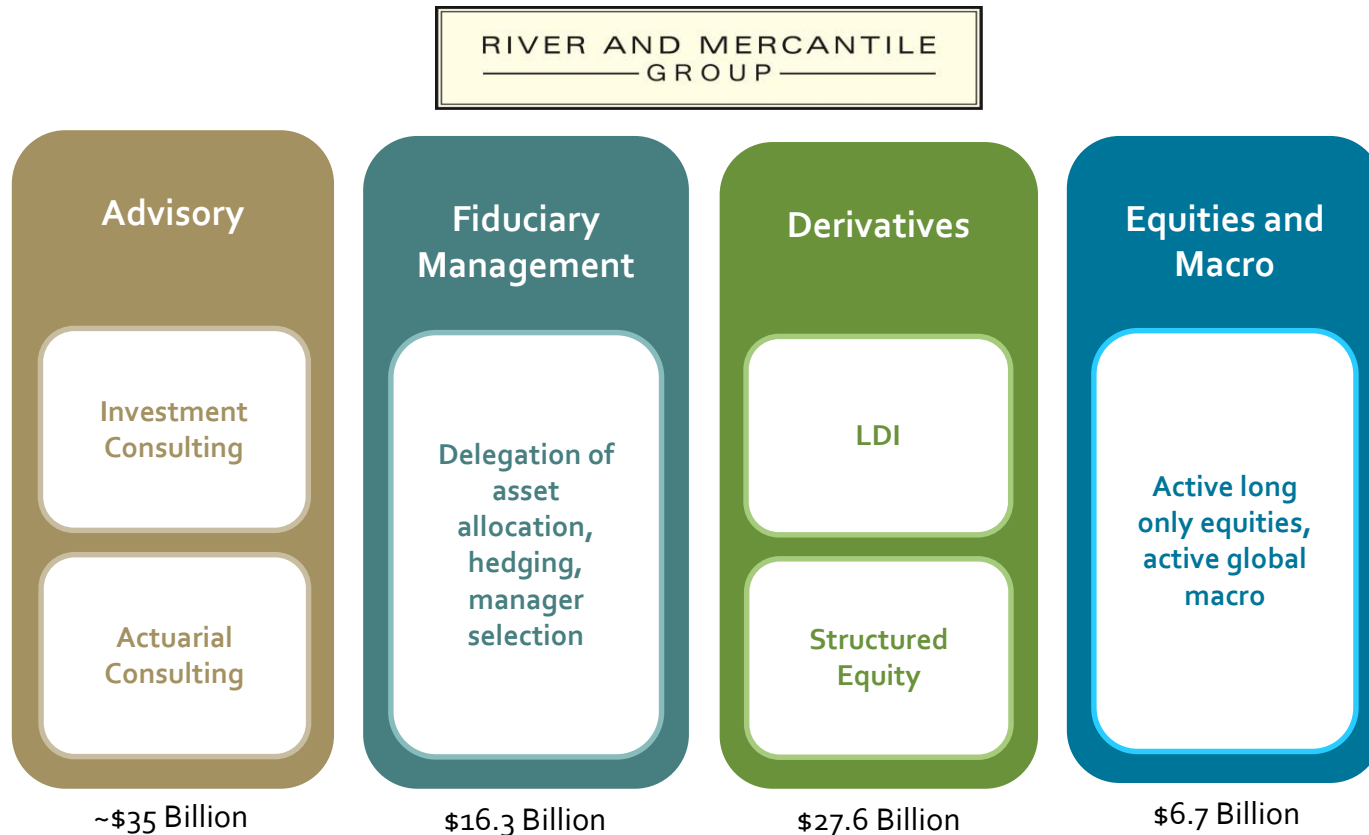


The Strategic Use of Derivatives in Pension Plans and Endowments

James Walton FSA, CERA

River and Mercantile Manage Derivatives Directly



All figures are for River and Mercantile Group globally and include assets advised and/or managed by River and Mercantile Investments Limited, River and Mercantile LLC, and RAMAM LLP. River and Mercantile LLC conducts business under the "River and Mercantile Solutions", "River and Mercantile Asset Management" and "River and Mercantile Derivatives" brand names in the US. All figures as at June 30, 2019 using USD/GBP exchange rate of \$1.2699 / £1 Note: Derivatives assets represent notional amounts under management, the notional amount of the derivative contracts that River and Mercantile executes and manages for its clients and may also include government securities. River and Mercantile LLC is the US division of River and Mercantile Group and provides advisory, fiduciary management and derivatives solutions, utilizing parent company resources when appropriate.

Strategic Use of Equity Derivatives



What Is It?

- Equity derivatives with defined payoffs held directly
- An alternative return seeking asset class

Design

- Customized strategies
- Ability to reallocate physical assets more effectively

Implementation Examples

- Risk management
- Comparison to rate hedging and use in glide paths

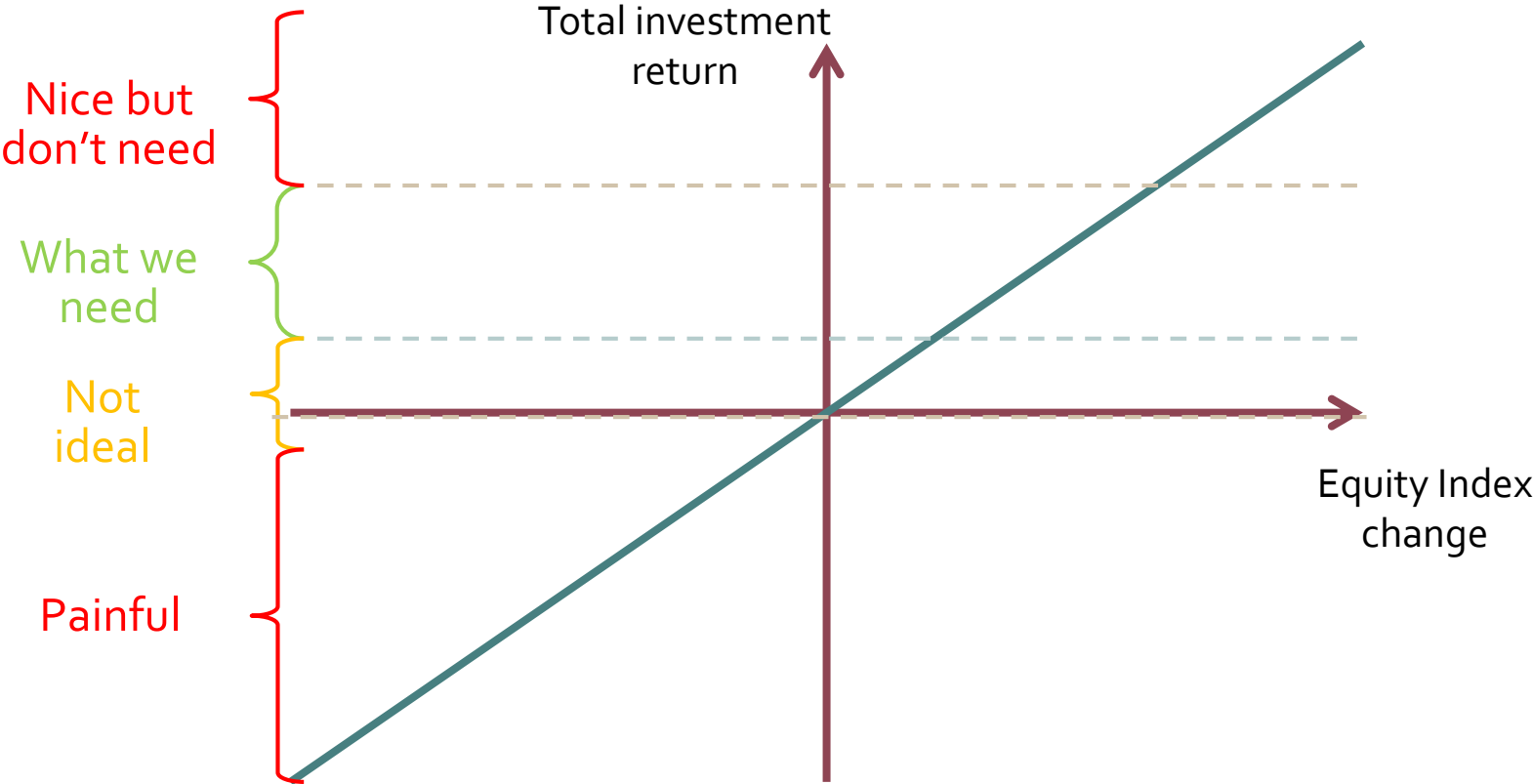
Approaches to Return Seeking Assets

	Principle	Key challenge
Equities	Stay invested to achieve long term Equity Risk Premium	Living with volatility
Defensive Equities	Lower volatility than average equities	Relies on judgement if managed actively
Sell to Bonds/Cash	Less exposure to equity-like assets	Low yields Risk of rising interest rates

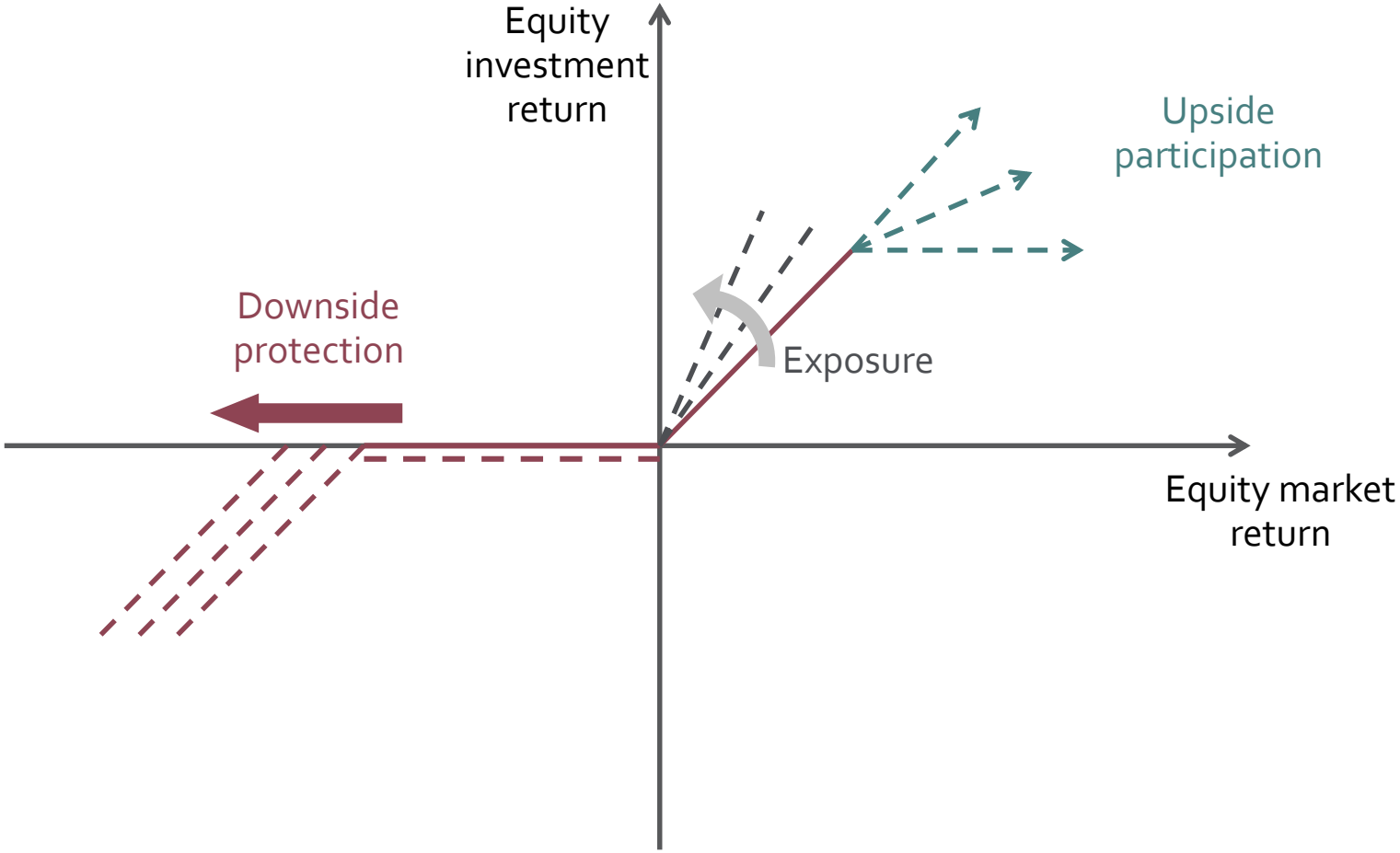
Approaches to Return Seeking Assets

	Principle	Key challenge
Asset allocation algorithms or 'Smart Beta'	Rules based allocations driven by market or company metrics	Reliant on model assumptions. Not transparent
Diversify with alternatives	Reduced volatility by diversification to other asset classes	Relies on correlation assumptions playing out in practice
Structured Equity	Tailored, contractual payoffs for different market levels	Requires skill and knowledge to design the right strategy for the right conditions

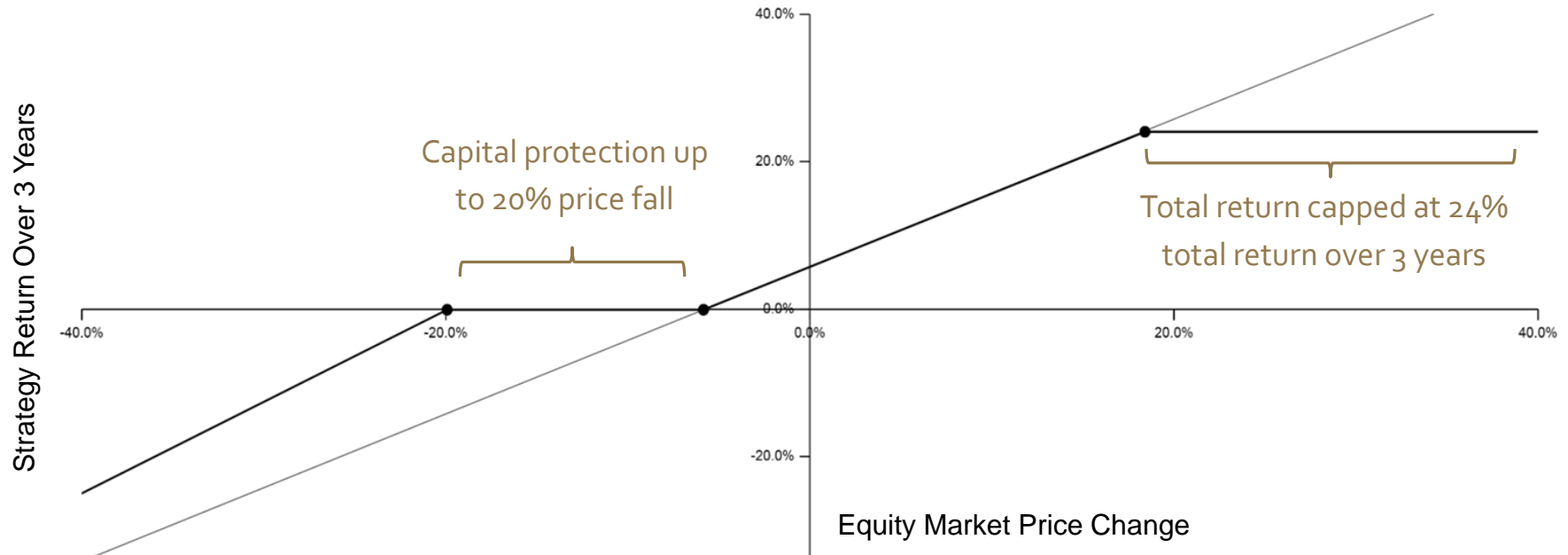
The issues with traditional equity investing



Structured Equity - shaping equity returns



Example Equity Portfolio Exposure Over 3 Years - 20% Protection


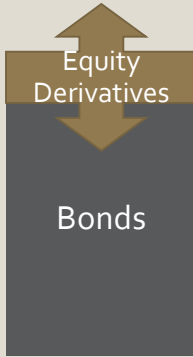


- Overlay to existing equity exposure (for zero premium)
- 'Synthetic' exposure where existing equity assets are held in bonds or cash

Option	Strike (% of Reference Index Spot)	Notional Scaling
Sold Put	80.0%	125%
Bought Call	94.2%	100%
Sold Call	118.4%	100%

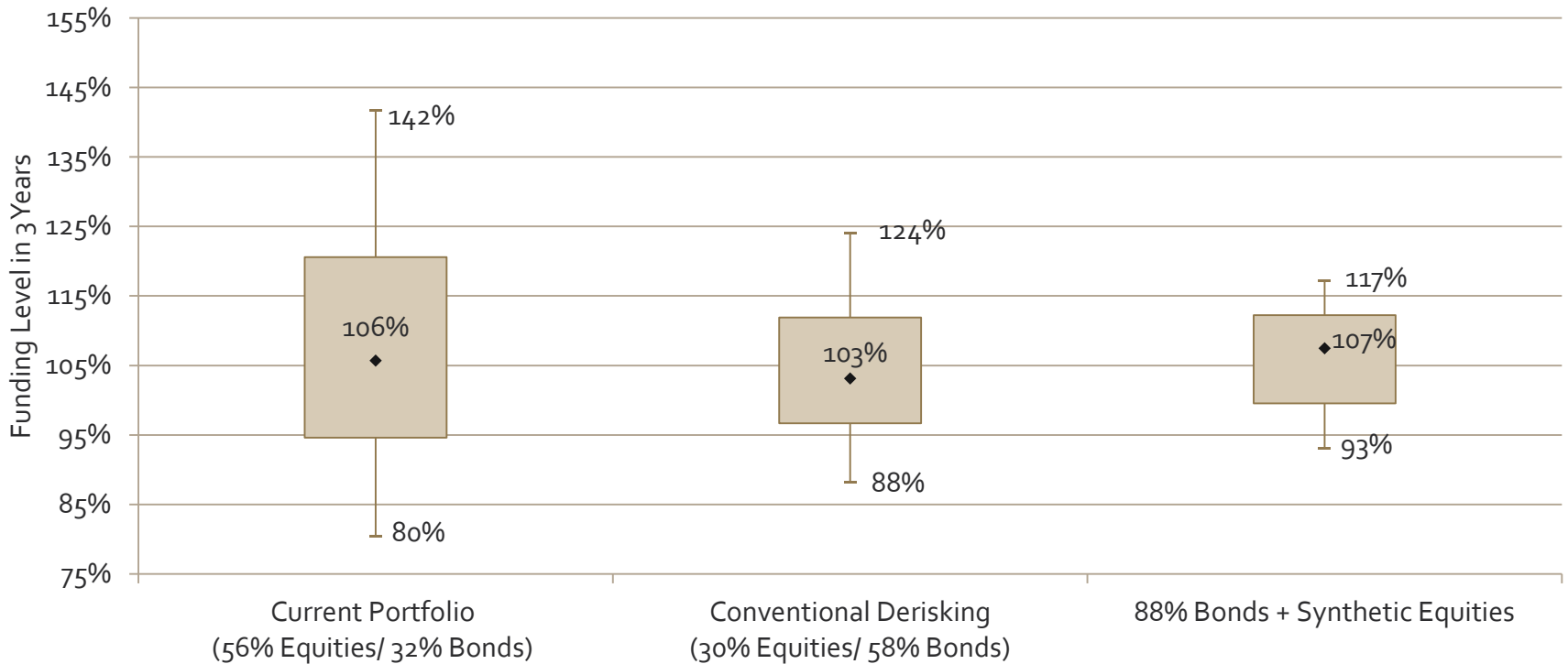
*Physical equities is represented by the MSCI World Index as the straight diagonal line; estimated option pricing reflective of current conditions using River and Mercantile data and pricing models

Equity vs Synthetic Equity

	Equities	Synthetic Equity
Description	Conventional equities 	Bonds + Equity Derivatives <i>Bonds are USTs and Investment Grade Corporates</i> 
Interest Rate Duration	Zero	0-20 years as desired <i>May act as LDI asset and increase hedge ratio</i>
Manager Alpha	Equity manager alpha	Bond manager alpha
Expected Returns	Equities plus Equity Alpha	Equities less Cash plus Bonds plus Bond Alpha
Expected Return Example pa*	$6.5\% + 0.50\% = 7.0\%$	$6.5\% - 1.75\% + 2.75\% + 0.50\% = 8.0\%$
Equity return exposure	Linear	Linear or shaped as desired <i>Potential to add equity protection</i>
Credit Exposure	None directly	Corporate Bonds <i>Exposure to defaults/downgrades but potentially less credit spread sensitivity on accounting and termination deficits</i>

*Expected Return example applies over the long term where cash rates are expected to average 1.75%pa, and long duration investment grade corporate bond return 2.75% pa, net of the impact of downgrades and defaults assumed to be 30 bps pa. Equity Alpha and Bond Alpha are net of fund management expenses. Based on yields as at 30 September 2019.

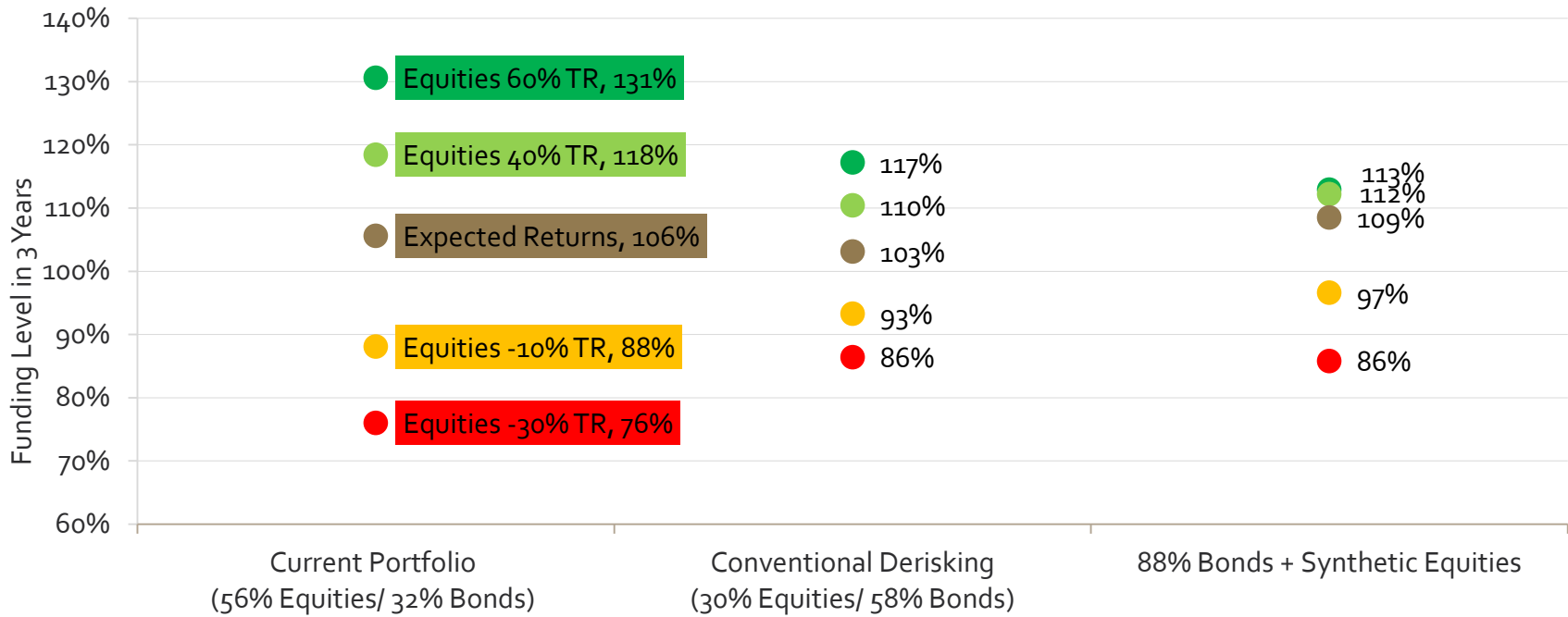
Illustrative Pension Investment Strategies with Equity Derivatives



	Current Portfolio (56% Equities/ 32% Bonds) + Synthetic Structure	Derisking (30% Equities/ 58% Bonds)	Derisking (0% Equities/ 88% Bonds) + Synthetic Structure
Equity	56%	30%	0%
Bonds	32%	58%	88%
Other	12%	12%	12%
Synthetic Equity Derivative	0%	0%	56%

*This chart shows an estimated potential range of outcomes based on Monte Carlo simulation. Plan is 100% Funded. These projections are indicative only and are designed to show the relative risk of various asset allocations. Assumes contributions equal to service cost, 13 year liability duration. The shaped synthetic equity strategy is the same as that outlined in the payoff diagram on the previous slide.

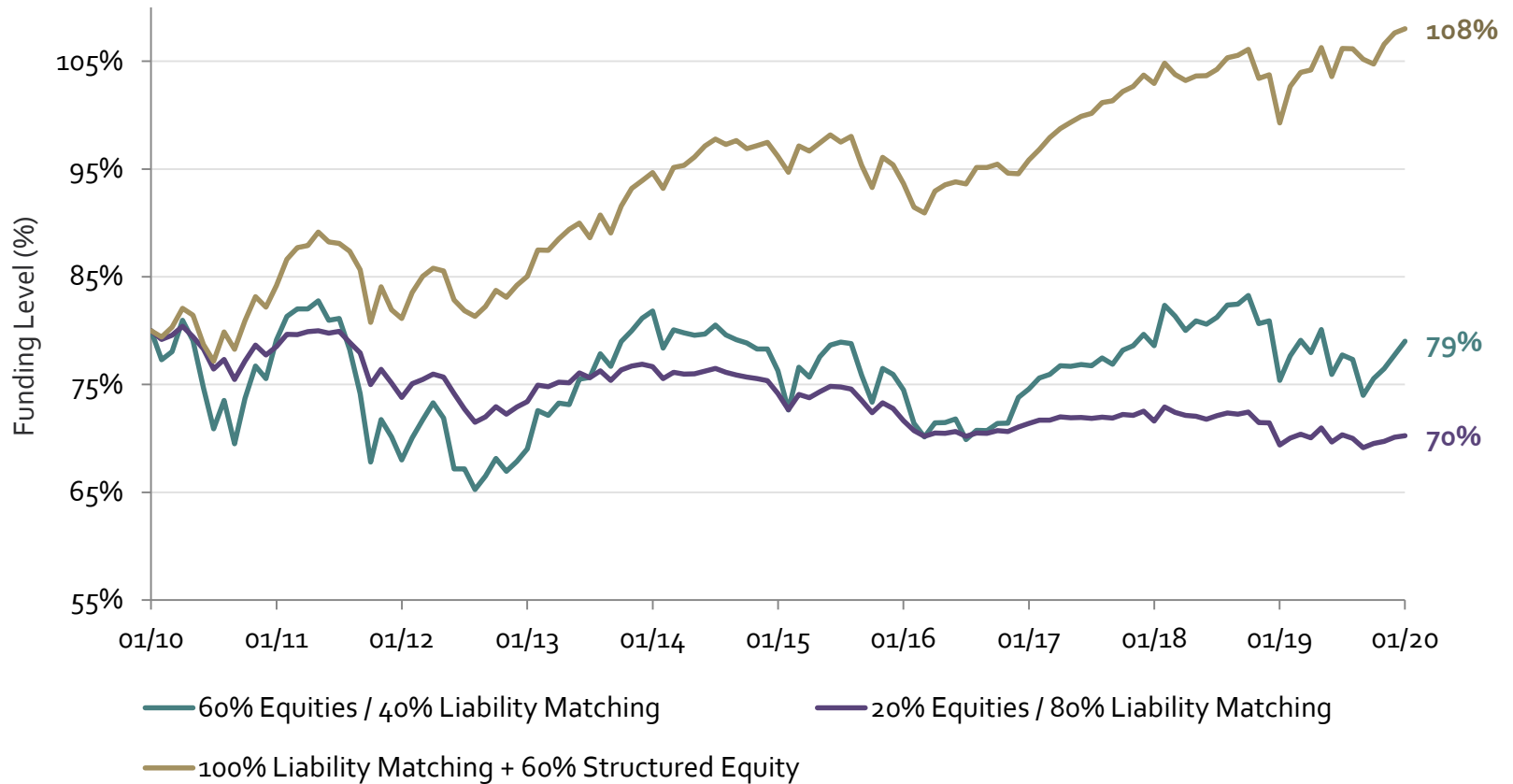
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The Decade to End 2019



**Charts show funding levels for plans 80% funded at 1/1/2010. Plans have 13 year duration as at 1/1/2020, service cost of 2.5% of liabilities per annum and contributions equal to service cost. Liability Matching portfolios are a combination of 65% Barclays Long Credit and USTs to match the duration of liabilities. Equity portfolios are MSCI World Total Return. Structured equity strategies use put and call options to deliver participation to global equities with capital protection down to a 20% fall in markets over a period of 3 years, with downside participation thereafter. Equity upside above a certain level is forgone in the structured equity strategy. The strategy shown incorporates 3 year term strategies that are initiated 1/1/2008, 1/1/2011, 1/1/2014 and 1/1/2017. All returns net of fees.*

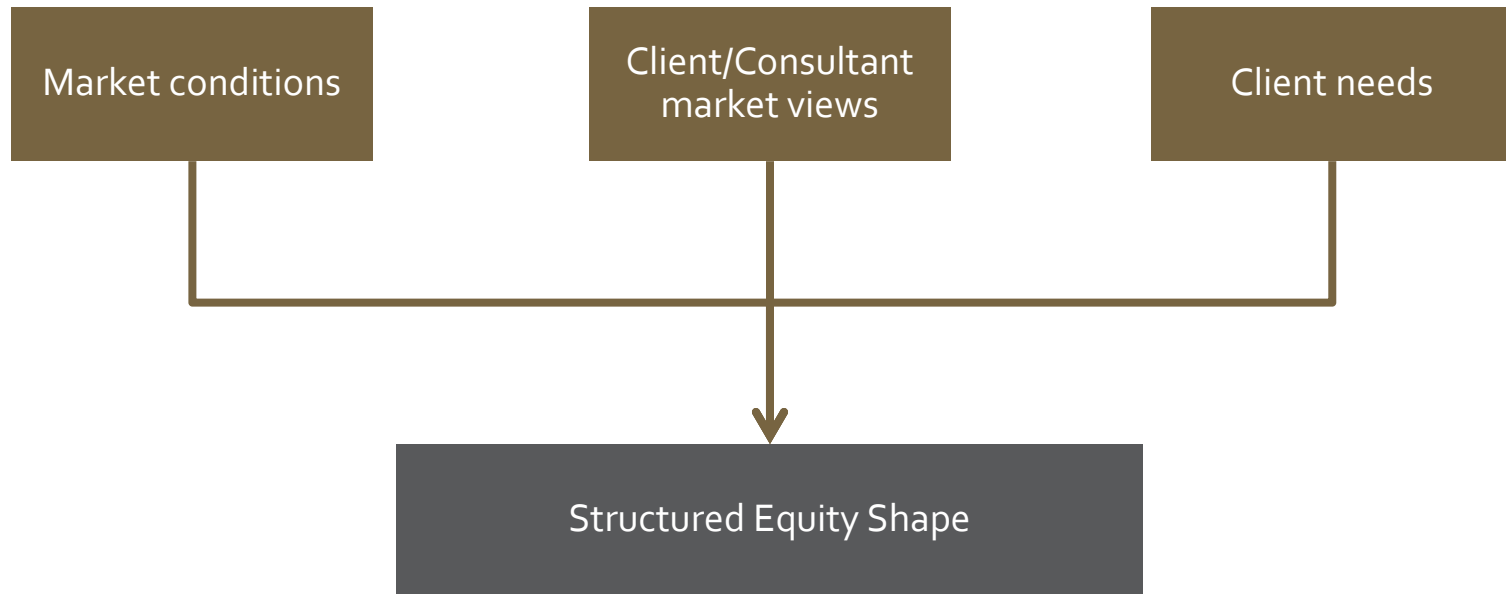
Use In De-risking 'Glide Paths'

- A glide path is a plan to de-risk from return seeking assets to liability matching bonds, when certain pre-defined triggers are hit. For example:
 - 50% bonds at 85% funded
 - 60% bonds at 90% funded
 - 70% bonds at 95% funded
 - 100% bonds at 105% funded

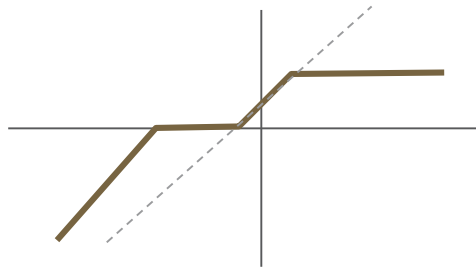
- Two key challenges with glide paths:
 1. There is significant risk at the outset, i.e. there is a 50% allocation to equities in the example. Without a funding improvement no de-risking occurs.
 2. If de-risking does occur expected returns decline. The probability of reaching full funding or termination without additional contributions, or an extended time period, also declines.

- Equity derivatives can resolve these challenges:
 1. Equity downside risk can be reduced immediately by forgoing equity upside.
 2. Expected returns can be maintained, despite the bond allocation increasing, by retaining controlled equity exposure through derivatives.

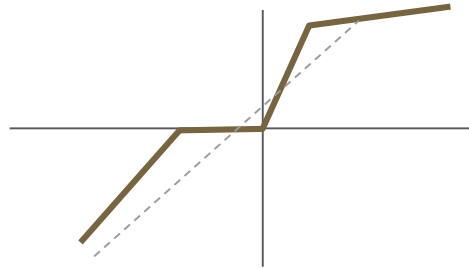
Structured Equity is not an off the shelf product



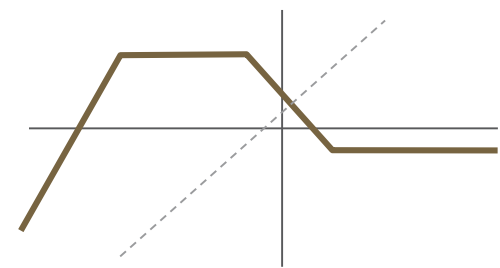
Structured Equity Roles – it's not just about protection



Equity with protection



Enhanced return



Diversifier

Governance benefits

Reduced need to time the market

- Stay exposed and protected
- Ratcheted returns

Defined outcome

- Outcome designed up front
- Reduced need to govern investment process

Familiar design process

- Initial strategy is the hardest
- Following strategies use the same process

Trade roll flag

- Asymmetry helps decide when to replace the strategy

Implementation and Ongoing Management



Index and Instrument Choice Considerations

- Pricing and liquidity is best for major indices:
 - S&P 500
 - MSCI World
 - MSCI EAFE
 - Eurostoxx 50
 - FTSE 100
 - Topix
 - MSCI ACWI (on ETF only)

- Care should be taken when choosing which indices to use to hedge an equity portfolio. Simplicity and liquidity can be balanced against a desire for precision.

- OTC vs Exchange Traded
 - FLEX options provide similar customization and pricing as OTC contracts
 - OTC requires ISDA/CSA documentation
 - Ability to post US Treasuries under OTC can be attractive
 - Bank counterparty risk mitigated by daily collateralization

Delta One Implementation for Global Equities

- Derivatives without optionality (futures and TRS) can be used to access passive equity returns

	TRS on Index	Futures on regions
Replication and tracking error	Minimal tracking error.	Higher tracking error and increased governance
Currency hedging	None required to match Index	Rebalancing and monitoring required
Regional exposure	Matches global index only (eg MSCI ACWI)	Can change regional sub-exposure easily without possible break costs
Expected Funding costs p.a.	3m LIBOR <i>less</i> 10 – 30 bps for MSCI ACWI	Aggregate effective funding costs should be similar, but this is not transparent
Transaction costs	Bid-ask spread ~5-10 bps	Lower bid/ask for futures

Further Implementation Considerations

- Strategies can have a long (3-5 year) or shorter (1) year maturity
 - Shorter maturities provide greater certainty, but come with a higher perceived cost in terms of upside that must be forgone to finance a given level of protection
 - Longer maturities will look more attractive in risk/reward terms, but will provide a less robust hedge early in the contract
- Consider collateral
 - An options overlay requires access to collateral, which is cash or Treasuries, that can be posted
 - For a typical collar strategy, this may translate into 10-15% of the overlay notional needing to be available as collateral at the inception of the hedging program
 - The overlay position will be valued daily and collateral will move to, or from, the counterparty

Mark to Market through time

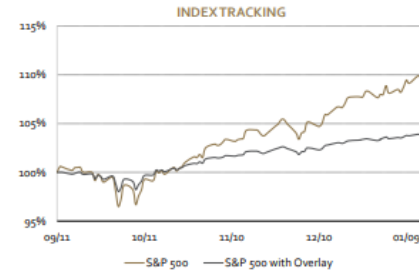
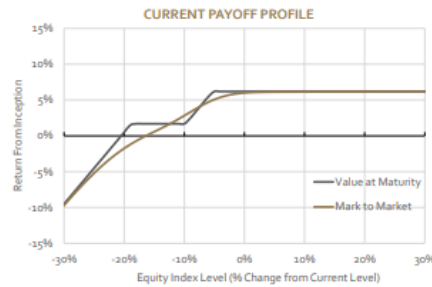
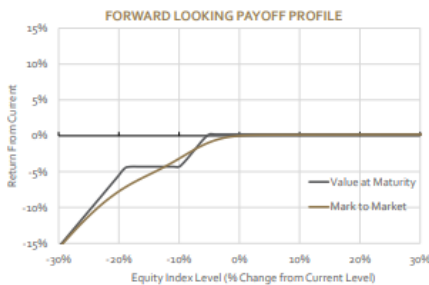
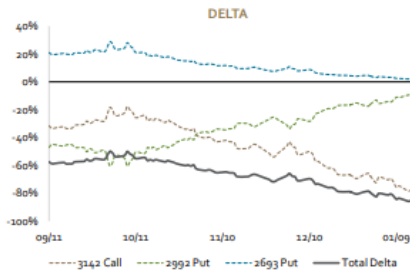
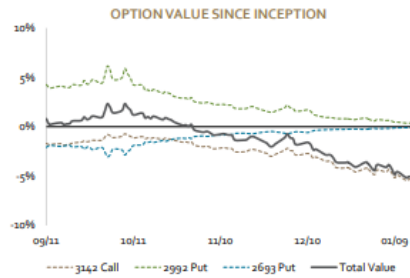


- **Black line** - strategy payoff at maturity (3 years), provides capital protection down to a 20% fall in markets, with the upside capped at a 27.1% total return over 3 years
- **Green curved line** - mark to market line with 3 years left to maturity (at inception)
- **Blue curved line** – mark to market line with 2 years left to maturity
- **Red curved line** – mark to market line with 1 years left to maturity

*Physical equities is represented by the S&P500 Index as the straight diagonal line with pricing reflective of current conditions

Monitoring Trades

EQUITY DERIVATIVE DASHBOARD



VALUATION

	CURRENT	COMPARED TO
As at	1/16/2020	9/30/2019
Equity Index Level	3,317	2,977
Model Option Value	-6.0%	0.9%
Delta	-88.4%	-55.8%
Gamma	-0.1%	-0.1%
Vega	-2.0%	-4.6%

INSTANT SHOCK SCENARIOS (OPTION VALUE ONLY)

AS AT 01/16/20	VOL UP 1.0%	CURRENT VOL	VOL DOWN 1.0%
Equities up 10%	-16.3%	-16.1%	-16.1%
Equities up 5%	-11.4%	-10.9%	-10.9%
Equities Flat	-6.7%	-6.0%	-5.6%
Equities Down 5%	-2.7%	-1.8%	-0.9%
Equities Down 10%	0.8%	1.6%	1.4%

OPTION EXPOSURE

	OPTION 1	OPTION 2	OPTION 3
Underlying Index	S&P 500	S&P 500	S&P 500
Direction	Sold	Bought	Sold
Type	Call	Put	Put
Expiration Date	3/11/2020	3/11/2020	3/11/2020
Strike	3,142	2,992	2,693
Leverage	100%	100%	100%
Option Value	-6.2%	0.3%	-0.1%

EQUITY SCENARIOS AT EXPIRATION (OPTIONS + UNDERLYING EQUITY)

	Return From 01/16/20	S&P Return From 01/16/20	Return From 09/11/19	S&P Return From 09/11/19
Equities up 20%	0.2%	20.3%	6.2%	32.3%
Equities up 10%	0.2%	10.3%	6.2%	22.3%
Equities up 5%	0.2%	5.3%	6.2%	17.3%
Equities Flat	0.2%	0.3%	6.2%	12.3%
Equities Down 5%	0.2%	-4.7%	6.2%	7.3%
Equities Down 10%	-4.3%	-9.7%	1.7%	2.3%
Equities Down 20%	-5.5%	-19.7%	0.5%	-7.7%

Examples of Swaption Use

Interest Rate Risk Management and Swaptions

- Plans use a variety of asset classes to obtain interest rate exposure. Endowments may have a desire to obtain interest rate exposure, particularly if benchmarked against “60% equities / 40% Agg. Bonds”.

Credit	<ul style="list-style-type: none">• Yield enhancement• Accounting/termination hedging
US Treasuries	<ul style="list-style-type: none">• Duration• Collateral source
Treasury Futures / IR Swaps	<ul style="list-style-type: none">• Extend duration and improve efficiency• Increase hedging precision
Swaptions	<ul style="list-style-type: none">• Extend duration and improve efficiency• Shape outcomes

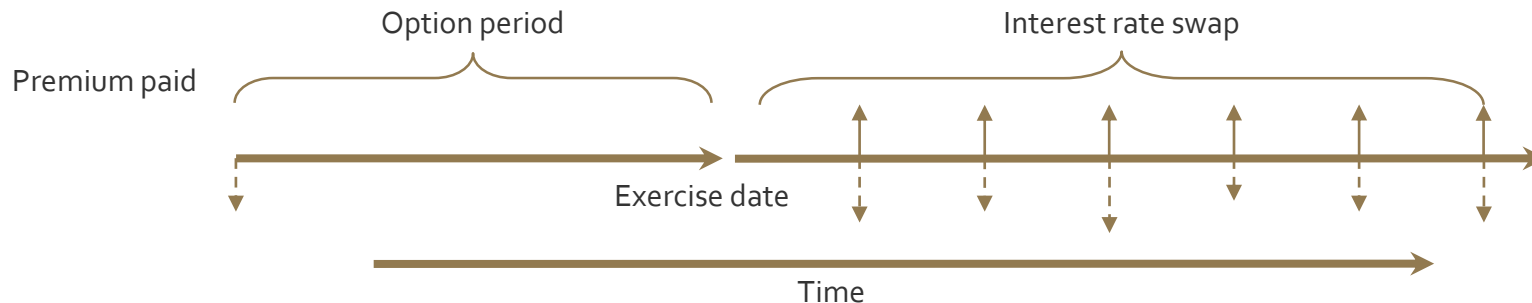
- Examples of Interest Rate Swaption benefits include:
 - **Protection** against falling interest rates to a greater extent than would be possible with conventional credit/US Treasury holdings
 - **‘Shaping’** exposure to interest rates to generate a more efficient outcome, for example by monetizing the future decision to hedge interest rates at higher levels using triggers
 - **Reducing collateral requirements** compared to UST futures, freeing up assets to be invested elsewhere
-

What are Swaptions?

- An option to enter into an interest rate swap, i.e. the option to put in place a liability hedge. For example:



- Whether it is exercised is a function of the swap rate at maturity of 2 years. The swaption has value to the holder if interest rates fall 80bps.



Pension Plan Example

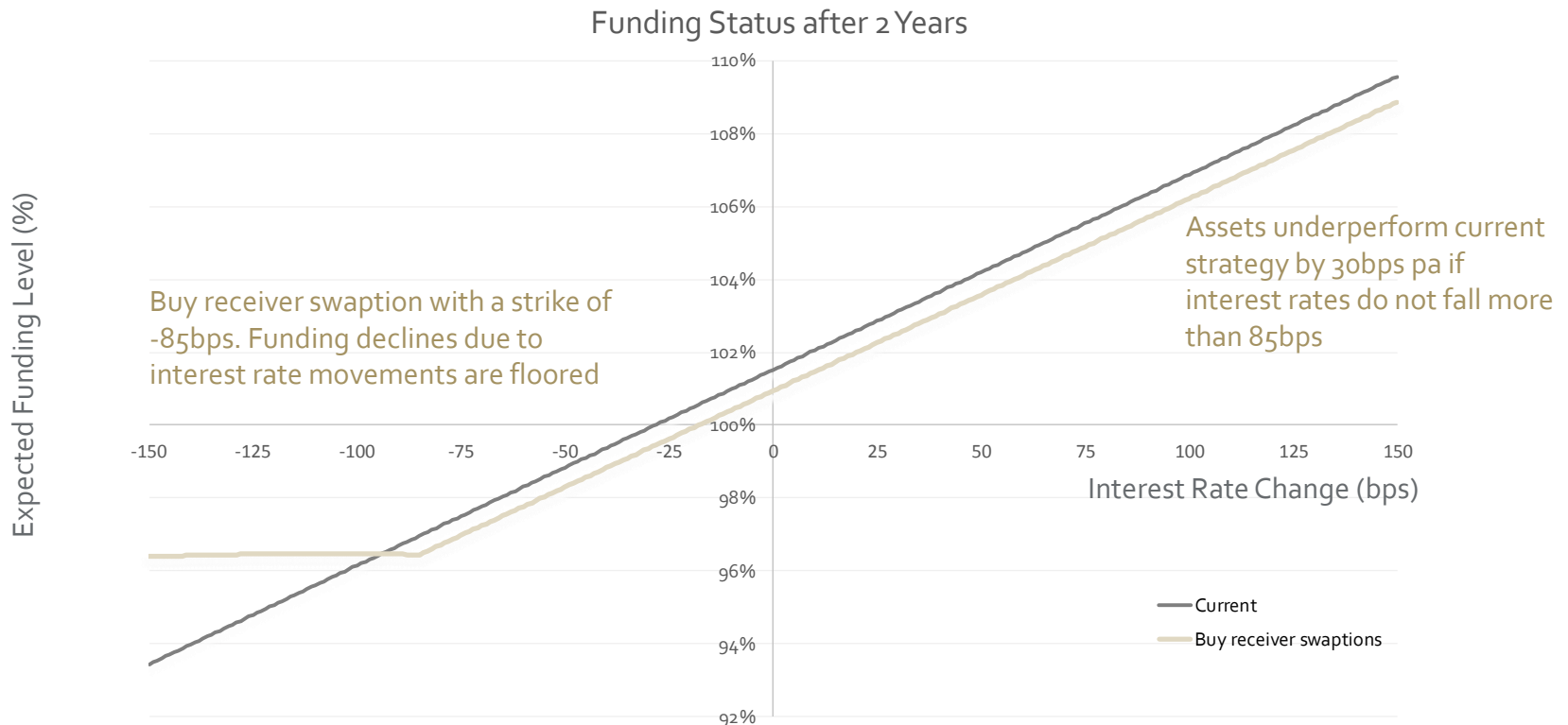
- A \$1.0 bn plan is 100% funded with a 40% liability matching allocation. Plan extends duration and uses futures to achieve a 60% interest rate hedge ratio:

Liability Matching Assets	\$400 m
Return Seeking Assets	\$600 m
Total Assets	\$1000 m
Total Liabilities	\$1000 m
Funding Level	100%
Interest Rate Hedge Ratio	60%

- c. \$400m notional, 15 year term interest rate swap (or US Treasury future of similar duration) would increase interest rate hedge ratio to 100% immediately
- For comparison, ~\$400m notional of swaption (with an underlying 15 year term swap) would increase interest rate hedge ratio to 100%... if the option is exercised following pre-defined interest rate moves.
- Plan targets 106% funding level to terminate, which would be achieved if interest rates rise 85 bps and return seeking assets return 4.5% pa over 2 years for example.

Liability duration is 13.0 years, liability matching asset duration is 20 years to achieve a hedge ratio of 60%.

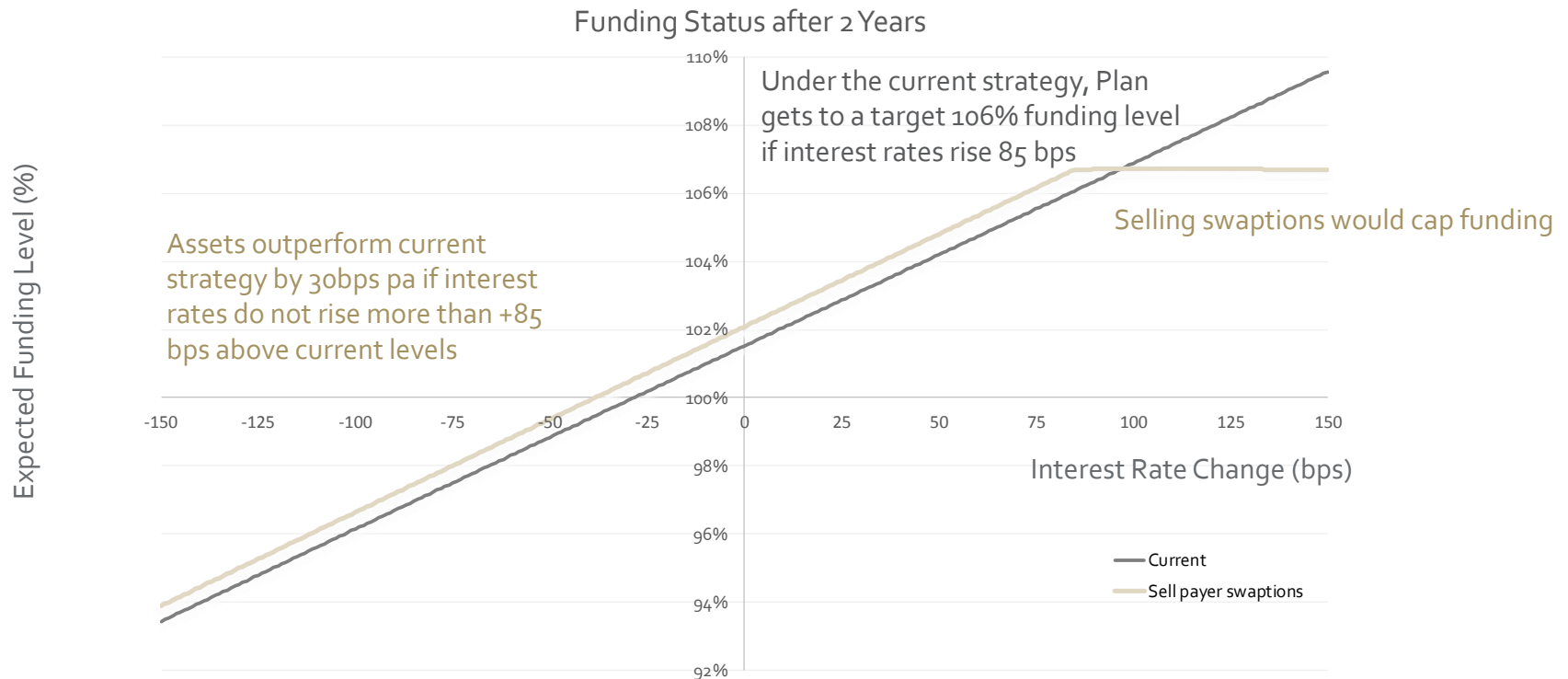
1. Buying Receiver Swaptions Reduces Interest Rate Risk



- Plan **buys** \$400m notional of swaption paying a premium for the option to enter into pay floating/receive fixed interest rate swap in 2 years time at interest rates **below** current levels (eg 85 bps lower).
- Swaption has a value to the Plan if interest rates fall more than 85bps in 2 years time.
- This fully hedges interest rate exposure after an 85 bps fall, at a cost of \$6m over 2 years (**0.30%** of liabilities per annum). Plan funding improves if interest rate rise as with the current strategy.

Interest Rate change is the parallel shift to the interest rate yield curve that applies over the 2 year period. Projections assume return seeking assets return 4.5% and liability matching assets yield 3.2% at the start of the period. Swaption is "2y15y", notional \$400m, with a premium of 1.4% of notional. Source: Bloomberg, Gross of management fees.

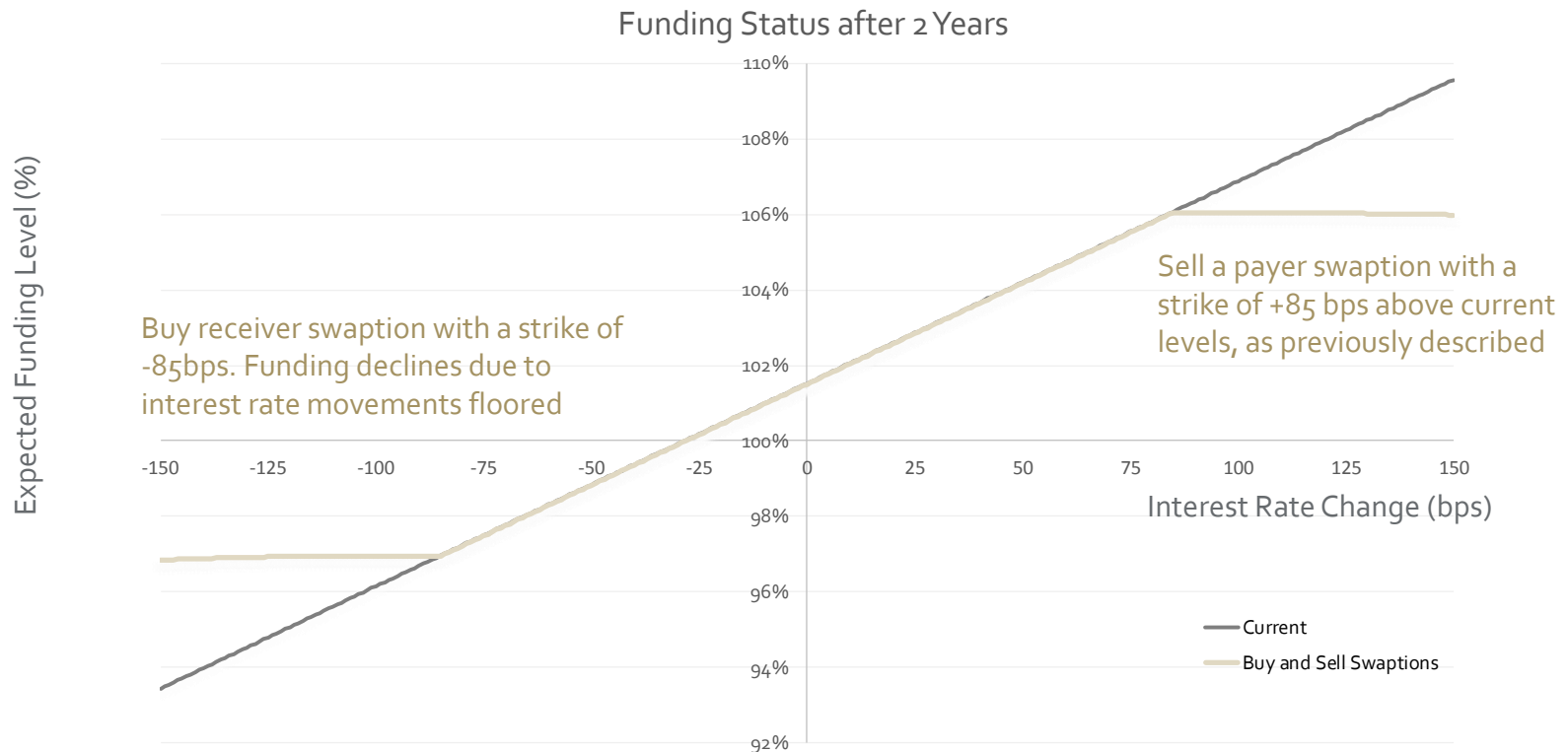
2. Selling Payer Swaptions Generates Income



- Plan **sells** \$400m notional of swaption and **receives** premium from a bank. The bank counterparty has the option to enter into receive floating/**pay** fixed interest rate swap in 2 years time at interest rates **above** current levels (eg +85 bps higher).
- Swaption has a **negative** value to the Plan if interest rates **rise** more than 85bps in 2 years time.
- Funding improvements are capped and the Plan receives \$6m over 2 years (**0.30%** of liabilities per annum). Plan funding declines if interest rates fall as with current strategy.

Interest Rate change is the parallel shift to the interest rate yield curve that applies over the 2 year period. Projections assume return seeking assets return 4.5% pa and liability matching assets yield 3.2% at the start of the period. Swaption is "2y15y", notional \$400m, with a premium of 1.4% of notional. Source: Bloomberg, Gross of management fees.

3. Combine Swaptions for a Zero Cost Collar



- Premium received from payer swaption (capping upside) is used to purchase a receiver swaption (protecting downside).
- Reasonably “symmetric” collars are possible forgoing a similar level of upside and downside protection received.
- Collar has little impact to interest rate exposure if interest rates remain at existing levels.

Interest Rate change is the parallel shift to the interest rate yield curve that applies over the 2 year period. Projections assume return seeking assets return 4.5% and liability matching assets yield 3.2% at the start of the period. Swaptions are “2y15y”, notional of receiver is \$400m, notional of payer is \$400m as per previous slides. Source: Bloomberg, Gross of management fees.

Summary



Equity and Interest Rate Options

Return Seeking Assets

- Equity like returns with a smoother journey
- ... or can be used to target higher returns
- Low governance and low cost

Interest Rate Management

- Retain upside but hedge interest rate falls
- .. or sell of unwanted upside

Bespoke Designs

- Typically some downside protection
- Adaptive to views or market conditions

Implementation

- Equity or interest rate leverage can help de-risk a pension plan
- ... or be used to generate portable alpha

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