The Evolution of Investment Management: The Cost of Constraints

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Average Returns Produce Average Performance

"Compound returns, not average returns or performance relative to a benchmark, should be our major focus. They are enhanced most by mitigation of tail losses and participation in tail gains, each period of time. The options market prices provide valuable information about the risk of each period's gains and losses."

– Myron Scholes, Nobel Prize recipient in Economics, 1997

"Much of the real world is controlled as much by the 'tails' of distributions as by means or averages: by the exceptional, not the mean; by the catastrophe, not the steady drip…We need to free ourselves from 'average' thinking."

– Philip Anderson, Nobel Prize recipient in Physics, 1997

Compound Return Facts: Tail Risk Dominates!

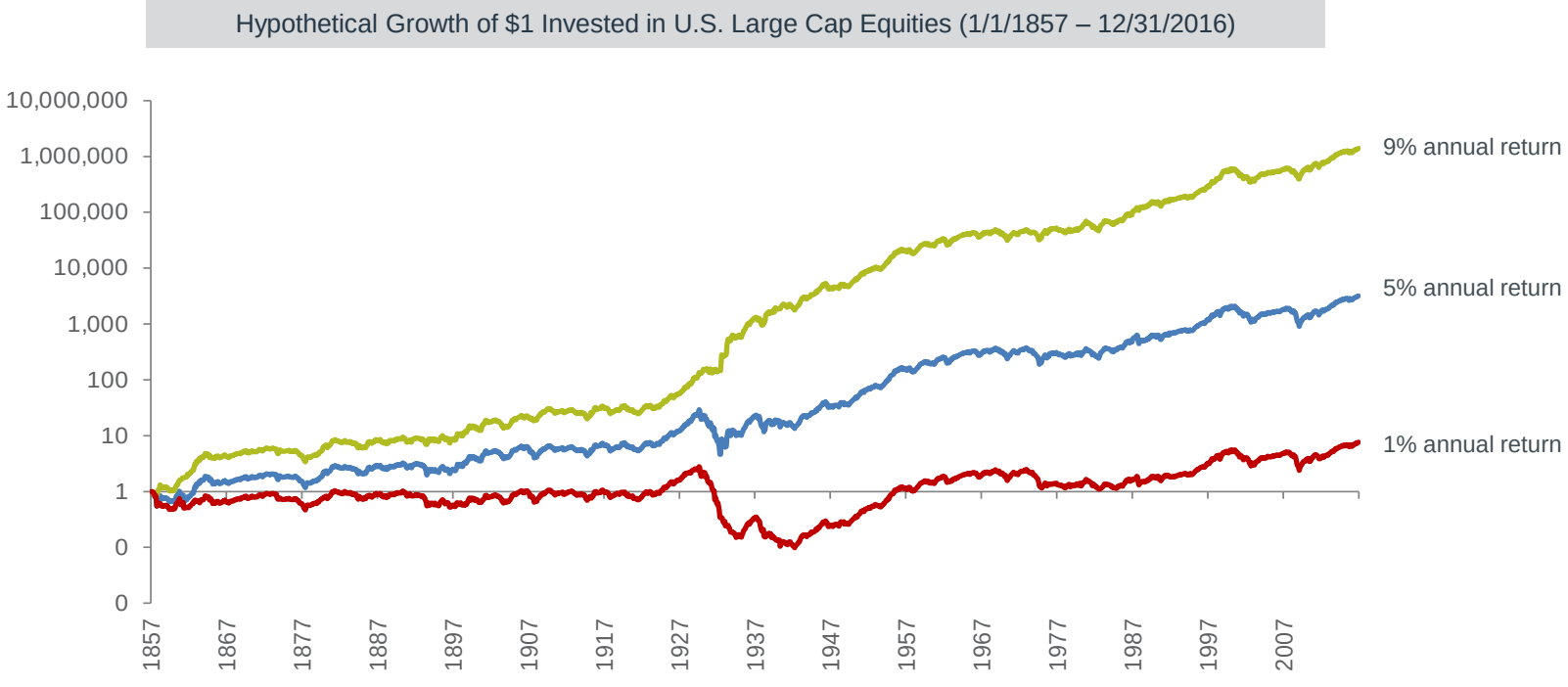
The risk of returns is much more important than the average return, with tail risk playing the dominant role.

Example: The realized return of U.S. equities can be explained by the extreme tail gains or extreme tail losses.

✓Take out the extreme tail gains, realized return falls to almost zero.

✓Take out the extreme tail losses, realized return nearly doubles.

✓All the little moves up or down don't matter.



Options are Insurance Contracts: Future Estimates of Risk

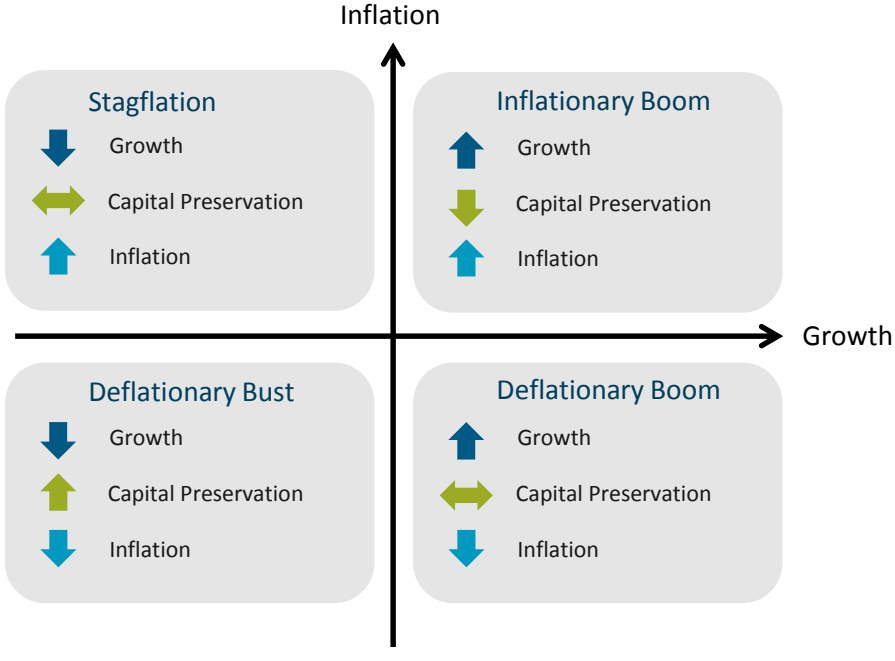
- Historical Data: Provides backward estimates of risk (rear view mirror)
  - Not much evidence of impending tail risks.
  - What period to use?
  - What distributional assumptions?
  - Average risks.

- Insurance prices are forward looking and price risks
  - They are only a function of risk.

- Option Prices are forward looking; they are Insurance Contracts.
  - Out-of-the money Put option, protects the holder against tail loss
  - Efficient market at the short-end (i.e., 2 to 3 months), very liquid, narrow spreads, large open interest on growth assets, safety assets and inflation assets around the world.
  - Market makers survive. Set prices, Darwinian survival of the fittest. "Smart money."
  - As risks change the prices of options change. The prices of options can be used to infer risk-neutral probabilities of forward outcomes.

Macro Economy

- Macro Economist Thinking:
  - Quantity Theory of Money: Money Supply × Velocity = Price (Inflation) × Output (Growth)
  - Cambridge extension: there is a wealth effect and propensity to save suggesting long-term capital preservation is a driver as is short-term liquidity.
- Groups chosen based on tail correlation behavior:
  - During tail events, members within each group (e.g., growth assets) have high correlation (near one.)
  - During tail events, across groups, tail correlations are not constant, and provide varying amounts of diversification benefits



Think Tails of the Distribution

- It takes time for speculators to re-establish a fixed point and intermediate once lose confidence (fixed point). Calendar time moves faster than decision time. (E.g., friend has a heart attack.) When to intermediate, momentum or reversion?
  - Problem: Cycles are not deterministic in business/finance. When does mean reversion take over from momentum, E.g. bitcoin at $5,000, $10,000 … $18,000?
  - Smart money discloses their views in market prices: options as insurance.

- With shocks all growth assets nearly perfectly correlated, all safety assets perfectly correlated and all inflation assets perfectly correlated. This is a good approximation to understand the macro economy. Assets become redundant.
  - Diversification is not a "free lunch" in investment. This is a key consideration.
  - Tail correlations among these asset classes are not constant.

- However, need to estimate how these three asset classes correlate with each other in the tails not, on average, not in the past but next quarter, etc.
  - Over long periods of time, bonds exhibit low correlation with equities.
  - Over long periods of time, inflation assets exhibit low correlation with equities.
  - But, with shocks could be highly positive or negatively correlated, as in above boxes.

Enhancing Compound Returns Through Risk Management: Cost of Static Benchmarks

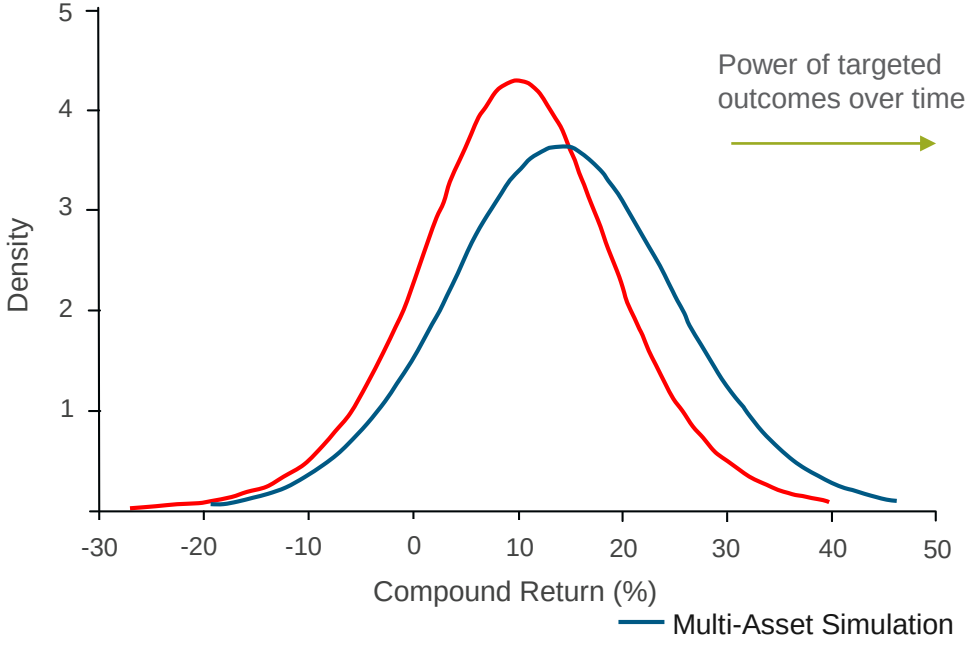
Forecasting returns with accuracy has shown to be futile….Risk Management enhances compound returns. Easier to estimate risk than expected returns.

Target the following outcomes to improve the shape of the distribution.

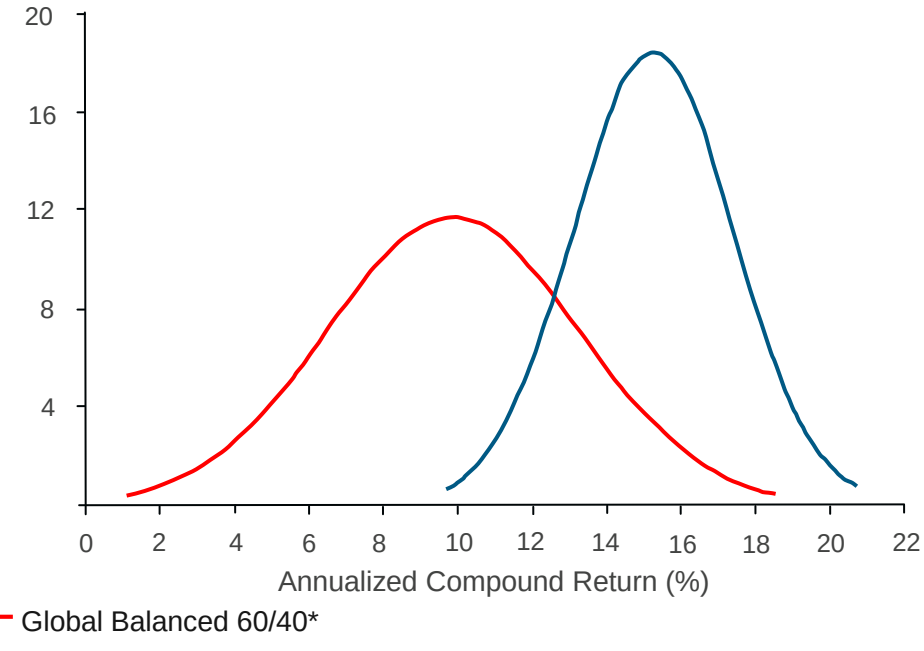
1. Reduce risk (probabilities) of drawdown (left tails),
2. Increase risk (probability of upside or less tail loss)

Compound returns through dynamic tail-risk management – not managing expected returns, but rather managing risk through using the option markets estimates of risk.

1 Year Compound Return (Multi-Asset Simulation vs. Global 60/40)*



5 Year Compound Return (Multi-Asset Simulation vs. Global 60/40)*



Multi-Asset Simulation Global Balanced 60/40*

*Global 60/40: 60% MSCI All Country World Index/40% Bloomberg Barclays Global Aggregate Index, 2003 to 2015.

Relative Performance Constraints Costly: Tracking Error and Trust

- Stay close to the herd (other investors). The costs and benefits of staying close to a benchmark – predominately the current model of investment performance and allocation –
  - (1) **Stock Selection**: Active management, alpha generation. Performance, however, at average. Stay close to benchmark, little tracking error.
  - (2) Passive Investment: ETFs. Index funds, Smart Betas (factors) – constraints => lost returns.
  - (3) Static Asset Allocations: Creates static cross-sectional investing (e.g. 60% equities/40% bonds). Active managers diversify to their benchmarks. A costly constraint. Static policy portfolios lead to reduced returns, an implicit cost.
  - Does not allow for dynamic risk control.

Constraints Lead to Returns for Others: Elephant

- (1) Prediction of cash flows, growth rates, discount rates of companies or factors. (Turning over inventory, proactive).
  - (i) Alphas => Where to fish, deep value? Themes? NEED TIME AND TRACKING ERROR
    - Demographics, Technology, Scarcity, Governance.
  - (ii) TRUST OR COMMITTED CAPITAL (e.g., Buffet). Constraints, KEY: ELEPHANT NOT GOING DIRECTLY TO ULTIMATE DESTINATION.
  - (iii) Risk Management; hide behind benchmarks, factors vs. ignore benchmarks.
- (2) Providing intermediation services to the market. Liquidity (risk transfer), differential skills to understand uncertainty. (Turning over inventory, reactive). Absolute return – Libor benchmark (but do take beta risk). Funded by pensions/sovereign wealth funds, high net worth => Endowment model. NEED TRUST:
  - (i) Omega => resistance. Making markets work. Supply/demand imbalances. But, time needed and illiquid. DUNG OF ELEPHANT. CONSTRAINTS
    - E.g. banks, broker/dealers, hedge funds, PE firms, corporations
  - (ii) Leveraged Markets: why? skills differ from long investors – managing debt –
  - (iii) Less liquid investments, costs to liquidate high
  - (iv) Risk management: Bad tail risks, leverage use options markets to hedge.

Three Ways to Earn Returns: Elephant

- (3) Holding systematic exposures that are priced in the market. (Holding inventory, e.g. index funds, ETFs => but no risk dynamics)

  - Betas, but what are factors and their dynamics, (cluster dynamics)
  - WHO MANAGES MARKET RISKS? RIDING THE ELEPHANT.
  - Most investors want to maximize compound returns (the growth of their portfolios) subject to drawdown constraints (consumption or contingency needs, which are difficult to ascertain requiring drawdown controls.)
  - The Distribution of returns is not constant. That is impossible.
  - Focus on the importance of Riding the Elephant today.

Investment Strategies – Asset Allocation Static Constraints are Costly

- Static Asset Allocation Strategies – Common Approach – Benchmark and Tracking Error
  - E.g. 40% bonds and 60% stock. Based on static weights that, on average, provide a risk profile. Buckets are filled within the bond/stock allocations (e.g., ETFs and hedge funds).
  - Other static methods: life-cycle products (based on age and glide paths), index fund products, or factor products (smart betas) (small vs. big, etc.) also ignore risk dynamics.
  - Policy portfolios static; Endowment model is not dynamic. Pick omega managers.

- Dynamic Asset Allocation Strategies – Risk management – backward looking
  - [1] Risk-parity strategies. Keeping risk constant? Only measure risks and only based on history and assume normal distributions and constant correlations. Use long-term (?) average measures. Invest heavily in leveraged bond holdings to equate risk to equities.
  - [2] Tactical allocation strategies forecast expected returns to asset classes – difficult to forecast expected returns. Quant strategies such as smart beta allocate to factors using risk parity.
  - [3] Barbell omega strategies: invest in PE or HF or VCs or stocks and keep cash for liquidity.

Dynamic Risk Management Crucial

The future course: a concentration on dynamic asset allocation strategies that seek to manage risk, the changing beta risk of the portfolio. That is,

- Maximize terminal value –> wherein, compound returns (the product of one plus returns), not average returns, are the focus, which implies a shift from a complete concentration on estimation of expected returns to dynamic risk management to enhance compound returns.

- Time diversification (keeping risk at target) and tail risks are the most important in determining compound returns.

- Don't only focus on cross-sectional diversification, which works, generally, but not at times of shock.

- One run of time. What is target risk? Cost of tracking error (benchmark) constraints.

Time Diversification

Strategy 1: .5 in stocks, .5 in bonds

E(R) = .5 E(R_m) + .5 E(R_b)

Strategy 2: In stock 50%; bonds 50% of time, no skills, randomly

Both strategies have same expected return

Volatility with normal distribution and with zero volatility of bonds

Strategy 1: $\sigma_1^2 = .5^2\,\sigma_m^2$; $\sigma_1 = .5\,\sigma_m$

Strategy 2: $\sigma_2^2 = [\sigma_m^2 + 0 + \sigma_m^2 + 0 + \ldots]$; $\sigma_2 = .71\,\sigma_m$

Volatility greater in risk varying strategy,
reducing compound returns.

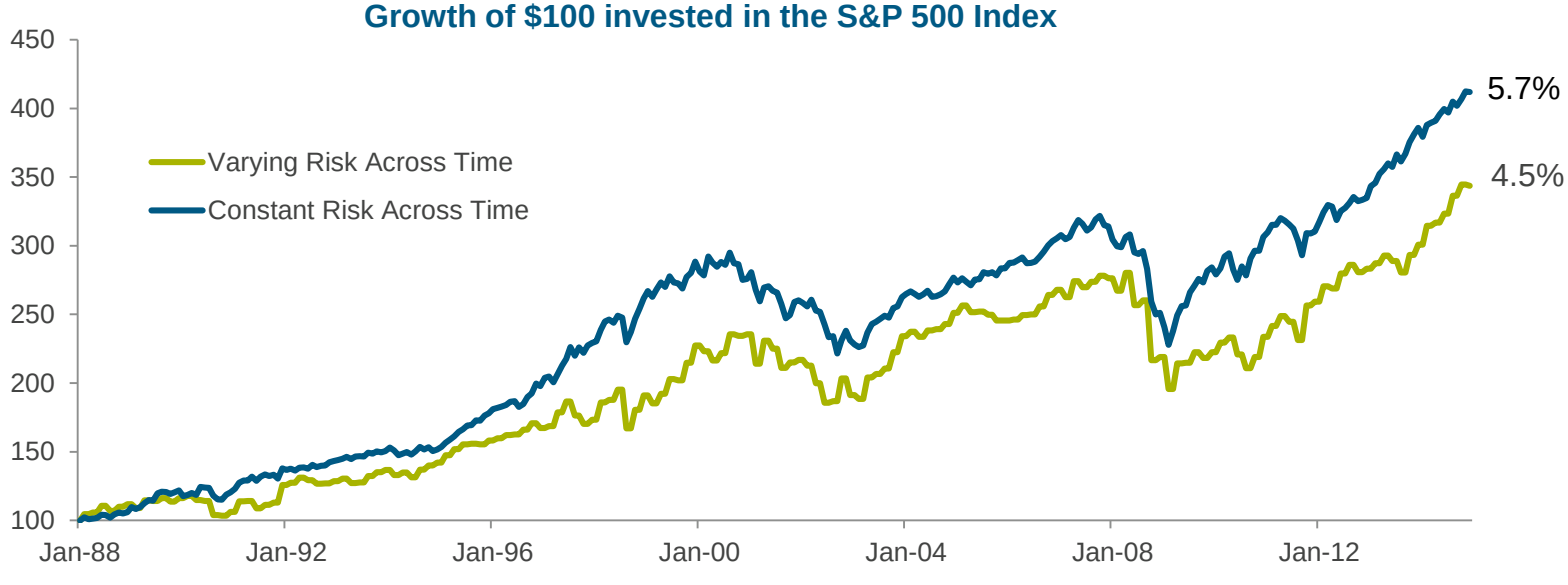
Factors that Affect Terminal Wealth

- S&P 500 no tracking error, little fess but no risk management. Or; random tactical allocation strategy.

Example: Consider two strategies:

1. Variable Risk Across Time: Fully invested in stock market 50% of the time
2. Constant Risk Across Time: Half invested in the stock market 100% of the time

Strategy 2 is diversified across time – it has a volatility of 50% of the market vs. 71% for strategy 1



Compound Returns: Volatility Matters

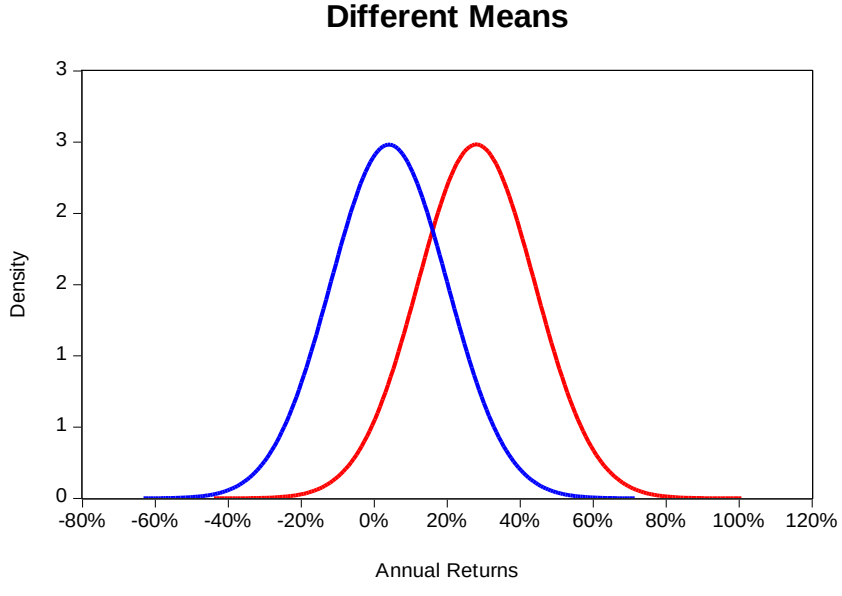
"The most powerful force in the universe is compound interest" – Albert Einstein

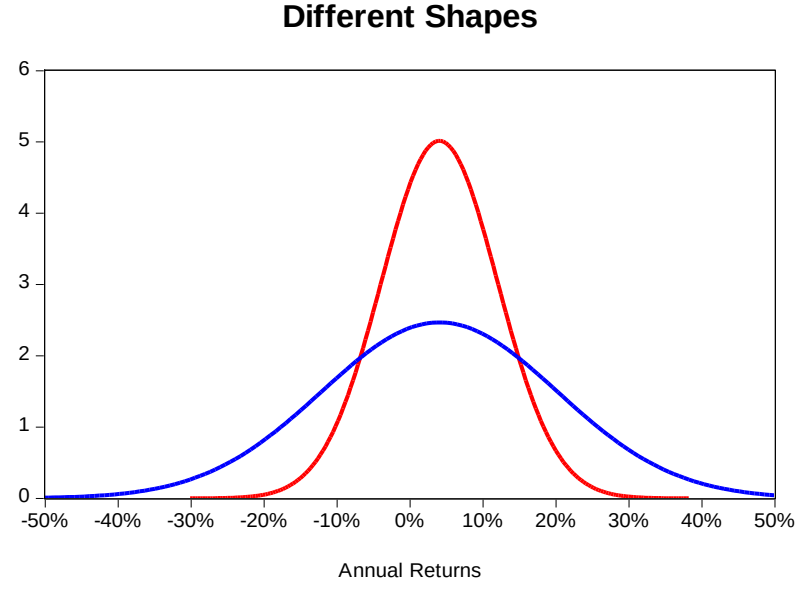
All you have to do is deposit one penny in a savings account in your own era, and when you arrive at the End of Time the operation of compound interest means that the fabulous cost of your meal has been paid for. This, many claim, is not merely impossible but clearly insane, which is why the advertising executives of the star system of Bastablon came up with this slogan: "If you've done six impossible things this morning, why not round it off with breakfast at Milliways, the Restaurant at the End of the Universe?" – Douglas Adams

What Determines Compound Returns

The distribution of future returns tells us everything we need to know; in particular, the…

1. Mean of the distribution of future returns: "Average Return"
2. Shape of the distribution of future returns: "Risk of Returns" - Dominates





Compound Returns: Volatility Matters

- Opportunity 1: Earn 100% each of two years.
- Opportunity 2: Earn 200% this year, 0% next year

Average return is 100% for both opportunities.

But, Compound returns:

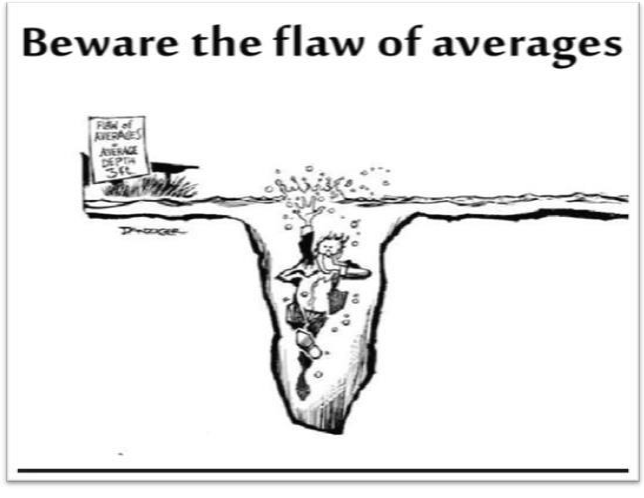
Opportunity 1: 2 x 2 ➔ wealth accumulates to 4
Opportunity 2: 3 x 1 -> wealth accumulates to 3.

Volatility reduces compound returns.

Factors that Affect Terminal Wealth

- Fact 1: Compound returns less than average returns even for a normal distribution. The more risky, and especially left tail risk, the smaller compound returns. Compound returns affect the level of terminal wealth.
  - Average returns (and risks) are misleading. Averages are only one part of compound returns.

Average: 3 ft.



  - The urns are not constant, not normally distributed. Average volatility versus next period's distribution.

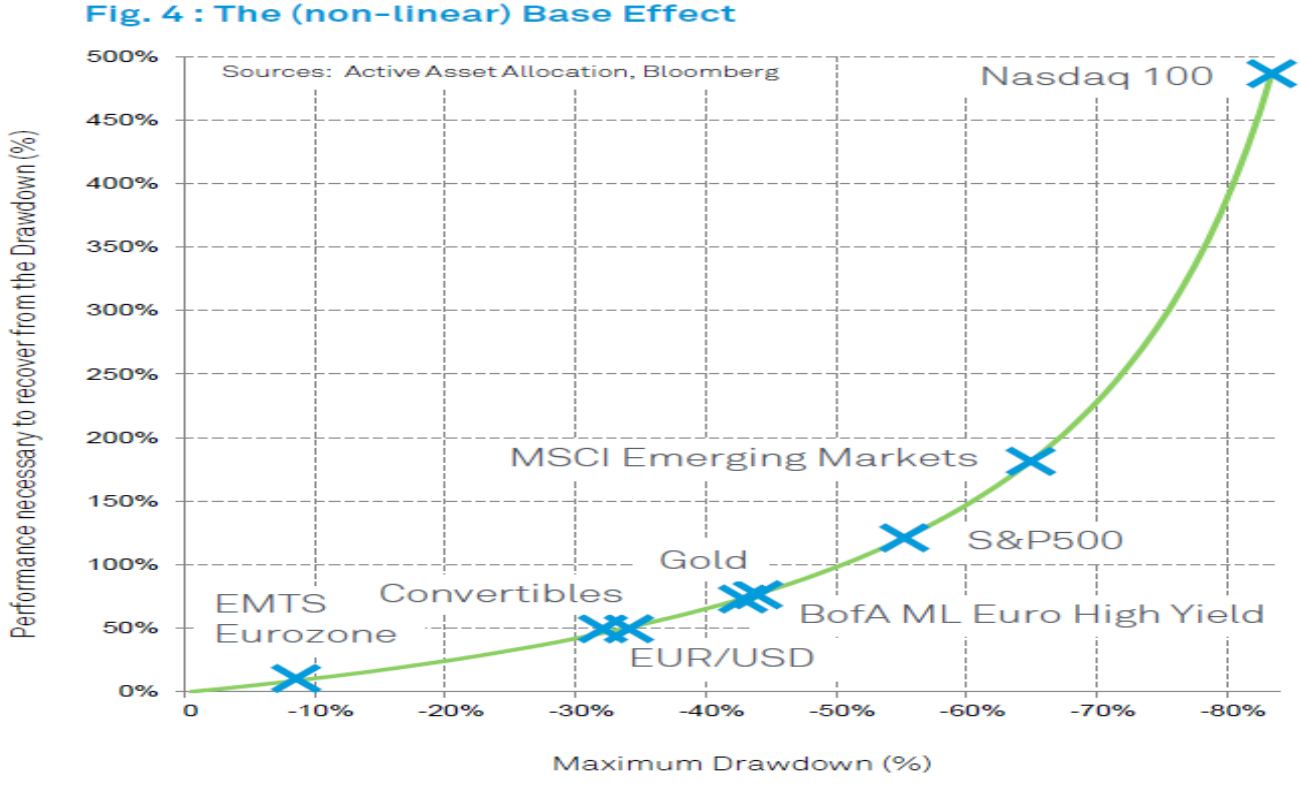
- **Fact 2:** Performance over every period matters to compounding returns. It is not enough to say "I am a long-term investor;" therefore, no need to worry about what happens in the short run => false. One run of time.

Factors that Affect Terminal Wealth

Fact 3: Risk of return much more important than average return: Over the short run, average return plays little or no role:

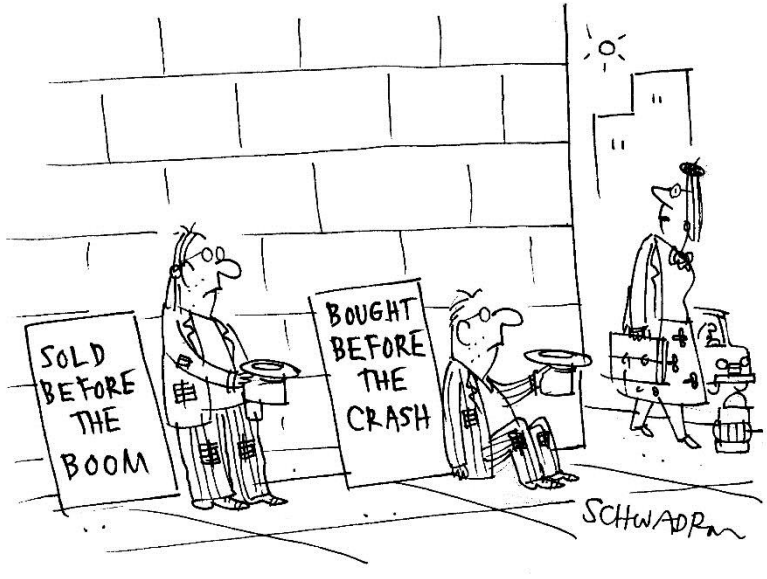
- ✓ Annual Sharpe ratio = 0.25, monthly = 0.07 → close to zero. Volatility is easier to measure.

Fact 4: Compound returns are asymmetric – larger loss require even larger gains to break-even.



Factors that Affect Terminal Wealth

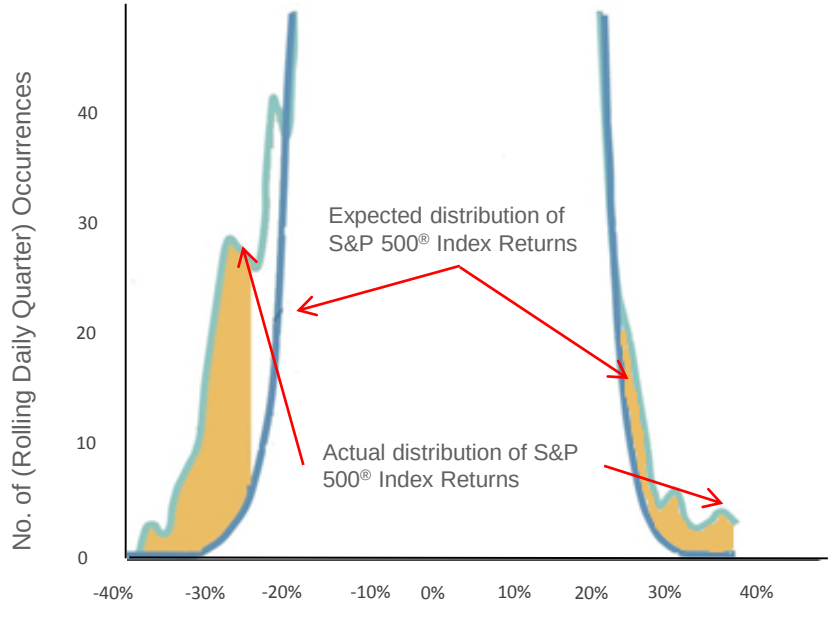
- Fact 5: Allowing risk to fluctuate around average (target) risk reduces compound returns – Excess Volatility is a cost in lost returns, reducing compound returns.
  - Time-series diversification is key, more so than cross-sectional (security & asset class) diversification
- Fact 6: Skewness: Volatility ignores skewness. Negative skew reduces compound returns. Positive skewness: greater expected tail gains than expected tail loss enhances expected compound returns.
  - Fat-tailed events (tail gains **AND** losses) biggest effect on compound returns. The tails are everything.



Big Problem: Tail Events More Frequent than Normal Distribution.

Unexpected Equity Tail Risk

Based on Actual vs. Expected S&P 500® Index Returns (June 1960 – December 2015)



The actual frequency of severe losses occurred 72**x** more frequently than expected.

	Number of Quarterly Occurrences		
Severe Quarterly Losses	Actual S&P 500 Returns	Expected S&P 500 Returns*	Unexpected Left Tail Risk Events**
-26%	29	1	+28
-28%	20		+20
-30%	10		+10
-32%	7		+7
-34%	2		+2
-36%	3		+3
-38%			
-40%	1		+1
Total	72	1	+71

The chart above plots a histogram of the S&P 500's *actual* rolling compound 65-day returns (i.e. quarters) and the *expected* distribution of returns based on a normal distribution assumption with the same return and variance using standard Monte Carlo methods.

7/1/1960 – 12/31/2015

*assuming a normal distribution of returns

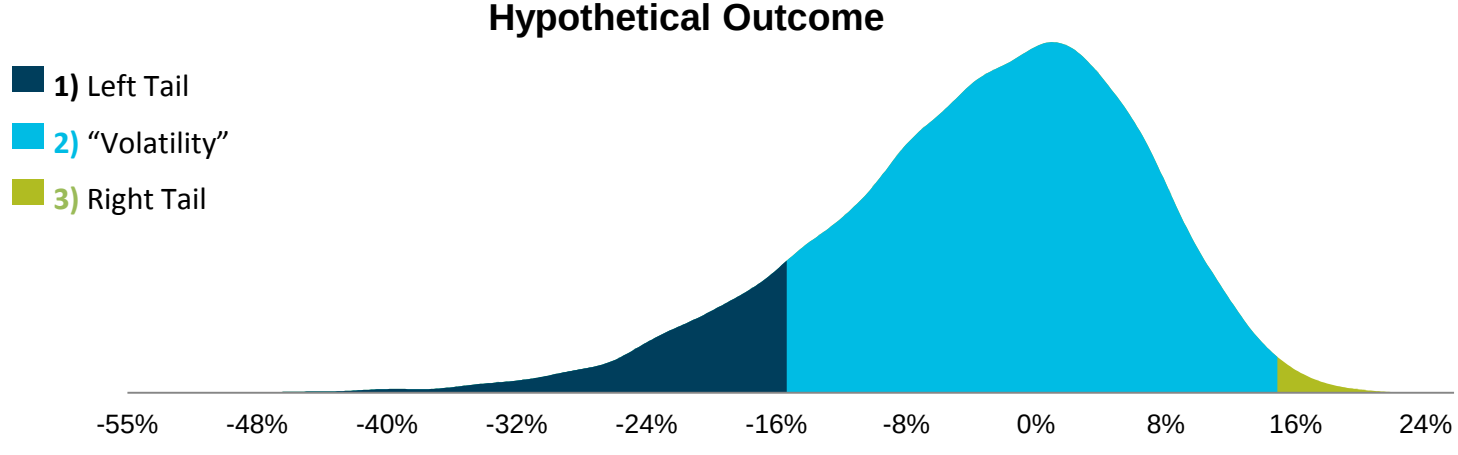
**visually depicted as the gold region in the chart to the left

Measuring Tail Risk Using Market Prices.

- Prices of put options are like "insurance." Predictive markets: Poon and Granger (2003) options best estimate

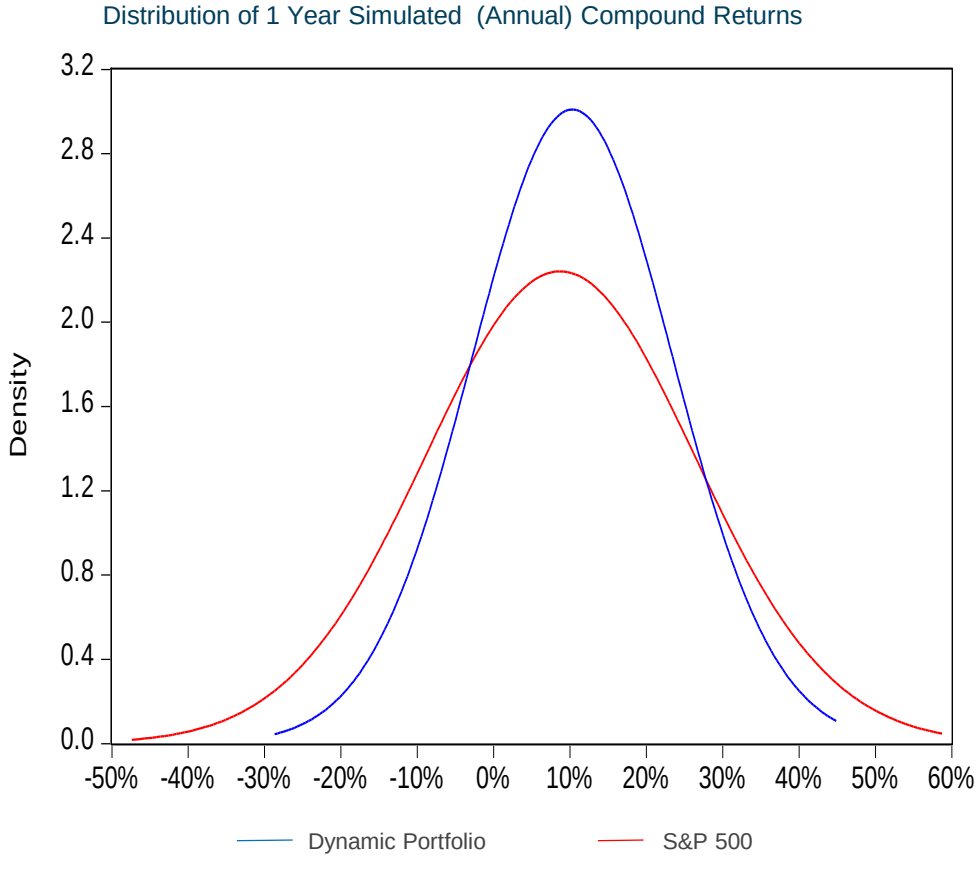
Generally: three types of options:

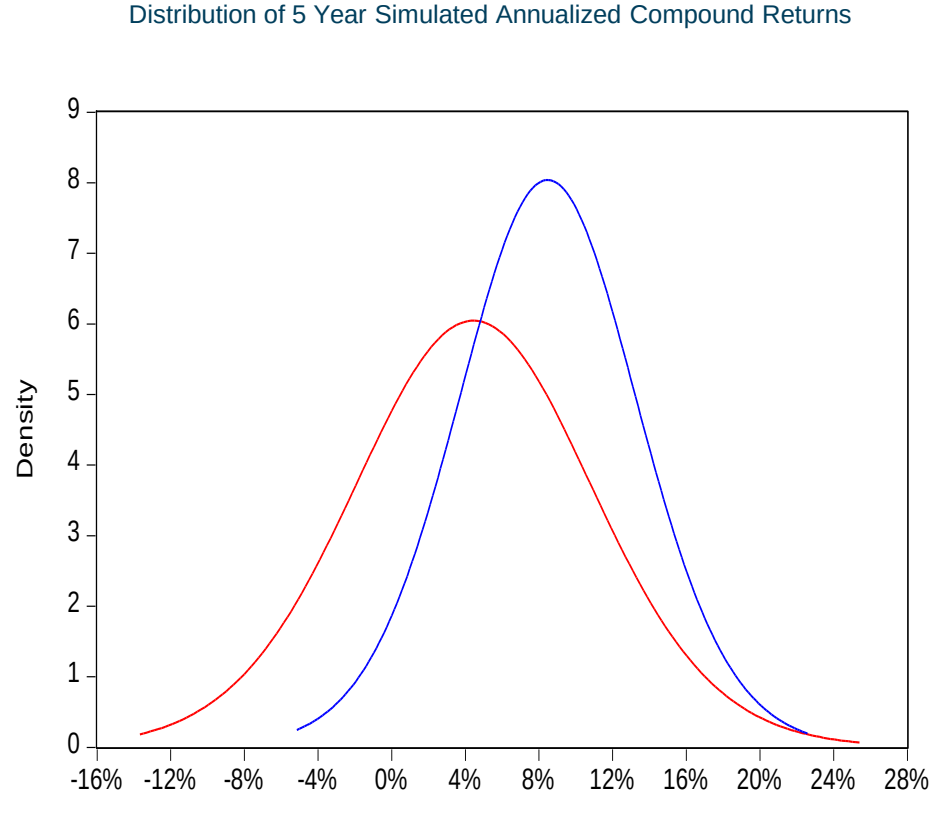
1. Out-of-the-money put options protect you against very large losses. The higher their price the larger the left tail.
2. At-the-money options benefit from both large and small moves. Their price can tell you about the distribution of most moves (volatility) (e.g. VIX)
3. Out-of-the-money call options are "lotto" tickets on the large gains. The higher their price the larger the right tails
4. Out-of-the-money option prices more predictive than at-the-money.



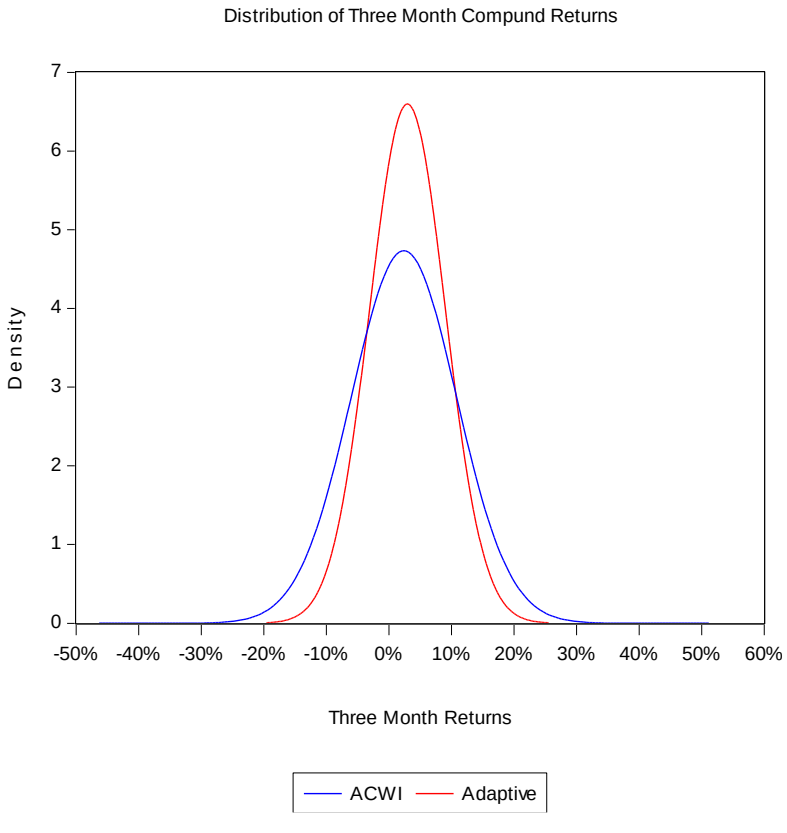
Risk Manage The Portfolio

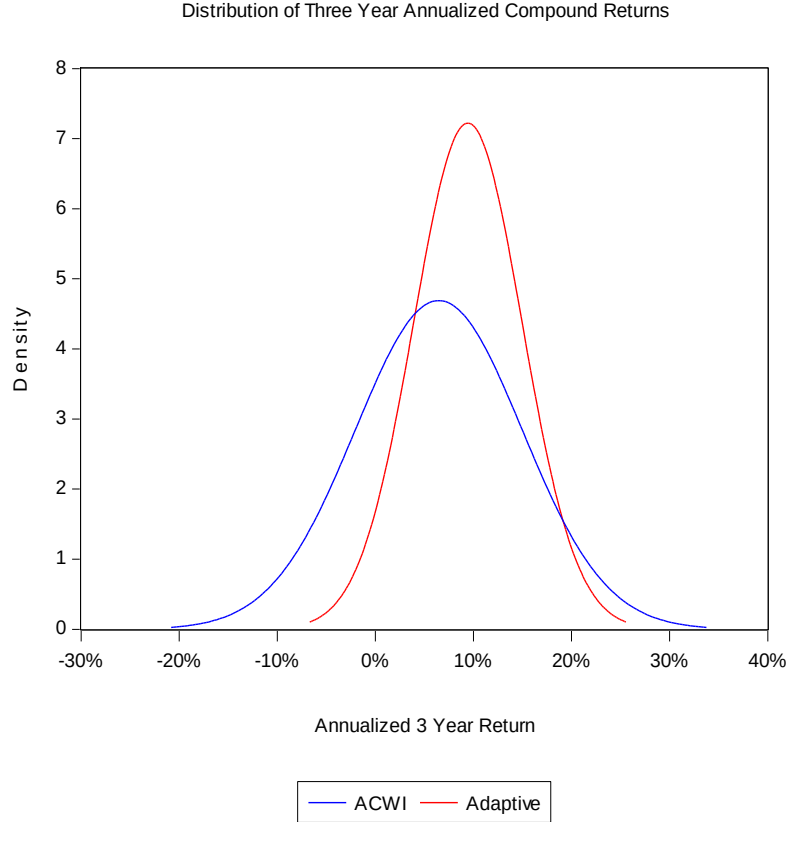
- Measurement of the benefits of risk management. Risk managed S&P 500 (1996-2015) using Option Price risk information. (Could be ACWI or CSI 300, etc.)
- Bootstrap technology to estimate the actual distribution of probable investment returns.



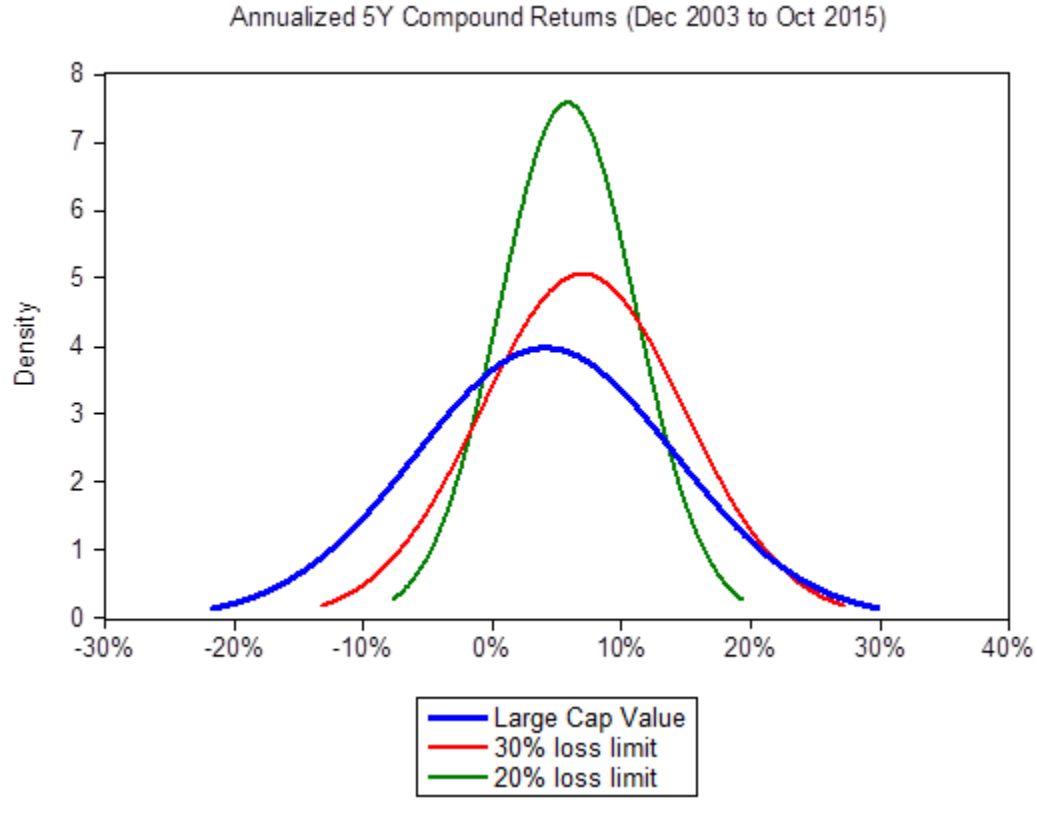


Risk Manage the World Portfolio (ACWI) (limit to 30% drawdown)





Constraints Affect Asset Prices



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  - Policy portfolios static; Endowment model is not dynamic.
- Dynamic Asset Allocation Strategies – Risk management – static to dynamic.
  - Dynamic risk allocation strategies: Garner information about tails of the distributions for dynamic risk management.
    - Concentrate on downside risk to help manage draw downs.. Manage risk to target risk levels. Dynamic adjustments as risks and correlations change. Dynamic beta management.
  - Use information about risk in market prices of ”insurance” assets.
  - Risk Management: One period: (a) Stocks vs Bonds; (b) Diversify: (c) insurance
    - Multiperiod: Time and dynamic risk management (portfolio risk/beta risk), most important effect on compound returns