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Dynamic Tail Risk Hedging

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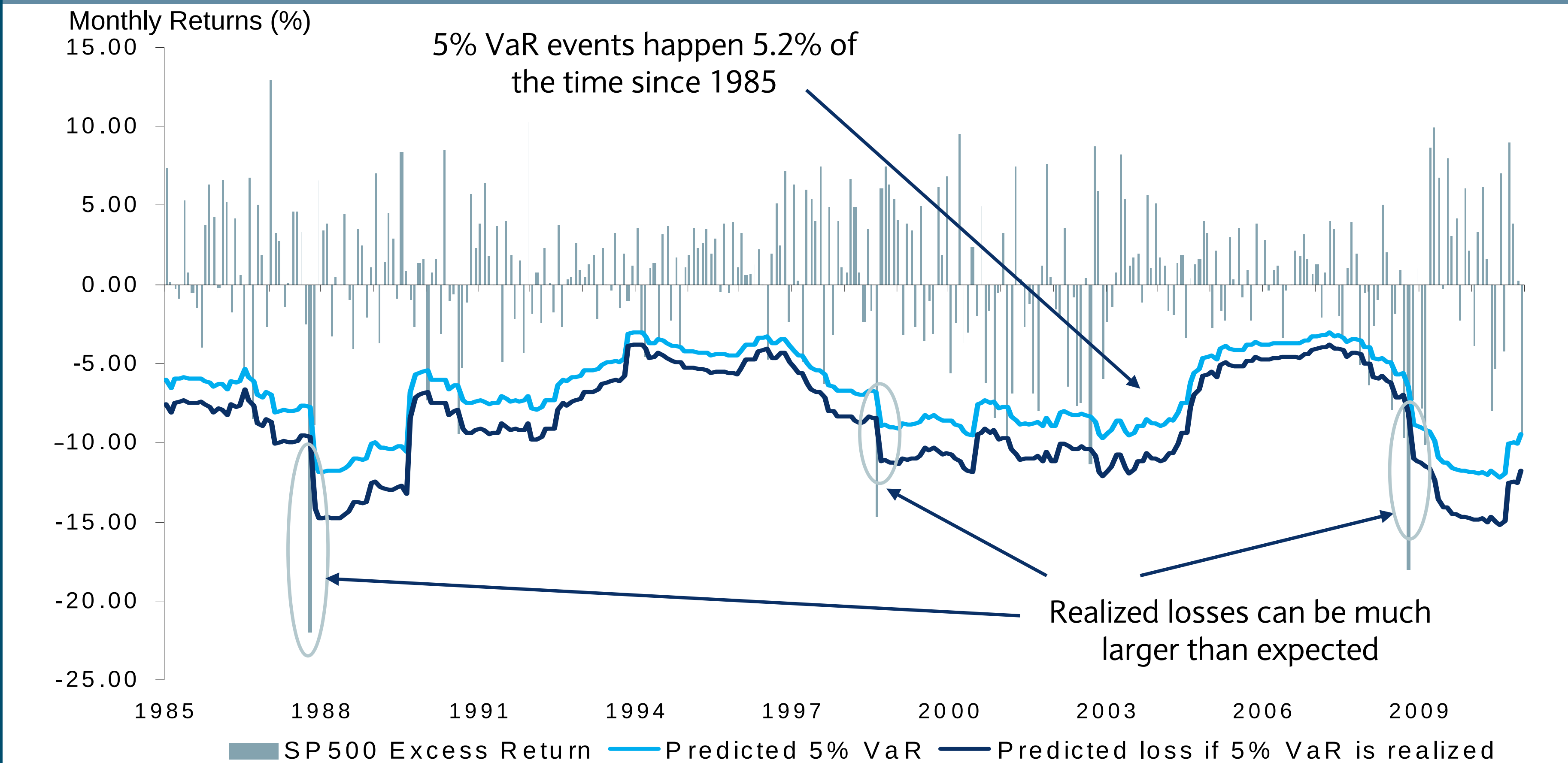
Systematic Strategies | IPRS

Conditional Tail Risk: The Known 'Unknowns' and the Unknown 'Unknowns'

- Tail risk is typically defined as low-probability 'extreme' moves in asset values
- Conditional Tail Risk is relatively predictable, however …
- Unpredictable extreme losses are the most severe type of tail risk

Monthly S&P 500 Tail Risk Predicted by Rolling Normal Distribution



Source: Barclays Capital

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Tail Risk Characteristics and Hedging Approaches

Tail Event Characteristics	Tail Hedging Approaches
• Macro/systemic shocks that lead to large negative returns across asset classes • Volatilities rise, absolute correlations increase sharply • Flight-to-quality: investors flee to perceived safe haven assets and currencies • Liquidity squeeze	Decreasing Cost ↑ • De-risk the portfolio, purchase flight-to-quality instruments • Approximate hedging: invest in strategies and asset classes that are negatively correlated to tail risk • Dynamic portfolio protection • Explicit hedging: purchase option-like hedging instruments Increasing Protection ↓

Source: Barclays Capital

Outline

There is no unique tail risk hedge for all strategies and portfolios

- Shaping the higher order distributions of a return profile depends on preferences, costs, capacity, etc.

We consider two situations to highlight tail hedging issues and approaches:

I. Approximate Hedging: Tail Risk Hedging Overlays for Balanced Portfolios

- Is tail hedging different from asset allocation?
- How to choose and size approximate hedges
- A (dynamic) diversified minimum shortfall hedge overlay for a benchmark portfolio

II. Explicit Hedging: Tail Risk Hedging as a Systematic Trading Strategy

- Tail risk in the FX carry trade
- Shaping the hedged carry payoff distribution with options
- Tail hedging as an alpha opportunity

Tail Risk Hedging Overlays for Balanced Portfolios

Diversification versus Tail Hedging

- Traditional method of reducing risk is to hold diversified portfolios (across instruments and across asset classes)
  - Traditional diversification can break down in the tails

- Tail hedging can be explicitly incorporated into allocation/optimization frameworks…

But

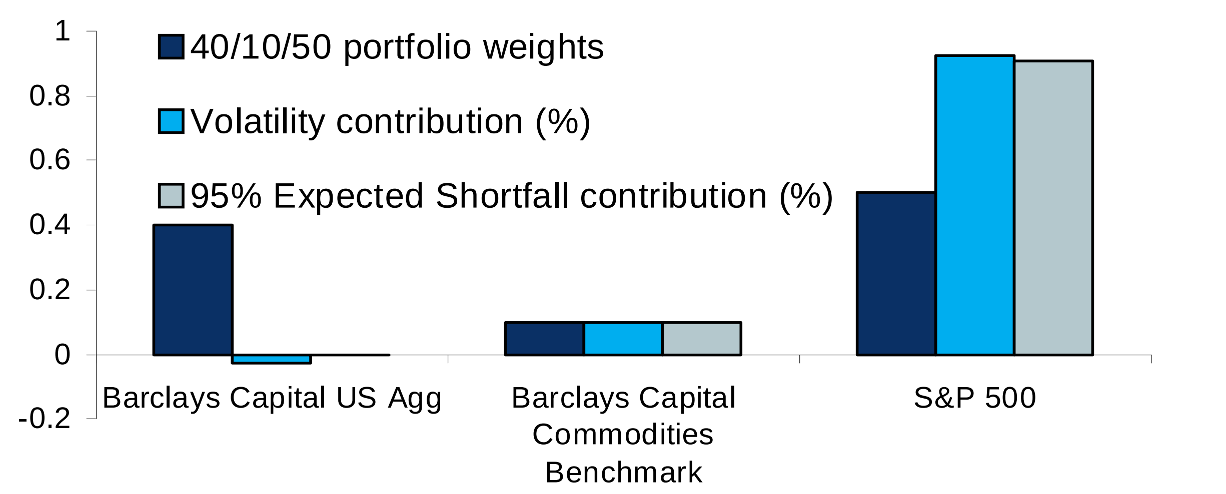
- While there is no explicit cost of hedging through portfolio allocation, there is always an implicit cost since allocation to an attractive asset may be reduced to reduce risk
- Requires high-dimensional tail risk models and complicated optimization techniques

Therefore

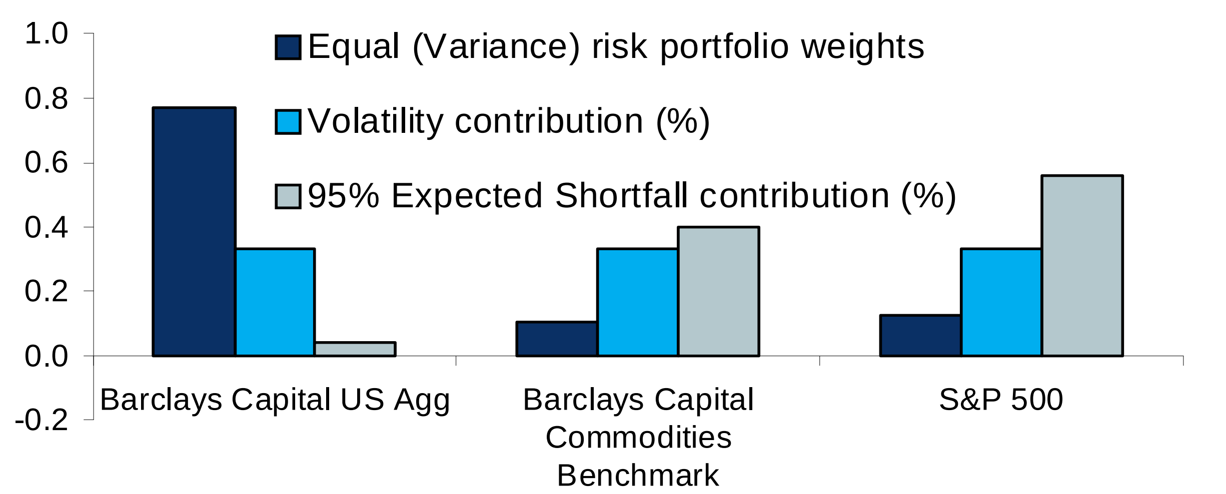
- Hedge tails through a post-allocation ‘overlay’ approach

Asset Allocation or Hedging?

Asset Class Diversification Is Not Risk Diversification



Volatility Risk Diversification Is Not Tail Risk Diversification



Source: Barclays Capital

- Traditional portfolios are characterized by skewed risk profiles
- Alternative allocation mechanisms can give very different risk results
- Asset allocation has its limits as a tail risk mitigation tool

Hedging Overlays: Minimum Risk Approach

Tail risk instruments should be selected in the portfolio so that the 'stress beta' is lower than the 'normal beta'

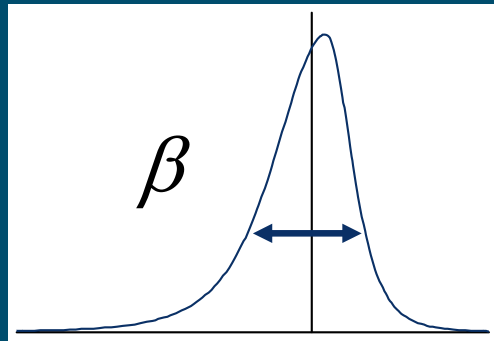
Minimum Risk Hedging

$$\underset{\beta}{Min} \quad Risk\left(R_p - \beta \cdot R_H\right)$$

- Traditional symmetric hedging approaches aim to neutralize both positive and negative movements
- Tail risk hedging should focus on reducing extreme risks, not negative returns and volatility in general

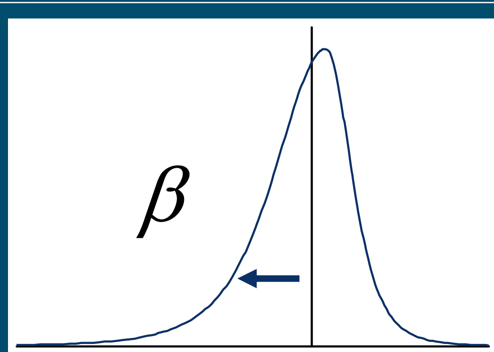
Sizing the Hedge: A Beta for Every Occasion

Traditional Beta



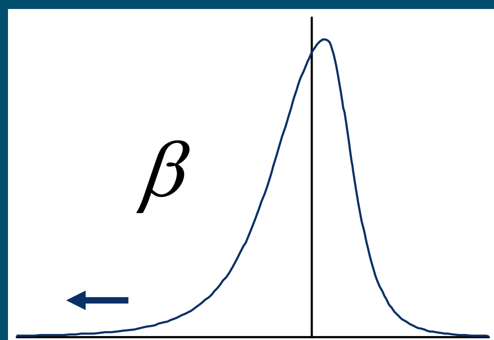
- Objective: Minimize the *variance* of the hedged position
- Traditional betas are widely used but do not target tail properties and treat losses and profits symmetrically
- Useful if distributions are normal

Downside Beta



- Objective: Minimize the *downside semi-variance* of the hedged position
- Downside betas target losses explicitly
- Useful if distributions are skewed

Tail Beta



- Objective: Minimize the *expected shortfall* of the hedged position for a given confidence level (VaR)
- Tail betas explicitly target tail co-movement and expected size of returns on hedging instrument (convexity)
- Useful if distributions are skewed and fat-tailed

Source: Barclays Capital

Why Tail Betas?

- Tail betas explicitly target two criteria for a good hedge:

$$\beta = \frac{E[\text{Return on Portfolio}|\text{Tail Episode Hedged Portfolio}]}{\underbrace{E[\text{Return on Hedge}|}_{\text{Convexity}}\underbrace{\text{Tail Episode Hedged Portfolio}]}_{\text{Tail Co-movement}}}$$

- Tail betas can be used as a criteria to select best cost/impact instruments in an intuitive way

- Tail betas apply to nonlinear, as well as linear instruments, strategies, and portfolios

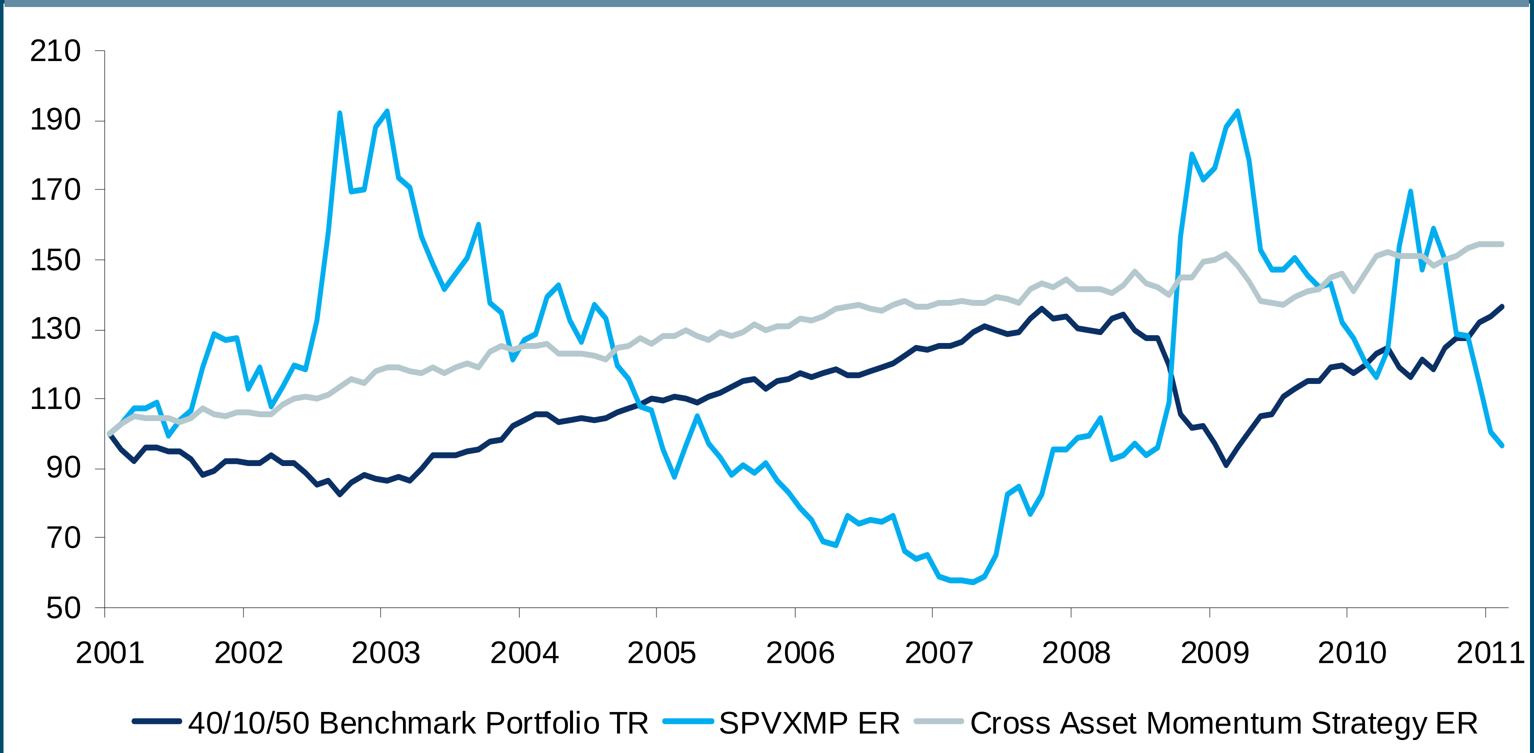
- Techniques such as quantile regressions give good results for approximate hedges and allow for dynamic modeling of tail betas

Hedging Instruments for a 40/10/50 Portfolio

We consider two strategies as tail hedging instruments for a 40/10/50 benchmark portfolio to minimize the monthly average loss below 4% (approx. 5% portfolio VaR)

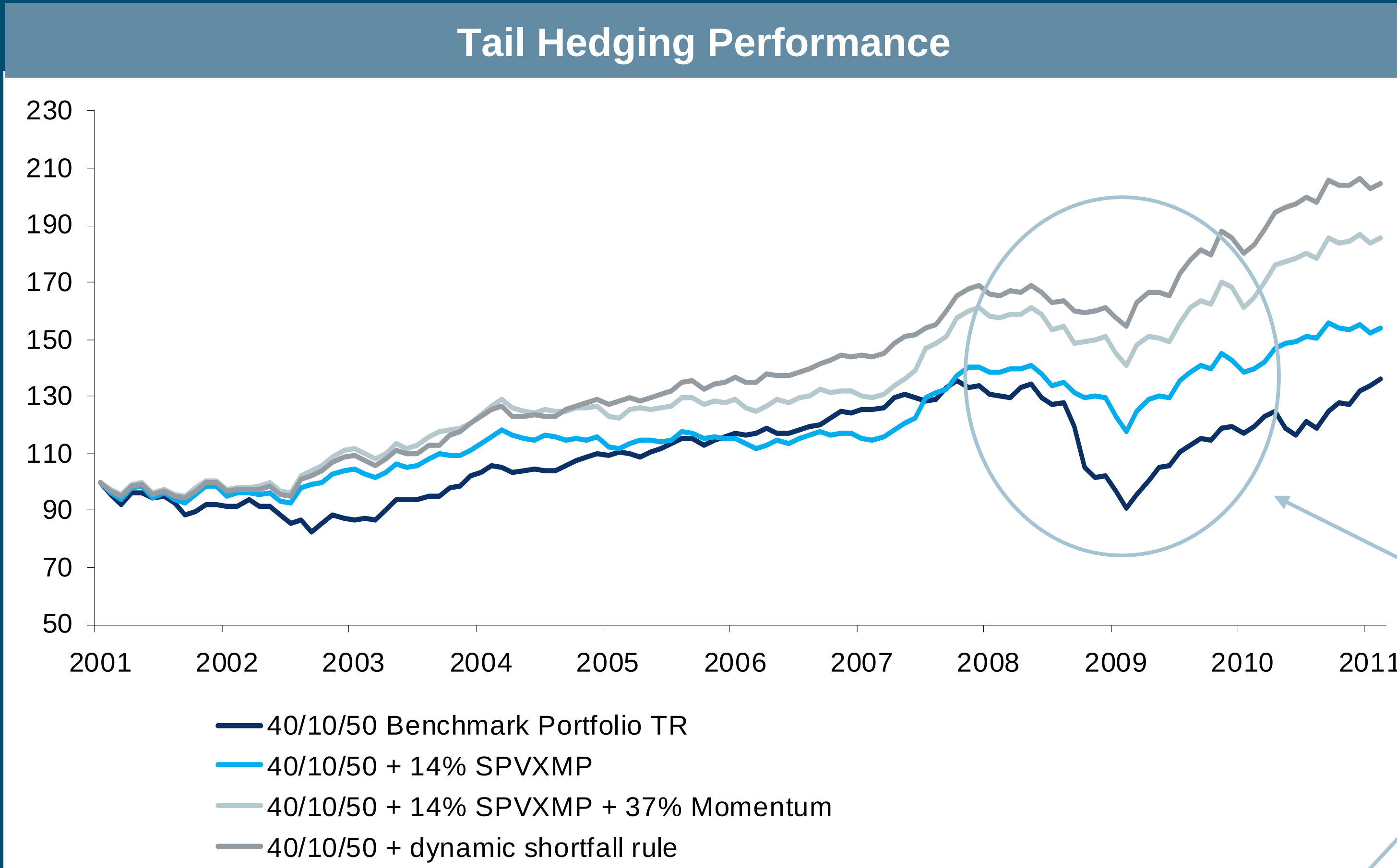
- Long equity volatility, SPVXMP: $\beta = 0.21,\ \mathrm{Tail}\beta = 0.14$
- A Cross Asset Momentum Strategy: $\beta = 0.22,\ \mathrm{Tail}\beta = 0.37$

Portfolio and Hedging Instruments



Source: Barclays Capital

Hedging a 40/10/50 Portfolio With (Dynamic) Tail Betas



Tail Beta hedging approaches reduce downside risk

2001-current	Mean	S.d.	ES below -4%	Drawdown
40/10/50 Benchmark Portfolio TR	3.1%	9.2%	**-7.1%**	**33.2%**
40/10/50 + 14% SPVXMP	3.8%	7.2%	**-6.1%**	**17.6%**
40/10/50 + 14% SPVXMP + 37% Momentum	4.3%	7.1%	**-6.2%**	**13.8%**
40/10/50 + dynamic tail beta	6.7%	6.4%	**-4.6%**	**10.4%**

Source: Barclays Capital

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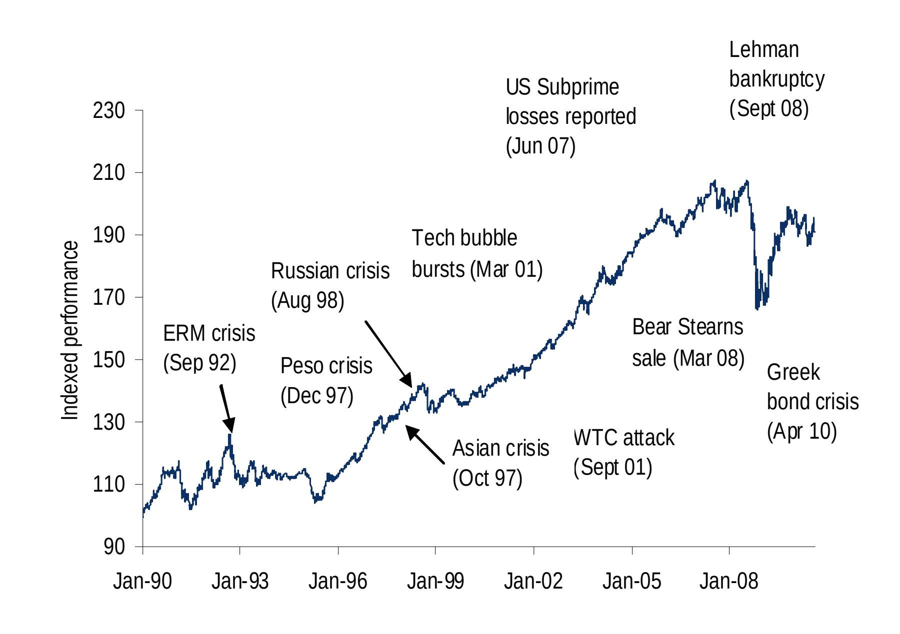
Tail Risk Hedging as a Systematic Trading Strategy

The FX Carry Trade

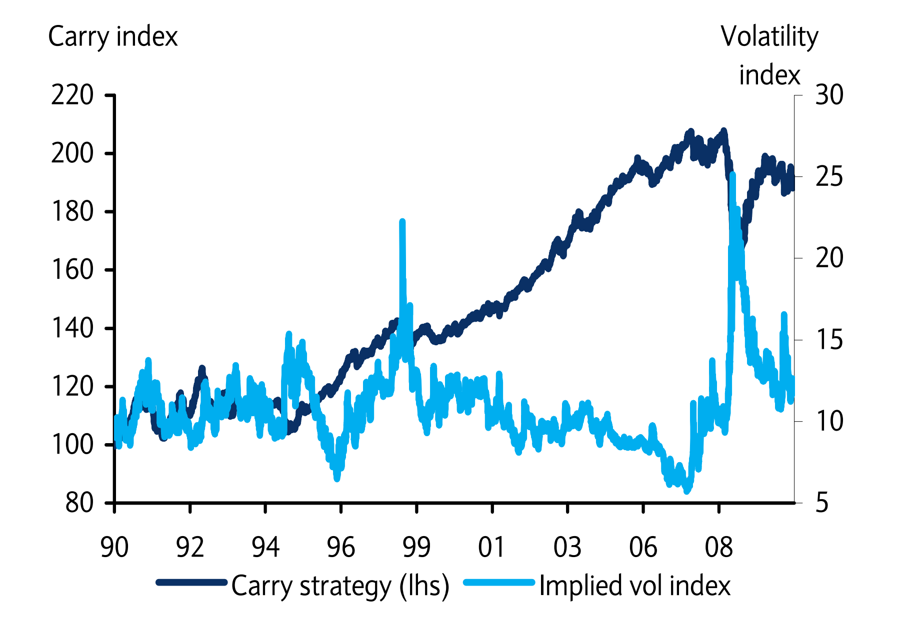
FX Carry is one of the most popular investment strategies amongst FX investors

- Positive long-run excess performance but significant tail risk
- Short volatility strategy: Carry performs poorly during periods of high volatility and risk aversion

The FX Carry Trade



FX Carry versus FX Volatility

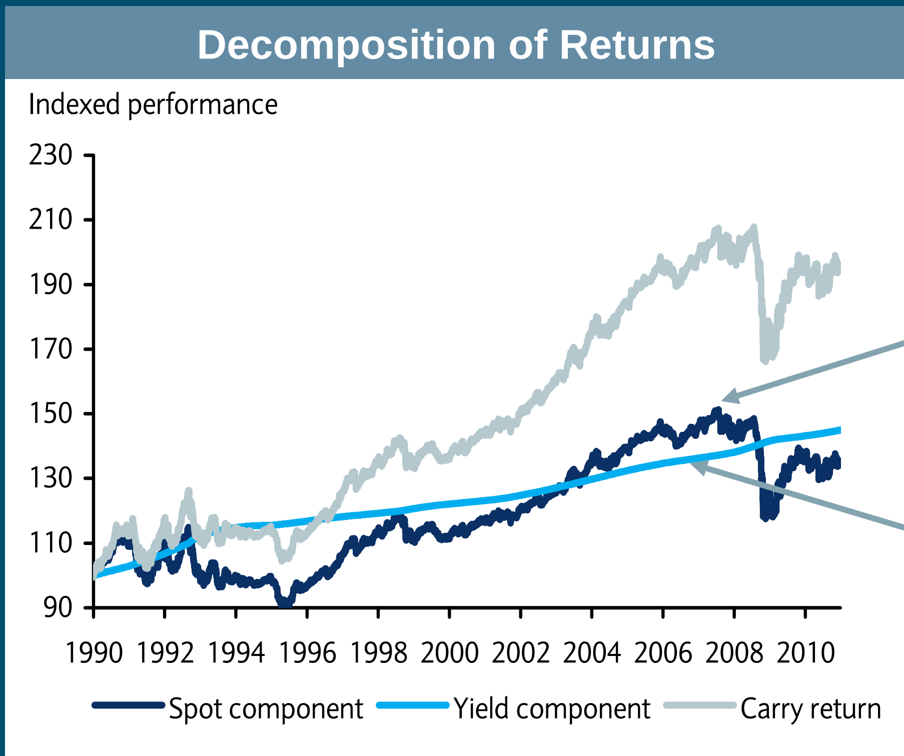


Source: Barclays Capital

- Tail Risk in FX Carry is realized over very short periods: between September and October 2008, an investor with long exposure to AUD/JPY lost 33% in a little under four weeks

Understanding FX Carry Returns

We can isolate the carry portfolio risk by decomposing the performance into the pure carry component and movements in spot rates



Source: Bloomberg, Barclays Capital

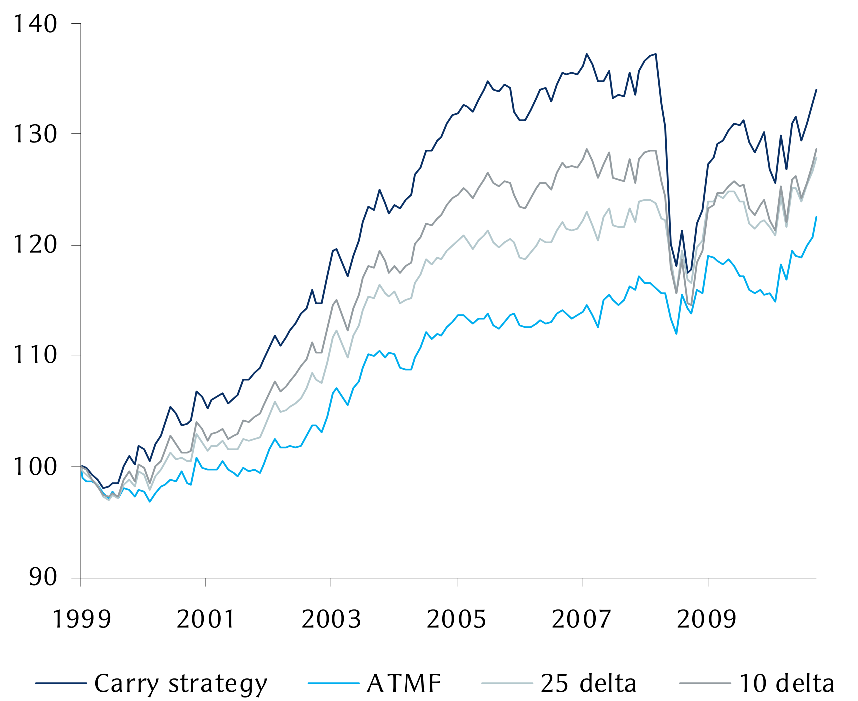
Movement in spot rates is the dominant source of tail risk

Yield component provides steady returns

- G-10 passive carry basket consists of nine US dollar pairs and five euro crosses. Pairs are rebalanced monthly, with long positions in the high yielding currencies, funded by short positions in the low yielding currencies

Option Overlays: Shaping the Downside with Long Puts

FX Carry with Tail Hedge



Hedge tail risk in the carry trade by rolling 1m put options on the investment currencies

Hedged FX Carry Performance

	Carry	Carry with options		
		ATMF	25 delta	10 delta
1st half (1999-2005)				
Annualised return	4.0%	1.7%	2.6%	3.1%
Volatility	2.9%	2.4%	2.7%	2.9%
Sharpe ratio	1.37	0.71	0.97	1.10
2nd half (2006 - 2011)				
Annualised return	-0.1%	1.8%	1.3%	0.4%
Volatility	6.7%	3.8%	4.7%	5.7%
Sharpe ratio	-0.01	0.48	0.27	0.07
Full sample (1999-2011)				
Annualised return	2.5%	1.7%	2.1%	2.2%
Volatility	4.6%	3.0%	3.5%	4.1%
Sharpe ratio	0.55	0.59	0.60	0.53
Max drawdown	-14.4%	-4.4%	-6.8%	-11.0%
Skewness	-1.64	1.00	0.34	-0.46
% profitable months	0.66	0.52	0.54	0.59
Max monthly loss	-8.1%	-2.1%	-2.8%	-5.1%

Source: Barclays Capital

Option Overlays: Improving the Upside with Short Calls

We consider a long put, covered call strategy that cheapens the cost of the tail hedge and provides income in times of distress

- Long put is struck ATMF to provide robust downside protection
- Call strike set to reflect the trade-off between premium earned and the expected cost of the payout

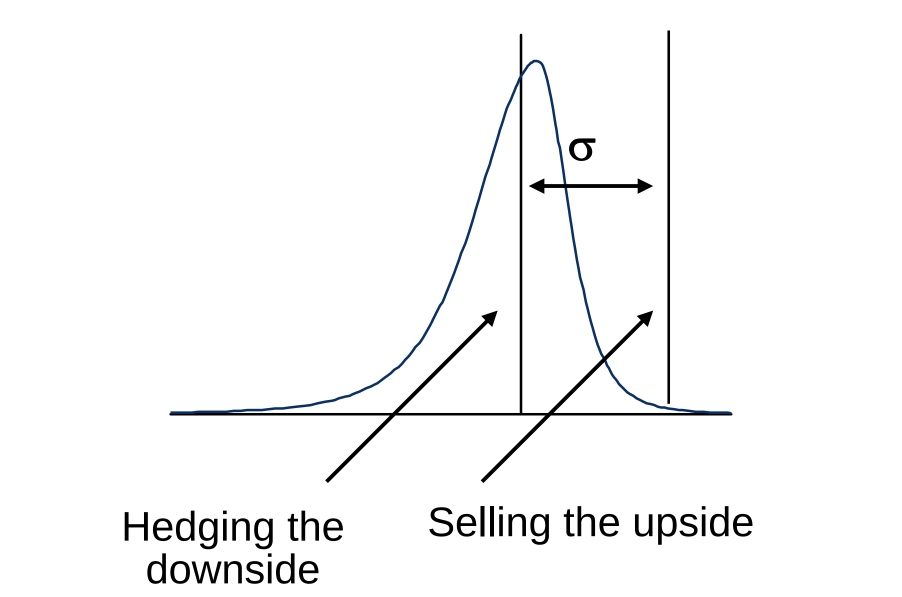
A simple Strike Setting Rule:

- Receive the full amount of pairwise carry available
- Set the strike as a function of the expected upside potential in spot rate movements

$$K_t = F_t \cdot [1 \pm (C_t + \lambda \cdot \sigma_t^{Upside})]$$

K = strike, F = forward rate, C = yield, σ = upside spot volatility and λ = volatility factor

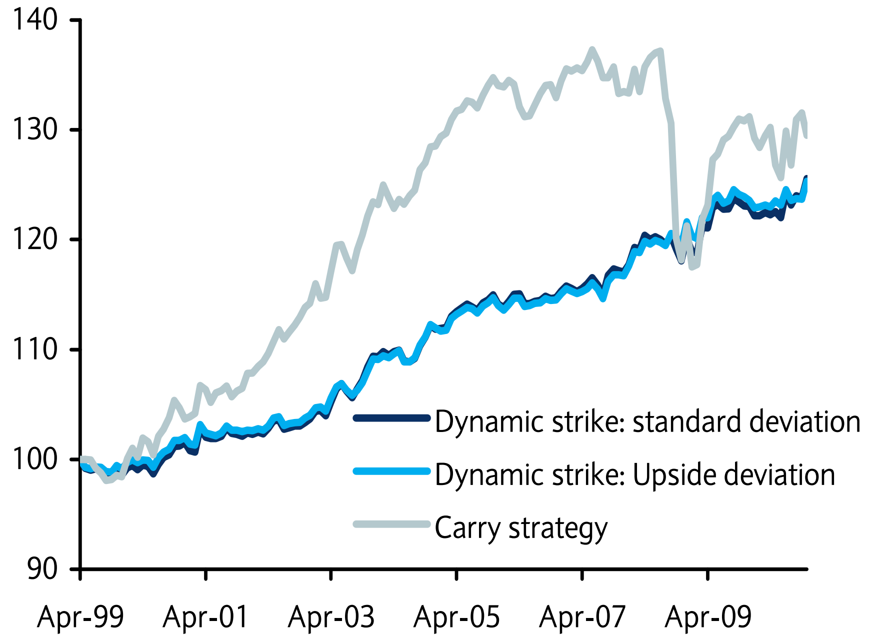
Dynamic Strike Setting



Source: Barclays Capital

The Alpha in Tail Hedging

FX Carry with Tail Hedge



FX Carry Performance

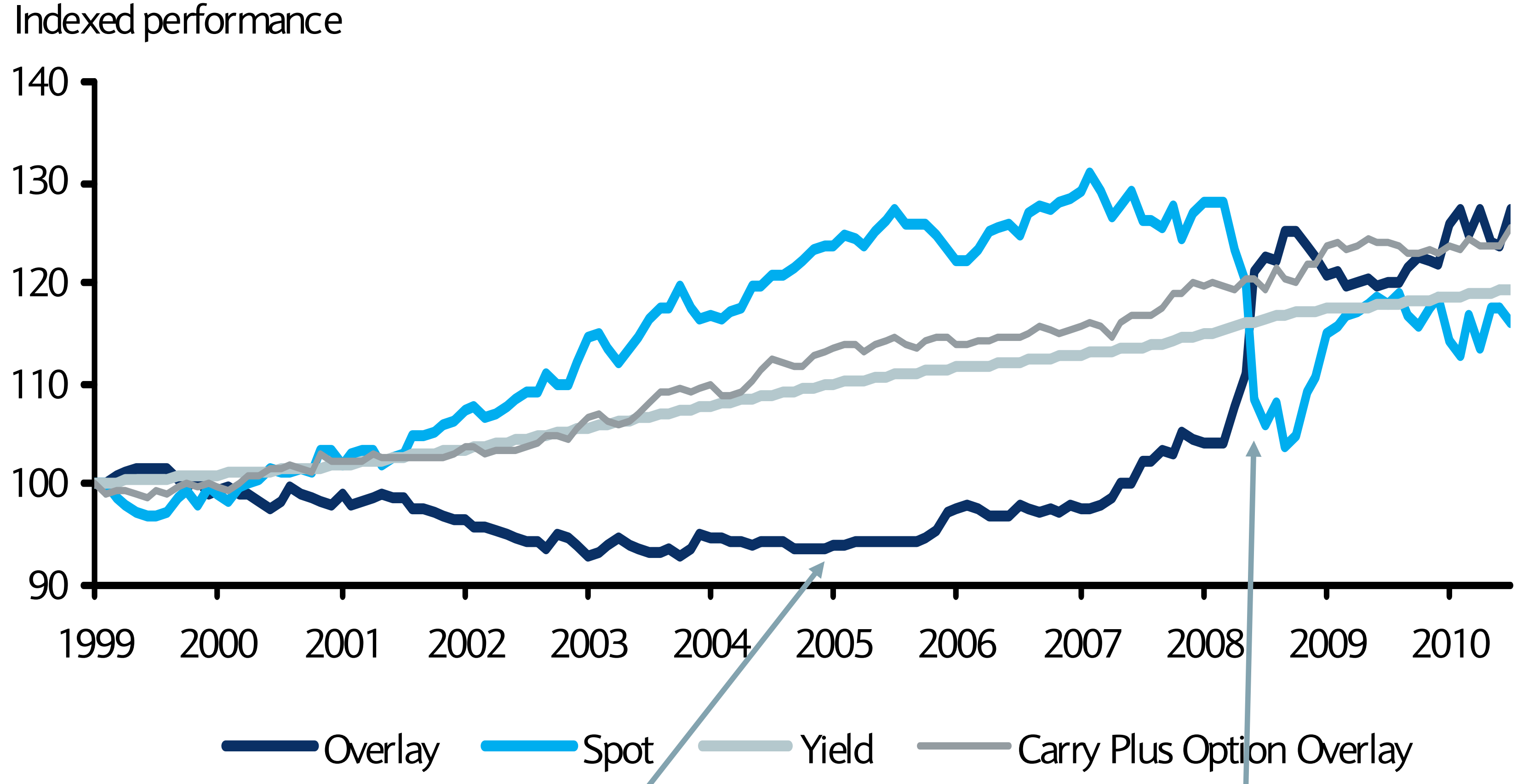
	Carry	Carry with options overlay				
		Dynamic strike (lambda)				
		0.25	0.5	1	1.5	2
1st half (1999-2005)						
Annualised return	4.0%	0.6%	1.1%	1.7%	2.0%	2.1%
Volatility	2.9%	1.1%	1.2%	1.6%	2.0%	2.2%
Sharpe ratio	1.37	0.57	0.85	1.07	1.02	0.96
2nd half (2006 - 2011)						
Annualised return	-0.1%	1.9%	2.1%	2.4%	2.4%	2.4%
Volatility	6.7%	2.0%	1.9%	2.2%	2.6%	3.0%
Sharpe ratio	-0.01	0.92	1.09	1.10	0.94	0.78
Full sample (1999-2011)						
Annualised return	2.5%	1.1%	1.4%	2.0%	2.2%	2.2%
Volatility	4.6%	1.5%	1.5%	1.9%	2.2%	2.5%
Sharpe ratio	0.55	0.70	0.93	1.07	0.98	0.87
Max drawdown	-14.4%	-1.9%	-1.2%	-1.3%	-1.7%	-2.4%
Skewness	-1.6	0.2	0.4	0.5	0.6	0.8
% profitable months	0.7	0.6	0.6	0.6	0.6	0.5
Max monthly loss	-8.1%	-1.6%	-1.1%	-1.1%	-1.1%	-1.0%

Incorporating dynamic tail hedging in the FX carry trade isolates the alpha

Source: Barclays Capital

Intuition: Decomposing FX Carry with Options Overlay

FX Carry with Overlay Decomposition



Provide cheap insurance when investment spot rates are trending up

Provide income from call selling and put payoffs during unwind episodes

Source: Barclays Capital

Concluding Remarks

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Tail risk hedging is a complex problem that requires tailored solutions:

- Identify risks/risk factors
- Explicit versus approximate hedging
- Hedging instruments' effectiveness and costs
- Hedging approaches

The potential for better investment performance is substantial:

- Approximate tail hedging in a risk measurement framework can improve portfolio return characteristics
  - Tail betas could be used to 'warehouse' tail risk

- Explicit tail hedging overlays can be designed to improve overall investment results of individual strategies and asset classes
  - Understanding the return distribution allows for more effective targeting of payoff preferences

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