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TAIL RISK HEDGING FOR PENSION FUNDS

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THE AGENDA

1

Situation

- A pension fund is managing a path toward full funding
  - Required return
  - Target risk level

2

Problem

- Extreme events can knock a scheme off its flight plan

3

Implication

- Why tail risk hedging could play a role in flight plan management
- What objectives a scheme might adopt for their tail risk hedges

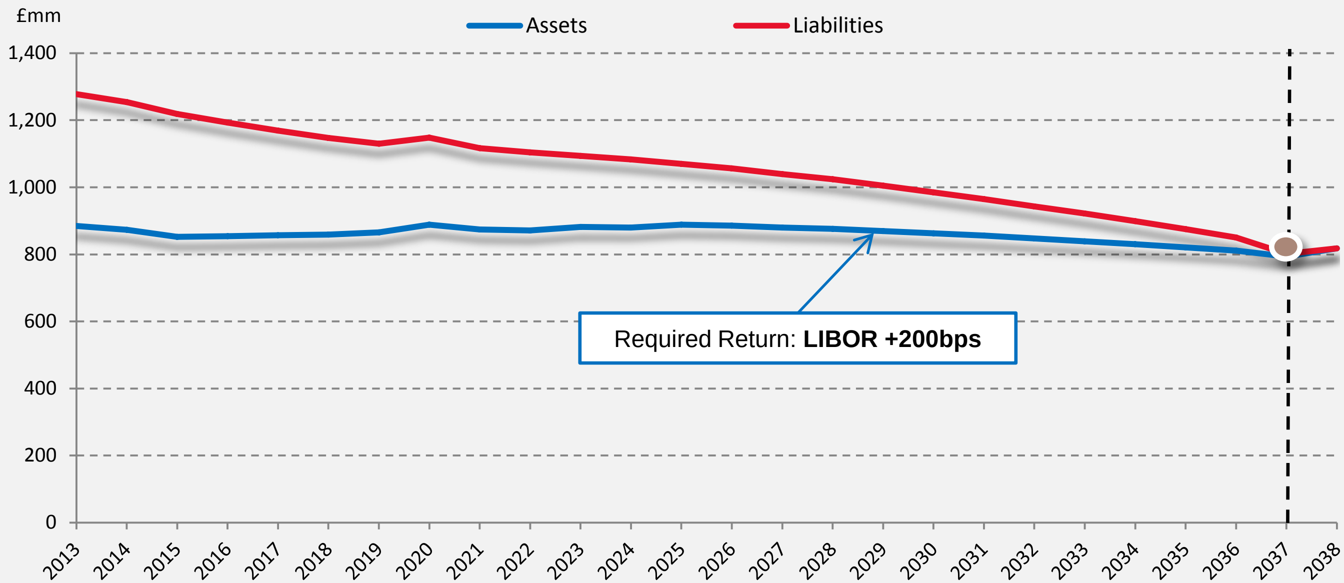
4

Need

- What approaches are available
- How the available approaches might achieve the objective(s)

TAIL RISK HEDGING FOR PENSION FUNDS
SITUATION

Step 1	Description
Clear goals & objectives	

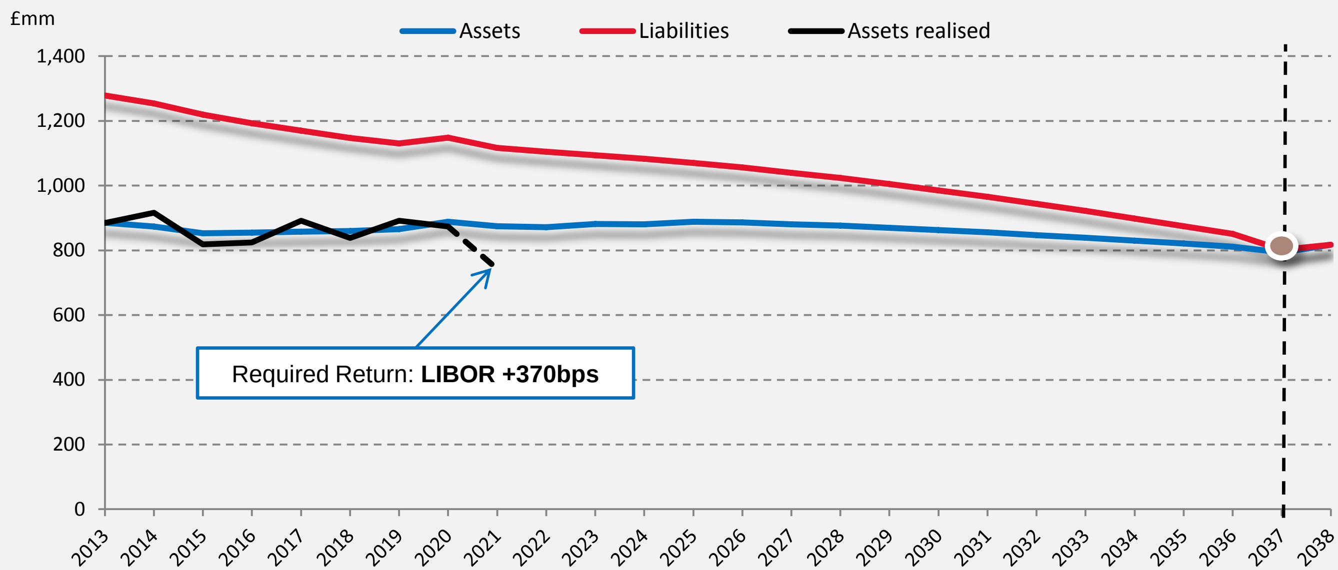


Objective	RAG	
Primary Funding Objective	●	Expected return: **LIBOR + 205** Required return to 2037: **LIBOR +200**
Risk	●	1 Year 95% VaR **£122m**
Hedging	●	Funding ratio swaps flat basis **73%** Nominal hedge ratio **73%** Inflation Hedge ratio **73%**

Source: SG Engineering, Bloomberg and Redington as of October 2013. The value of your investment may fluctuate. The figures relating to past performances and/or simulated past performances refer or relate to past periods and are not a reliable indicator of future results. This also applies to historical market data.

TAIL RISK HEDGING FOR PENSION FUNDS
PROBLEM

Step 1	Description
Clear goals & objectives	



Objective	RAG	
Primary Funding Objective	Red	Expected return: **LIBOR + 205** Required return to 2037: **LIBOR +370**
Risk	Green	1 Year 95% VaR **£122m**
Hedging	Green	Funding ratio swaps flat basis 73% Nominal hedge ratio 73% Inflation Hedge ratio 73%

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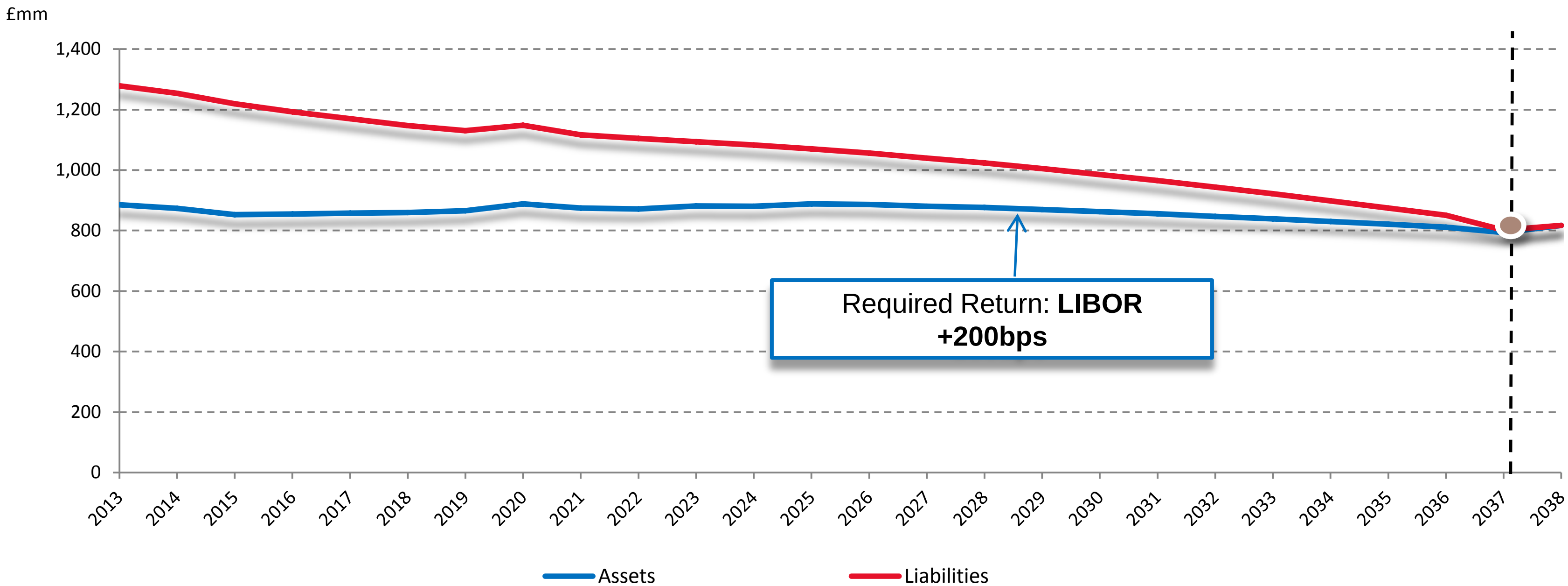
TAIL RISK HEDGING FOR PENSION FUNDS
PROBLEM

- **Current Flight Plan and Required Return**



Strategy	Starting Position	Required Return (Over LIBOR)	Full Funding Date	Funding Level
Current	**Base**	**200**	**31/03/2037**	**71%**
	-10% fall in assets	275	31/03/2037	64%
	-15% fall in assets	320	31/03/2037	60%
	-20% fall in assets	368	31/03/2037	56%
	-25% fall in assets	421	31/03/2037	53%

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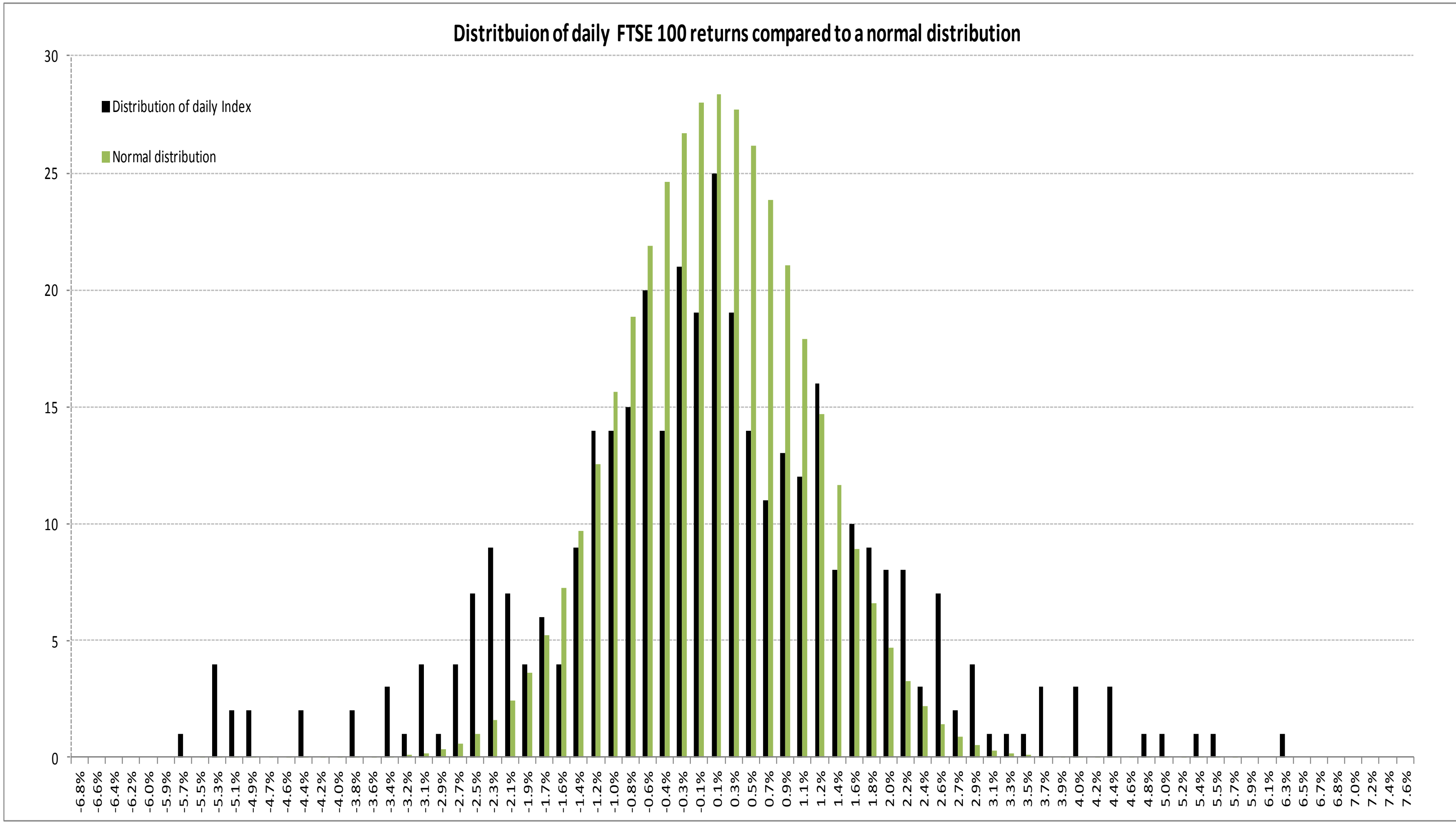
TAIL RISK HEDGING FOR PENSION FUNDS
PROBLEM



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TAIL RISK HEDGING FOR PENSION FUNDS
IMPLICATION

- **A definition of tail risk :**
  - ***An event that falls outside the risk confidence levels that an organisation operates to.***

Significance level	Associated 1 year move	1 month move	Number of occurrences (average frequency)
95%	-42%	-12%	19 (4.5)
98%	-49%	-14%	13 (6.6)
99%	-53%	-15%	10(8.6)
99.5%	-57%	-16%	10(8.6)

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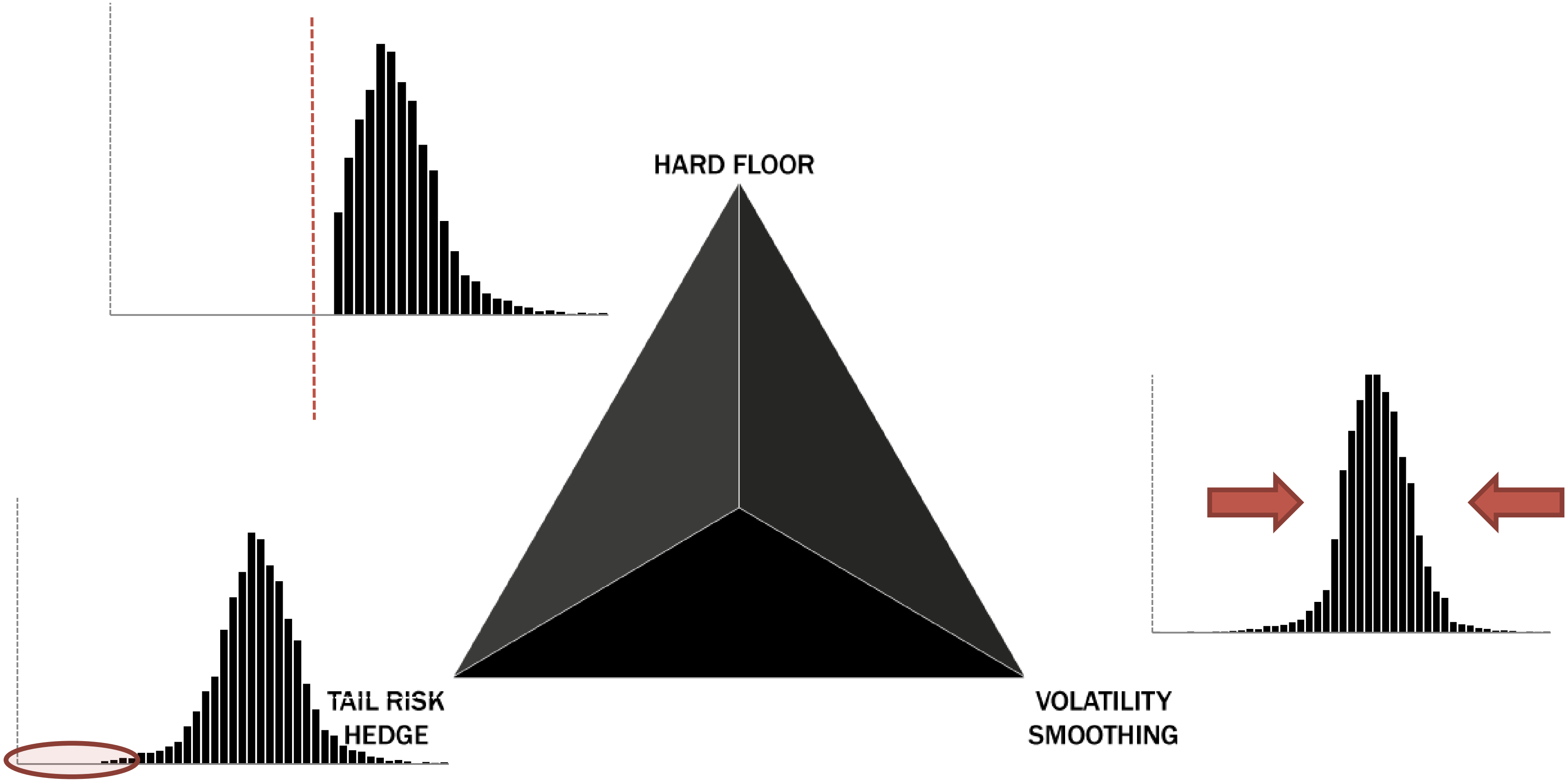
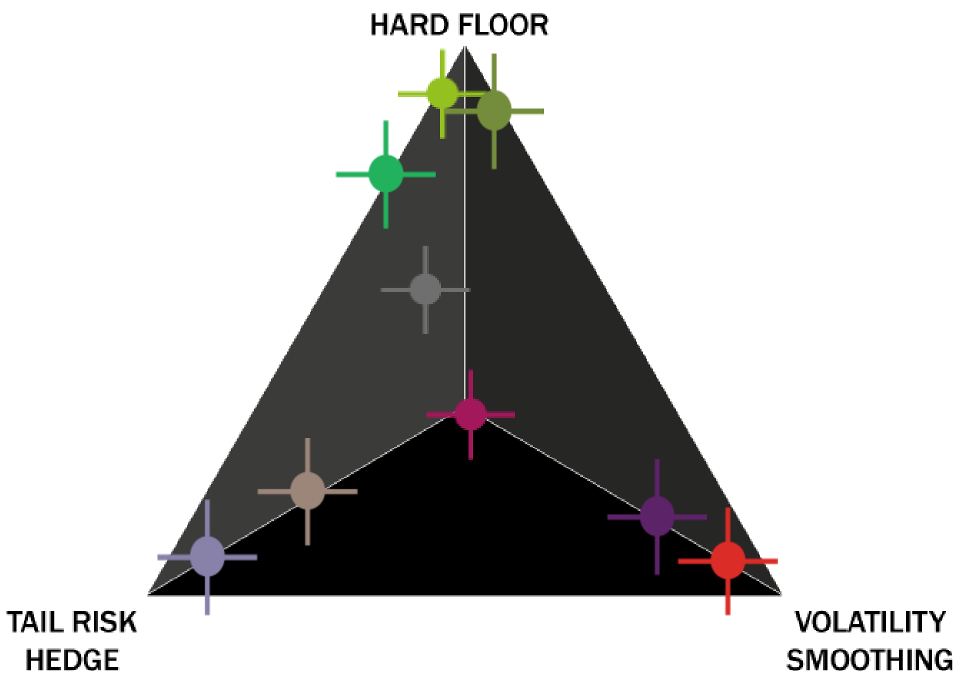
TAIL RISK HEDGING FOR PENSION FUNDS
IMPLICATION



The figures used in this example are given for purely indicative purposes, the objective is to describe the mechanism of the product. It allows an understanding of how the product would have performed at different market stages over previous years, but is no guarantee as to future returns and has no contractual value.

TAIL RISK HEDGING FOR PENSION FUNDS
NEED



KEY	
	Single Static Put Option Strategy
	Multiple Static Put Option Strategy
	Dynamic Option Strategy
	Systematic Option Strategy
	VIX
	Variance
	Volatility Control
	Low Volatility Stocks
	Volatility Control + Annual Put Option

COMMONLY USED EQUITY DOWNSIDE STRATEGIES
NEED

1. Put options

2. VIX futures

STRATEGY 1: ROLLING PUT OPTIONS

- Strategy 1 involves the systematic purchase of a Put option written on the benchmark of the equity portfolio

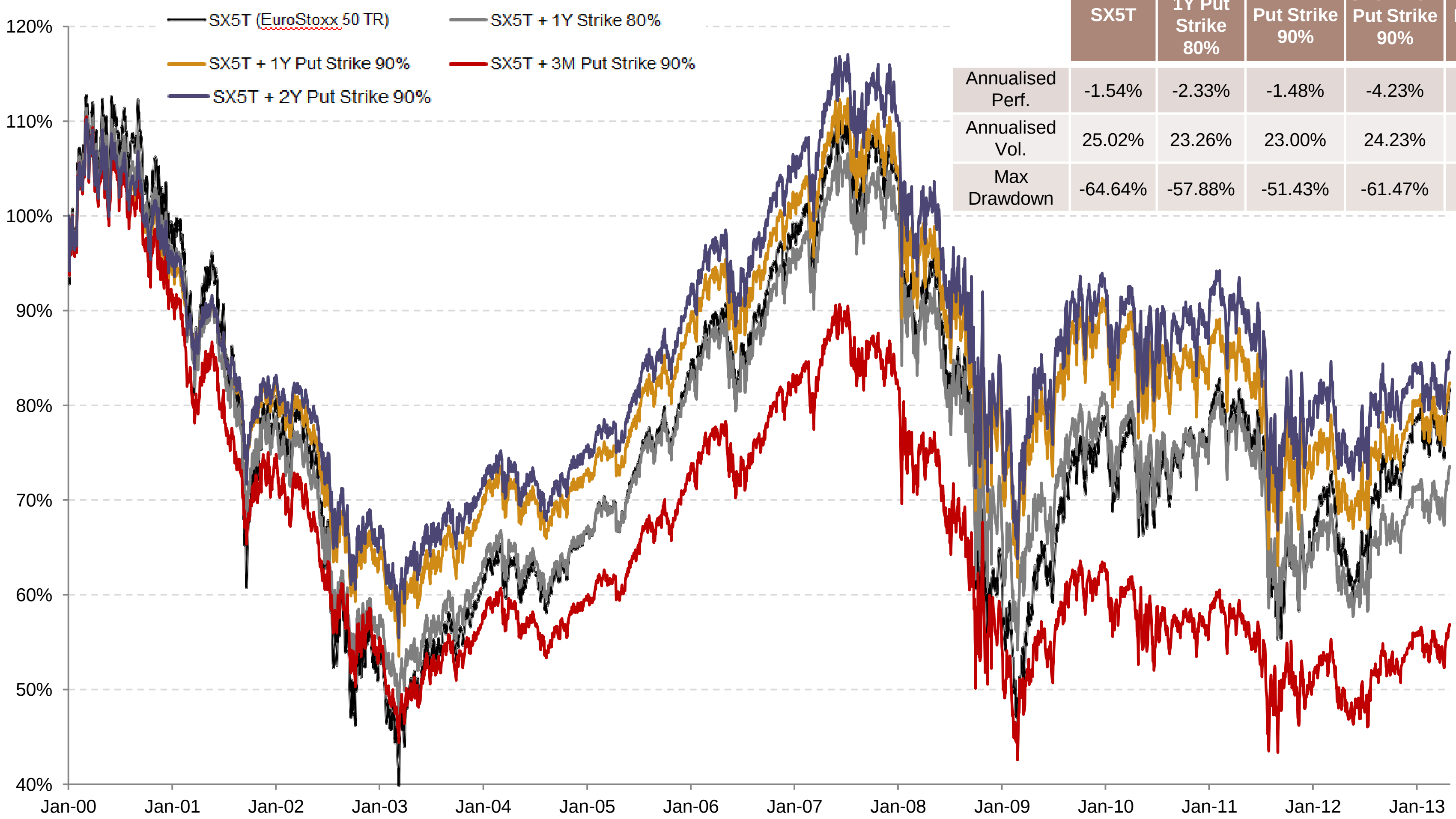
- We have simulated the historical performance of this strategy since 2000 for different strikes and different maturities (we have assumed equity portfolio benchmark being EuroStoxx 50 TR)

- Based on that simulation, there are a few observations that we can distinguish:
  - Longer maturity protection is preferred (from 2 years)
  - High level of protection is preferred (90%)

- However those observations need to be tempered:
  - In rising or flat markets this strategy will underperform by the amount of premium paid, which is substantial and varies through time
  - This strategy is dependent on strikes and roll dates chosen

STRATEGY 1: ROLLING PUT OPTIONS

	SX5T	SX5T + 1Y Put Strike 80%	SX5T + 1Y Put Strike 90%	SX5T + 3M Put Strike 90%	SX5T + 2Y Put Strike 90%
Annualised Perf.	-1.54%	-2.33%	-1.48%	-4.23%	-1.19%
Annualised Vol.	25.02%	23.26%	23.00%	24.23%	23.10%
Max Drawdown	-64.64%	-57.88%	-51.43%	-61.47%	-49.68%



Source: Bloomberg, Societe Generale as of October 2013. The simulations presented in this document result from estimations of Société Générale at a given time, on the basis of parameters selected by Société Générale, the market conditions at such time and historical data which can in no way be considered as a guarantee of future performance. Therefore, the prices or figures indicated in this document only have an indicative value and do not constitute in any manner a firm price offer from Société Générale. The value of your investment may fluctuate. The figures relating to past performances and/or simulated past performances refer or relate to past periods and are not a reliable indicator of future results. This also applies to historical market data.

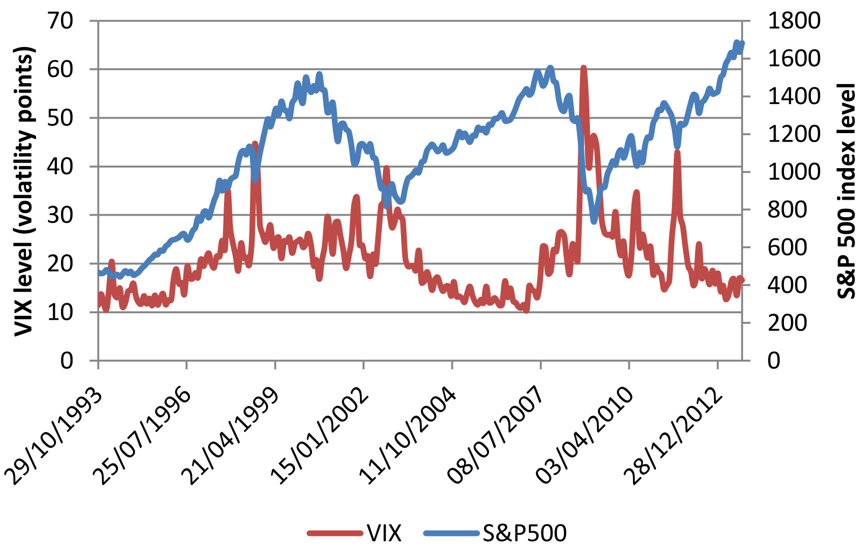
STRATEGY 2: VIX FUTURES
NEED

- **Equity volatility futures such as the VIX, VSTOXX and VFTSE are often used for benchmarking hedging strategies, and have become synonymous with the term "volatility".**

- **Some background on the VIX:**
  - Started in 1993, methodology adapted in 2003
  - Based on short term options on the S&P 500 index across strikes (technically equal to the square root of a constant 30 day maturity variance swap)
  - Although indices have been released on Eurostoxx, DAX and FTSE, liquidity is very limited compared to VIX
  - Clear reasons why this looks like a promising equity hedging asset :

Monthly changes in S&P index vs VIX since 1993

S&P 500 and VIX since 1993



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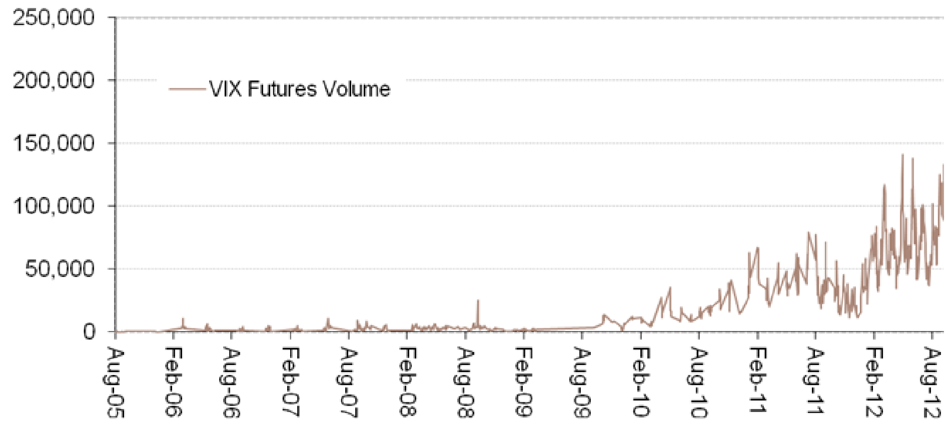
STRATEGY 2: VIX FUTURES
NEED

- But, massive growth in the use of the VIX as a portfolio hedge has changed the behaviour of the futures curve.
- Which means that a strategy which invests in the front futures contract will have different behaviour to “spot” Vix (which is not directly investable).
- On average the early futures contracts can trade several volatility points above the “spot” level.
- For example 28 October 2013 VIX = 13.4 December future = 15.49 January future = 16.83



Source: SG Engineering, Bloomberg, VIX Central.com and Redington as of October 2013. The value of your investment may fluctuate. The figures relating to past performances and/or simulated past performances refer or relate to past periods and are not a reliable indicator of future results. This also applies to historical market data.

STRATEGY 2: VIX FUTURES
NEED

- **A strategy that takes a long position in the first VIX future and rolls into expiry has lost a substantial amount of money in the last 4 years. Even over periods of time when the VIX did not change.**

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ENHANCED STRATEGIES THAT ATTEMPT TO ADDRESS SHORTCOMINGS IN BASIC STRATEGIES

i. Calendar Collars

ii. Volatility Controlled Equity with Put Option

STRATEGY (i): CALENDAR COLLARS

- Strategy developed by Societe Generale for Pension Funds that involves the purchase of medium-term Put options and the sale of short-dated Call options

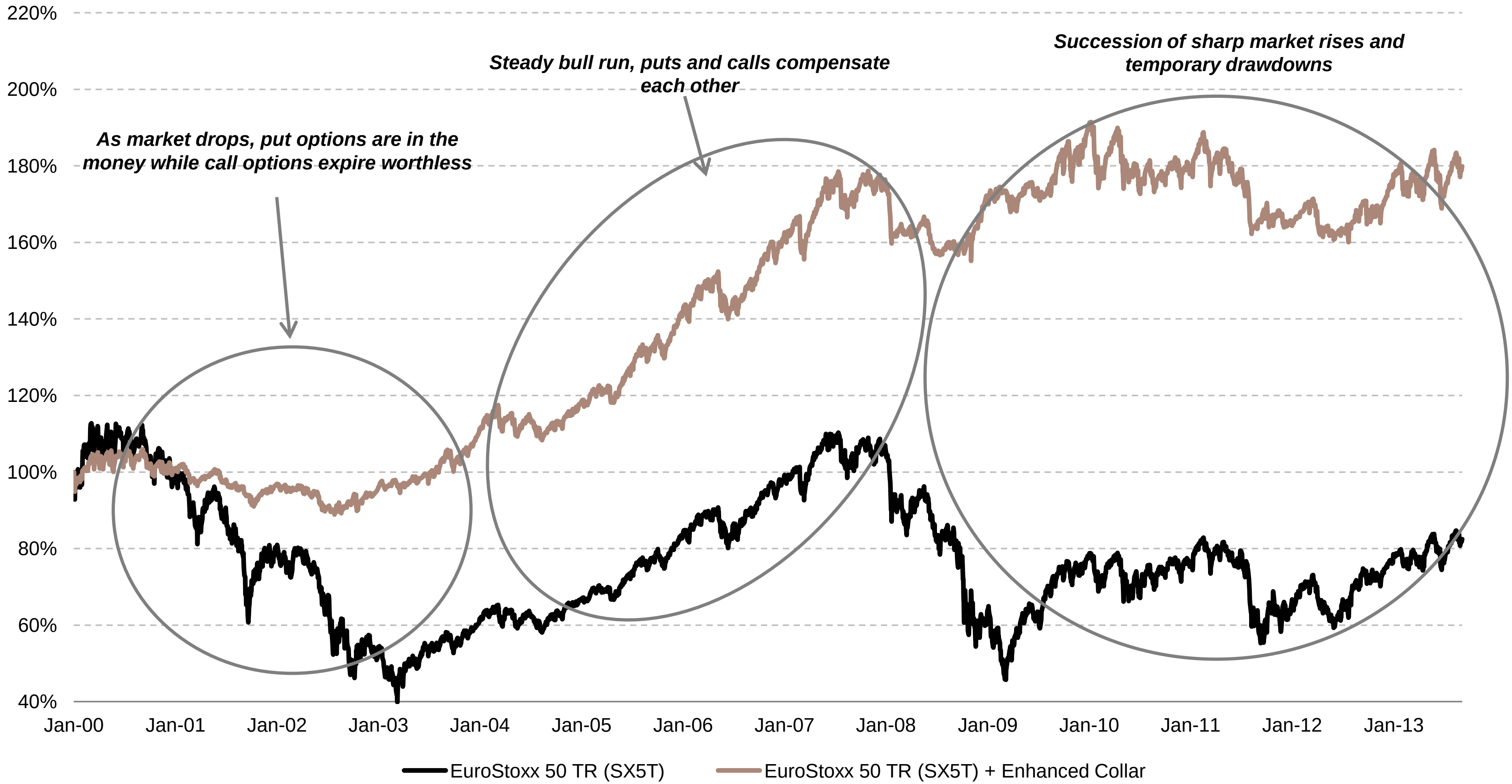
- Why ?
  - Historical evidence shows that investors generally overpay for shorter term call options, so systematically selling these is an efficient way to mitigate the premium of the put options
  - We have simulated historical performance of this strategy since 2000 (we have assumed equity portfolio benchmark being EuroStoxx 50 TR)

- What ?
  - Protection does not guarantee a set hard floor, but provides good volaitlity smoothing and tail hedging

- Based on that simulation, few observations we could draw:
  - **High level of protection during periods of declining equity markets**
  - **Losses can be experienced in periods of sharply rising markets**

- However those observations need to be tempered:
  - Efficiency of the strategy is better appreciated across various equity market cycles
  - This strategy is dependent on strikes and roll dates chosen

STRATEGY (i): CALENDAR COLLARS

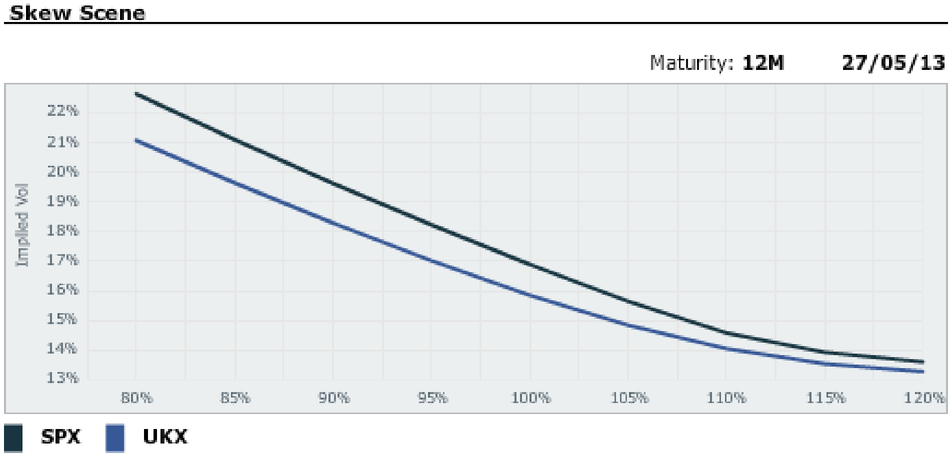


	SX5T	Enhanced Collar Strategy
Annualised Perf.	-1.54%	**4.49%**
Annualised Vol.	25.02%	**9.53%**
Max Drawdown	-64.64%	**-16.41%**

Source: Bloomberg, Societe Generale as of October 2013. The simulations presented in this document result from estimations of Société Générale at a given time, on the basis of parameters selected by Société Générale, the market conditions at such time and historical data which can in no way be considered as a guarantee of future performance. Therefore, the prices or figures indicated in this document only have an indicative value and do not constitute in any manner a firm price offer from Société Générale. The value of your investment may fluctuate. The figures relating to past performances and/or simulated past performances refer or relate to past periods and are not a reliable indicator of future results. This also applies to historical market data.

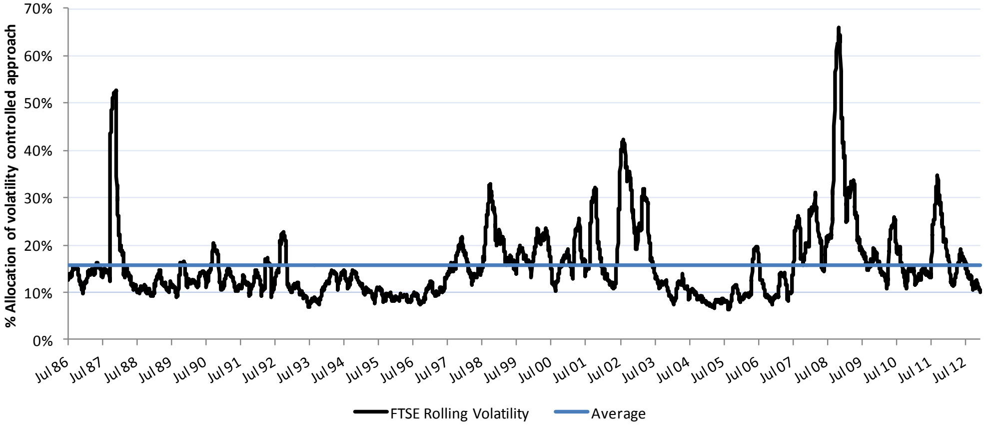
STRATEGY (ii): VOLATILITY CONTROL + PUT OPTION
NEED

- **Strategy 2a involves changing the benchmark for the scheme's underlying equity allocation to a volatility controlled benchmark, and buying a put option on this**
- Volatility control benchmark targets a fixed level of risk by varying the equity exposure
- **Why?**
  - One challenge with standard equity option instruments is the presence of the volatility "skew" that leads to relatively higher prices for more out of the money options – which are often those a pension scheme would most like to use



Source: VolCenter, Barclays Live

- Equity Volatility varies very substantially through time
- Both above and below the long term average
- Fear of volatility spikes explains the volatility skew



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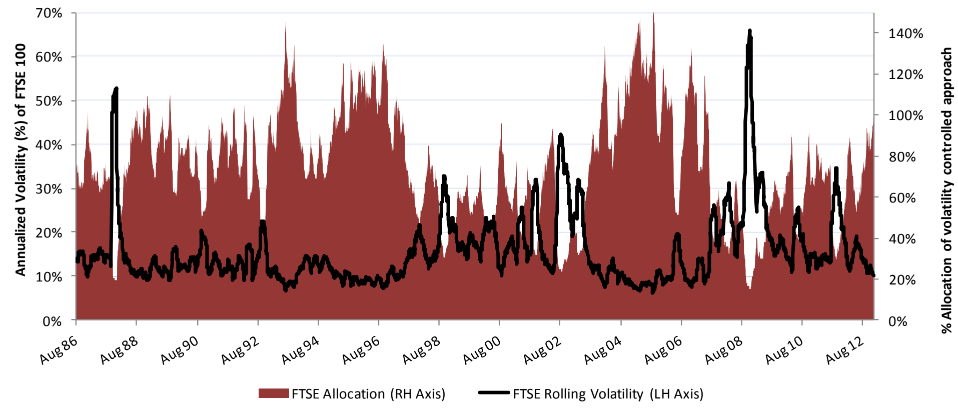
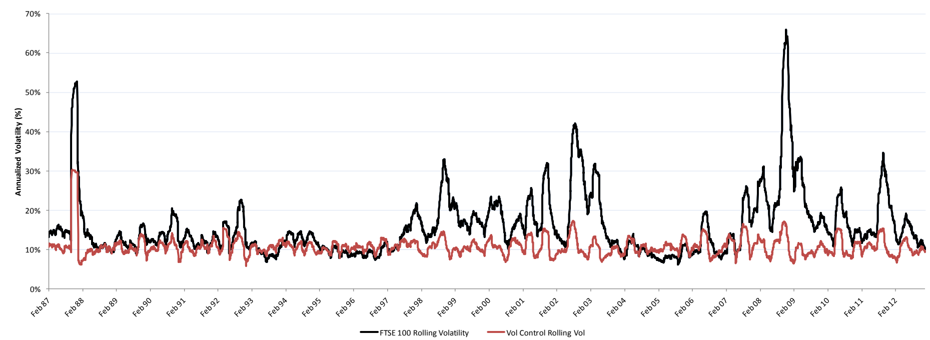
STRATEGY (ii): VOLATILITY CONTROL + PUT OPTION
NEED

- **What ?**
  - Volatility control rebalances away from equity exposure as volatility rises, to target a fixed level of volatility
  - Which means that the price of the put option is both cheaper and more stable
  - Put option provides hard floor over a set period of time, volatility control smoothes the returns of the strategy.
  - In any given year a volatility controlled benchmark may have a lower exposure than a passive index and experience a lower return





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STRATEGY (ii): VOLATILITY CONTROL + PUT OPTION

NEED

Put option cost	MSCI World Index (as of May 2013)	MSCI World Index (Stressed market conditions)	Volatility controlled MSCI World Index
90% strike	3.70%	8.4%	1%
85% strike	2.63%	7.2%	0.5%
80% strike	1.84%	6.2%	0.2%

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SUMMARY

1

Situation

- A pension fund is managing a path toward full funding
  - ➢ Required return
  - ➢ Target risk level

2

Problem

- Extreme events can knock a scheme off its flight plan

3

Implication

- Tail risk hedging can play a role in flight plan management with three possible objectives:
  - ➢ Hard Floor
  - ➢ Tail Risk Hedge
  - ➢ Volatility Smoothing

4

Need

- Instruments exist that can satisfy some of these objectives, but understanding is required

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