Strategic Asset Allocation

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Sudhir Rajkumar
Head, Pension Investment Partnerships
World Bank Treasury
srajkumar@worldbank.org
treasury.worldbank.org

Assets under Management

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WB Group Liquidity & Reserves	WB Group Pension Funds	External Clients & Trust Funds
$47 billion	$15 billion	$19 billion
Global Fixed-Income	Global Balanced	Global Fixed-Income
Government Bonds Agencies Repurchase Agmts. Asset Swaps ABS/MBS Derivatives Bank Deposits	Global Equities Global Fixed-Income High Yield Bonds Emerging Markets Private Equity Real Estate Hedge Funds Currencies	Government Bonds Agencies Repurchase Agmts. Derivatives Bank Deposits

Treasury manages over $80 billion in assets, acting as both liquidity manager and asset manager for World Bank and external clients.

What is Strategic Asset Allocation?

Strategic Asset Allocation (SAA):

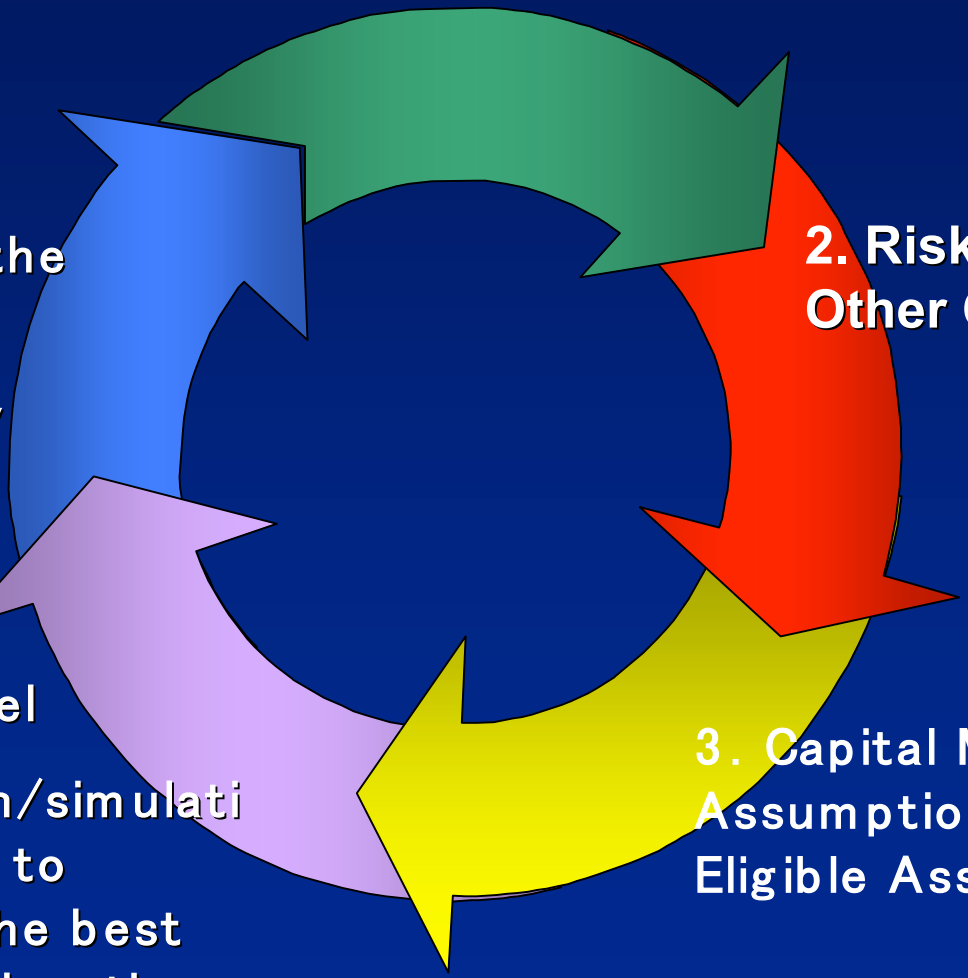
An investor has to decide on a portfolio of assets, in order to meet a sequence of cash-flows needs (or liabilities) over time.

Allocation should maximize expected investment return subject to a set of risk constraints which takes into account the uncertainty of cash-inflows and cash-outflows

SAA involves:

1. **Choosing Eligible Asset Classes** (definition of asset classes, operational considerations, etcetera)
2. **Finding Percentage Allocation to each Asset Class** (using optimization/simulation techniques)
3. **Selecting benchmarks that reflect expected performance of each asset class**

Strategic Asset Allocation Process



Evaluating Eligible Asset Classes

	Liquidity Risk*	Market Risk*	Credit Risk*	Total Risk Score
Government Bonds (Dev. Mkt.)	L	L	L	L
Agency Bonds/MBS	L/M	L/M	L	L/M
ABS/CMBS	M	M	M	M
Corporate Inv. Grade	M/H	M	M	M
Equities (Dev. Mkt.)	L	H	M/H	M/H
Emerging Market Debt	H	H	H	H
Corporate High Yield (junk bonds)	H	H	H	H
Emerging Market Equity	H	H	H	H
Private Equity	H	H	H	H
Real Estate	H	H	H	H
Hedge Funds	H	H	H	H

**L = Low, M = Moderate, H = high*

Fund Objectives and Risk Constraints

Defined Benefit Pension Funds

- **Fund Objectives:**
  - Fund stream of cash outflows in cheapest possible way, given that:
    - cash inflows (e.g. contributions) can be controlled
    - cash outflows (e.g. benefit payments) uncertain and cannot easily be controlled or influenced
- **Investment Horizon:**
  - Typically fairly long, but may be affected by regulatory and accounting factors
- **Risk Tolerance:**
  - Moderate to High, but can vary depending on funded status and demographic profile of beneficiaries

Fund Objectives and Risk Constraints

Defined Contribution Pension Funds

- **Fund Objectives:**
  - Create stable and sufficient retirement income, given that:
    - cash inflows (e.g. contributions) are known
    - cash outflows (e.g. required income in retirement) relatively more uncertain
- **Investment Horizon:**
  - Typically fairly long, but depends on age of individual
- **Risk Tolerance:**
  - Low, Moderate, or High, depending on age and retirement goals of individual

Fund Objectives and Risk Constraints

Central Bank Reserves

- **Fund Objectives:**
  - Absorb shocks when ability to borrow is curtailed
  - Maintain confidence in exchange rate regime
  - Maintain ability to service foreign obligations during crisis periods
  - Reserve for national disasters
  - Generate income
- **Investment Horizon:**
  - Typically 1 to 3 years
- **Risk Tolerance:**
  - Low to Moderate, but can vary depending on level of reserves or reserves adequacy

Fund Objectives and Risk Constraints

Commodity Savings & Endowment Funds ('Funds for the Future')

- **Fund Objectives:**
  - Accumulate savings for future generations
  - Create stable and sufficient spending without depleting capital
  - Cash inflows (e.g. oil revenues) uncertain and cannot easily be controlled/influenced
  - Cash outflows (spending) can be controlled
- **Investment Horizon:**
  - In perpetuity
- **Risk Tolerance:**
  - Moderate to High, but can vary depending on spending policy

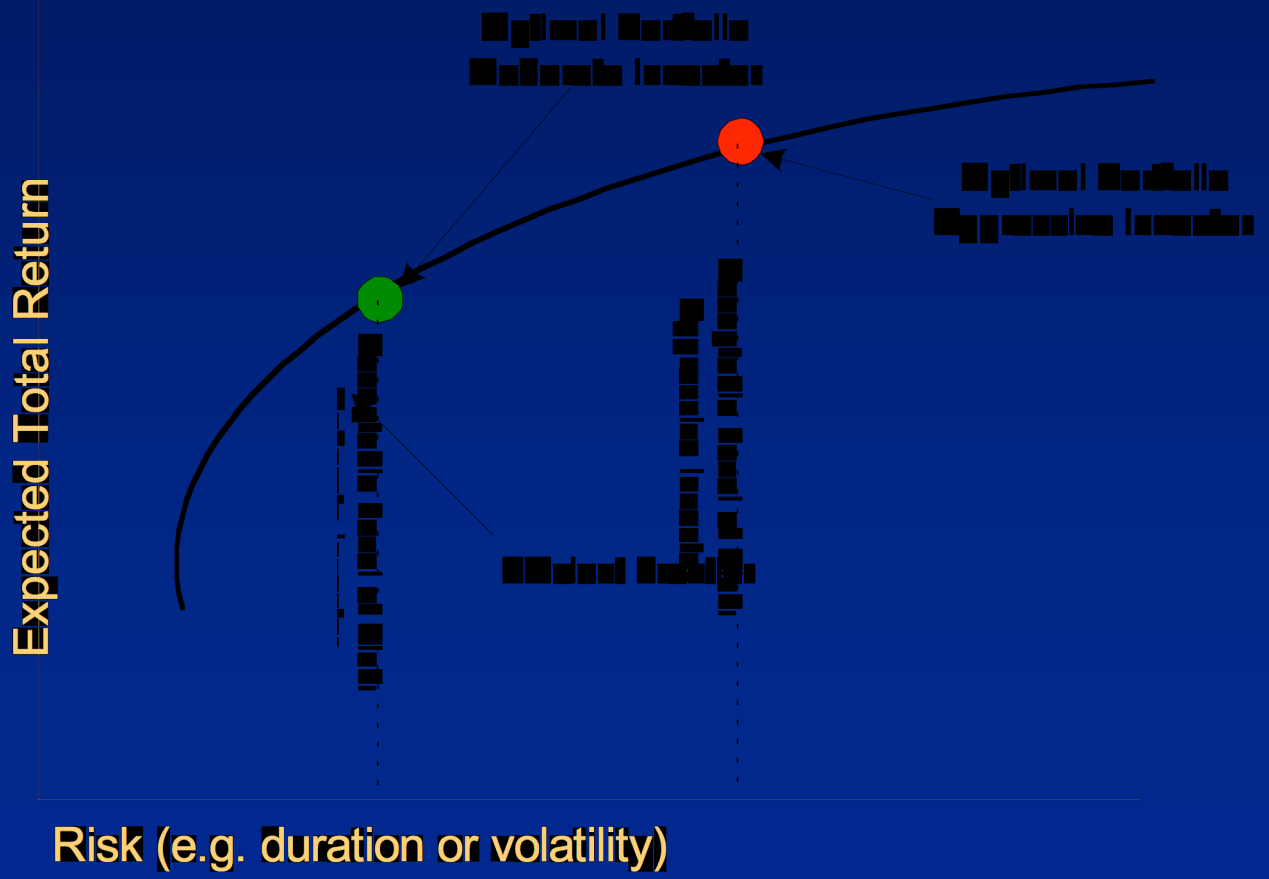
Fund Objectives and Risk Constraints

Liquidity Reserves

- **Fund Objectives:**
  - Source of cash for operational requirements
  - Provide flexibility in execution of borrowings
  - Enhance investor confidence – impact on credit rating
  - Generate income
- **Investment Horizon:**
  - Typically 1 year
- **Risk Tolerance:**
  - Low to Moderate

Trading-Off Risk and Reward

- Efficient frontier: set of portfolios which have the highest possible expected total return for a given risk level.



Traditional Approach to SAA

The traditional approach to determine the strategic asset allocation is *mean/variance analysis*:

- Investors are risk averse: for higher risk they require higher expected return
- Risk is represented by volatility or variance
- Diversification reduces risk
- Efficient portfolio: highest possible return for a given level of variance (or volatility) as a risk measure

*But mean/variance analysis has important short-comings, that may result in the **wrong** asset allocation for most institutional investors!*

Shortcomings of Mean/Variance Analysis

Mean/Variance Analysis has several shortcomings:

I. Ignores cash-inflows and cash-outflows and correlations between assets and liabilities

II. Myopic and single period nature

Assumes that returns are independent over time (e.g. mean-reversion is ignored, assumes that the term-structure of volatilities and correlations are flat)

III. Based on variance of asset returns as the measure of risk – penalizes both upside and downside

IV. Returns are assumed to be unconditionally normally distributed:

Ignores fat-tails and skewness in returns and time-variation in correlations and volatilities

V. Ignores parameter uncertainty and estimation risk

VI. Definition of Risk Tolerance is somewhat arbitrary

New Directions in the SAA Process

I. Take into account cash-inflows and cash-outflows (e.g. contributions and benefit payments for DB Pension Funds) and correlations between asset returns and cash-flows

II. Multi-period nature (to properly take into account future cash-flows, a multi-period model should be used and returns should be modeled accordingly)

III. Use measures of risk that are appropriate (focus on downside risk measures)

III. Returns modeled in a dynamic context reflecting the underlying characteristics of asset classes (e.g. regime switching and mean-reversion)

IV. Take into account parameter uncertainty and estimation risk (e.g. use Bayesian Monte Carlo simulation methods)

V. Risk tolerance based on clear anchor points (e.g. funded ratios for DB Pension funds; value-at-risk or conditional value at risk for Central Banks and liquidity reserves; spending-at-risk for endowments)

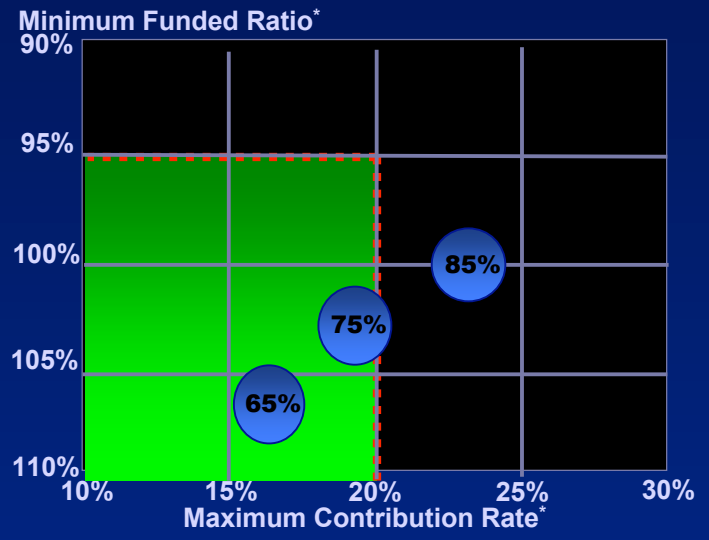
Example: SAA for DB Pension Fund

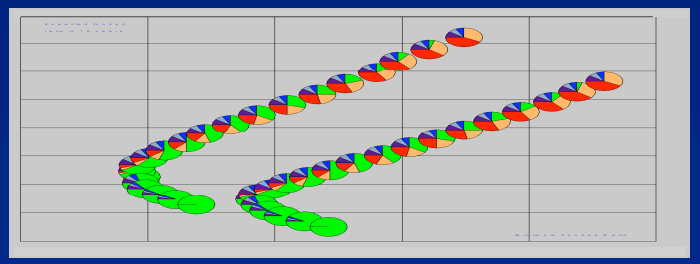
Express either by decision matrix or graphically

Allocation to Risky Assets

95%* Funded Ratio - At - Risk

95%* Contribution Rate - At - Risk	105%	100%	95%
10%	60%	65%	70%
15%	70%	75%	80%
20%	80%	85%	90%





** There is still a 5% probability that funded ratio will be lower or contribution rate will be higher*

Risk budget to these 'value-at-risk' measures determines policy allocation

New Directions……

- Setting Realistic Expected Return Assumptions
- Modeling Risk: Downside Risk Approaches
- Modeling Future Returns

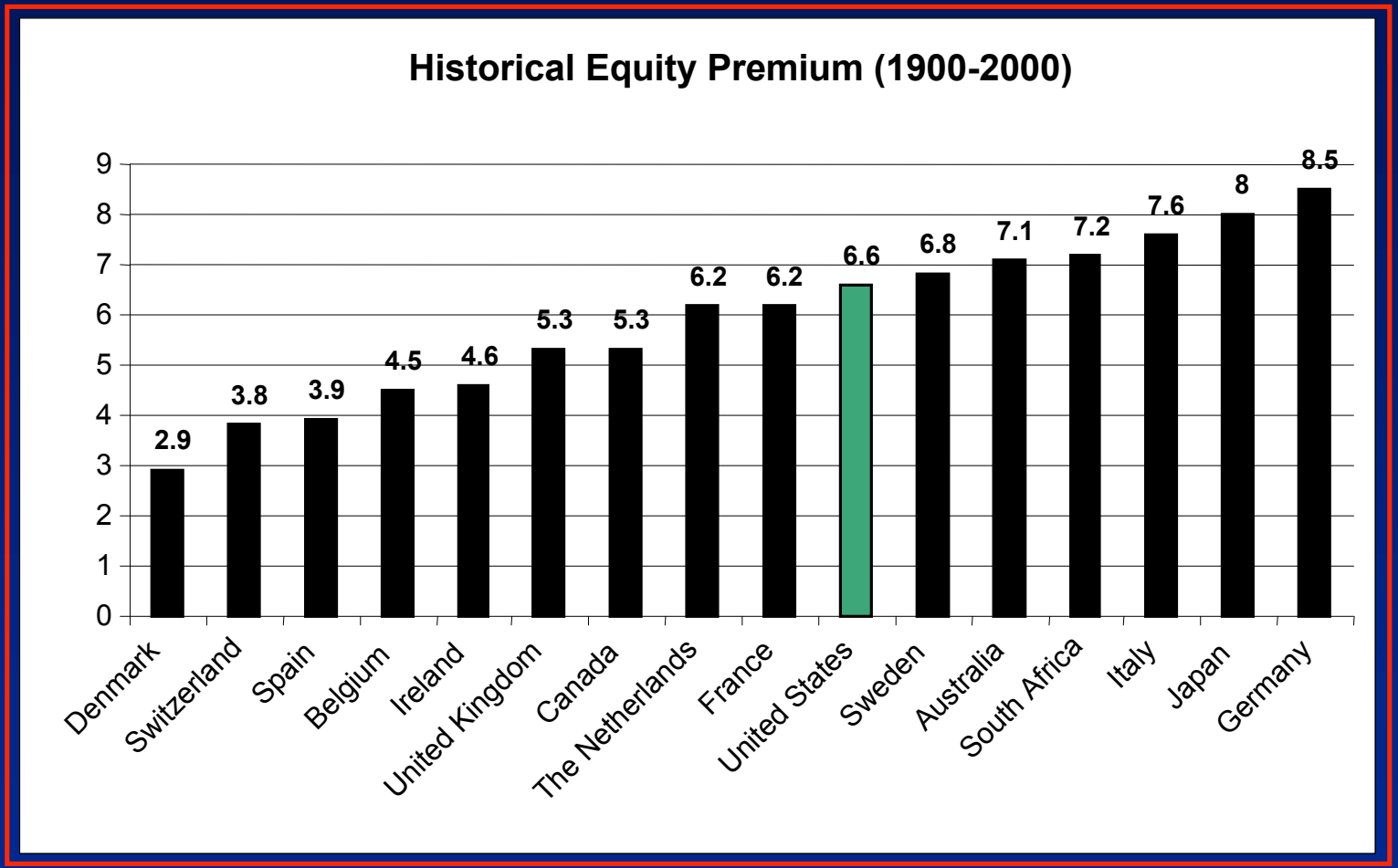
Ensuring Realistic Expectations…

Setting Realistic Return Expectations:

Asset allocation optimizations are extremely sensitive to expected return assumptions. How do we ensure realistic expectations?

- Should we use long-term historical returns?
- Should we use equilibrium expected returns?
- What are the drivers of actual returns?
- Should expected returns be *valuation-independent* ('no view' approach) or do valuations matter?
- How often do you review expected return assumptions?

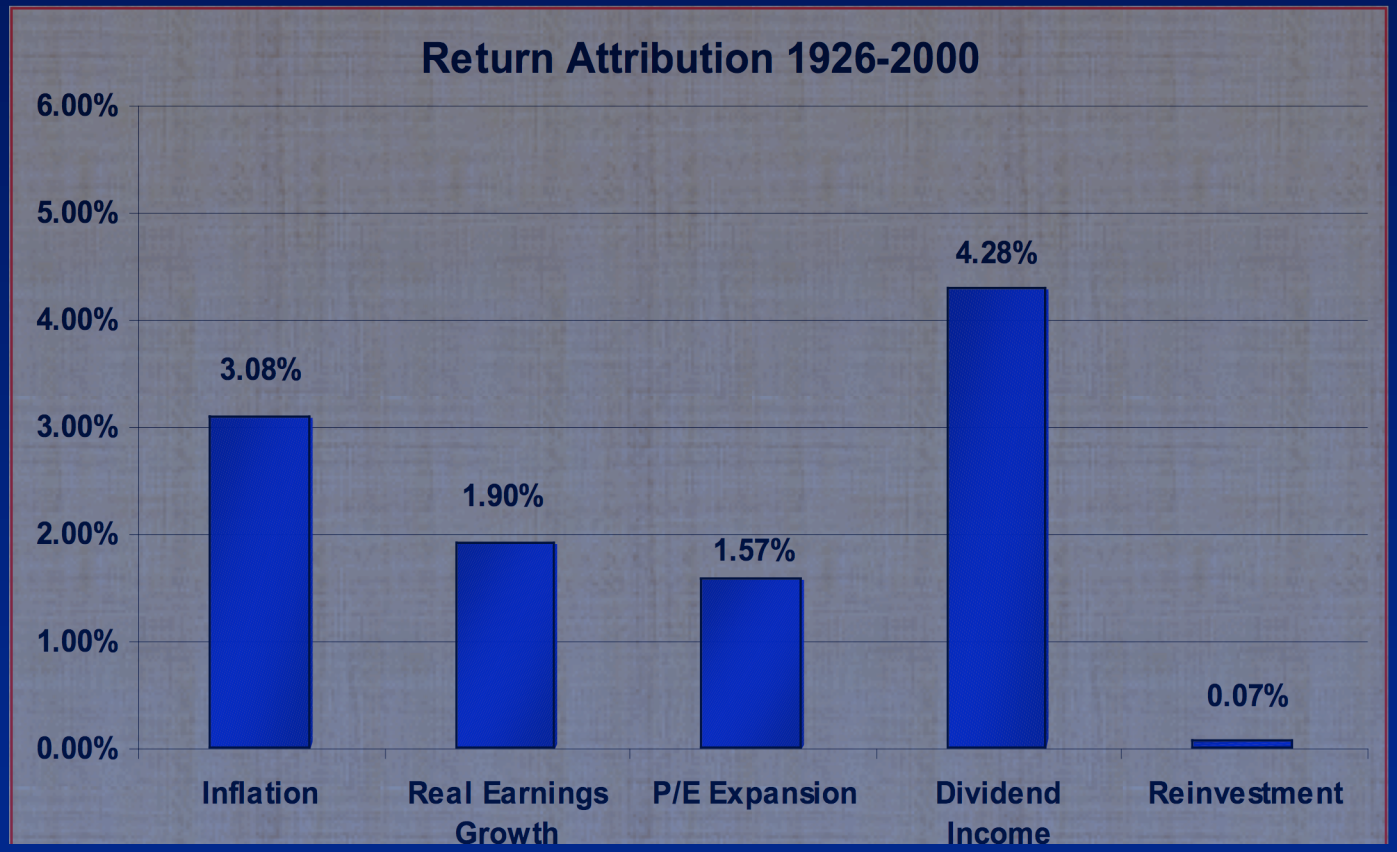
Ensuring Realistic Expectations…



Historical equity risk premia are unrealistically high…

Ensuring Realistic Expectations…

Return Attribution of Historical US Equity Returns:



Going forward equity returns are likely to be lower than what we have observed in the past!

Modeling Risk

Accurately capturing risks of investment portfolios:

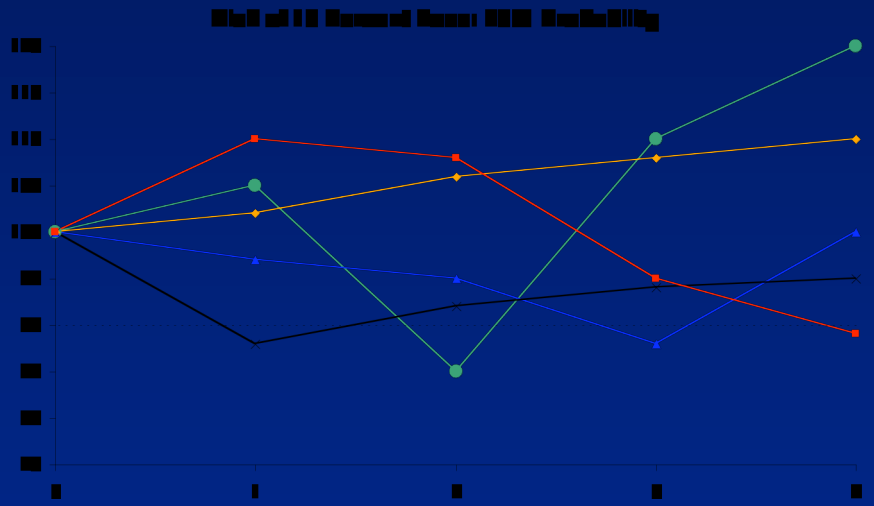
Variance of asset returns penalizes both the upside and downside equally, but what if we care more about downside risk?

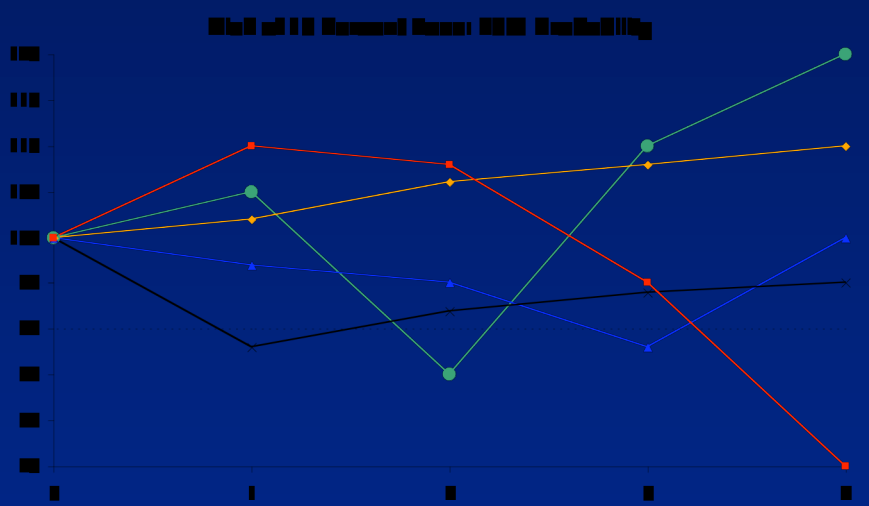
- Likelihood versus magnitude of losses
- Risk at the end of the investment horizon versus risk during the investment horizon

Likelihood vs Magnitude of Losses

Likelihood of a loss versus the magnitude of the loss

Consider the following two situations:



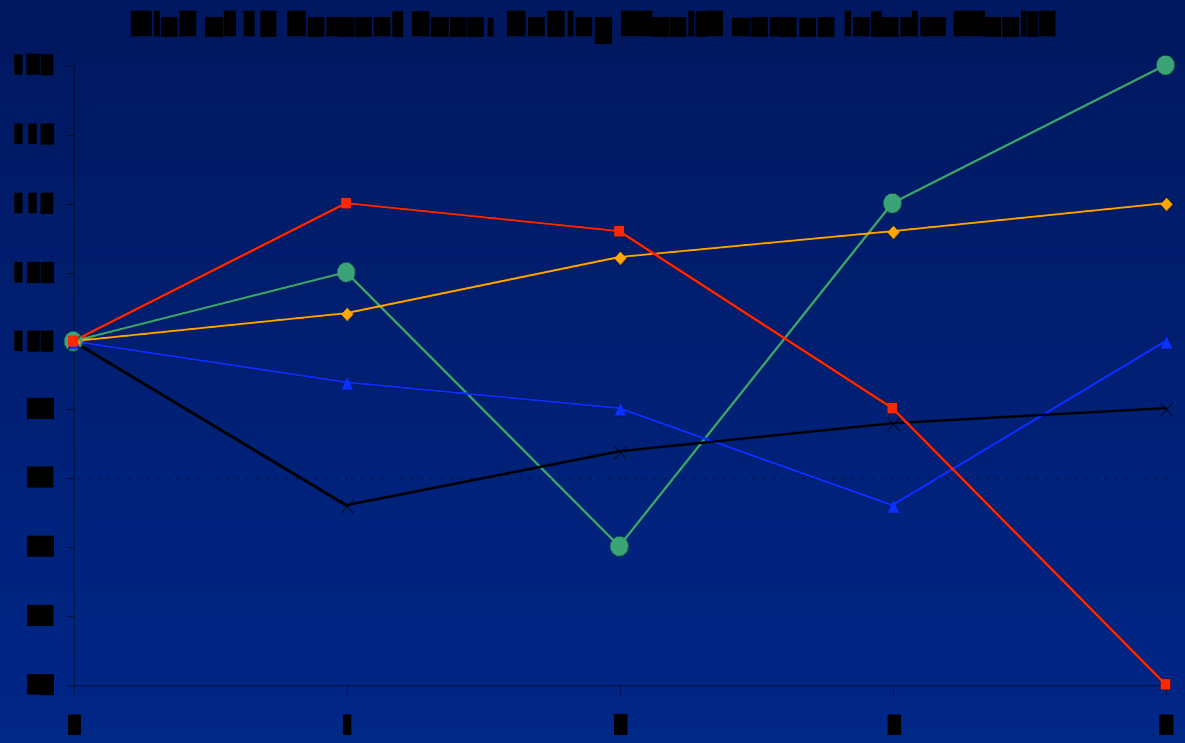


In both cases the probability of a 10% loss at the investment horizon is 20%. Are you really indifferent between both cases?

The actual loss in the first case is 11% and in the second case it is 25%.

Conditional Value-at-Risk: measures both the likelihood and the magnitude of losses

Inter-temporal vs Terminal Losses



The probability of losing 10% at the end of the investment horizon is 20%; but the probability of losing 10% during the investment horizon is 80%.

Inter-temporal shortfall probability and Max.VaR: measure investment risk during the investment horizon and not only at the end

Modeling the dynamics of asset returns

How do we realistically model the dynamics and characteristics of asset returns?

Key Questions:

I. What distribution for returns do we use?

normal, lognormal, fat-tailed and skewed distribution, extreme value theory

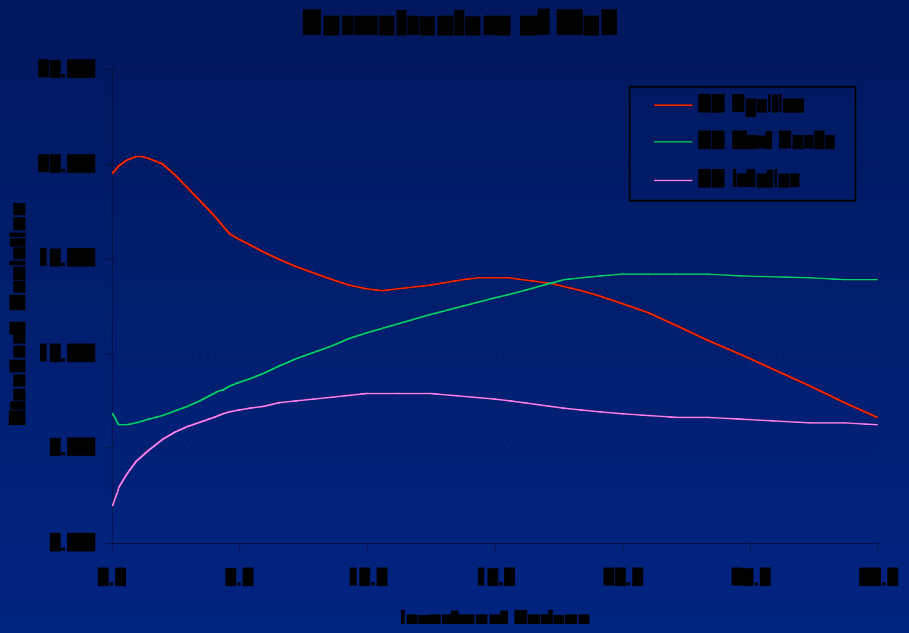
II. Do we assume constant or time-varying parameters?

III. How do we deal with parameter uncertainty, length of the sample period, and parameter mis-estimation?

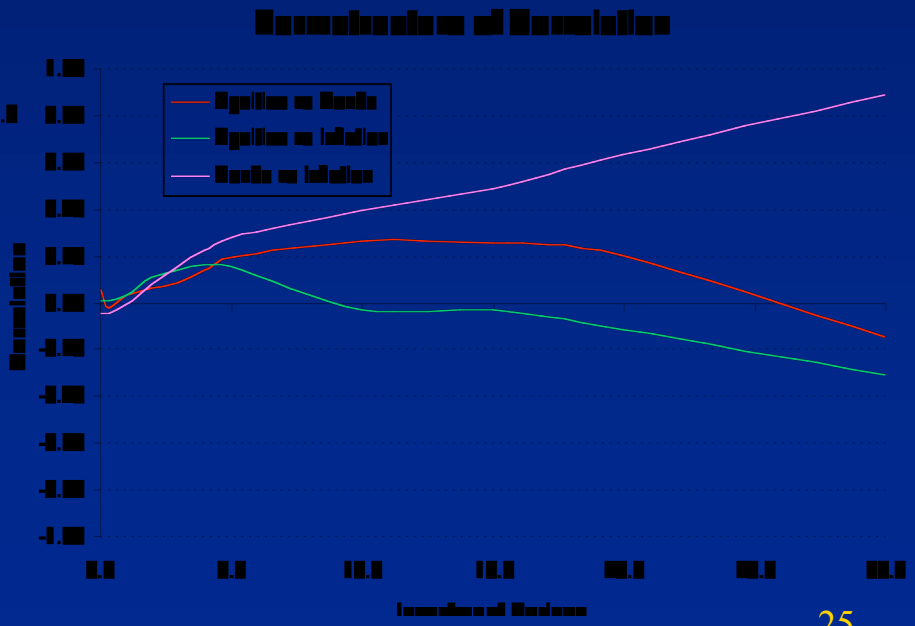
Time-varying Correlations

Correlations are not constant over time, but tend to mean-revert over long cycles!

The Term-Structure of Risk

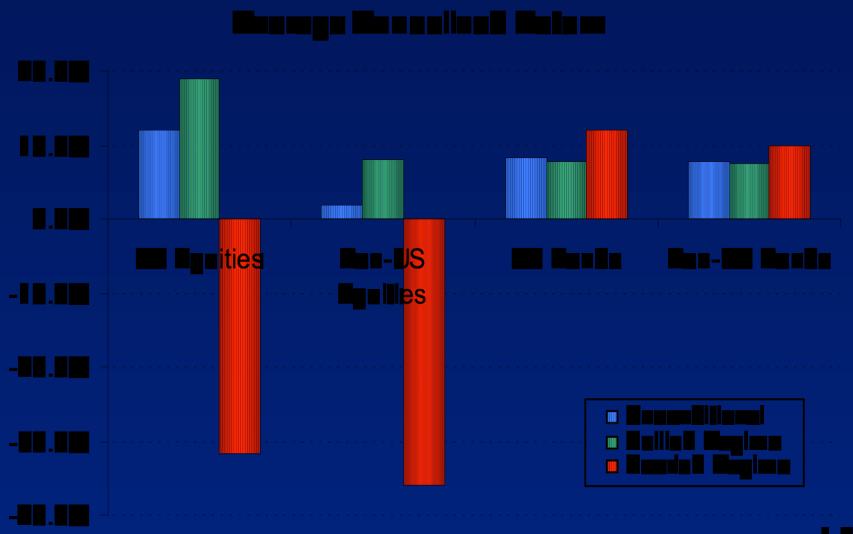


The term-structure of volatilities is not flat! Some asset classes are more attractive in the long-run than others

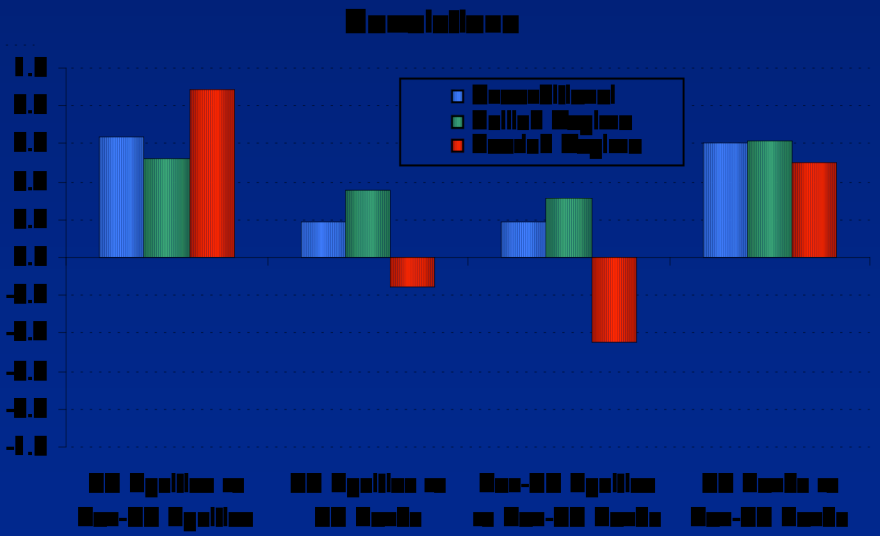


Diversification effects depend on investment horizon

The Market Environment Matters!



Average equity returns in bad times outweigh average equity returns in good times



Diversification breaks down in bad times

Regime Switching Models can be applied to analyze the conditional behavior of economic or financial factors