative strategies can be employed to either synthetically create exposures or to manage the risks with existing exposures.

  The main derivative strategies are:
  — Bonds plus equity call options
  — Option budgets
  — Dynamic replication

- **Insurance/outsourcing** relies on partnerships between funds and third-party institutions to deliver particular products or strategies to members. Some examples within the insurance industry might include;
  — Variable annuities
  — Lifetime annuities

This research report explores each of these strategies in detail in the following sections.

ANALYSIS

METHODOLOGY AND CALIBRATION BASIS

The following analysis was conducted for each of the investment strategies contained within this report:

For the purposes of this research, passive index funds were used, although any of the strategies contained in this report are well suited to passive or actively managed funds.

The underlying equity investment was based on the ASX 200 (Australian Equity) index. For strategies including bond exposures, the underlying bond fund was assumed to follow a broad government bond index fund.[7]

Common features across all of the underlying approaches were:
- Funds management charges of 75 bps
- Fees for option buy/sell spreads have been modelled separately

It should be noted that actual fees and costs associated with each of the strategies presented in this report will differ based on factors such as the presence of any profit margin, scale, capital requirements (if any), administration, and/or distribution costs (e.g., commissions).

The analysis contained within this report was conducted based on the following approaches:

Historical Back-Test

Each strategy was projected over the last five years (2005-2010) based on Australian market returns, interest rates, and implied volatility.

The main advantages of this back test are that it is intuitive, objective, easy to understand, and communicates results. Because the focus of this paper is on strategies to manage downside risk, market returns over this period, which include the global financial crisis (GFC), provide insight regarding performance under stressed conditions. As this time horizon includes the final rally of the bull market from 2005 to the onset of the GFC, it also demonstrates the performance of each strategy within markets experiencing an upwards trend.

Simulation

In order to capture the potential distribution of results for each strategy under a wide range of scenarios, a projection approach involving simulation over a set of 250 randomly generated 'real-world' scenarios of equity returns, interest rates, and implied volatilities calibrated to Australian market history was used.

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Appendix 1 contains further detail regarding the scenario generator used to produce these scenarios together with the underlying assumptions. Summary statistics of the generated scenarios are contained in the table in Figure 8.[8]

FIGURE 8: SCENARIO DISTRIBUTION STATISTICS

VARIABLE	MEAN	STD. DEV.
EQUITY RETURNS*	10.80%	16.85%
GOVERNMENT BOND RETURNS	6.16%	8.83%
1-YR. FORWARD INTEREST RATES	5.42%	2.44%
IMPLIED VOLATILITY (1-YR. AT-THE-MONEY)	20.41%	6.45%

*Total equity return

7 Consideration should be given to basis risk when using actively managed funds in conjunction with protection strategies.

8 The analysis in this report is based on a set of scenarios calibrated to historical data, and history cannot be relied on to predict the future. Different scenario calibrations may alter the results presented in this report.

TARGET-DATE FUNDS

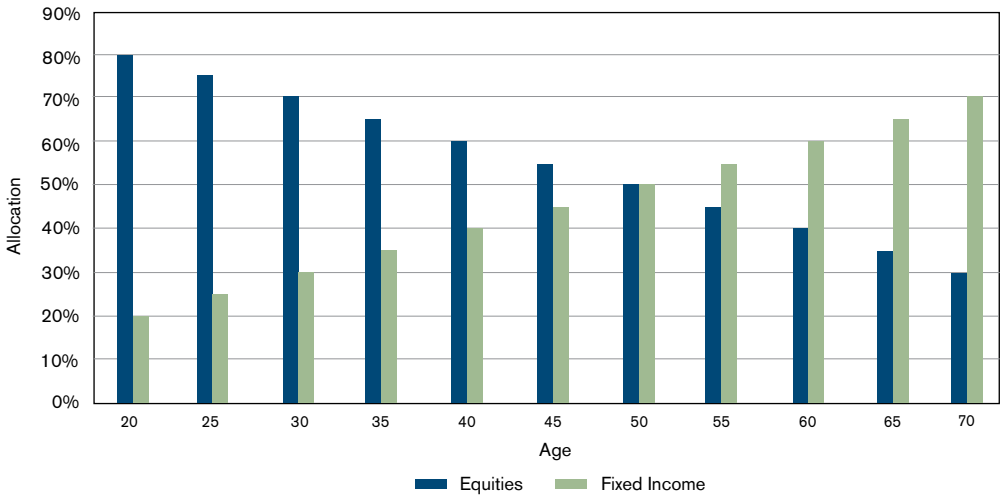
Description

Target-date funds have evolved over a number of years as retirement plan sponsors recognised the changing risk preferences of their members as retirement approaches.

Target-date funds attempt to tailor the investment strategy to the changing risk preferences of investors by reducing the allocation to risky or growth assets over time.

Target-date funds attempt to tailor the investment strategy to the changing risk preferences of investors by reducing the allocation to risky or growth assets over time. As a result, this strategy rebalances investors' assets between different mixes of conservative and growth assets based on an age-based 'glide path', traditionally focused on the investor's planned retirement age. Figure 9 provides an example of a possible glide path.

FIGURE 9: TARGET-DATE FUND ILLUSTRATION



Target-date funds have become increasingly popular in the United States. The Securities and Exchange Commission (SEC) estimates assets in SEC-registered target-date funds to be $US270 billion as at 16 June 2010.[9] According to the SEC, target-date funds are becoming popular default investments in employer-sponsored 401(k) plans, helped in part by their designation as 'qualified default investment alternatives' by the US Department of Labor (DOL).

Risk Protection Mechanism

The principle behind target-date funds (also known as life-cycle funds, target-maturity funds, and age-based retirement funds) is that investors need to adopt more conservative investment styles as they approach retirement.

As discussed in the earlier section, utilising exposure to growth assets as a proxy for risk neglects a number of things, mainly:

- The impact of changes to volatility and correlation
- The length of the retirement time-horizon

Key Product Design Variables

Target-date funds are constructed to be similar to standard managed balanced funds, with assets allocated to stocks (small cap, large cap, international) and fixed income (bonds and cash). Besides the asset allocation, the most important design variable is the glide path, which determines which portion of the portfolio should be invested in growth assets at a given date. This is usually

9 SEC press release (June 16, 2010). SEC proposes new measures to help investors in target date funds. US Securities and Exchange Commission. Retrieved July 13, 2010, from http://www.sec.gov/news/press/2010/2010-103.htm.

represented by the date attached to the fund, which may be used to indicate a range of years over which investors were born (fixed retirement age) or a target retirement year.

There is no industry consensus on what constitutes the appropriate asset allocation or glide path for a target retirement date fund, and allocations across funds with similar target dates can vary widely.

Cost Structure

Costs for target-date funds are similar to traditional managed funds. Because glide paths are predetermined, fund managers may offer target-date funds at little or no additional cost compared to similar funds without the target-date mechanism. The key cost driver will be the composition of the underlying asset classes (i.e., actively or passively managed) together with any additional administrative burden or scale issues that may exist.

Because glide paths are predetermined, fund managers may offer target-date funds at little or no additional cost compared to similar funds without the target-date mechanism.

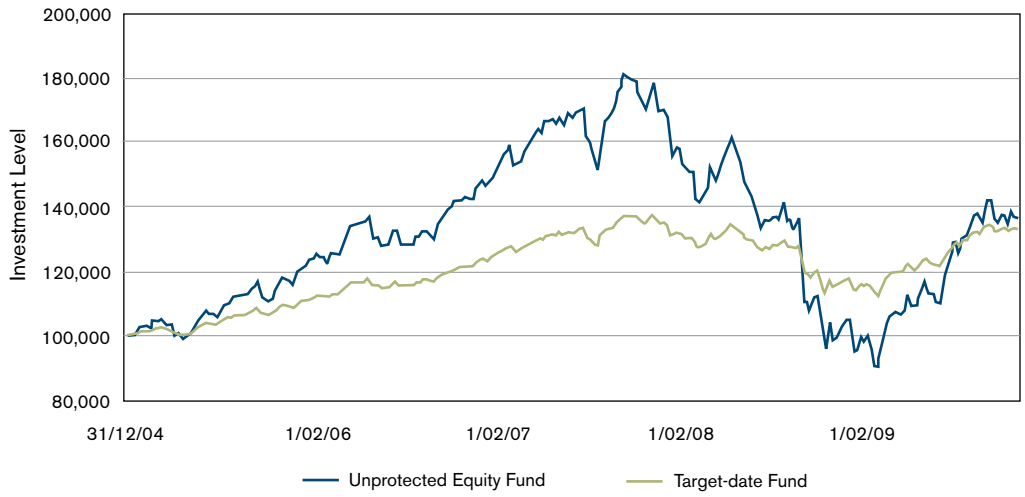
Analysis

Back-test

For the purpose of this report, a target-date fund was constructed based on the 'invest your age in bonds' allocation rule for a 60-year-old investor (e.g., five years until retirement). Based on this rule, the target-date fund is initially invested 60% in bonds, with the remaining 40% in equities and adjusted annually.

Figure 10 illustrates how this target-date fund would have performed through the 2005-2010 period. As the majority of this portfolio is invested in bonds, returns significantly underperform a 100% equity fund as expected. The high bond allocation also serves to mute negative returns during the equity downturn in 2008.

FIGURE 10: TARGET-DATE FUND ILLUSTRATION 2005-2010



Impact of varying key parameters

Varying the key parameters of target-date funds, or the glide path rule, results in a trade-off between full participation in equity or growth markets and stable returns via conservative allocations. Funds with more conservative glide paths will naturally sustain smaller losses than aggressive glide paths, but will also post smaller gains during market rallies.

Summary

Much of the success of target-date funds was built on the foundation of a 'set-and-forget' strategy. Although target-date funds were never promoted as explicit risk-management vehicles, investors

were nevertheless shocked at the level of losses sustained in these funds during the GFC, with the average return among target-date funds surveyed being -25% in 2008.[10]

Debate has centred on the grounds that there is no 'one-formula-fits-all' solution to the needs of investors with widely varying needs, lifestyles, and levels of risk tolerance,[11] and also that, absent risk-management techniques, market volatility can defeat even the most carefully planned glide path. In the United States, the SEC and DOL held joint hearings in June 2009 to review target-date funds and their appropriateness for investors.[12] In June 2010, the SEC produced a number of recommendations for target-date funds, mostly concerned with how target-date funds are marketed to investors.

The SEC recommended that target-date fund marketing materials:[13]

- *Consider the investor's risk tolerance, personal circumstances, and complete financial situation*
- *State that an investment in the fund is not guaranteed and that it is possible to lose money by investing in the fund, including at and after the target date*
- *Communicate whether, and the extent to which, the intended percentage allocations of a target-date fund among types of investments may be modified without a shareholder vote*

We anticipate that strategies such as target-date funds will undergo substantial change as a result of increased scrutiny and focus on the management of risk.

We anticipate that strategies such as target-date funds will undergo substantial change as a result of increased scrutiny and focus on the management of risk. Enhancements to these strategies incorporating some of the protection strategies or volatility management approaches referred to later in this report may offer a more tailored approach and provide for a more robust solution in the face of volatile markets.

TARGET-VOLATILITY FUNDS

Description

Target-volatility approaches attempt to address some of the inherent flaws in target-date approaches by designing a dynamic asset allocation model around a more direct measure of risk—volatility.

A more recent development has been the construction of target-volatility approaches. Building on the concepts used to successfully market their target-date cousins, target-volatility approaches attempt to address some of the inherent flaws in target-date approaches by designing a dynamic asset allocation model around a more direct measure of risk—volatility.

Consider a hypothetical 'balanced' fund containing 70% equities and 30% bonds. This type of static allocation is typically based on mean variance analysis to meet the investor's risk/return profile. Consequently, periods of high market volatility will result in a more aggressive risk profile than in times of low market volatility. A target-volatility fund seeks to remedy this by rebalancing between growth and defensive assets dynamically in order to maintain a particular volatility profile.

Risk Protection Mechanism

Target-volatility funds rely on managing risk by divesting growth or risky assets in times when volatility is high and increasing exposure when volatility is low on the basis of an underlying model or algorithm. This approach is based on the assumption that periods of high volatility are strongly correlated with market corrections.

Key Product Design Variables

There are a number of variables to consider when constructing a target-volatility fund:

10 Schapiro, Mary L., Chairman (June 18, 2009). Speech by SEC Chairman: Statement at SEC-DOL hearing on target date funds. Retrieved July 13, 2010, from http://www.sec.gov/news/speech/2009/spch061809mls.htm.

11 Rowland, Marilyn M. (Spring 2008). All target date funds are not created equal. Milliman Benefits Perspectives. Retrieved April 1, 2010, from http://www.milliman.com/expertise/employee-benefits/publications/bp/pdfs/BP06-10-08.pdf

12 SEC press release (May 12, 2009). SEC, DOL to hold joint hearing examining target date funds. US Securities and Exchange Commission. Retrieved July 13, 2010, from http://www.sec.gov/news/press/2009/2009-107.htm.

13 SEC proposes new measures, ibid.

- **Volatility Target**
  The target band or cap that the fund is attempting to produce. This may be customised, based on the investor's risk appetite.

- **Volatility Measure**
  There are a number of ways to monitor the "target-volatility" measure including model-based approaches (e.g., a GARCH process), model-free measures (e.g., the VIX index), or market-implied volatility.

- **Rebalancing Strategy**
  The timing and frequency of rebalancing will also have an impact on the performance of the strategy and its associated costs.

Cost Structure

As with target date fund strategies, the target volatility structure is rule based and can therefore be implemented with little or no cost in addition to the existing fund management costs, although there may be higher fees due to an increased administrative burden as a result of the regular rebalancing required under this approach.

As with target date fund strategies, the target volatility structure is rule based and can therefore be implemented with little or no cost in addition to the existing fund management costs.

Analysis

Background

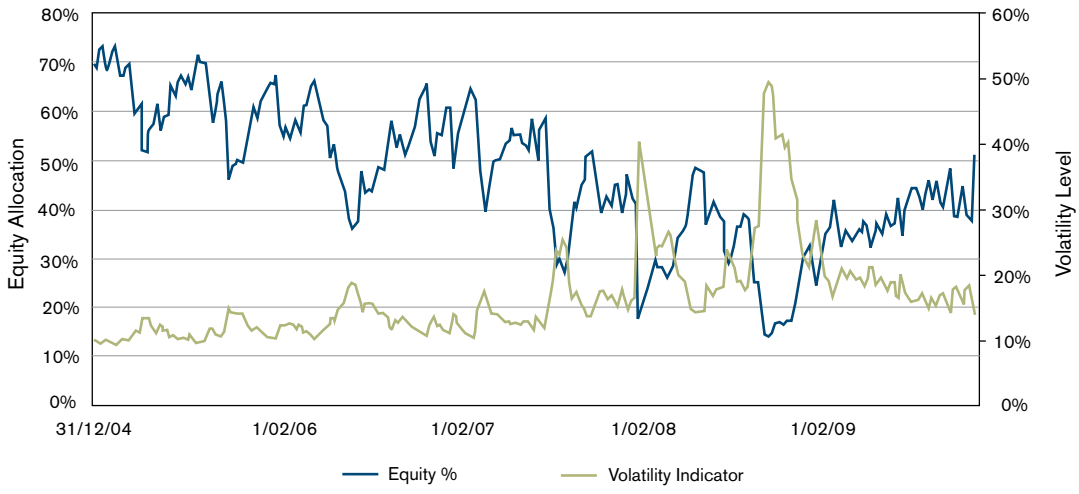
The target-volatility funds assessed within this research report were based on the following parameters:

- 6.9%, 8%, and 9.8% target volatility levels
- A GARCH process was used to track the volatility measure
- Rebalancing at each time step

Figure 11 illustrates the changing equity allocation for the 8% target-volatility fund throughout a back-test of the 2005-2010 period as well as the level of volatility.

As Figure 11 shows, the portfolio allocation varies between equities and bonds as volatility increases, especially during the spike in volatility witnessed during the GFC in the second half of 2008.

FIGURE 11: TARGET-VOLATILITY EQUITY ALLOCATION (2005-2010)



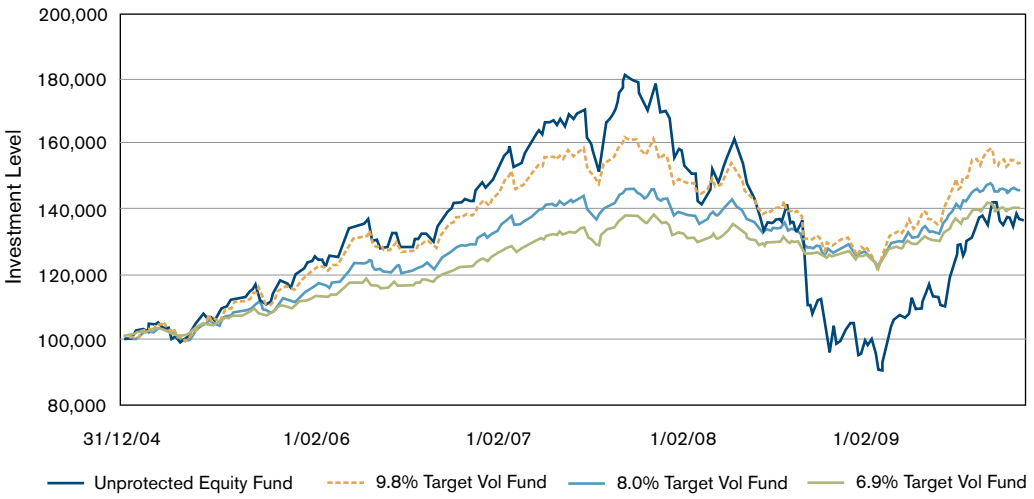
Back-test

Figure 12 illustrates the performance of these target-volatility funds during the period 2005-2010.[14]

Target-volatility strategies look promising when back-tested over historical scenarios. This is due to the tendency for market crashes to be preceded by increases in leading volatility indicators.

Target-volatility strategies look promising when back-tested over historical scenarios, as shown in Figure 12. This is due to the tendency for market crashes to be preceded by increases in leading volatility indicators.

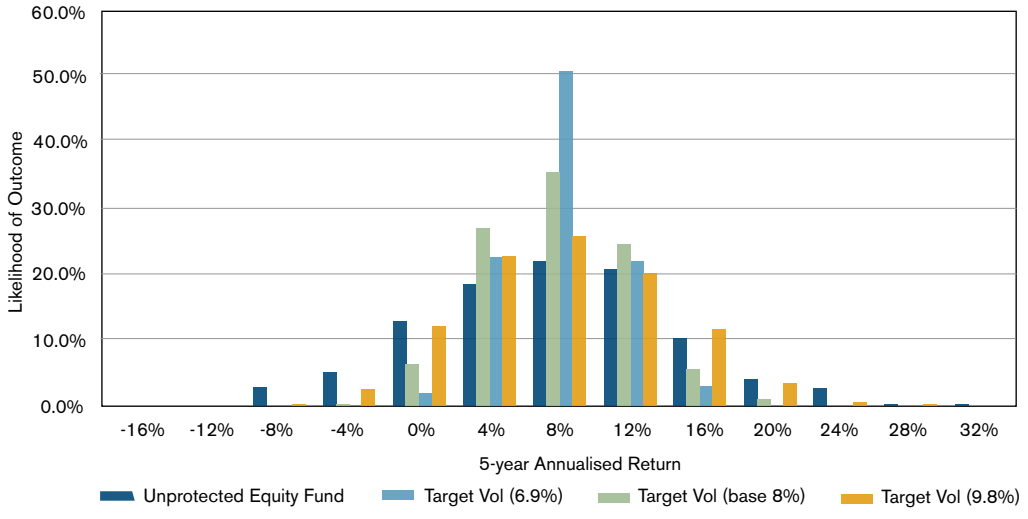
FIGURE 12: TARGET-VOLATILITY BACK-TEST (2005-2010)



Projection

Figure 13 illustrates annualised returns of a target-volatility strategy over the set of scenarios created with randomly sampled historical returns and compared to an unprotected equity fund. As the chart shows, the target-volatility strategy substantially reduces the variability of returns, and in particular, reduces the size of the tail–normalising the overall return distribution.

FIGURE 13: TARGET-VOLATILITY SAMPLED RETURNS



14 75 basis points per annum fund management charges were assumed for both strategies.

Impact Of Varying Key Parameters

As shown in Figure 13, varying the volatility target has an impact on realised returns, with more aggressive targets leading to an asset allocation with higher participation in performing markets at the expense of increased sensitivity to market corrections.

Summary

Figure 14 contains summary statistics for each of the target volatility strategies relative to the unprotected equity investment strategy outlined above.

FIGURE 14: TARGET-VOLATILITY SUMMARY STATISTICS

STRATEGY	MEAN	STANDARD DEVIATION	PROBABILITY OF NEGATIVE RETURN	AVERAGE NEGATIVE RETURN
UNPROTECTED EQUITY INVESTMENT	5.96%	7.21%	20.80%	-3.85%
9.8% TARGET VOL FUND	6.03%	5.93%	15.20%	-2.80%
8% TARGET VOL FUND	6.09%	4.12%	6.80%	-1.52%
6.9% TARGET VOL FUND	6.05%	2.93%	2.00%	-0.48%

As mentioned earlier, target-volatility strategies serve to normalise the distribution of returns, which can be observed through the consistency of the mean return for each of the strategies in the table in Figure 14.

Ultimately, the performance of target-volatility strategies will be dependent on the realised correlation between the volatility indicator and equity returns or the predictive power of the model used and should be thoroughly tested and considered prior to implementation.

The performance of target-volatility strategies will be dependent on the realised correlation between the volatility indicator and equity returns or the predictive power of the model used.

CONTINUOUS PORTFOLIO PROTECTION INSURANCE (CPPI)

Description

Continuous portfolio protection insurance (CPPI) has been around for some time in various forms. It evolved as the need to efficiently provide downside protection emerged in the late 1980s and was marketed as a dynamic asset allocation strategy focused on protecting the capital of the investor.

Risk Protection Mechanism

In general, CPPI rebalances investors' assets between bonds and growth assets based on an algorithm designed to crudely replicate an option payoff. The goal is to preserve capital, and CPPI may be combined with options provided by an investment bank to offer a capital guaranteed solution.

Key Product Design Variables

There are a number of parameters to consider when setting a CPPI strategy such as:

- **Protection Floor Level**
  The basic protection level is a static floor set below the initial investment to provide a point at which investors can be fully allocated to bonds or another risk-free asset class and be guaranteed of recovering their capital by the end of the term. More complex structures incorporate ratchet features that lock in positive performance and reset the protection floor to a higher amount, as well as open-ended structures without a fixed term of investment.

- **Buy/Sell Triggers**
  Buy/sell triggers are established to determine levels at which the investment is reallocated between bonds and equities. As with other strategies these triggers are designed to achieve the optimal balance between trading frequency or transaction costs and tracking error.

- **Equity Exposure**
  Equity exposure is typically designed as a function of the surplus of the investment over the protection floor. More aggressive strategies will take leveraged positions in equities as the surplus grows.

- **Fund Structure**
  There are two common structures that can be implemented. The fund can be structured to invest directly in equities and gradually or immediately rebalance into bonds as equities fall in order to meet the protection floor target. Alternatively, the fund can be structured to invest in bonds and implement leveraged derivative positions (such as futures) to synthetically create equity exposure.

- **Gap Protection**
  CPPI strategies are exposed to gap risk in markets experiencing sudden changes because rebalancing is based on end-of-day prices and market movements occur throughout the trading day. To mitigate this risk, 'gap protection' may be offered by combining the CPPI approach with a financial option, often referred to as a 'crash put.' For this reason, bundled CPPI structures that provide a guarantee to investors are often offered by investment banks.

A CPPI strategy has low economic cost and is primarily an administrative solution.

Cost Structure

In general, a CPPI strategy has low economic cost and is primarily an administrative solution. Costs emerge through the additional administrative burden, as well as via any financial options that may be used to provide insulation from market gap events to which the strategy is exposed.

In the absence of a guarantee, it is possible that a CPPI strategy could be provided for a relatively minor fee.

Analysis

Background

For this report, we have analysed a CPPI strategy with the following attributes:

- Investment horizon of five years
- Initial investment of $100,000 and annual fee of 75 bps p.a.
- Buy/sell triggers of 16.5% and 23.5% respectively
- Equity multiplier of 4
- Government bonds used as the risk-free investment
- 80% ratchet feature[15]

Figure 15 illustrates the performance of the CPPI mechanism during the 2005-2010 period. In particular it is worth noting the following;

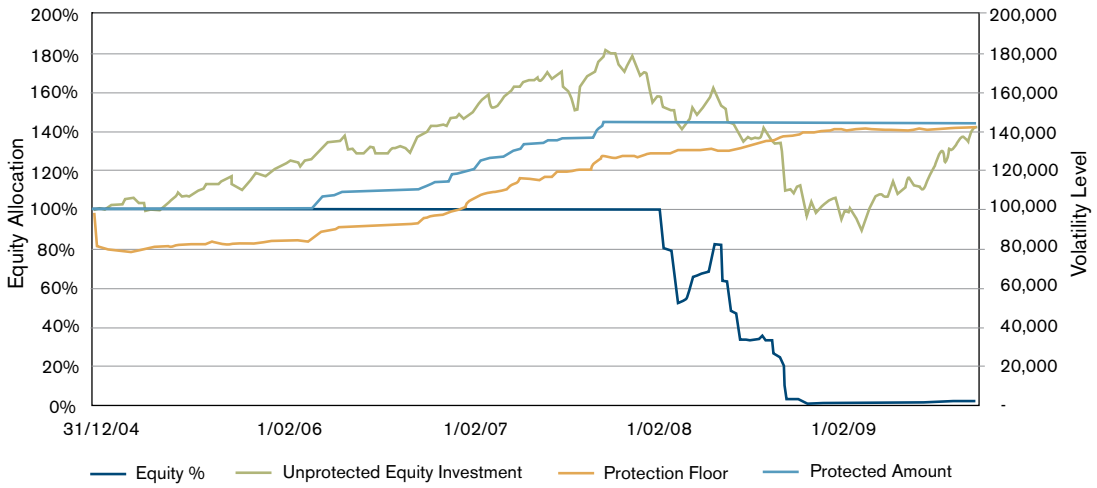
- The protection target resets to a higher amount midway through the back-test period, which is due to the strong performance of equity markets together with the presence of the automatic ratchet feature.

- The protection floor, the amount needed to be invested in bonds at any point in time so that the bond investment accumulates back to the protection amount by the end of the strategy term, converges to this amount at the end of the term.

15 Continuously resets protection amount to 80% of the maximum account value.

- The equity allocation (red line) is generally high until the market decline in late 2008. As the protection floor is approached, assets are reallocated (in stages) to bonds. By the end of term, this CPPI strategy was 'cash locked.'

FIGURE 15: CPPI ASSET ALLOCATION ILLUSTRATION

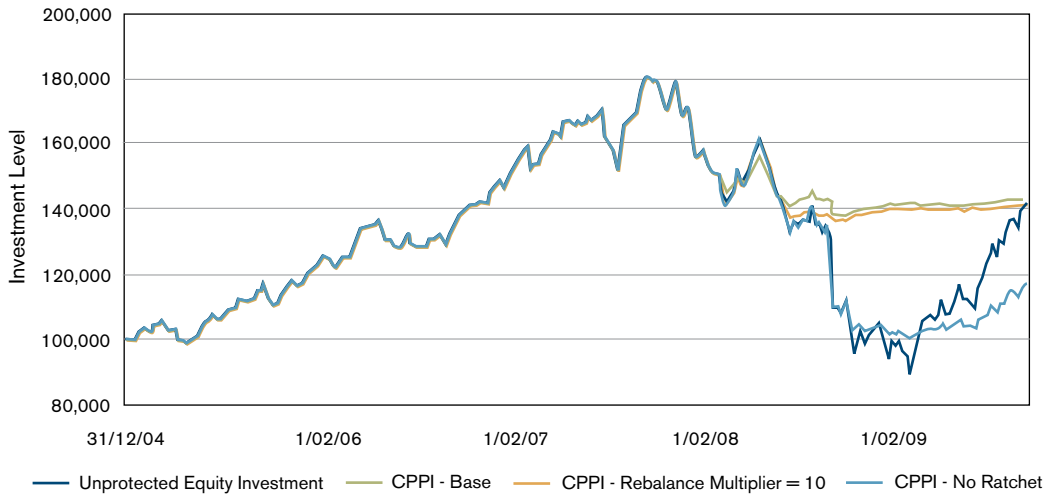


Back-Test

Figure 16 illustrates the performance of the CPPI strategy over the 2005-2010 back-test period compared to an unprotected investment.

Throughout the first half of the back-test, the CPPI strategy tracks the unprotected investment as the assets remain fully invested in equities. However, after the steep decline in equities in 2008, the CPPI strategy increases the allocation to bonds, causing investors to be "cash locked" and insulating them from further deterioration in markets. It can also be observed that the strategy fails to reallocate as equity markets rebound, and investors in this strategy do not participate in the recovery.

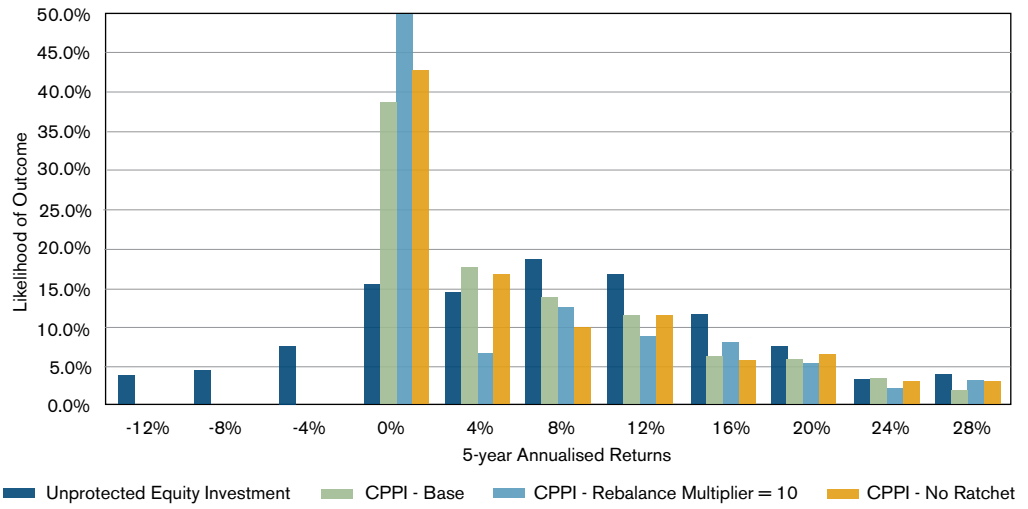
FIGURE 16: CPPI BACK-TEST



Projection

Figure 17 illustrates the distribution of outcomes of the CPPI strategy compared to an unprotected equity investment. The CPPI strategy effectively removes the tail of the distribution–resulting in little downside risk over the time horizon under consideration.

FIGURE 17: CPPI SIMULATION



Impact of varying key parameters

Interestingly, the 2005-2010 back-test (Figure 16) shows little difference between the parameters tested in this analysis. This is to be expected considering the performance of Australian equities from 2005 through early 2008.

However, the simulation results shown in Figure 17 indicate that varying the key parameters, such as the multiplier (speed to rebalance), rebalancing thresholds, or removing the ratchet, all contribute to shaping the distribution of outcomes.

Summary

The table in Figure 18 contains summary statistics for each of these CPPI strategies compared to the unprotected equity investment.

Overall, the CPPI strategies perform exceptionally well at protecting against downside returns. Standard deviations have been reduced slightly, but most importantly, negative return scenarios are minimal.

Overall, the CPPI strategies perform exceptionally well at protecting against downside returns. Standard deviations have been reduced slightly, but most importantly, negative return scenarios are minimal. This also demonstrates the limited value of the "crash put" protection that is often combined with these strategies.

Mean returns for the CPPI strategies are lower than unprotected equities, reflecting the opportunity cost of these strategies. Figure 17 indicates this is due to some sacrifice in large positive equity retruns compared to the unprotected equity investment.

FIGURE 18: CPPI SIMULATION SUMMARY STATISTICS

STRATEGY	MEAN	STANDARD DEVIATION	PROBABILITY OF NEGATIVE RETURN	AVERAGE NEGATIVE RETURN
UNPROTECTED EQUITY INVESTMENT	8.22%	10.14%	18.80%	-6.96%
CPPI, BASE	7.01%	7.56%	0.00%	0.00%
CPPI, REBALANCE MULTIPLIER=10	6.39%	8.20%	0.00%	0.00%
CPPI, NO RATCHET	7.04%	8.09%	0.00%	0.00%

CREATING EXPOSURE: BOND PLUS CALL STRATEGY

Description

Some strategies utilise derivatives to provide market exposure while combining them with conservative assets to provide security. A bond combined with a call option (BPC) is an example of one such strategy and is the subject of this section.

BPC strategies are often used to provide investors with the security of a stable yielding investment (bond) together with a return of capital at the end of the term. The option (usually a call option) is used to provide investors with exposure to equity market performance.

Risk Protection Mechanism

Unlike other derivative strategies that focus on providing protection against a market downturn, the options utilised within a BPC strategy are used to provide exposure to market returns. The bond portfolio is ultimately used to provide a floor on the investment and the option is used to provide exposure to upside of the selected index.

Unlike other derivative strategies that focus on providing protection against a market downturn, the options utilised within a BPC strategy are used to provide exposure to market returns.

Key Product Design Variables

The key design rules for most strategies involving options, whether for protection or exposure, are similar and include:

1. **Option Budget and Strategy**
   The degree of upside exposure of the BPC strategy will largely depend on two factors: fixed income proceeds allocated to the option budget and the call strategy chosen.

   To the extent that the option budget is increased, the degree of exposure to positive markets is leveraged at the sacrifice of yield from the bond portfolio.

   Current option prices will also have an effect on the level of exposure and will vary over time based on:

   - Interest rates
   - Volatility
   - Strike price of the option

2. **Composition of the Bond Portfolio**
   The composition and yield available from the bond portfolio will also directly affect the performance of the strategy. In this case, increases in the yield will generally be correlated with the level of credit risk contained within the portfolio. Given the purpose of these structures, bond portfolios are generally constructed with minimal or no credit risk.

3. **Rebalancing Frequency**
   The relative economics of the underlying bonds and call options will influence the rebalancing strategy and hence performance.

   For example, shorter-term call options (three months) may trade at favourable prices compared to one-year options. On the other hand, interest rates are generally higher for longer durations, meaning a strategy backed by short-term bonds would result in a smaller option budget to pursue growth opportunities. Transaction and buy/sell costs will also increase with more frequent trading.

Fees for BPC strategies are typically funded from the option budget, and therefore may not be transparent to investors.

Cost Structure

Fees for BPC strategies are typically funded from the option budget, and therefore may not be transparent to investors. Although not explicit, additional costs include the premium paid/received for equity options, as well as option buy/sell spreads.

Analysis

Background

To illustrate the BPC strategy for an initial investment of $100,000, we have modelled the performance over a five-year time horizon, with annual rebalancing based on the following parameters:

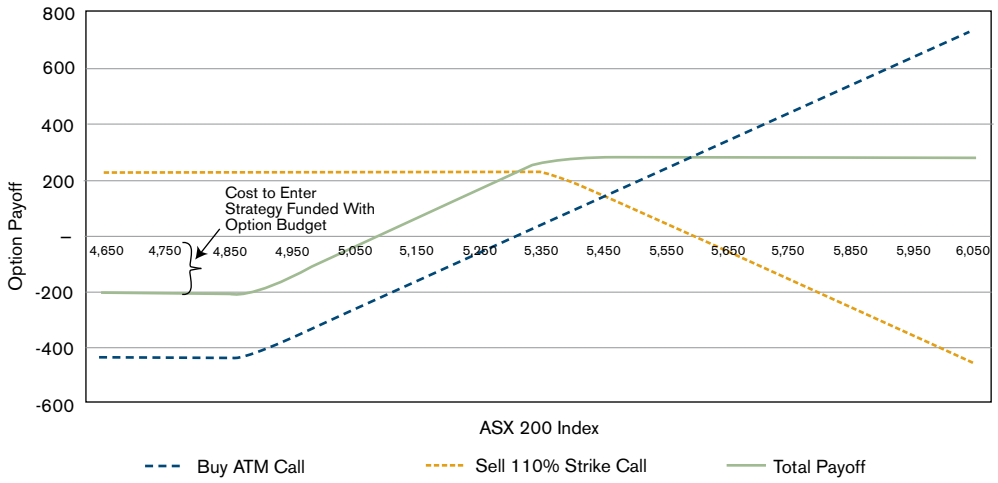
1. Purchase a one-year, zero coupon government bond with a face value of $100,000.

2. Purchase a call option or bull call spread with the remaining funds, or option budget.[16]

3. At bond maturity and option expiration, using the available proceeds to enter into a new BPC position using one-year call options. See below on how the position is constructed.

Figure 19 illustrates a hypothetical bull call spread. Under this strategy, the investor is long one call (typically at-the-money) and sells an out-of-the-money call. Under a BPC strategy, the option budget, or funds available for purchasing the bull spread, is determined by bond yields at the time of purchase.

FIGURE 19: BULL (CALL) SPREAD



16 All option costs in this analysis are modelled with the Black-Scholes model, assuming a 1% spread between buy and sell implied volatility assumptions. A 75 bps of assets fund management charge was also deducted from the option budget.

Back-test

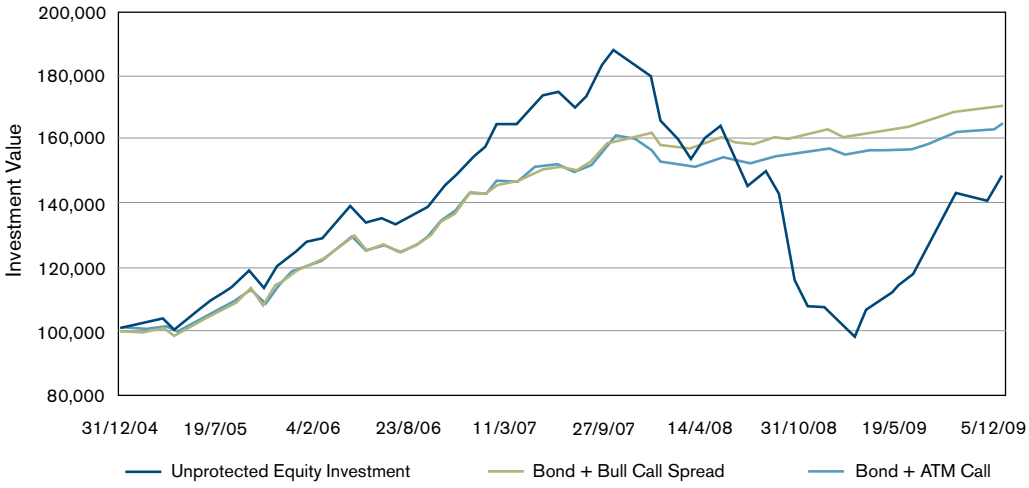
Figure 20 illustrates the performance of this strategy over the 2005-2010 period compared to an equal investment in a managed equity fund.

As with most of the strategies discussed in this report, the investor sacrifices upside potential for downside protection.

This can be observed in the early years of the back-test as markets perform well and the BPC strategy lags the performance of the pure equity investment. However, as markets experience a downturn through the latter half of the period, the BPC strategy enables the investor to lock in the upside earned through early years, and provides protection from subsequent declines in the equity market.

As markets experience a downturn through the latter half of the period, the BPC strategy enables the investor to lock in the upside earned through early years, and provides protection from subsequent declines in the equity market.

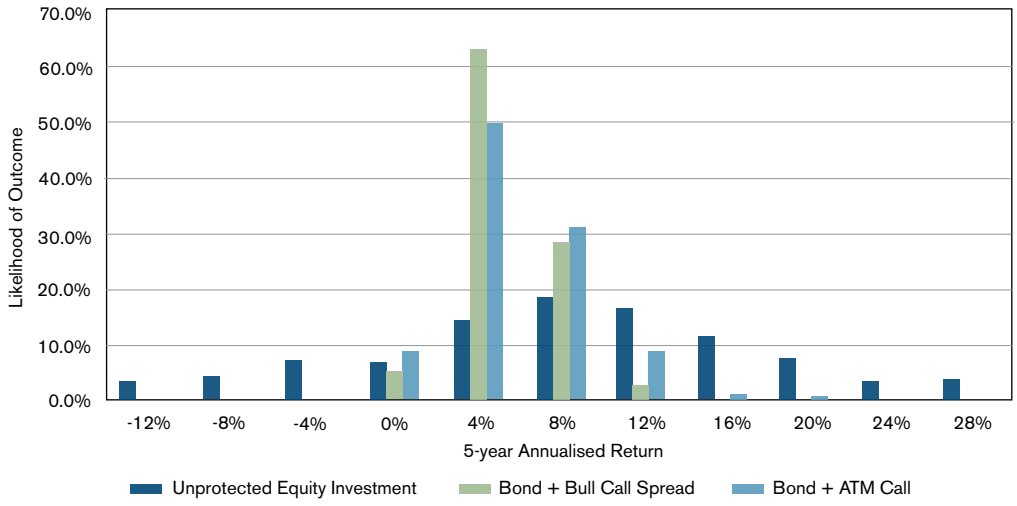
FIGURE 20: BOND PLUS CALL BACK-TEST 2005-2010



Projection

Figure 21 illustrates this BPC strategy over a set of stochastic scenarios. As expected, with the government bond representing the basis for this strategy, there are no negative returns and exposure to both the upside and downside relative to the equity investment is largely curtailed.

FIGURE 21: BOND PLUS CALL SIMULATION



Impact of varying key parameters

For the purpose of this analysis, two iterations of the BPC strategy were tested: purchasing an at-the-money (ATM) call with the available option budget and entering into a bull call spread. As shown in Figure 21, the bull call sacrifices a larger amount of the upside potential.

Summary

Summary statistics for the BPC strategies are shown in the table in Figure 22. From a risk-management perspective, BPC strategies are effective at limiting losses. However, this downside protection comes by sacrificing nearly all upside potential. In other words, the option budget afforded by the bond yield is not sufficient to offer significant equity exposure.

FIGURE 22: BOND PLUS CALL SIMULATION SUMMARY STATISTICS

STRATEGY	MEAN	STANDARD DEVIATION	PROBABILITY OF NEGATIVE RETURN	AVERAGE NEGATIVE RETURN
UNPROTECTED EQUITY INVESTMENT	8.22%	10.14%	18.80%	-6.96%
BOND PLUS ATM CALL	5.90%	3.17%	0.00%	0.00%
BOND PLUS BULL CALL SPREAD	5.11%	2.11%	0.00%	0.00%

OPTION BUDGETS

An alternative to the BPC strategies described above is the use of derivatives to explicitly manage downside risk. The variety of instruments and methods available gives funds flexibility in structuring solutions that fit with their approaches, views, and existing asset allocation strategies

Description

An alternative to the BPC strategies described above is the use of derivatives to explicitly manage downside risk. The variety of instruments and methods available gives funds flexibility in structuring solutions that fit with their approaches, views, and existing asset allocation strategies–for example, option budgets, put options, and futures.

These strategies become relevant to funds that believe in their ability to generate excess returns via growth assets and understand the need for growth potential to provide an implicit inflation hedge for a potentially lengthy retirement time horizon.

The simplest example of this strategy is equity investors who purchase put options to protect their portfolios from a decline in markets. In principle, this should be equivalent to a BPC strategy. [17] In practice, however, these strategies can yield significantly different results depending on the legislative and tax environment within which the investment is structured. For example, investors in Australian equities, depending on their tax environments (i.e., superannuation), would receive franking credits on the dividends, which would not accrue to BPC investors where the equity exposure is synthetically created through the use of call options.

Risk-Protection Mechanism

Option budgets involve purchasing options (either single options, spreads, or collars) intended to compensate for negative returns in an equity portfolio. For example, put options pay off when markets fall, so holding a put option combined with a long equity investment would limit the exposure of investors to falling markets.

17 Put-call parity.

Key Product-design Variables

As described in the previous section, considerations for designing option-based strategies are common regardless of whether the strategy is designed to create exposure or provide insulation against market downturns. They include:

- Option budget and strategy
- Rebalancing frequency

Cost Structure

In addition to fees for managing the underlying equity investments, additional charges may be levied for management of the put option strategy. The option budget itself will be an additional drag on fund performance, and will depend on the option budget strategy chosen.

Analysis

Background

For the purpose of the analysis contained in this report, the following strategies were considered:

- **1% Option Budget, ATM Put**: Allocating 1% of funds under management (FUM) p.a. to purchase an at-the-money put option.
- **1% Option Budget – OTM Put**: Allocating 1% of FUM p.a. to purchase an option 5% out-of-the-money.
- **Zero Cost Collar**: Buy an ATM put, sell OTM call and OTM put such that net cost is zero.

The 'zero cost collar' option strategy involves buying protection through an at-the-money put, and selling out of the money options (call and put) such that net proceeds are zero. Figure 23 illustrates this strategy. The dotted lines represent the individual option payoffs at expiration (including the premiums for buying or selling the option) and the solid line shows the total strategy profit at expiration as a function of the reference index level.

The 'zero cost collar' option strategy involves buying protection through an at-the-money put, and selling out of the money options (call and put) such that net proceeds are zero.

FIGURE 23: ZERO COST COLLAR PAYOFF DIAGRAM

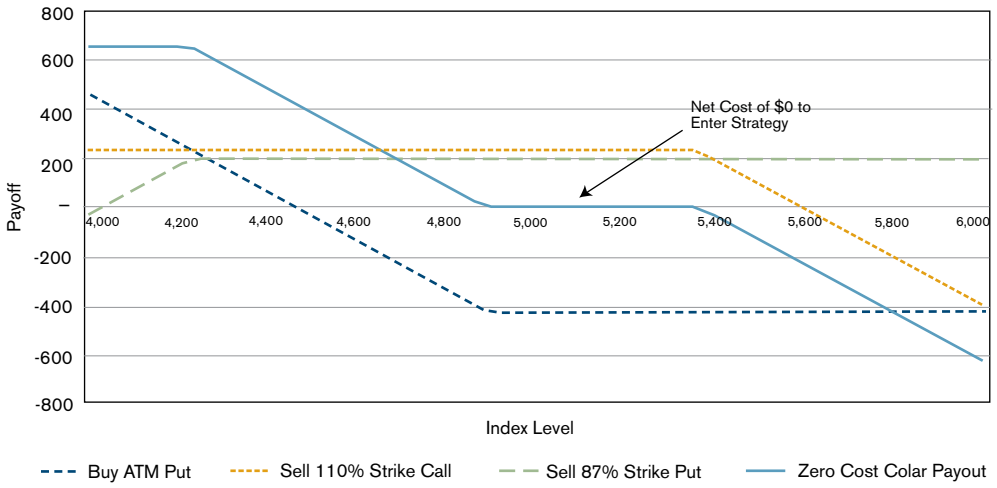
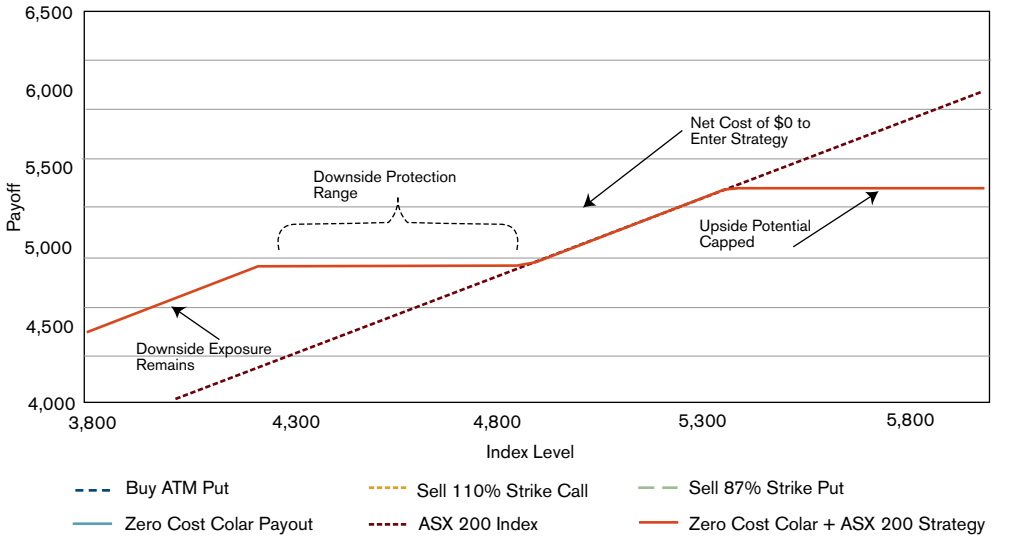


Figure 24 shows the total value of the zero cost collar strategy (at the options' date of expiration) when combined with an investment in equities.

FIGURE 24: EQUITY + ZERO COST COLLAR ILLUSTRATION

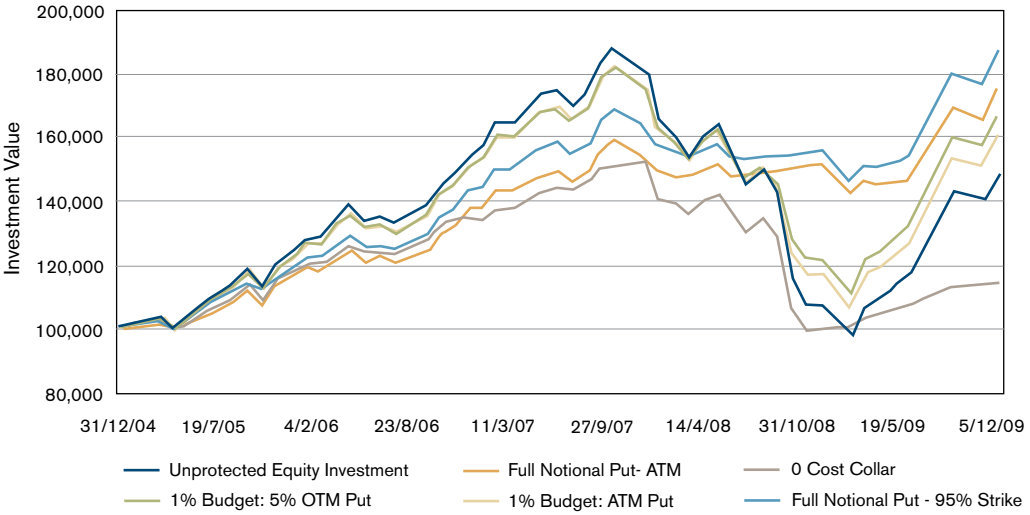


The zero cost collar described above is only one possible strategy. For example, funds could enter the same collar, but allocate an option budget (i.e., 1% of assets per annum), which would give a wider collar (more upside potential and downside protection). Or the option budget could be used to simply purchase as much protection as possible, either through at-the-money puts or out-of-the-money puts. Rather than allocating a certain budget to the options, a fund may also target a certain protection amount (i.e., buy an at-the-money put to cover the entire notional invested).

Figure 25 illustrates the value of $100,000 invested in several versions of protective option strategies (with remaining funds invested in equities) compared to an unprotected investment in equities:

Back-test

FIGURE 25: PUT OPTION STRATEGY BACK-TEST 2005-2010



ATM vs. OTM Put Strategy

The differences in performance between the at-the-money (ATM) and out-of-the-money (OTM) strategies can be attributed to the value of the options available for the same budget.

- The 1% budgets with ATM puts vs. OTM puts are similar except for the strike price of the option chosen.
- The ATM option will pay first (higher strike price), but in periods with large market declines (as is seen in the back-test) the OTM puts outperform the ATM put in the latter half of the scenario.
- In bull markets, neither of the options expire at-the-money, effectively matching the 100% equity investment less the 1% per annum option budget.

Zero Cost Collar Strategy

Whilst the zero cost collar is naturally appealing because, as the name suggests, there is a net option premium of zero to enter the strategy, the low 'sticker price' comes with two inherent costs that emerge via the investment itself, namely:

- Imperfect downside protection (selling OTM put)
- Reduced participation in the upside (selling OTM call) to fund the ATM put

It is important to note that the 2005-2010 back-test is precisely the type of scenario under which the zero cost collar is disadvantaged; strong bull market returns are capped by the option sold, and the portfolio is not protected from significant market crashes because some of the downside protection was sold to achieve a 'zero cost' proposition.

Projection

FIGURE 26: PUT OPTIONS STRATEGIES SIMULATION: 1% OPTION BUDGETS AND ZERO COST COLLAR

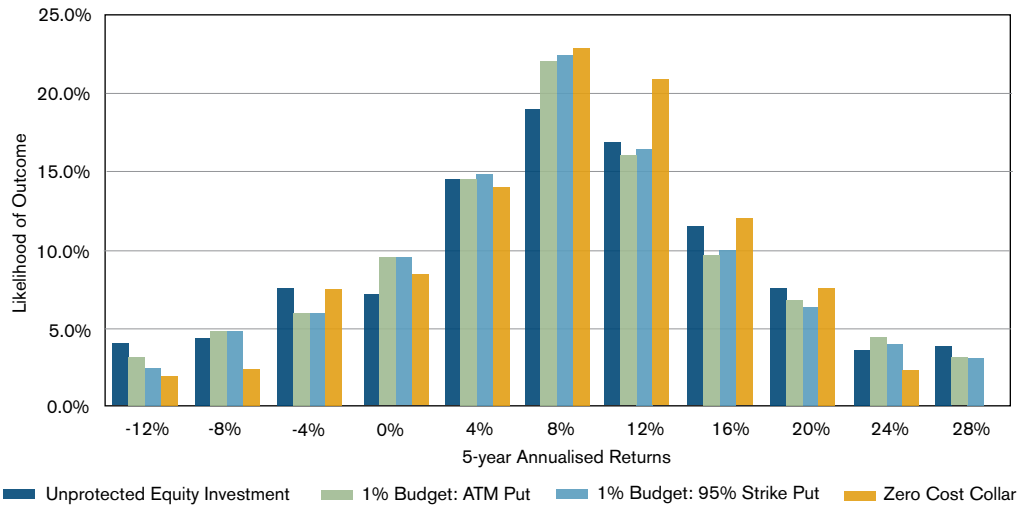


Figure 26 illustrates the distribution of outcomes of each of the three option-based strategies considered.

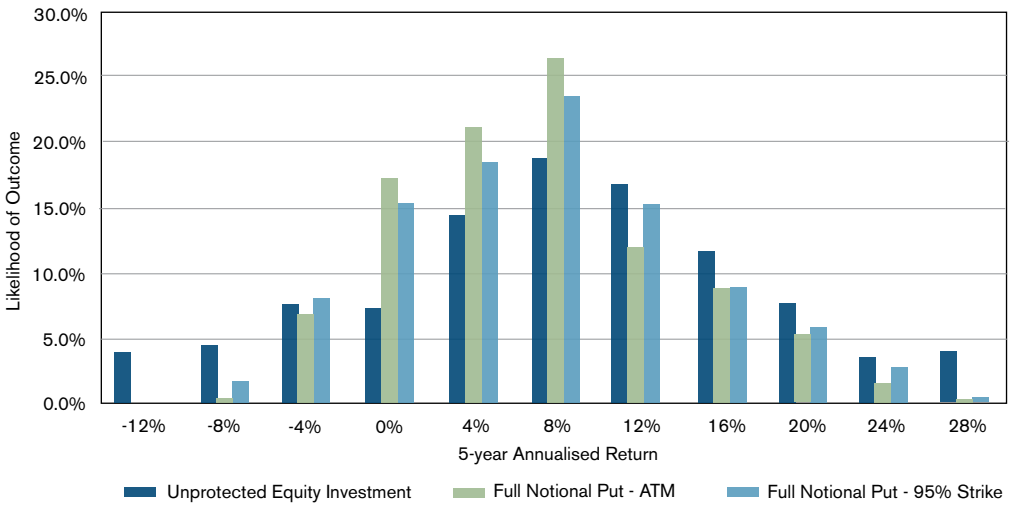
The zero cost collar results in less downside risk (smaller tails) than the unprotected equity investment, and a tighter distribution of returns, with less upside potential.

The zero cost collar results in less downside risk (smaller tails) than the unprotected equity investment, and a tighter distribution of returns, with less upside potential.

The at-the-money and 95% strike put strategies (both purchased with 1% budget p.a.) show profiles similar to each other. While the zero cost collar is protected from market falls, before the collar bound is reached, the budget strategies are still partially exposed to all market declines, because only a portion of the equity is protected with the limited budget. Still, these strategies do mitigate some of the downside risk compared to unprotected equities.

Figure 27 illustrates the summary statistics for each of these option-based strategies.

FIGURE 27: PUT OPTIONS STRATEGIES SIMULATION: FULL NOTIONAL PROTECTION



As described above, Figure 27 effectively illustrates the key feature of all strategies presented in this report, namely that it is impossible to deliver them without incurring a cost, whether financial or via changes to the underlying distribution of returns. Strategies with higher option budgets ultimately provide better downside protection, at a cost of reduced upside participation.

Impact of varying key parameters

As the back-test and simulation results indicate, option budget strategies will produce markedly different protection outcomes depending on the parameters and approach utilised.

Strategies which allocate only a small portion of funds to protection (i.e., 1% option budgets) do not provide much protection (as can be seen in Figure 26). However, when the full notional is targeted for protection (as shown in Figure 27) significant downside risk is removed, albeit by sacrificing significant upside returns. In both the 1% option budget and full notional analyses, varying the option strike (at-the-money vs. 95% strike) does not appear to drastically affect results. In practice, funds would likely monitor the relative economics of varying strikes and tenors in the option markets.

In general, reduction in risk (both standard deviation and the probability of negative returns) is a function of the budget allocated to the protection strategies.

Summary

Summary statistics for the option budgets are shown in the table in Figure 28. In general, reduction in risk (both standard deviation and the probability of negative returns) is a function of the budget allocated to the protection strategies. The zero cost collar is the exception, because it behaves in a similar fashion to the BPC strategies by limiting both positive and negative returns.

FIGURE 28: OPTION BUDGET SIMULATION SUMMARY STATISTICS

STRATEGY	MEAN	STANDARD DEVIATION	PROBABILITY OF NEGATIVE RETURN	AVERAGE NEGATIVE RETURN
UNPROTECTED EQUITY INVESTMENT	8.22%	10.14%	18.80%	-6.96%
1% BUDGET: ATM PUT	8.14%	9.27%	16.40%	-6.18%
1% BUDGET: 95% STRIKE PUT	8.18%	9.19%	16.40%	-5.99%
ZERO COST COLLAR	7.99%	7.88%	15.60%	-5.22%
OTM PUT (FULL NOTIONAL)	7.46%	7.28%	12.80%	-3.56%
ATM PUT (FULL NOTIONAL)	6.98%	6.63%	13.20%	-2.41%

DYNAMIC REPLICATION

Description

An alternative to the option-based structures described above is a dynamic replication strategy. Under this approach, a dynamic asset allocation strategy using exchange-traded futures is employed to provide a customised protection strategy. As this approach does not involve options, and can be implemented in the absence of an investment bank, fees are generally lower.

Risk Protection Mechanism

Downside risk within a dynamic replication strategy utilises derivatives, such as equity index futures, to synthetically create defensive allocations. As the name suggests, dynamic strategies rely on rebalancing allocations to these instruments to construct specific investment profiles and, consequently, can avoid the use of more expensive instruments such as over-the-counter (OTC) options.

Downside risk within a dynamic replication strategy utilises derivatives, such as equity index futures, to synthetically create defensive allocations.

Key Product Design Variables

Dynamic replication strategies are easily customised. Essentially, any protection target that can be modelled using an option pricing model and dynamically replicated can be used as the basis for a dynamic replication strategy.
Product features to consider include:

- **Option Term**: Fixed terms are better suited to close-ended funds, while rolling terms are suited to open-ended funds.
- **Risk Budget**: The strategy can target a return of capital (i.e., replicating a put option), or short-term constraints, such as allowing for minimum periodic withdrawals.
- **Strategy Enhancements**: These strategies can be customised to lock in upside potential (resets/ratchets), or rebalance funds from protected funds to growth funds at predetermined thresholds to avoid cash locking.
- **Hedging Strategy**: Besides replicating the option (delta hedge), it is possible to hedge other risk metrics,[18] such as rho (interest rate exposure) or vega[19] (volatility exposure). In addition, fund managers may elect to follow opportunistic hedges, such as hedging market volatility or other exposures when they are viewed to be "cheap."

This offers product providers significant flexibility in being able to design products with features tailored to meet the specific needs of their clients.

18 Commonly referred to as "Greeks."

19 Vega can also be managed by running the dynamic replication strategy on funds which utilised volatility management (target volatility).

Cost Structure

Compared to the option strategies detailed above, fees will generally be lower through the use of liquid exchange-traded instruments where liquidity is high and counterparty risk is negligible.

Costs for replication strategies are experienced through the need to develop administration capabilities as well as any impact on returns in rising markets.

Costs for replication strategies are experienced through the need to develop administration capabilities as well as any impact on returns in rising markets. Strategies may be set to attempt to maximise protection benefits whilst moving out of hedge assets in strong bull markets to avoid dragging on fund returns.

Analysis

For the purpose of the analysis contained in this report, the following strategy has been considered:

- Initial investment of $100,000 with $95,000 invested in ASX 200 equities, and the remaining $5,000 held in cash.
- A dynamic replication strategy and rho hedge, which holds positions in equity and bond futures to replicate the desired strategies and neutralise interest rate exposure. The following strategies were replicated:

  1. A five-year return of capital strategy, which seeks to return at least the original principal invested with no resets or ratchets

  2. A strategy which continuously resets the protection floor to 90% of the highest fund value, and sets the minimum effective equity[20] position to be 80%

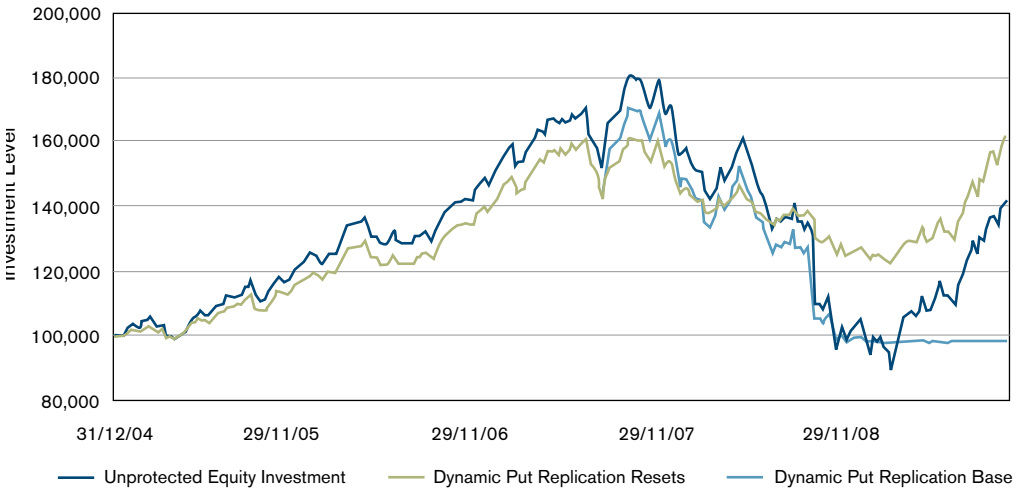
Back-test

Figure 29 displays back-test results for the replication strategy described above.

The simple return of capital strategy demonstrates that the protection strategy effectively sets a floor near the $100,000 mark during the market correction, locking in the investment for the remainder of the term.

The replication strategy allowing for a reset to 90% of the highest fund value and maintains a minimum effective equity position on the downside (to avoid cash locking) performs better throughout the market correction, at the cost of lost upside.

FIGURE 29: DYNAMIC REPLICATION BACK-TEST



20 Effective equity position equals equity position net of short equity futures positions.

Projection

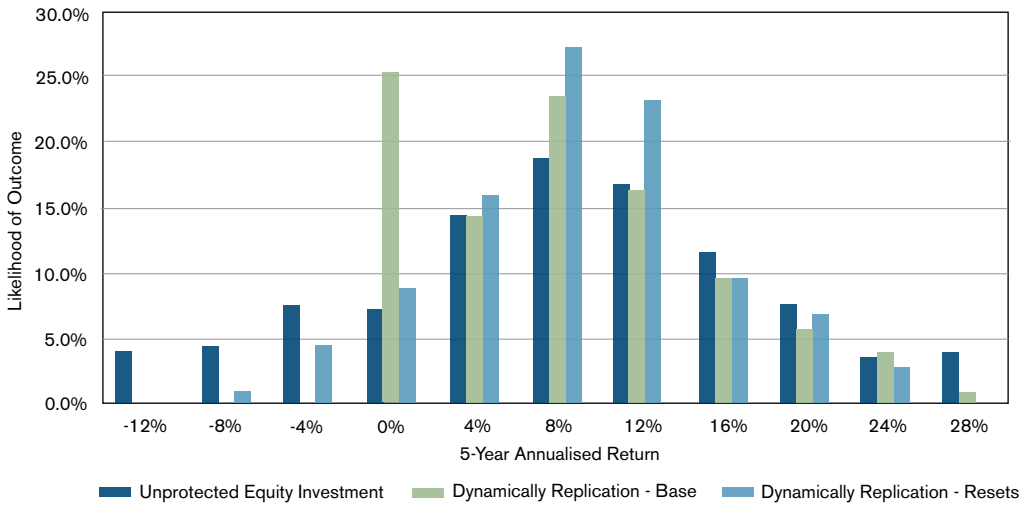
Figure 30 illustrates the dynamic replication strategies compared to the unprotected investment. The results for the base dynamic replication strategy (with no resets) indicate the distribution is truncated at 0%. The strategy with resets displays some downside because markets may fall further after assets are moved back to equities.

Impact of varying key parameters

Dynamic replication strategies can be customised to any number of protection targets. Although beyond the scope of this paper, the overall distributions will be similar to the protection option targeted.

Dynamic replication strategies can be customised to any number of protection targets.

FIGURE 30: DYNAMIC REPLICATION SIMULATION



Summary

FIGURE 31: DYNAMIC REPLICATION STRATEGY SUMMARY STATISTICS

STRATEGY	MEAN	STANDARD DEVIATION	PROBABILITY OF NEGATIVE RETURN	AVERAGE NEGATIVE RETURN
UNPROTECTED EQUITY INVESTMENT	8.22%	10.14%	18.80%	-6.96%
DYNAMICALLY REPLICATION, RESETS	9.05%	6.62%	8.80%	-2.59%
DYNAMICALLY REPLICATION, BASE	8.52%	7.08%	0.80%	-0.29%

As the results in the table in Figure 31 demonstrate, despite the fact that the probability of a negative return is marginally reduced, dynamic replication substantially reduces the extent of losses in poor scenarios.

SYNTHESIS AND CONCLUSIONS

COMPARISON OF APPROACHES

As described earlier in this report, strategies designed to provide risk management to fund members ultimately incur a cost, whether that is an explicit fee or an opportunity lost.

The applicability of the risk-management strategies contained within this report will vary across funds based on their investment philosophy, membership structure, size, expertise, and capabilities.

The table in Figure 32 highlights some of the key areas for comparison across each of the various strategies.

FIGURE 32: COMPARISON OF RISK-MANAGEMENT STRATEGIES

DESCRIPTION	TARGET DATE & TARGET VOLATILITY	CPPI	OPTION-BASED STRATEGIES	DYNAMIC REPLICATION
STRATEGY	Rebalances between growth and defensive assets based on a predetermined algorithm.		Rebalances options / futures to manipulate the shape of the return distribution.	
ALIGNMENT WITH INVESTMENT PHILOSOPHY	Potential to align with most philosophies. Potentially involves regular rebalancing of underlying assets, which may be difficult or costly.		Easily applied to manage beta risk. Some difficulties if extended to manage risks across asset classes (e.g., infrastructure) where instruments do not exist.	
ADMINISTRATIVE BURDEN	Regular rebalancing of underlying funds required.		Regular rebalancing of options/futures positions required.	
RISK MANAGEMENT	No explicit risk-management strategy.	Higher exposure to gap events, resulting in CPPI strategies provided in conjunction with options for crash protection.	Depends on the strategy implemented. Lower potential exposure to gap events through the use of options.	Manages downside through exchange-traded instruments. Management of gap risk via existing futures position and ability to trade intraday.
UNDERLYING, COLLATERALISATION, AND LIQUIDITY	N / A	Transactions in the underlying can be subject to liquidity issues and collateralisation is not possible.	Depends on relationship with investment bank(s). Use of multiple counterparties together with collateralisation agreements possible.	Strategies focus on transacting index futures via exchanges resulting in highly liquid and collateralised positions.
COST	Minimal. Administrative burden low.	Minimal, although options may be expensive.	Options may be expensive. Administration capabilities required to manage multiple counterparties.	Minimal for instruments, administration capabilities required.

Each of the strategies discussed in this report should be considered alongside the particular objectives of the fund together with the ability to customise and administer them.

COMPARISON OF RESULTS

As mentioned earlier, each of the strategies discussed in this report should be considered alongside the particular objectives of the fund together with the ability to customise and administer them. In general, allocating more funds to a protection strategy, whether explicitly via an option budget or through rebalancing assets (such as the protection floor in a CPPI approach), results in greater insulation in the event of a market decline to the detriment of upside performance.

Identifying the optimal strategy across a single path produces results specific to the path and strategy selected. Fees will therefore be critical in assessing the relative value of different strategies given the consistent basis assumed for the purposes of this report. Consequently, we have summarized results based on the distribution of scenarios in the tables in Figures 33 and 34. These results have been ranked in order of their standard deviations.

FIGURE 33: PROTECTION STRATEGY SUMMARY STATISTICS (RANDOMLY GENERATED RETURN SCENARIOS)

STRATEGY	MEAN	STANDARD DEVIATION	PROBABILITY OF NEGATIVE RETURN	AVERAGE NEGATIVE RETURN
UNPROTECTED EQUITY INVESTMENT	8.22%	10.14%	18.80%	-6.96%
1% BUDGET: ATM PUT	8.14%	9.27%	16.40%	-6.18%
1% BUDGET: 95% STRIKE PUT	8.18%	9.19%	16.40%	-5.99%
CPPI, REBLANCE MULTIPLIER=10	6.39%	8.20%	0.00%	0.00%
CPPI, NO RATCHET	7.04%	8.09%	0.00%	0.00%
ZERO COST COLLAR	7.99%	7.88%	15.60%	-5.22%
CPPI, BASE	7.01%	7.56%	0.00%	0.00%
OTM PUT (FULL NOTIONAL)	7.46%	7.28%	12.80%	-3.56%
DYNAMIC REPLICATION, BASE	8.52%	7.08%	0.80%	-0.29%
5-YR. GMAB	6.91%	7.05%	0.00%	0.00%
ATM PUT (FULL NOTIONAL)	6.98%	6.63%	13.20%	-2.41%
DYNAMIC REPLICATION, RESETS	9.05%	6.62%	8.80%	-2.59%
BOND + ATM CALL	5.90%	3.17%	0.00%	0.00%
BOND + BULL CALL SPREAD	5.11%	2.11%	0.00%	0.00%

FIGURE 34: TARGET VOLATILITY SUMMARY STATS (SAMPLED RETURN SCENARIOS)

STRATEGY	MEAN	STANDARD DEVIATION	PROBABILITY OF NEGATIVE RETURN	AVERAGE NEGATIVE RETURN
UNPROTECTED EQUITY INVESTMENT	5.96%	7.21%	20.80%	-3.85%
9.8% TARGET VOLATILITY FUND	6.03%	5.93%	15.20%	-2.80%
8% TARGET VOLATILITY FUND	6.09%	4.12%	6.80%	-1.52%
6.9% TARGET VOLATILITY FUND	6.05%	2.93%	2.00%	-0.48%

As we can see, the bond-plus strategies provide the greatest insulation against volatility but at the cost of sacrificing almost all equity participation. Each of the other strategies results in different trade-offs between volatility and mean returns based on the strategy design and underlying costs.

As we can see, the bond-plus strategies provide the greatest insulation against volatility but at the cost of sacrificing almost all equity participation. Each of the other strategies results in different trade-offs between volatility and mean returns based on the strategy design and underlying costs.

SUMMARY

Option budgets, CPPI, and dynamic replication strategies are all suitable to managing downside risk while preserving upside exposure.

These results indicate that many of the protection strategies provide similar outcome using different approaches. Option budgets, CPPI, and dynamic replication strategies are all suitable to managing downside risk while preserving upside exposure. These products can be customised to achieve the desired balance between risk management and upside exposure.

Bond plus call strategies are expected to return the principal invested. However, equity exposure is extremely limited, so they may not be suitable for investors targeting asset growth.

There are other factors to consider besides simulation results. For example, CPPI and dynamic replication strategies can provide similar outcomes if designed as such. This is intuitive because both are intended to move assets between growth and defensive assets based on market levels. However, there are practical implications to both strategies. Because CPPI strategies are based on end-of-day unit prices, they cannot be rebalanced intraday. Dynamic replication strategies, on the other hand, can be rebalanced as markets move, and can also use derivatives in addition to the underlying assets. In the absence of a guarantee, the exposure to gap events may not be desirable.

Interestingly, many of the protection strategies can be used in conjunction with the others. Target-volatility funds, which may provide attractive risk/return characteristics as standalone investments, are also suitable as underlying investments in dynamic replication strategies.

The table in Figure 35 provides a high-level summary of each of the strategies considered in this report.

FIGURE 35: SUMMARY

STRATEGY	DESCRIPTION	COMMENT
TARGET DATE	Allocations between growth and conservative assets are determined based on age.	Consistent with existing approaches, but can be ineffective through periods of sustained volatility.
TARGET VOLATILITY	Allocations between growth and conservative assets are determined based on volatility.	Theoretically attractive approach that is beginning to gain traction in the market.
CPPI	Assets are rebalanced between bonds and the underlying.	Low perceived cost, but administratively complex, and potential for "cash lock."
BOND + CALL	Bonds provide security and market upside is provided through option exposure.	No long-term counterparty exposure, limited upside potential.
OPTION BUDGET	A budget is established for the purchase of options to provide protection.	Relatively simple to administer, but budgets can be ineffective in times of high market volatility.
DYNAMIC REPLICATION	Futures are rebalanced to replicate any option-based strategy.	No counterparty exposure and low cost, but can be exposed to market gaps.
INSURANCE	Utilise a third-party insurer to provide an integrated product solution.	Can include longevity risk (lifetime income guarantees) and other guarantees, but introduces long-term counterparty exposure.

PUTTING IT ALL TOGETHER

INCREASING USE OF RISK-MANAGEMENT STRATEGIES

As this research demonstrates, there are a variety of strategies and approaches available to funds seeking to provide risk management for their members' retirement savings. As more and more members move into the retirement phase, where risk and exposure to major market events is magnified, demand for more sophisticated investment strategies will create incentives and opportunities for funds willing to innovate.

A POTENTIAL SOLUTION FOR 'LONGEVITY' RISK

As debate continues to centre on longevity risk, many of these strategies will be seen as potential approaches to help sustain individual retirement savings accounts across a wide range of market scenarios, thereby helping to address the longevity issue.

Combining these approaches with alternative strategies and/or products such as reverse mortgages or longevity pooling vehicles (lifetime annuities) will further serve to help retirees manage their long-term income needs.

LOCAL CONSIDERATIONS

It is important to be aware that any risk-management solutions will need to function within the local regulatory environment without impinging on investors' tax or social security status. For instance, Australian investors receive franking credits on dividends for taxes paid at the corporate level. Strategies such as the bond plus call, whereby the investor does not hold the underlying equity, but retains equity exposure through the call options, will not provide the explicit benefit of franking credits.

It is important to be aware that any risk-management solutions will need to function within the local regulatory environment without impinging on investors' tax or social security status.

POOLED OR INDIVIDUAL APPROACHES

As described above, as individuals approach retirement their focus turns to achieving a specific outcome based on their own personal circumstances. The accumulation focus of most DC plans has resulted in the pooling of member monies in order to achieve economies of scale when investing.

As the need for a more tailored approach has evolved, funds have begun to retool their systems and methodology towards more sophisticated solutions. This is evident in the development of target-date funds, which are designed to cater to members with similar retirement dates along with a wider range of investment products and strategies (such as direct equity investments) catering to different levels of member affluence and sophistication.

This increasing demand for control at an individual level can also be observed through the growth in self-administered retirement savings products. In Australia, for instance, this sector of the market, referred to as 'Self-managed Superannuation Funds' (SMSF), has grown considerably and now represents over 30%[21] of the total retirement savings market. This is generally categorised through the presence of larger balances, and subsequently the demand for control and flexibility.

Despite this, many funds are still dominated by the concept of a default fund where members that do not make an explicit decision are automatically placed. Whilst this approach has been pivotal to the growth of the accumulation funds in the market today, adapting it to the post-retirement sector, with higher levels of engagement, may be more challenging.

21 SMSF's continue to grow market share – investordaily 28th May 2010, http://www.investordaily.com/cps/rde/xchg/id/style/9224.htm?rdeCOQ=SID-0A3D9632-33219234

The development of low-cost advice models or trends towards fee for service, combined with technology improvements and increasing competition, is likely to contribute to an increasing focus on providing individuals with the ability to construct their own tailored outcomes.

MINIMISING COSTS

Cost will play an important part in both the ability to create an attractive proposition and the ultimate outcome to the investor.

Whatever approach is adopted, cost will play an important part in both the ability to create an attractive proposition and the ultimate outcome to the investor. Any calculation of costs needs to take into account the following:

- **Cost of the strategy employed**: What is the cost of manufacturing the risk-management strategy? There is no free lunch here with all solutions bounded by the prices that the capital markets put on risk or the opportunity cost of foregone exposure to growth assets.
- **Distribution costs**: What is required to inform and educate plan members about the benefits of risk-management strategies?
- **Administration costs**: Any solution is likely to require additional administrative effort and it is important to ensure that this is conducted efficiently.
- **Profit for third parties**: Are there any third parties involved and, if so, what are their profit requirements? For example, in the event that a guarantee is offered, the institution offering the solution will be required to hold capital and will need an adequate incentive (return) to do so.
- **Transparency**: Given the potentially complicated structures underpinning some of these solutions, transparency to fund administrators and members will be vital.

Ultimately, funds and their trustees will favour models and approaches that provide them the ability to control and manage the costs associated with new strategies.

ADDRESSING COUNTERPARTY RISK

The long-term nature of retirement, combined with the fiduciary responsibilities of fund trustees, complicates the development of many traditional guaranteed solutions.

The long-term nature of retirement, combined with the fiduciary responsibilities of fund trustees, complicates the development of many traditional guaranteed solutions. In addition to the costs associated with guarantees, they are generally difficult for funds to provide without a counterparty, given that many do not have the balance sheet or licensing required to support them.

The need for a counterparty can introduce additional complications because problems involving a third party can damage a fund's reputation—not to mention the financial interests of its members. Recent examples across the insurance and banking industries have prompted fund administrators who work with third parties to exercise high levels of scrutiny and monitoring.

Consequently, it is possible that funds will look to employ the techniques utilized by guarantee providers within investment structures and strategies and present them to members as 'risk-management strategies' instead.

In the event that fund sponsors decide to offer guarantees to their members, counterparty management will be important via one of the following mechanisms:

- **Short-term commitments**: adopting approaches that rely on shorter commitments or instruments, or that eventually eliminate or reduce reliance on third parties
- **Collateralisation**: ensuring that third-party obligations are funded—something that is critical to protecting the fund and maintaining the ability to migrate from one provider to the next should a significant event make it necessary
- **Risk pooling**: spreading risk across multiple counterparties

COMMUNICATION FROM AN INCOME PERSPECTIVE

Some challenges are introduced through the need to communicate the benefits of alternative approaches, but this can be framed in a variety of contexts and is fundamentally an asset allocation decision to an asset class designed to perform counter to their net long position.

Whilst the strategies in this report have been presented in terms of absolute performance, they will need to be communicated differently for fund members and assessed in terms of their ability to sustain funds throughout various market conditions.

Whilst the strategies in this report have been presented in terms of absolute performance, they will need to be communicated differently for fund members and assessed in terms of their ability to sustain funds throughout various market conditions.

OPERATIONAL MODELS

Those wishing to adopt solutions will also need to consider the administrative burden of the various solutions and assess whether they have sufficient expertise to administer them over very long time periods.

Numerous potential models for developing risk-management strategies appear to be evolving:

- **Outsourcing**: This option is mostly limited to small funds that wish to retain an administrative role but do not have the necessary in-house staff resources and are comfortable outsourcing to a third-party institution. Selecting the correct partner and carefully monitoring performance will be critical.
- **Partnership**: Some funds may elect to work with a third party that assists by independently administering risk management strategies, collateralised or pooled structures in order to ensure that the fund's fiduciary duties are met, as well as to provide independent advice as appropriate.
- **Internal operations**: Some large funds will elect to develop their own risk-management solutions, with the option of outsourcing certain operations to others who have the appropriate expertise.

SUMMARY

We believe that alternative strategies delivering protection, rather than an absolute guarantee, may prove attractive and cost-effective within the DC market for a number of reasons:

We believe that alternative strategies delivering protection, rather than an absolute guarantee, may prove attractive and cost-effective within the DC market for a number of reasons.

- The lack of balance sheet restricts the ability of funds to provide an absolute guarantee.
- A partial solution to the problem of longevity risk, with assets more robust in the presence of sustained market downturns.

- A lower cost in the absence of a guarantee and requisite capital/profit margins as well as the potential ability to develop in-house capabilities or partners with greater scale/dynamics than traditional investment bank avenues.
- Minimal counterparty risk and complexity through the ability to eliminate reliance on third parties.
- Desire for a long-term sustainable proposition with greater control for plan sponsors and trustees.
- A better fit with existing investment philosophies. Guarantees often carry with them a number of restrictions which can be avoided through the use of protection strategies, without sacrificing the value proposition.
- Pooled approaches may be popular initially, but will transition to individual solutions as technology is enhanced and replaced. Some of these platforms already exist and others will be developed as the market for such solutions develops.

APPENDIX I: REAL-WORLD SCENARIOS

ECONOMIC SCENARIO GENERATOR (ESG)

The Milliman Economic Scenario Generator (ESG) produces a consistent set of real-world simulations into the future for multiple equity indices, implied volatilities, currencies, swap curves, forward curves, Treasury yield curves, and returns for various bond classes. The model accommodates multiple economies and any key dependencies between the various variables.

We model future equity returns for the ASX 200 using a regime-switching model. A regime-switching process attempts to model the behaviour of equity markets, which tend to alternate between periods of low- and high-return volatility. The regime features and the transition probabilities between the regimes have all been calibrated to be consistent with historical data. Although the equity returns within each regime follow a lognormal distribution, the combination of the two regimes produces a leptokurtic return distribution, consistent with real-world observed returns.

The future forward rate term structure is modelled using a three-factor LIBOR Market Model (LMM). The volatilities and the correlations of the three factors have been calibrated to be consistent with historical observations. The corresponding swap rate curve and Treasury yield curve at any point in time are derived from the simulated forward rate term structure, consistent with simulated swap and Treasury spreads. These additional volatilities and risk premiums have been calibrated using various historical corporate bond yields and returns.

Implied volatilities of at-the-money ASX 200 equity indices were modelled using a GARCH-style model, which simulates implied volatilities as a function of daily return variance and a random information factor. A correlation matrix is used to account for cross-dependencies between the implied volatilities of the various equity returns, after allowing for impacts of the returns. A volatility smile was modelled based on historical data, and proportionally applied to the simulated at-the-money volatility scenarios.

CALIBRATION

The following historical data were used in calibrating the real world economic scenario generator:

- All Ordinaries returns from August 1969 to January 2010.
- Australian government bonds have been used from 30 Dec. 1994 to 2 April 2010.
- Weekly ASX 200 implied volatility, 20 May 2005-19 March 2010.
- Australian par swap rates, 13 April 2001-19 March 2010.

The following charts and tables display the distribution of equity returns, implied volatilities, and interest rates used for the purpose of this analysis.

SCENARIOS SUMMARY

FIGURE 36: ASX SIMULATED VS. HISTORICAL ASX 200 TOTAL RETURNS

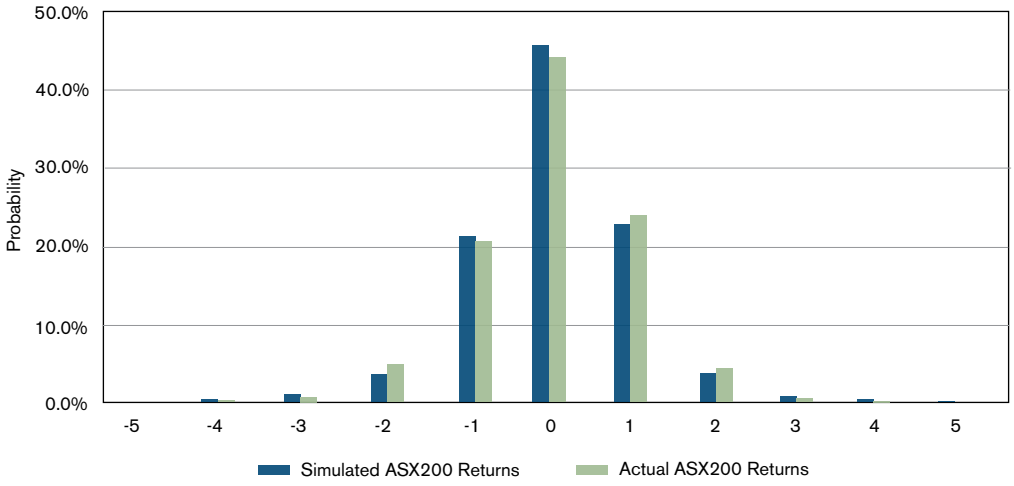


FIGURE 37: ONE-YEAR IMPLIED VOLATILITY DISTRIBUTION, HISTORICAL VS. SIMULATED

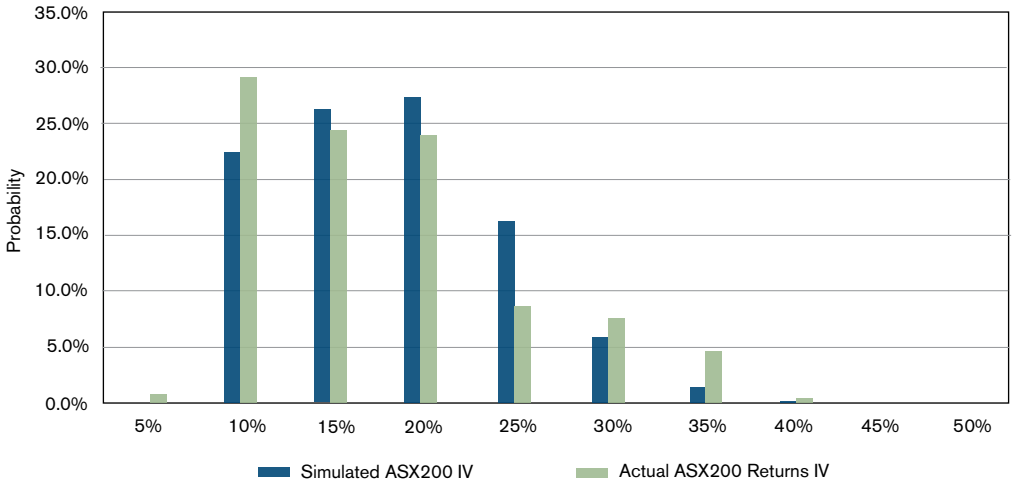


FIGURE 38: SIMULATED SHORT RATES

PERCENTILE	1	2	3	4	5
MIN	2.35%	2.29%	1.76%	1.49%	1.45%
1%	3.00%	2.60%	2.24%	1.93%	1.78%
5%	3.45%	3.14%	2.84%	2.60%	2.46%
10%	3.82%	3.40%	3.19%	2.88%	3.03%
25%	4.52%	4.25%	4.12%	3.80%	3.71%
50%	5.26%	5.26%	5.41%	5.04%	4.97%
75%	6.11%	6.45%	6.77%	6.96%	6.53%
90%	6.93%	7.76%	8.58%	8.37%	8.81%
95%	7.43%	8.50%	9.33%	9.61%	9.45%
99%	8.70%	9.89%	11.55%	11.45%	10.74%
MAX	9.68%	11.08%	14.14%	14.95%	15.14%
MEAN	5.36%	5.47%	5.65%	5.51%	5.38%
STD DEV	1.21%	1.68%	2.09%	2.25%	2.27%

FIGURE 39: SIMULATED 10-YEAR GOVERNMENT BOND YIELDS

PERCENTILE	1	2	3	4	5
MIN	3.11%	2.88%	1.66%	1.49%	1.17%
1%	3.48%	3.00%	2.11%	1.70%	1.49%
5%	4.34%	3.72%	3.21%	2.86%	2.57%
10%	4.59%	3.99%	3.62%	3.30%	3.06%
25%	5.20%	4.88%	4.40%	4.21%	3.99%
50%	5.97%	5.80%	5.64%	5.47%	5.43%
75%	6.60%	6.88%	6.87%	6.82%	7.08%
90%	7.44%	7.90%	8.16%	8.31%	8.49%
95%	7.93%	8.36%	9.39%	9.45%	9.63%
99%	9.06%	9.57%	10.94%	11.21%	11.17%
MAX	9.95%	11.15%	11.71%	14.48%	15.90%
MEAN	5.99%	5.90%	5.80%	5.72%	5.70%
STD DEV	1.13%	1.50%	1.88%	2.07%	2.32%

TARGET VOLATILITY SCENARIOS

To eliminate potential bias caused by simulating the target volatility fund strategy using a regime switching scenario generator, the target volatility funds were analysed using a set of randomly sampled returns from historical weekly ASX 200 accumulation returns during 1994-2010. A flat discount rate and bond yield of 6.5% was assumed.

ACKNOWLEDGEMENTS

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Milliman, whose corporate offices are in Seattle, serves the full spectrum of business, financial, government, and union organizations. Founded in 1947 as Milliman & Robertson, the company has 52 offices in principal cities in the United States and worldwide. Milliman employs more than 2,400 people, including a professional staff of more than 1,100 qualified consultants and actuaries. The firm has consulting practices in employee benefits, healthcare, life insurance/financial services, and property and casualty insurance. For further information visit.milliman.com.

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