Office of the Treasurer of The Regents

University of California

I-2
Hedging Tail Risk

Committee on Investments/
Investment Advisory Group
December 13, 2011

Agenda

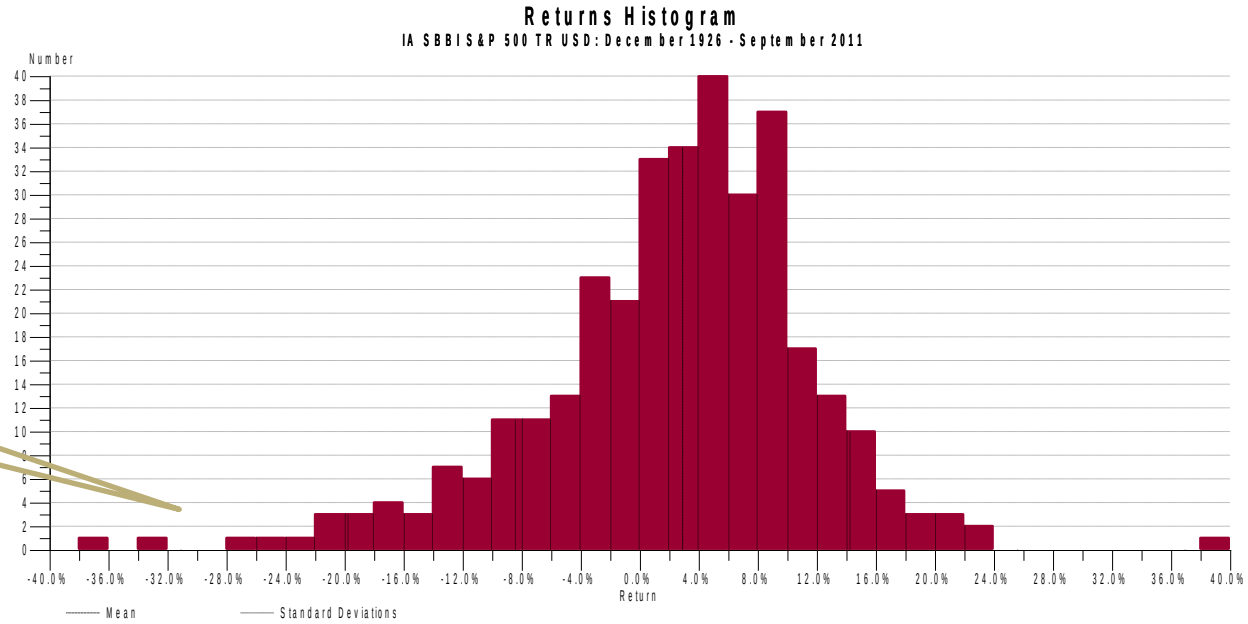
- Introduction to Tail Risk
- Approaches to Tail Risk Hedging
  - Direct
  - Indirect
- Implementation Choices
  - Strategic
  - Tactical
- Recommendation
- Appendix

Introduction to Tail Risk

- What is Tail Risk?
- Why do "Tails" Occur?
- Can Tail Risk be "Hedged"?

Histogram of quarterly S&P 500 returns 1926-2011

The (left) "Tail"



Introduction to Tail Risk

- **What is Tail Risk?**
  - A large loss
  - An "unexpected" large loss
  - A loss outside the bounds of what normally occurs in the markets
  - A loss greater than 2 (3?) standard deviations
  - A sudden and severe increase in risk aversion
  - **Unexpected large losses in multiple asset classes and across the globe**
  - **Losses beyond what can be mitigated by diversification alone**

Introduction to Tail Risk

- Why do "Tails" Occur?
  - The other side of the business cycle (cyclical)
  - Market liquidity "dries up" (1987, 2007-8)
    - Liquidity is inversely proportional to perceived uncertainty
    - The other side of a credit bubble (secular)
- In extreme (bad) events, risk asset markets move together (down) as fear gathers momentum
  - Since equity risk dominates most institutional portfolios, diversification does not protect against extreme events
  - Regime change (but these cannot be "hedged")

Introduction to Tail Risk

- Can Tail Risk be "Hedged"?
  - Yes: many liquid assets have derivatives markets
  - No: contractual hedges are expensive; not recommended as a static strategy
  - Maybe
    - Risk is not eliminated (counterparty, operational, basis, regulatory,…)
    - Terms of insurance may not correspond to actual events (e.g., slow decline in market)

Approaches to Tail Risk Hedging

- **Direct / Exact Approaches**
  - **Buying portfolio protection, e.g., options**
  - **Know what will be hedged and by how much over what period**
  - **Costly, especially if used as strategic policy**
  - **All strategies have better performance when applied selectively**

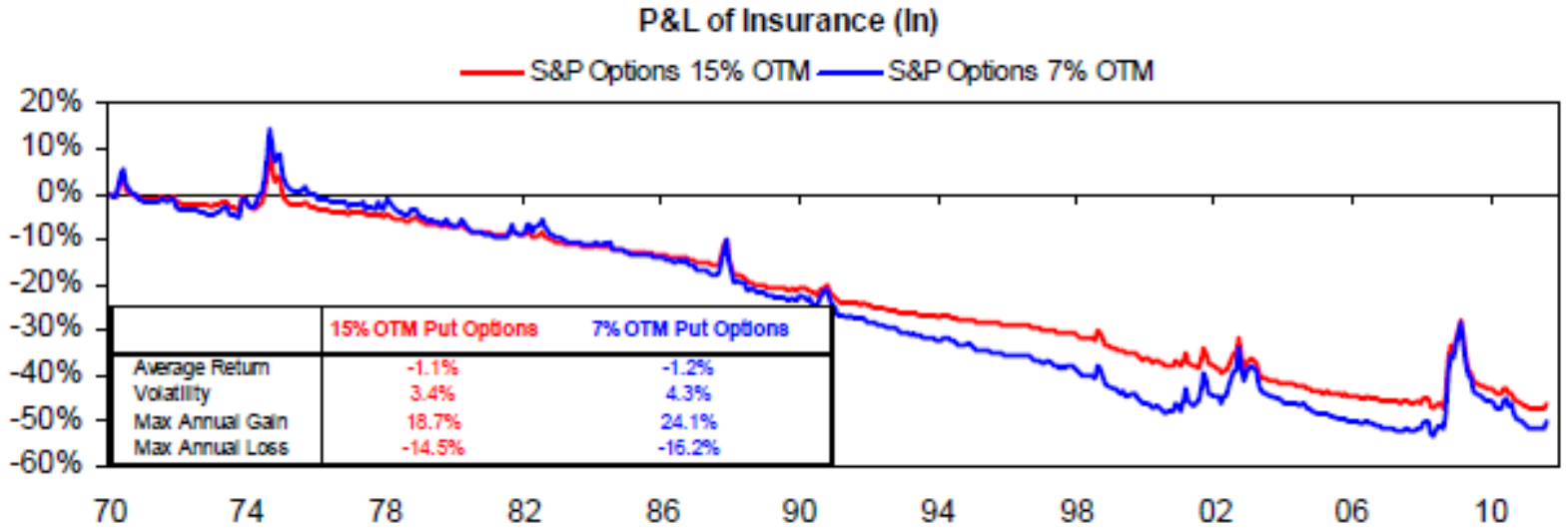
Approaches to Tail Risk Hedging - Direct

- Equity Options
  - Buying volatility: Puts
  - Buying / Selling volatility
    - Put-Call Collars
    - Put-Spread Collars
  - Selling Tail Insurance
- Dynamic Rebalancing
  - Use futures to increase / decrease risk exposures, always maintaining a "floor" value in safe assets

Put Options

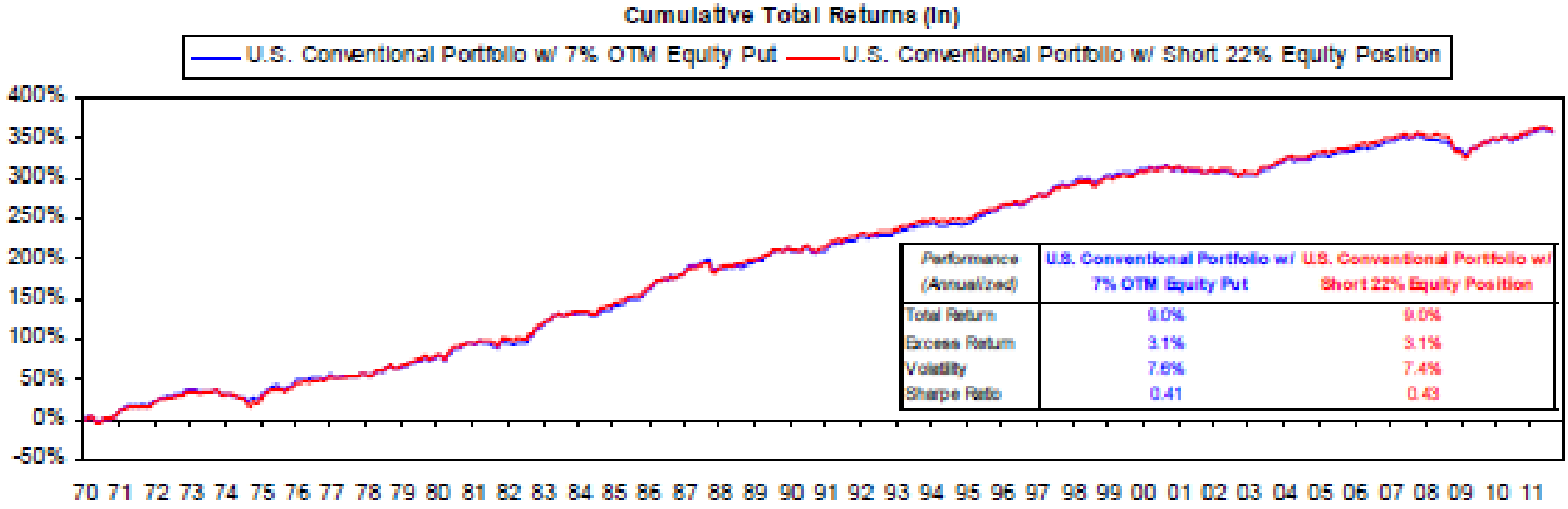
- If one expects a positive equity risk premium over time, then most options will expire out of the money (worthless)
- Chart below shows cumulative cost (P/L) of buying and exercising put options
- Source: Bridgewater Asset Management

Exhibit 7: Insurance reduces long-term returns.



Passive Put Options = Reduce Equity Exposure

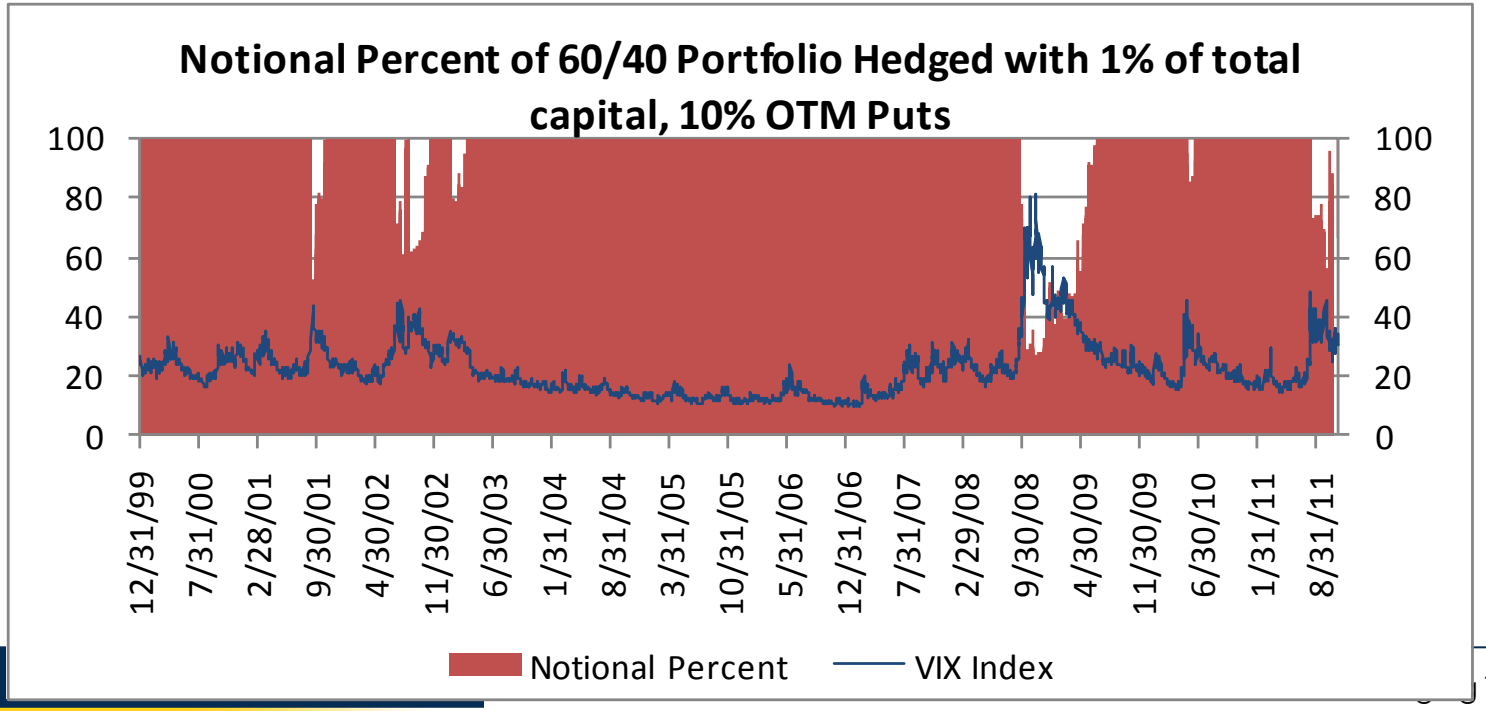
- A passive program of always buying 7% OTM puts has the same impact as a reduction in equity exposure of 22%!
  - US conventional balanced portfolio has same return, volatility, and drawdowns
- Source: Bridgewater Asset Management



Performance (Annualized)	U.S. Conventional Portfolio w/ 7% OTM Equity Put	U.S. Conventional Portfolio w/ Short 22% Equity Position
Total Return	9.0%	9.0%
Excess Return	3.1%	3.1%
Volatility	7.6%	7.4%
Sharpe Ratio	0.41	0.43

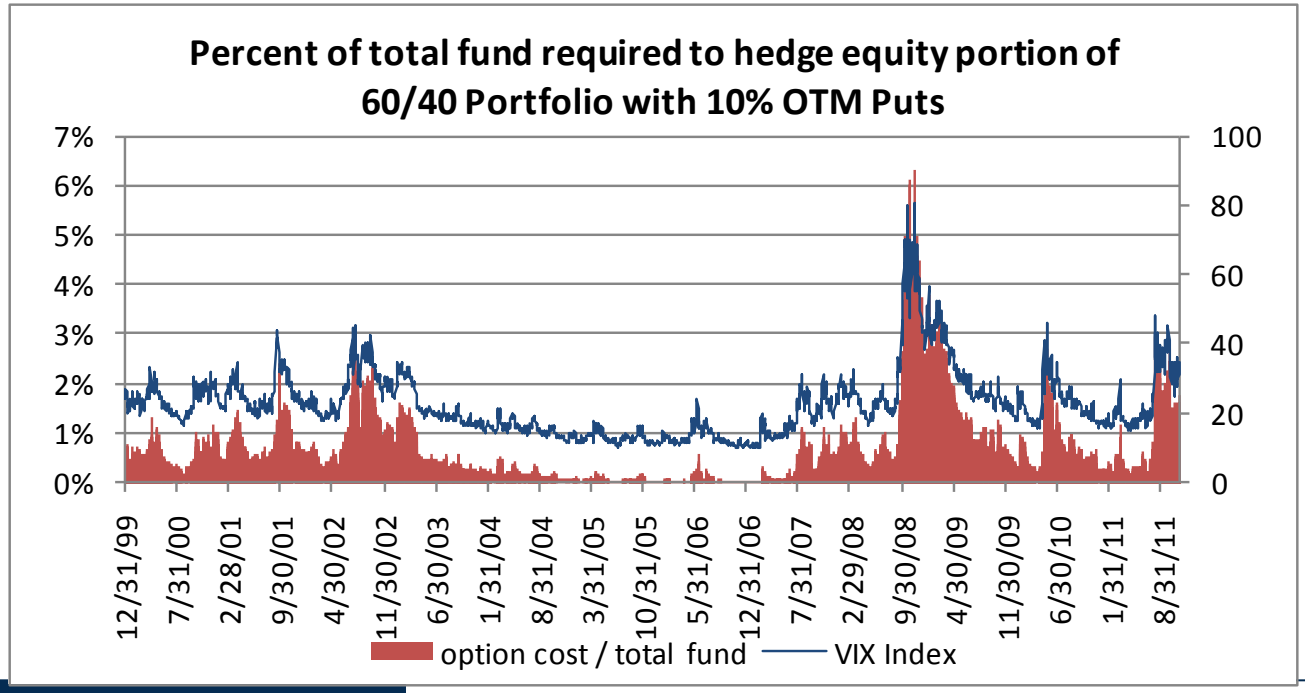
How Much Protection Does 1% Buy?

- Suppose we have $600 Equity, $1,000 total (60/40) portfolio
- The bar graph below shows the percent of equity notional value which could have hedged by buying 10% out of the money puts, using no more than 1% of the total portfolio value to buy hedges
- On most days – but not when the VIX gapped up - a 1% risk budget would have been more than adequate
- Source: Bloomberg, Treasurer's Office



What Risk Budget is Required for 100% Hedge?

- Suppose we have $600 Equity, $1,000 total (60/40) portfolio
- The bar graph below shows the percent of Total Fund value which would have been used to hedge 100% of equity by buying 10% out of the money puts
- The average cost was 63 bp / median cost was 41 bp. For days where the cost was over 1.0%, the average cost was 1.88%
- Source: Bloomberg, Treasurer's Office



Approaches to Tail Risk Hedging 2

- **Indirect / Approximate Approaches**
  - **More efficient diversification, or**
  - **Indirect (i.e., cross) hedges**
  - **"Actual results may vary" from what was intended**
  - **Opportunity cost and/or cost of hedges usually less than direct approaches**

Approaches to Tail Risk Hedging - Indirect

- Diversification – by asset class
  - Reduce equity allocation (de-risk)
  - Gold, Treasuries, Cash
- Diversification – by risk factor
  - Risk Parity / Risk Balanced
  - "Exotic Beta:" risk factors other than equity
- Cross-Asset Hedges
  - Volatility Products (e.g., VIX-based)
  - Credit Default Swaps (CDS)
- Active Management
  - Dedicated Tail Risk Hedging Funds

Balanced Risk Portfolio Strategies ("Risk-Parity")

- Risk Parity is a portfolio construction method that provides superior diversification potential
- Most institutional portfolios are heavily weighted to equity risk (even if "diversified")
- A "risk balanced" portfolio buys assets so the contribution to risk from different risk sources is roughly equal
  - Scaled to the same overall volatility as the conventional portfolio
- Result: better diversification, but with leverage
- This is approach used by Treasurer on a limited basis for portfolio protection during past 2 years

Implementation Choices

- First: what is the goal?
  - Avoid loss greater than X or reduce impact of specific event(s)?
  - Level of protection, cost / budget, horizon?
- Second: strategic or tactical?
  - Strategic
    - E.g., always buy puts, zero cost collars, etc.
    - Not necessarily static, but less discretion
  - Tactical
    - Use discretion (signals) to decide *when, what, and how much* insurance to buy

Implementation Challenges

- Investors are used to being paid to take risk
- Investors need to pay to avoid risk
  - Directly (by buying insurance)
  - Indirectly (by reducing risk assets)
- Fiduciaries
  - Willingness to occasionally underperform peers
- For Investment Staff / Investment Managers
  - Hard to buy protection only when needed
  - Hard to buy the right protection for uncertain outcomes

Recommendation

- Establish pilot "Tail Hedging" program for TRIP
- Recommend use of dedicated "tail risk" manager(s) to purchase an optimal portfolio of tail hedges
- Recommend revising fund Policy/Guidelines to permit investing in tail risk hedging strategies on an opportunistic basis
  - Range of 0-2% (capital used to buy hedges)
  - No change to policy benchmark
- Tail risk hedging program becomes part of the asset allocation decision

APPENDIX

- What is hedging?
- Options and Insurance
- Risk disclosure
- Direct Approaches
  - Put Options
  - Zero Cost Collars
  - Put Spread Collars
- Indirect Approaches
  - Gold, Treasuries, Cash
  - Risk balanced diversification (risk-parity)
  - Exotic Beta
  - Cross Asset Hedges (VIX, CDS)
  - Active Management

What is Hedging?

- Hedging = taking an opposite or offsetting position to temporarily neutralize the fluctuation in value of a risky portfolio
  - Futures
    - A short futures position + the underlying index = no gains (losses) if the index rises (falls)
    - Minimal trading cost only
  - Options
    - An option's payout is contingent on the market index exceeding a given level by a given time
    - Premium (cost to purchase contract) can be material

Options and Insurance

- Buying put options on an equity portfolio is like buying fire insurance on a primary home
- Option premium is like insurance premium
  - If the fire doesn't occur, the premium is "lost"
  - On average, buying insurance is a bad "investment"
  - Yet for most people, the certain loss of a small premium is worth avoiding the catastrophic loss of a home
  - Do you feel the same way about your investments?

Options and Insurance - 2

- The level of loss protection of an equity option is like the deductible in an insurance contract
- Differences
  - Fires are random events, distributed over space
  - Equity market losses, like hurricanes, happen at the same time to everyone

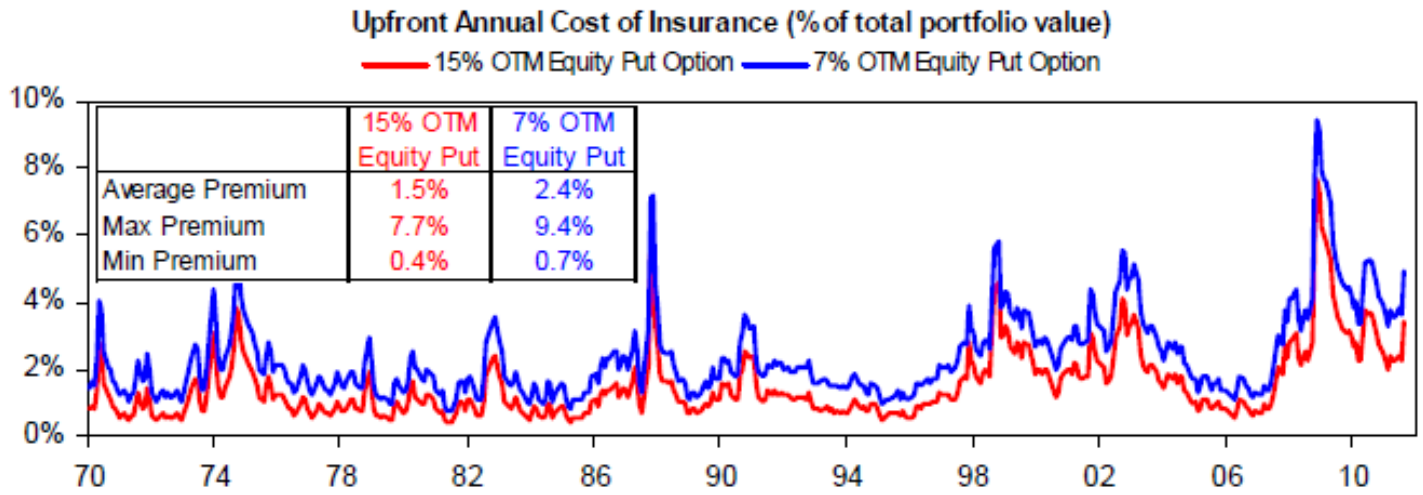
Risk Disclosure

- Static Strategic Policy Allocation
  - Simple to manage and understand
  - Ignores changing environment; no longer "best practice"
- Dynamic Strategic Policy Allocation
  - May include Tail Risk Hedging component
  - More complex to manage and evaluate
    - Counterparty risk for OTC instruments
    - Timing / Manager risk (investment decisions)
    - Regret risk

Put Options

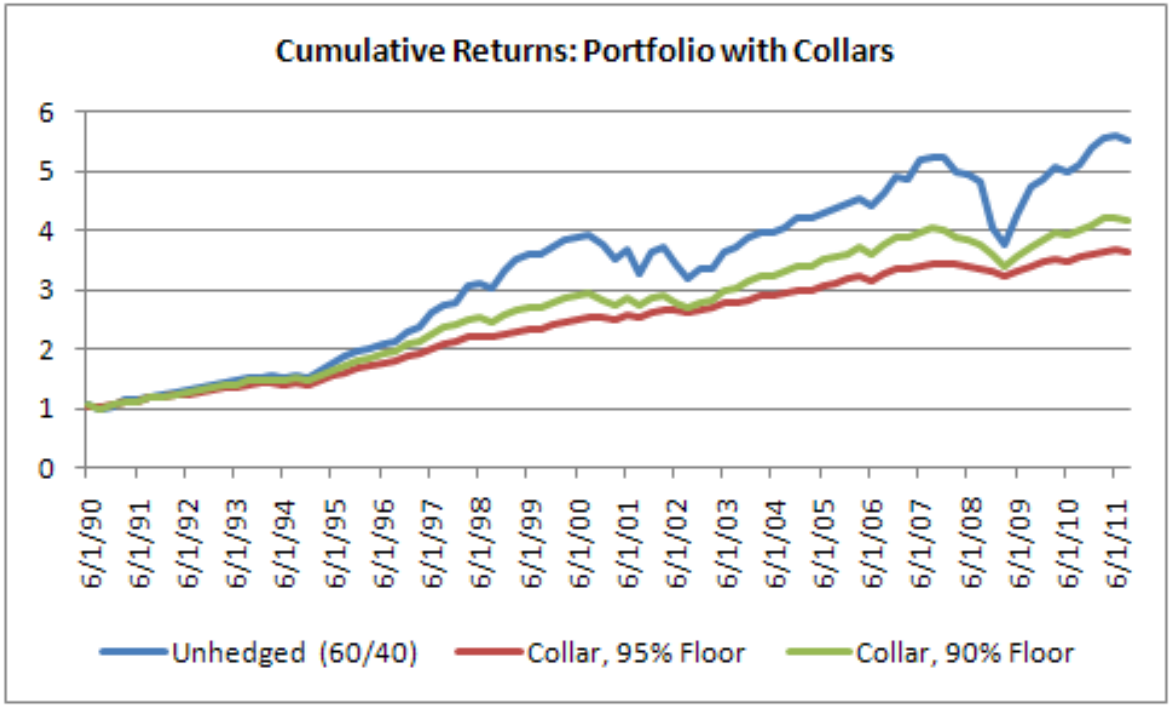
- Cost of insurance (buying puts) is a significant drag on performance
  - 7% OTM: average cost 2.4% of portfolio value
  - 15% OTM: average cost 1.5% of portfolio value
- Insurance costs more after market has fallen
- Source: Bridgewater Asset Management

Exhibit 8: Insurance premiums fluctuate over time, and at times are extremely high.



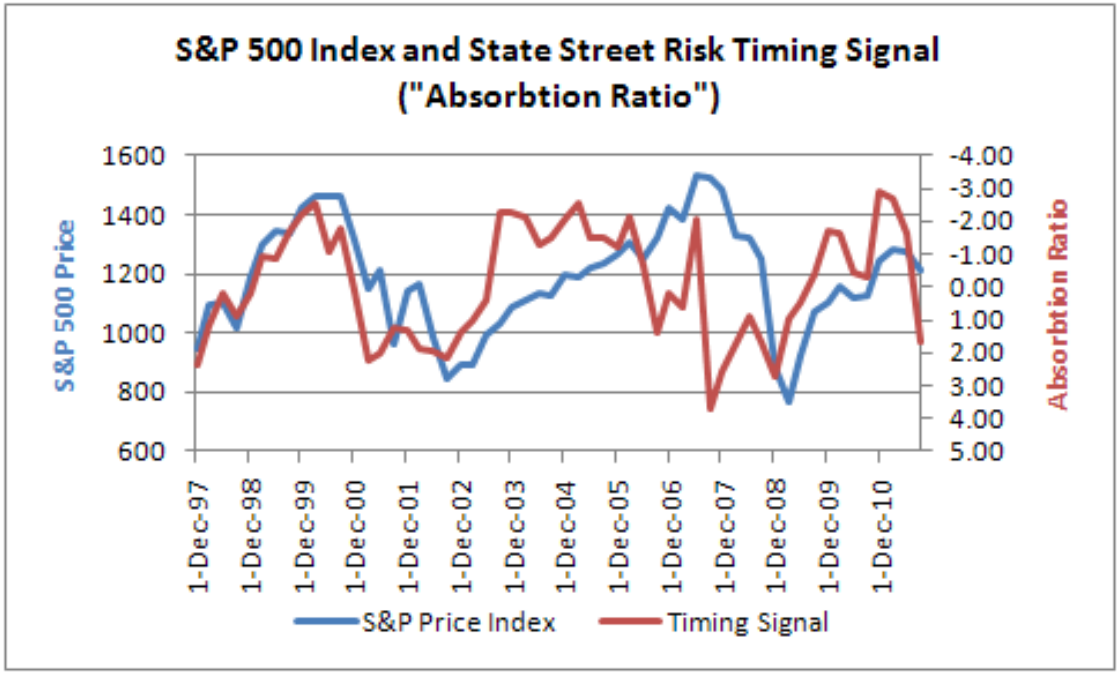
Zero Cost Collars: Limit Downside + Cap Upside

- Example shows naïve use of zero cost collars on a 60/40 portfolio
- Two different floors: 5% loss and 10% loss, quarterly
- Strategy underperforms unhedged portfolio
- Source: State Street Associates



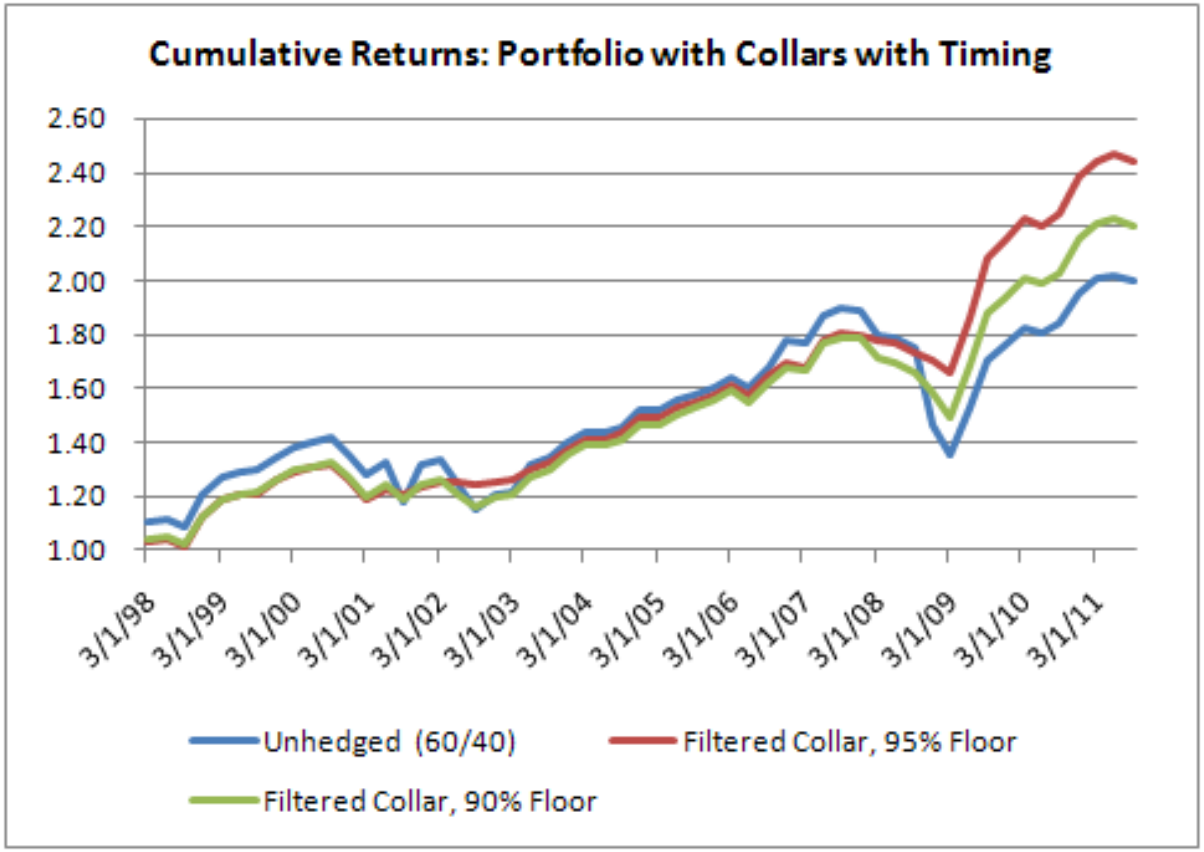
Application of Market Timing

- Use of a risk aversion index can be profitable in determining when to use protection strategies
- This filter is based on a "Systemic Risk Index" which indicates increased likelihood of potential losses when market indexes begin to move together
- Source: State Street Associates



Zero Cost Collars with Timing

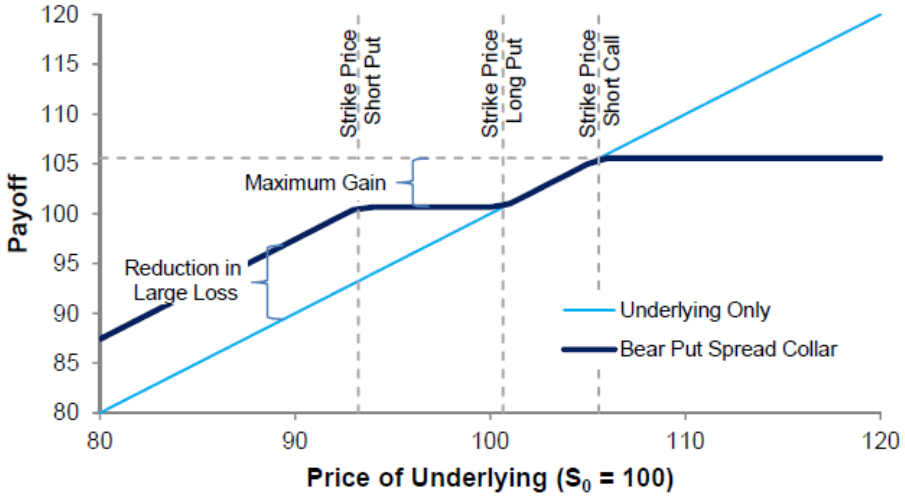
- **Selective use of insurance strategies outperforms an unhedged portfolio**
- **Source: State Street Associates**



Put Spread Collars

- A Put Spread Collar (PSC) is an option strategy in which one purchases an out of the money and sells a call (like a zero-cost collar) but then also sells another put further out of the money
- Like a collar, it limits upside and protects on the downside. Unlike a collar, the downside protection is limited to the range between the two put strikes
- The investor collects a volatility premium and "self-insures" beyond the second put strike

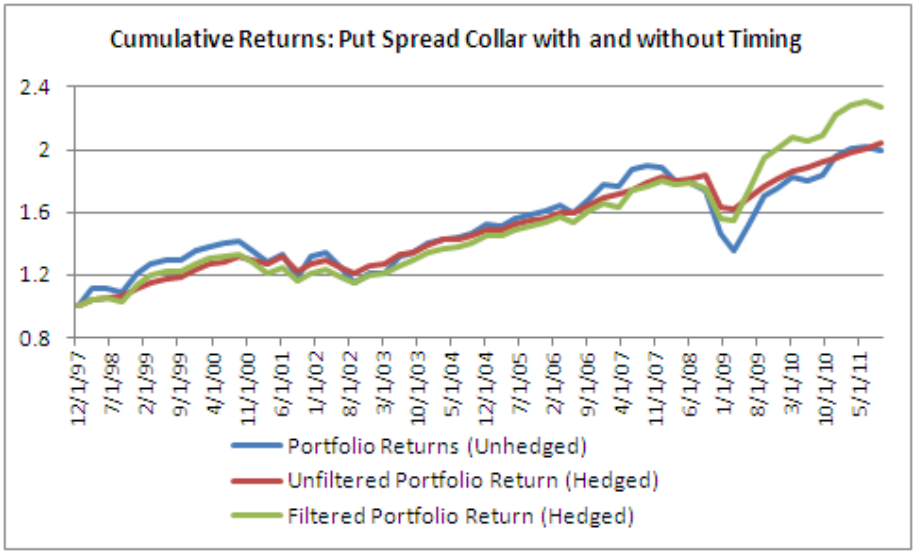
Figure 2: Bear Put Spread Collar Payoff



- Source: State Street Associates

Put Spread Collars

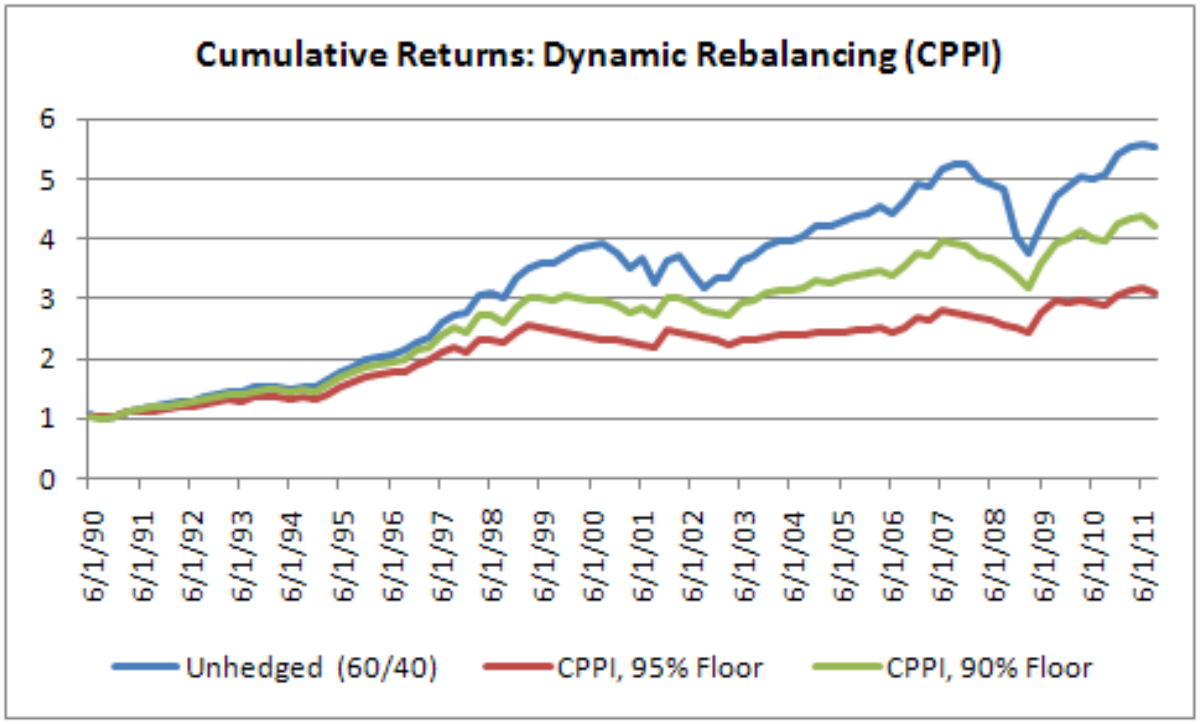
- A Put Spread Collar (PSC) is a Zero Cost Collar plus the sale of an out of the money put. This strategy provides premium income (from the short put) and effectively "self-insures" below its strike
- It thus loses less than a collar in rising markets, while protecting against moderate losses
- When applied selectively, the results are even better



- Source: State Street Associates

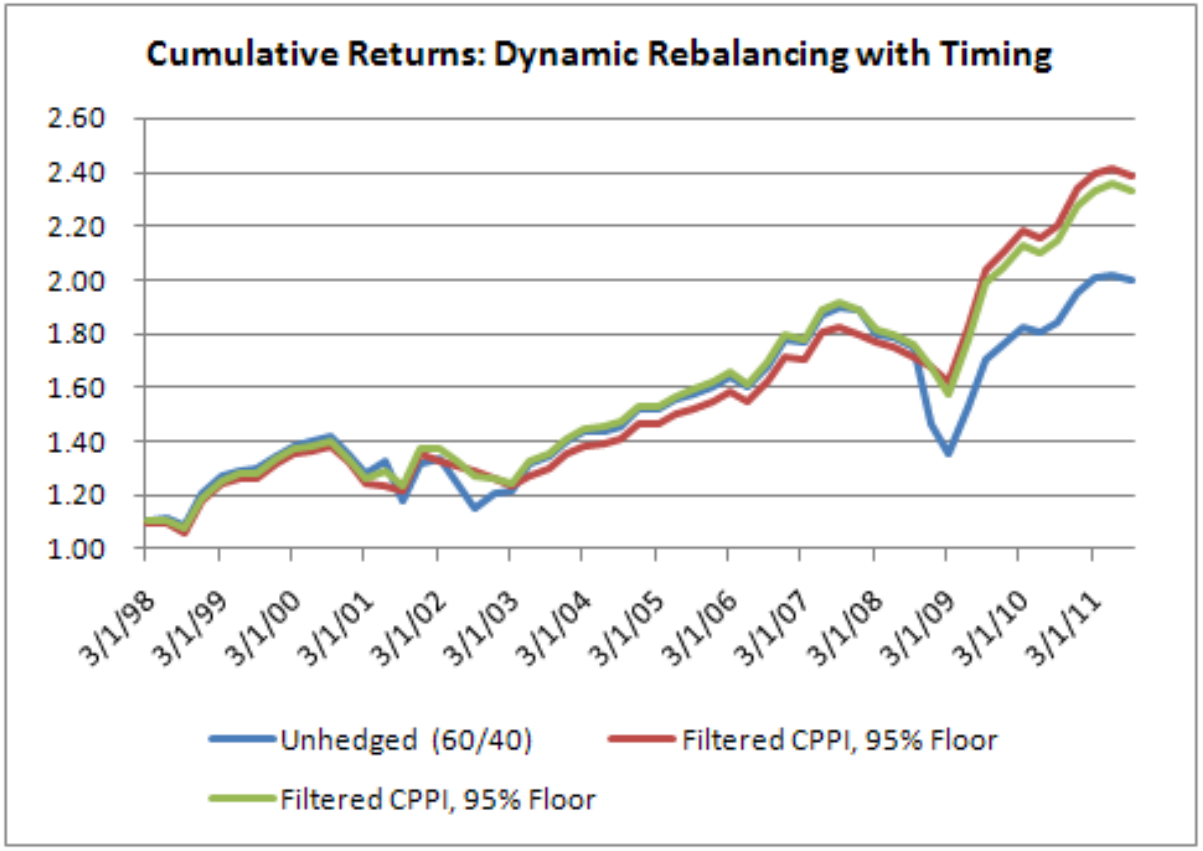
Dynamic Hedging (Portfolio Insurance)

- Another approach to portfolio protection is Dynamic Hedging, also called Constant Proportion Portfolio Insurance (CPPI)
- This is successful at avoiding losses but at the cost of losing most of the upside
- Source: State Street Associates

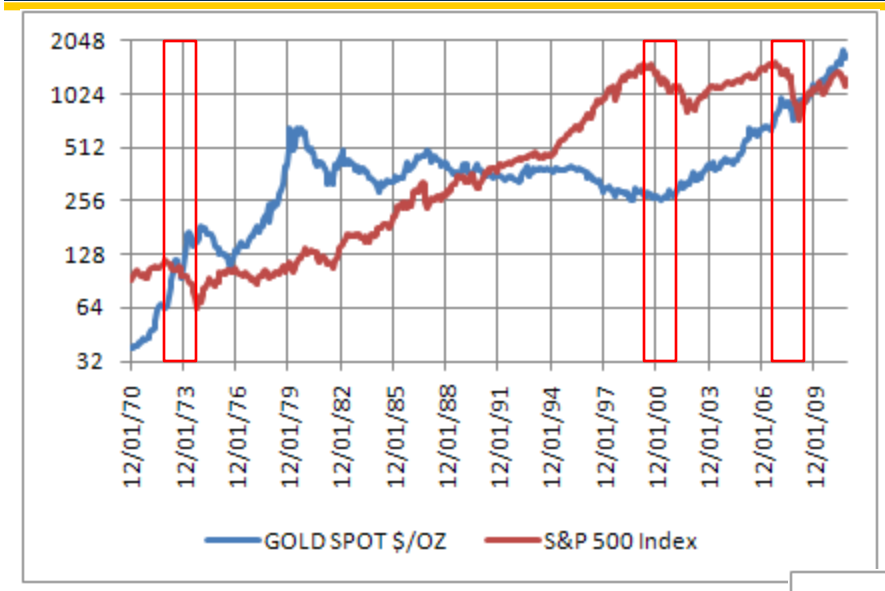


Dynamic Hedging, with Timing

- **Selective use of insurance strategies outperforms an unhedged portfolio**
- **Source: State Street Associates**

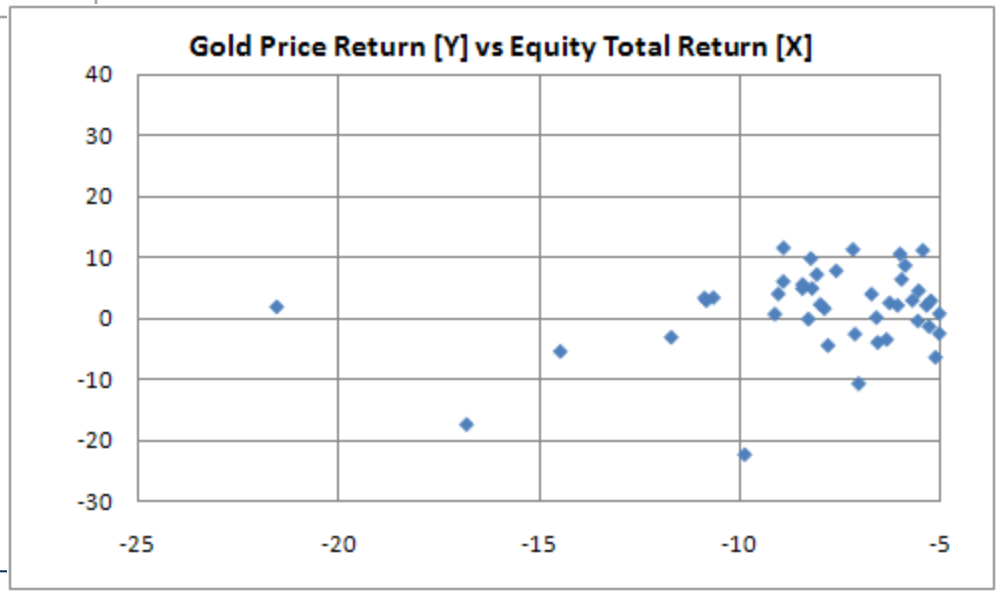


Gold: Not a Consistent Hedge



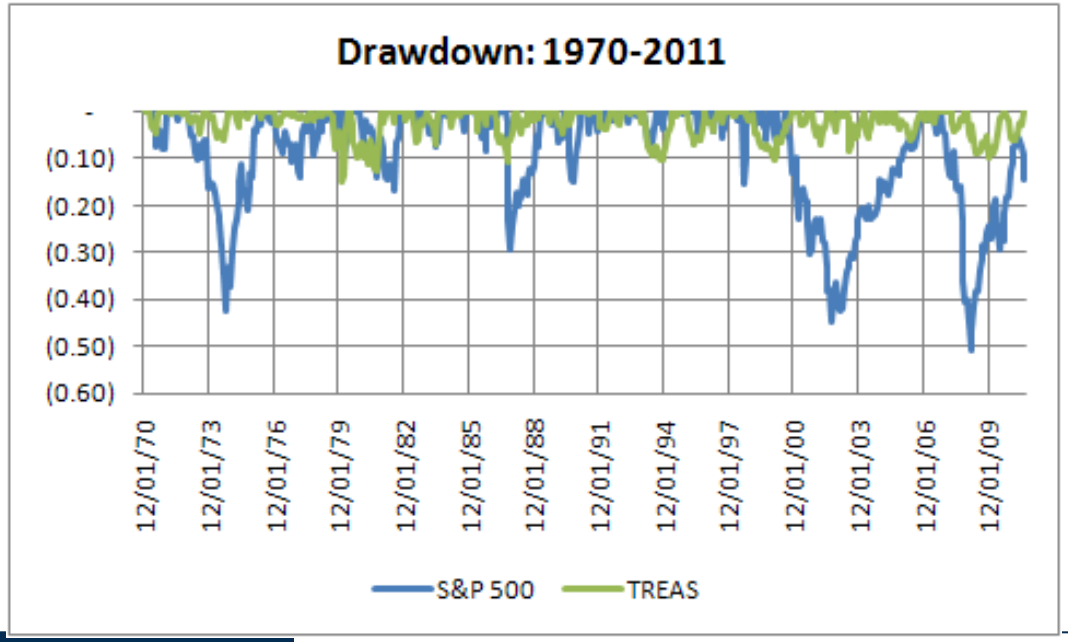
- Gold has provided a hedge against equities during select periods
  - 7/1972 thru 8/1974
  - 3/2000 thru 12/2002
  - 7/2007 thru 2/2009

- But Gold had a negative return from 6/1980 thru 3/2000 (20 years!)
- For monthly equity losses of - 10% or more, the value of holding gold is questionable
- Source: Bloomberg



Treasuries: Benefit from "Flight to Quality"

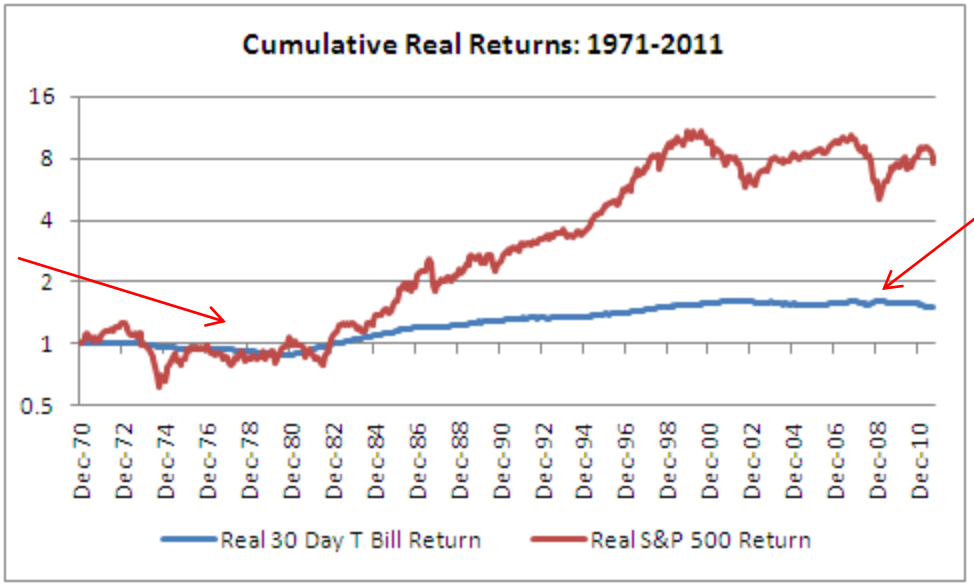
- When the S&P 500 had a negative return, its mean monthly return was -3.44% versus 0.36% for a 10 year US Treasury Bond
- The correlation of negative equity periods with Treasuries was -0.10
- Most importantly, Treasuries never had significant losses during large equity drawdowns
- Hence sovereign debt has historically been the "hedge" component of institutional portfolios



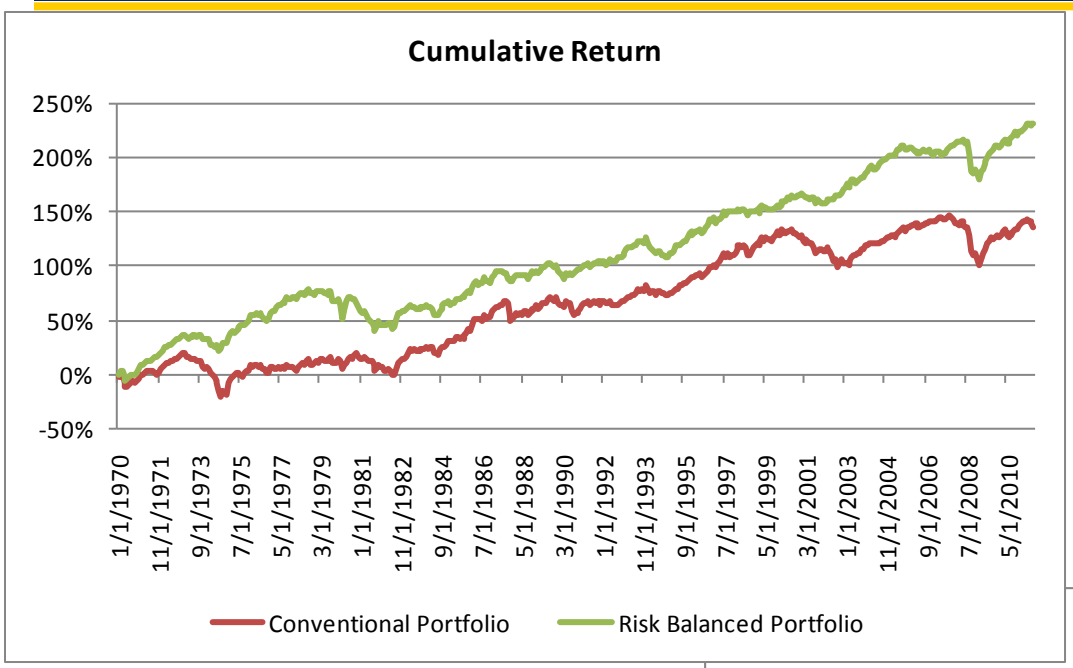
Cash: the Ultimate Tail Hedge

- Cash always has a positive return, and *almost* always a positive real return (*but not now*)
- It has value as a tail hedge only given superior market timing ability
- Except for the inflationary 1970's and early 80's, it has failed to keep up with equities, so it can only be used tactically
- Source: Bloomberg, Morningstar

Negative real cash return

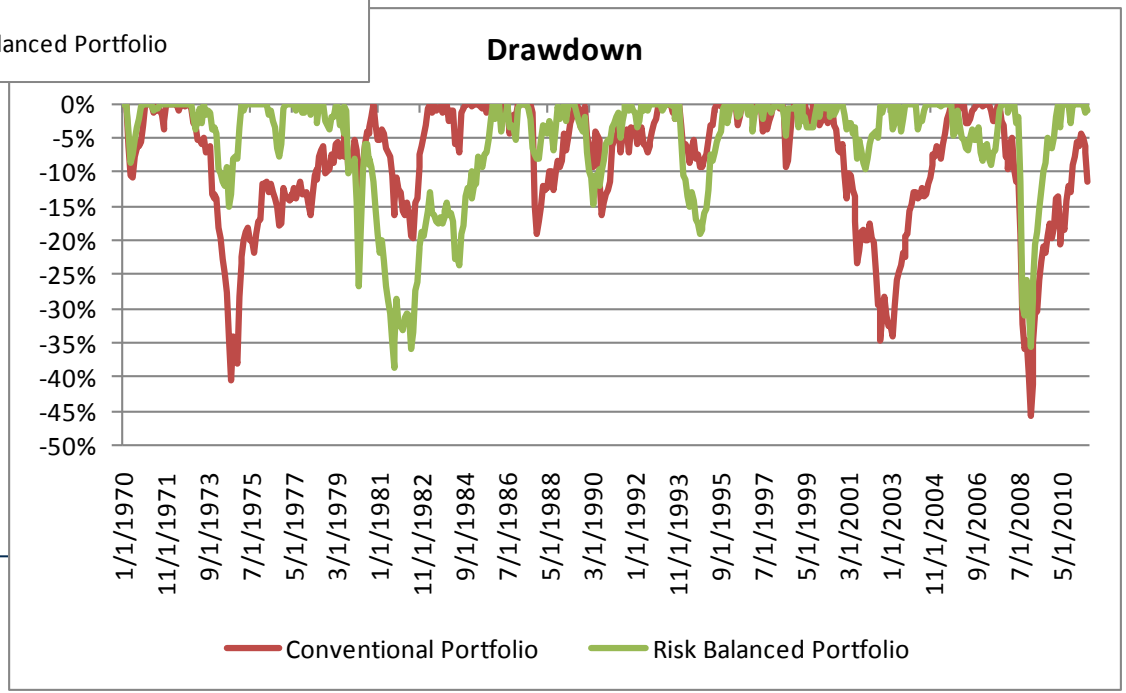


Balanced Risk portfolio strategies - example



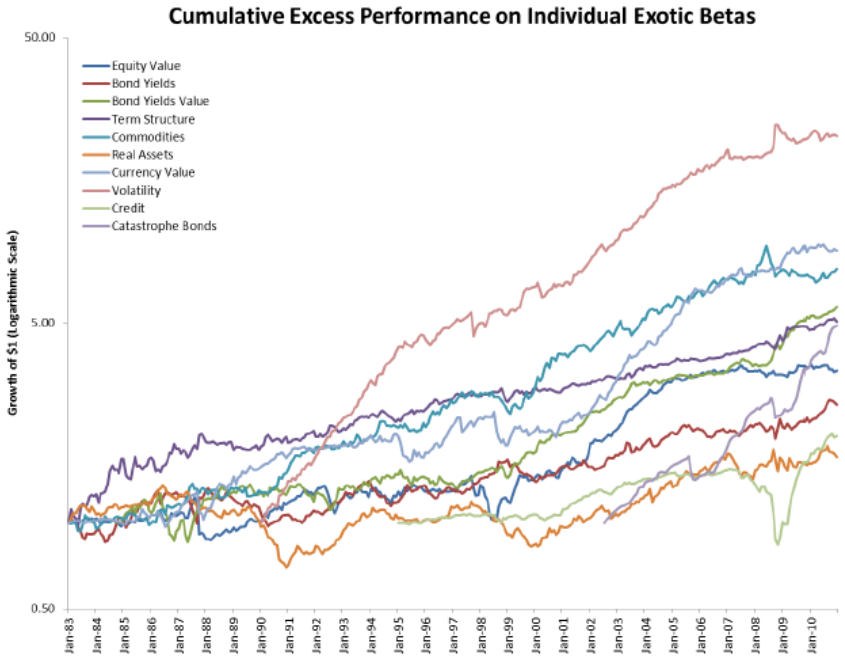
- Annualized return is 2.4% higher in the risk balanced portfolio
- The Return to Risk ratio (Sharpe ratio) of the risk balanced portfolio is 0.64 versus 0.37 for the conventional portfolio
- Leverage of about 2:1 is used in this example

- Drawdowns were substantially reduced during 1973-74 and 2000-2002, and somewhat mitigated during 2008-09
- The strategy suffered during the interest rate spikes of 1980 and 1981-82



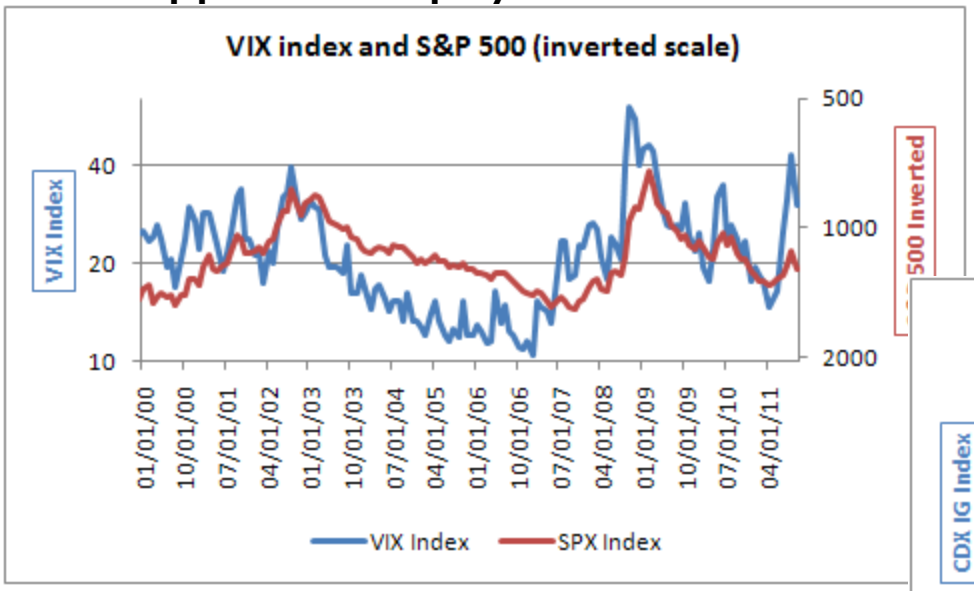
“Exotic” Beta = Risk Factors other than Equity

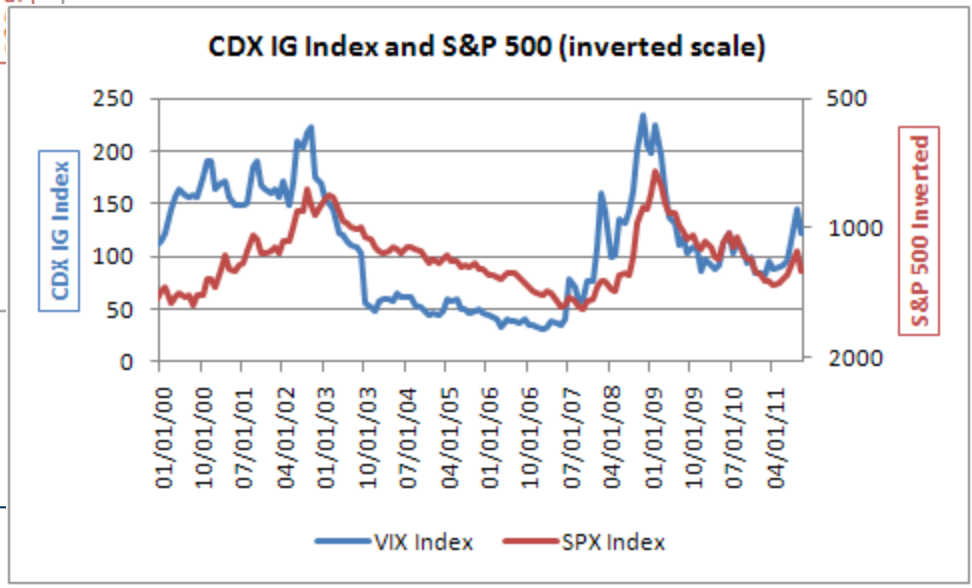
- There are many risk factors uncorrelated with equity
- A portfolio of these strategies can be an efficient return source, while lowering overall volatility
- Not a direct hedge, but a more efficient use of risk
- Examples: Value, Momentum, Carry, Volatility, Liquidity
- Source: Kepos Capital



Cross-Asset Hedges

- Some assets are strongly related to equity on the downside, and thus can be effective as indirect - and potentially inexpensive - hedges
- The two most widely used are VIX derivatives and corporate Credit Default Swaps (CDS)
- As shown below, when protection is most needed, these markets move opposite to equity





- Source: Bloomberg

Active Tail Risk Management

- **Passive use of equity puts has been a poor long run strategy**
- **Even naïve active strategies would have produced superior results**
- **Both strategies shown below spend 1% of fund value per year to buy tail hedges**
- **Rather than just buy and roll" puts, the active strategy monetizes (i.e., exercises) the puts when they increase in value, generating liquidity during equity drawdowns**
- **Source: PIMCO**