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ASSET-LIABILITY MODELLING: WHAT IS IT AND HOW DOES IT WORK?

MARSH & McLENNAN COMPANIES

Objectives of Asset/Liability Modelling

Business Goals

- Reduce volatility of surplus
- Meet policyholders' bonus expectations and delivery with lower volatility
- Reduce incidence of capital injections required to maintain solvency/capital adequacy

Influence of Investment Returns

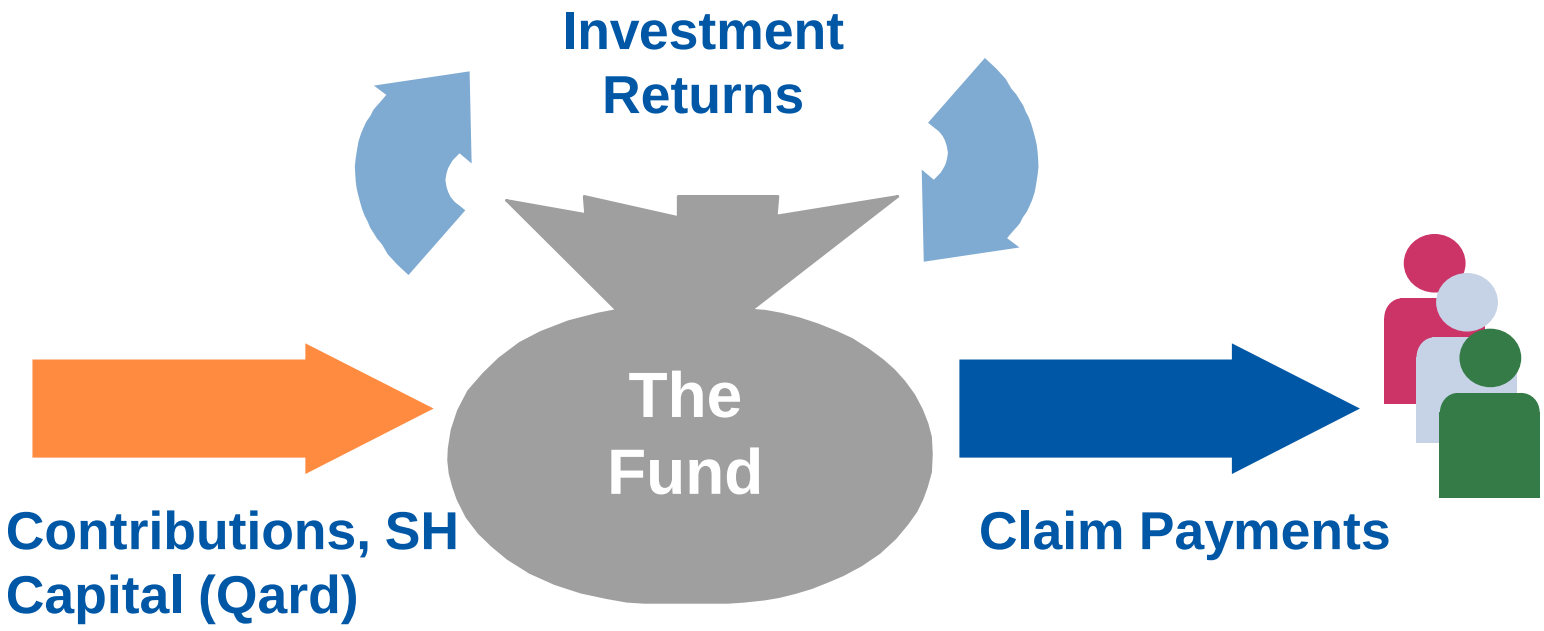
- Impact of other non-investment related drivers to profit (differences between actual experience from assumptions) is expected to be small in the short to medium term compared to impact of investments

Asset/Liability Modelling enables the interaction of assets and liabilities to be assessed in order to determine strategies to achieve business goals

Introduction to Asset Liability Modeling
Financial Model

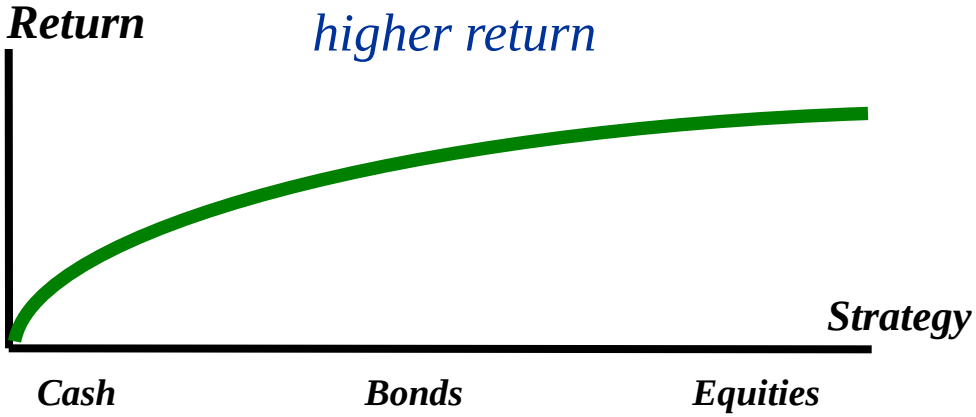
- Claims payments are due in the future. To make sure that there is sufficient money to meet those payments, a fund is being built up over the years
- Within a Takaful fund there is a fundamental equation:

  Claim Payments = Contributions + Investment returns
- This multigenerational process is monitored and adjusted through the valuation of balance sheet items

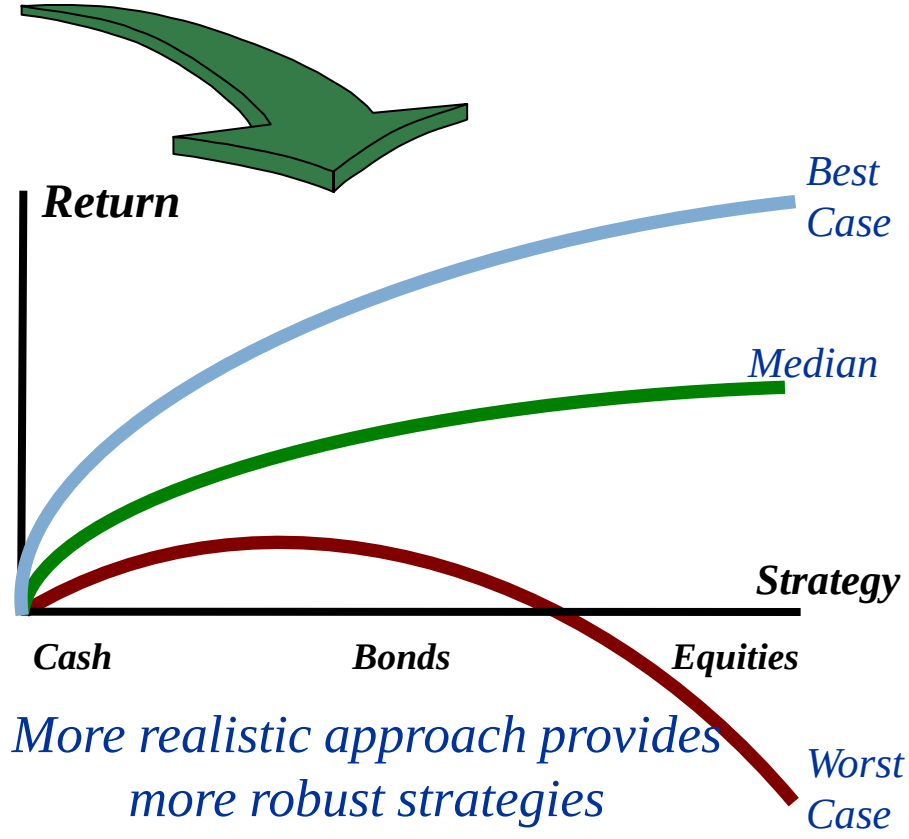


Why Asset Liability Modelling?

Simplified approach can lead to misleading results, higher allocation to equities does not necessarily lead to higher return

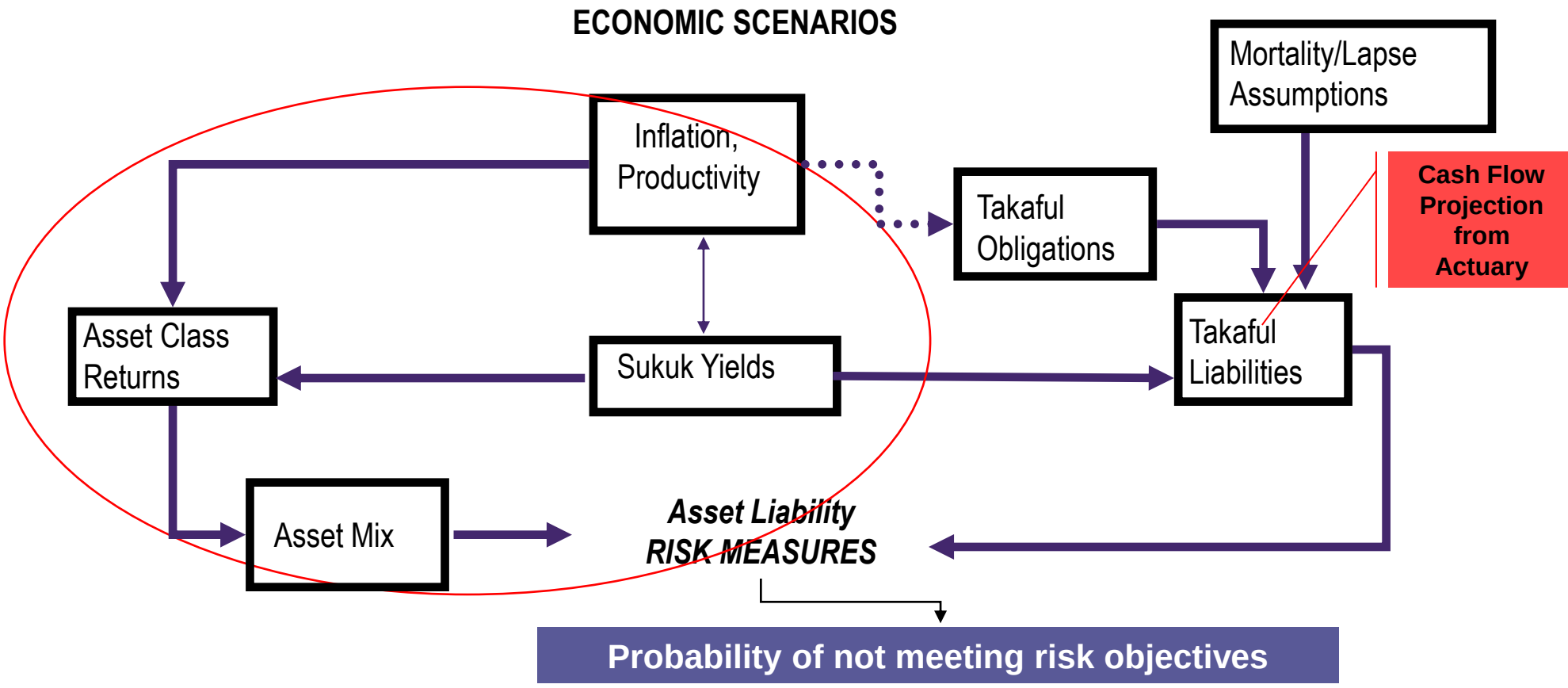


- Discipline
- Objectivity
- Linked to objectives
- Considers full range of potential future outcomes

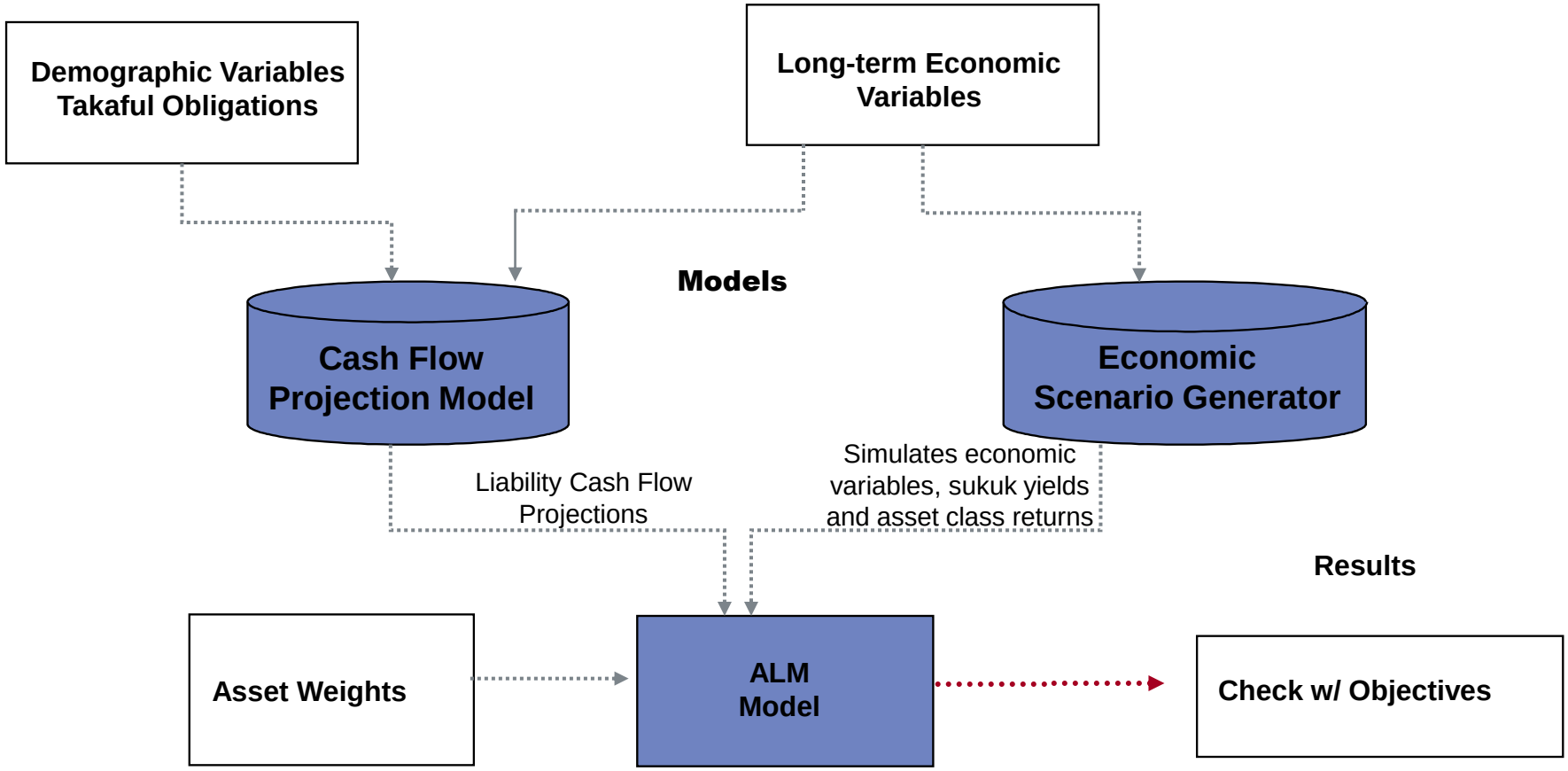


More realistic approach provides more robust strategies

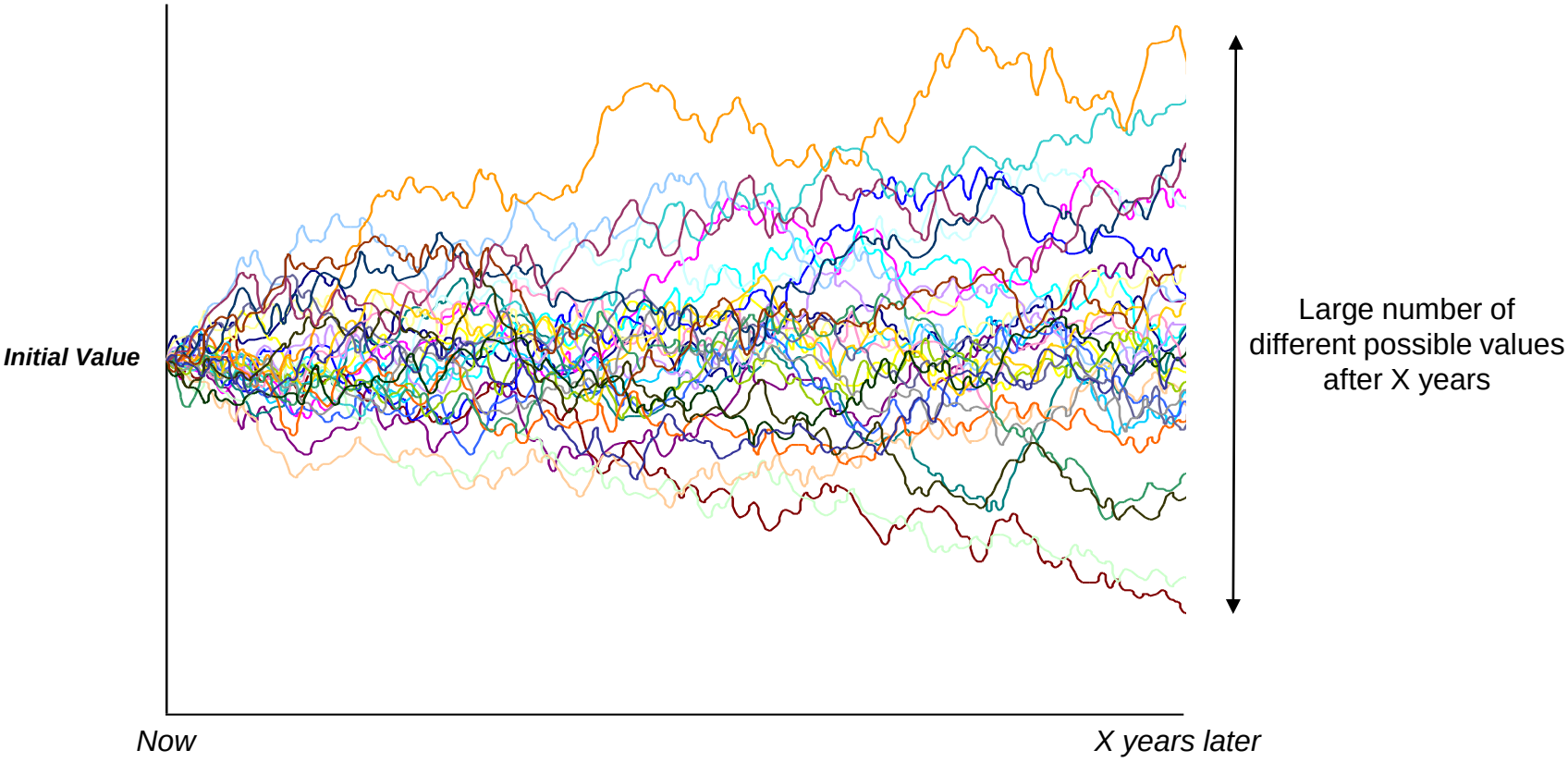
Modelling of Asset/Liability Linkages



Overview of Asset/Liability Methodology



Stochastic Simulations



Asset/Liability Metrics

- Capital Adequacy Ratios
  - No more than x% chance of CAR falling below statutory minimum over next 10 years
  - ‘Worst Case’ Projected CAR in any year over next 10 years

- Surplus
  - ‘Worst Case’ Projected Surplus in any year over next 10 years
  - Probability of annual change in surplus greater than x% in any one year

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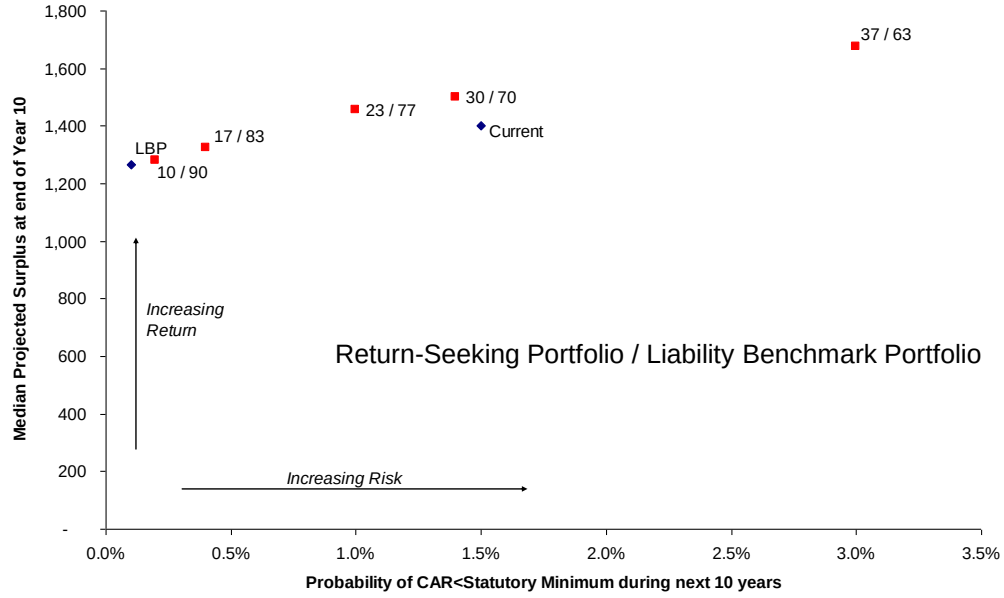


Limitations Of ALM

The Future Is Uncertain

- ALM requires assumptions as to future
  - Important that these aim to be forward-looking rather than just relying on historical data

Model Risk

- All models will not adequately capture market extremes
  - Important that models do reason job of capturing such extremes
- The more complex the model, the more assumptions needed to be made, the more scope for mis-calibration

ALM can help with understanding inter-relationships, but cannot be a complete solution in itself

There are many different types of Asset/Liability modelling approaches

Asset Liability Model	Function	Purpose
Risk budgeting (A-L duration)	▪Liability benchmarking (i.e. long assets, short liabilities)	▪Broad strategic asset allocation ▪Portfolio structuring
ALM (1) Fixed cash flows	▪Accumulation of fixed cashflows ▪Fixed liabilities projection	▪Broad strategic asset allocation.
ALM (2) Feedback on A, Static L	▪Accumulation of cashflows, feedback of investment returns into future asset related cashflows ▪Projected liabilities valued at a constant discount rate ▪Discount rate can vary by asset allocation	▪Detailed strategic asset allocation for insurance funds
ALM (3) Feedback on A, Stochastic L	▪Accumulation of cashflows ▪Feedback of investment returns into future asset and liability cashflows ▪Adjustment of liabilities for stochastic economic variables (bond yields, inflation)	▪Detailed strategic asset allocation for insurance funds ▪Detailed strategic asset allocation for shareholder funds
ALM (4) Feedback on A, Stochastic L^2	▪Accumulation of cash flows ▪Feedback of investment returns into future cash flows ▪Adjustment of liabilities for both stochastic economic and demographic variables	▪Complex strategic asset allocation

Mercer has been refining its asset allocation tools/processes

Portfolio Structuring Toolkit (PST)

Optimization and efficient frontier

Alpha beta separation

Mean-variance approach (PST) high parameter risk and assumes normality. Also less suitable for alternative asset classes or multi-period analysis

Returns, Risks, Correlations

Assumptions

Dataset

Qualitative consultant input inc. DAA analysis

Identify and diversify risk factors

Growth Portfolio Toolkit

Robust portfolio

Most appropriate strategy can only be reliably delivered by **identifying realistic risk / return characteristics** of investments and their impact. Can not be achieved by single model.

Dataset

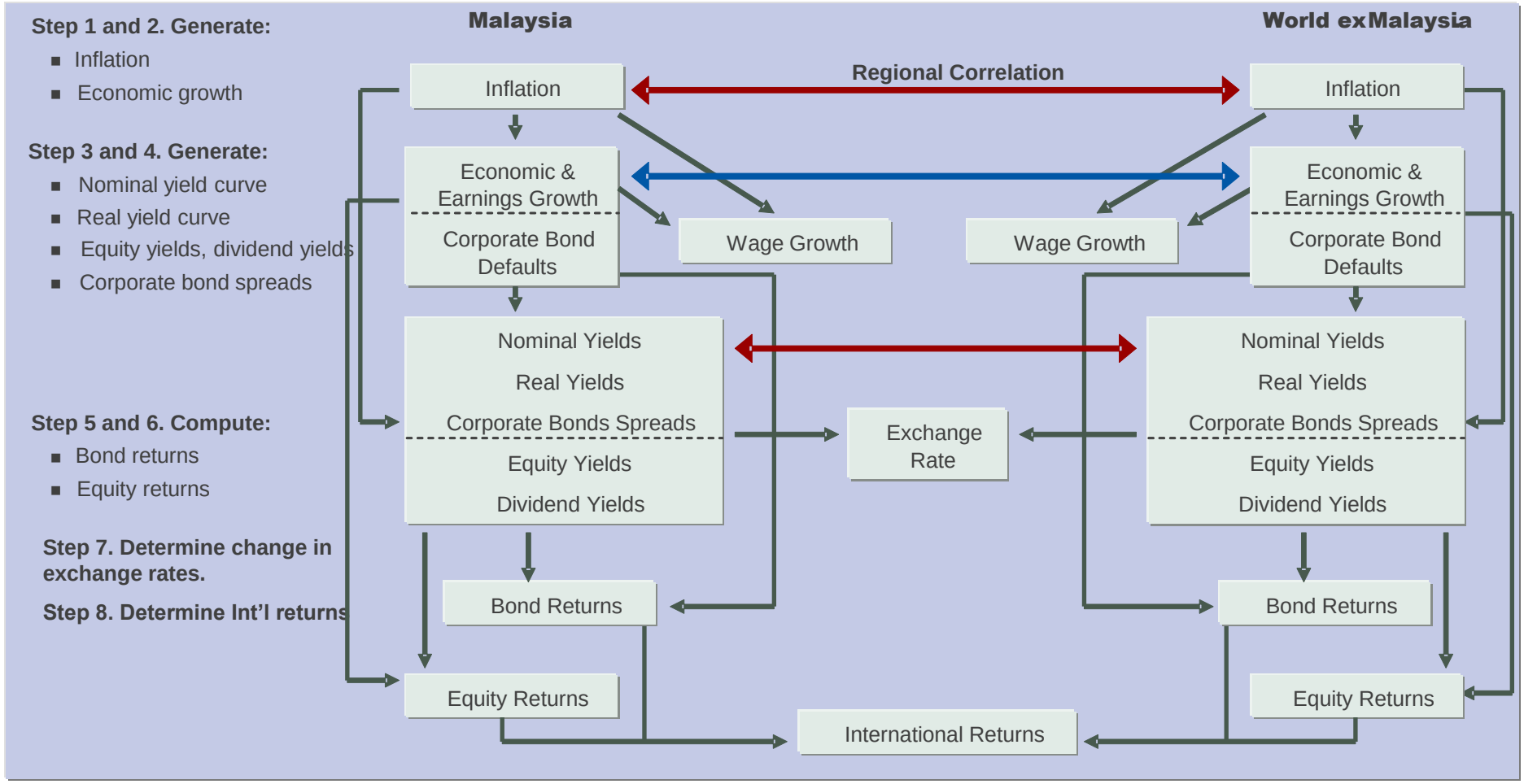
Stochastic Projection Tools

Likelihood of meeting objectives

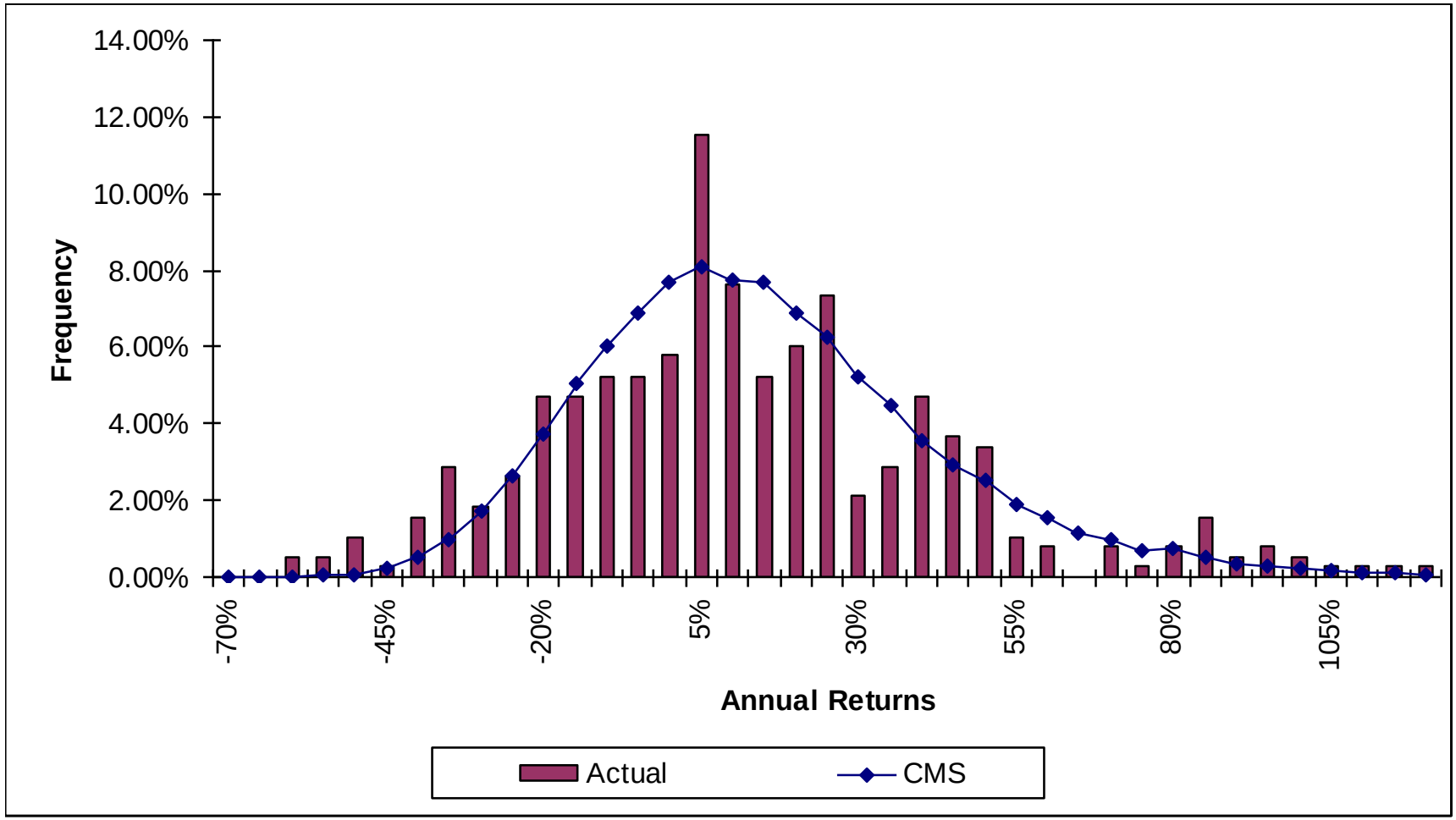
Downside risk (CVaR, VaR) analysis

Stochastic approach has more model risk and hence needs to be supplemented with qualitative overlay and scenario analysis

Overview of Capital Market Simulator (Mercer's Economic Scenario Generator)

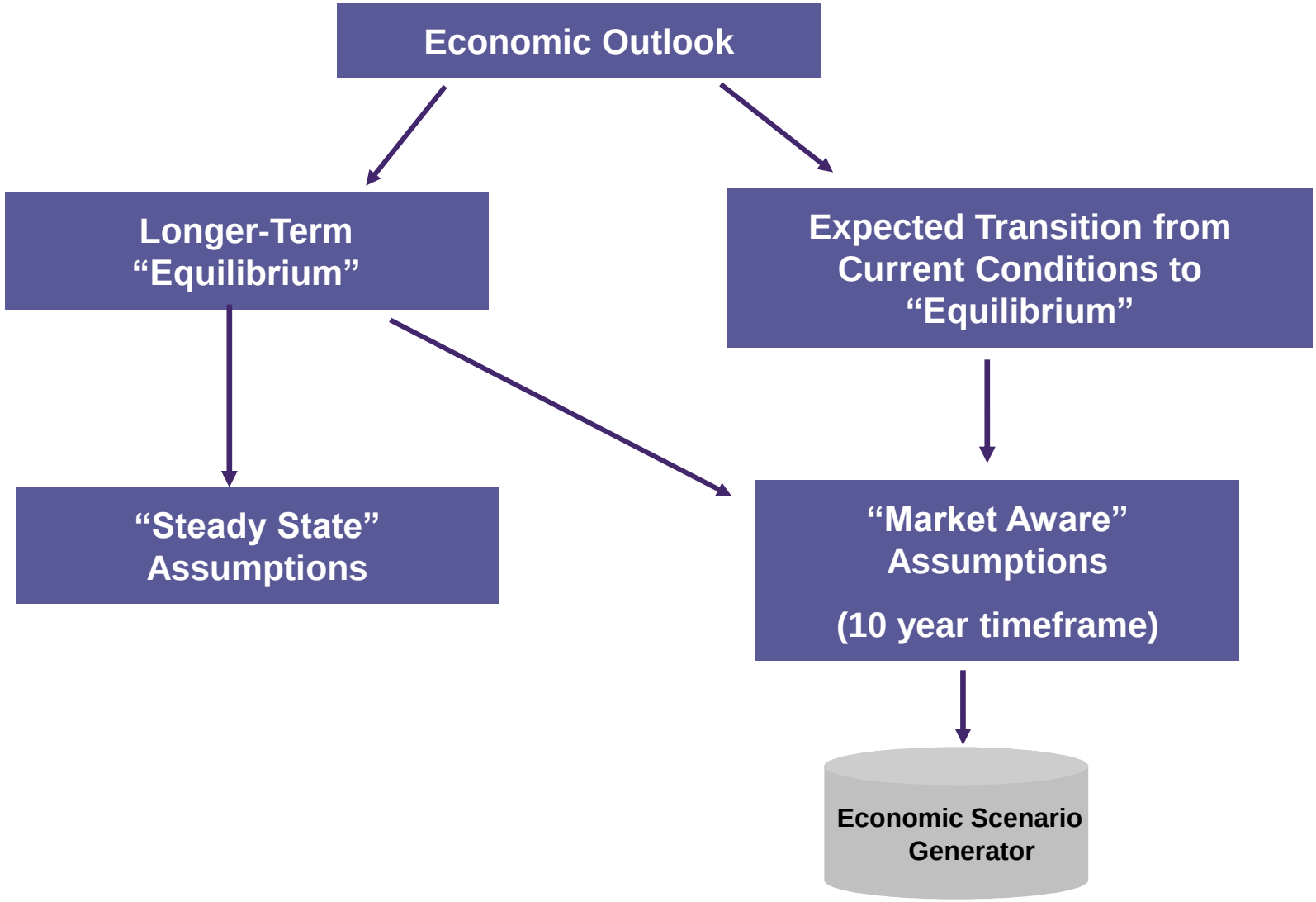


Mercer's regime switching model compared to actual experience for Malaysian equities



Note: Actual experience relates to KLCI since beginning of 1980

Overview of process for deriving capital market assumptions



Overview of approach to deriving bond expected returns

- Establish equilibrium sovereign yield curve
  - Based on assumed equilibrium inflation
  - Assumed real cash yield based on historical relationships and how we expect these to hold going forward
  - Assumed term premium at various maturities, based on historical term premiums and our future expectations
- “Steady State” expected returns based on returns associated with different maturities weighted to reflect required maturity of appropriate sovereign benchmark
- “Market Aware” expected returns allow for impact of moving from current yield curve to equilibrium
- Similar approach used for non-government bonds (and lower grade sovereign) reflecting required credit quality:
  - Assumptions for equilibrium credit spreads
  - Assumptions also made for probabilities of default and for recovery ratios

Overview of approach to deriving expected equity returns

- Approach to deriving equity expected returns is based on the Gordon Growth Model where:

  Expected Return = Dividend Yield
  + Expected Growth of Earnings/Dividends
  + Changes to Earnings/Dividend Yield
  x Expected Inflation

- Long-run growth in dividends will equal earnings growth if the payout ratio remains constant
- In turn, earnings growth will be in line with GDP growth if company profits account for a stable proportion of GDP, but historically earnings has grown less than GDP:
  - Dilution from new share issuance.
  - GDP includes faster growing unlisted companies.
  - Equity market may not have been fully representative of economy and therefore the drivers of economic growth
  - Conflicts of interest cause managers to retain too much earnings and over-invest

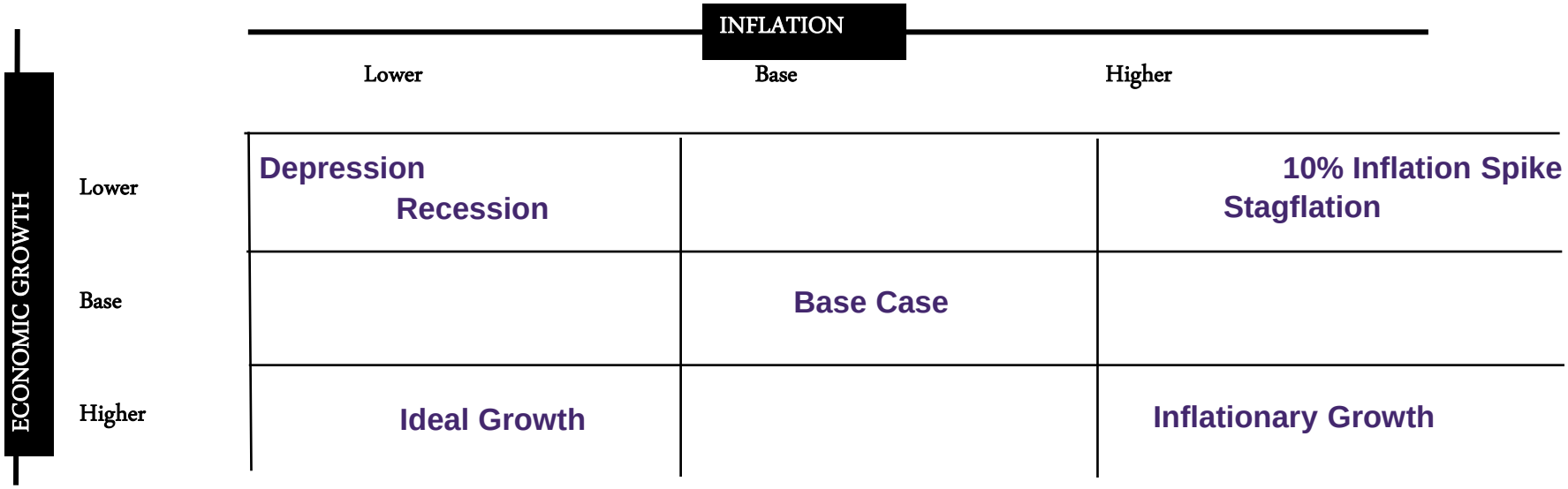
Deterministic simulations can be important supplement to stochastic simulations

- What investment/economic risks does the fund/company face?
  - Assign likelihood and consequence score to each risk
  - Combine to determine overall significance

		Consequences				
		Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Likelihood	**Rare**	Low	Low	Moderate	High	High
	Unlikely	Low	Low	Moderate	High	Extreme
	Possible	Low	Moderate	High	Extreme	Extreme
	Likely	Moderate	High	High	Extreme	Extreme
	Almost Certain	High	High	Extreme	Extreme	Extreme

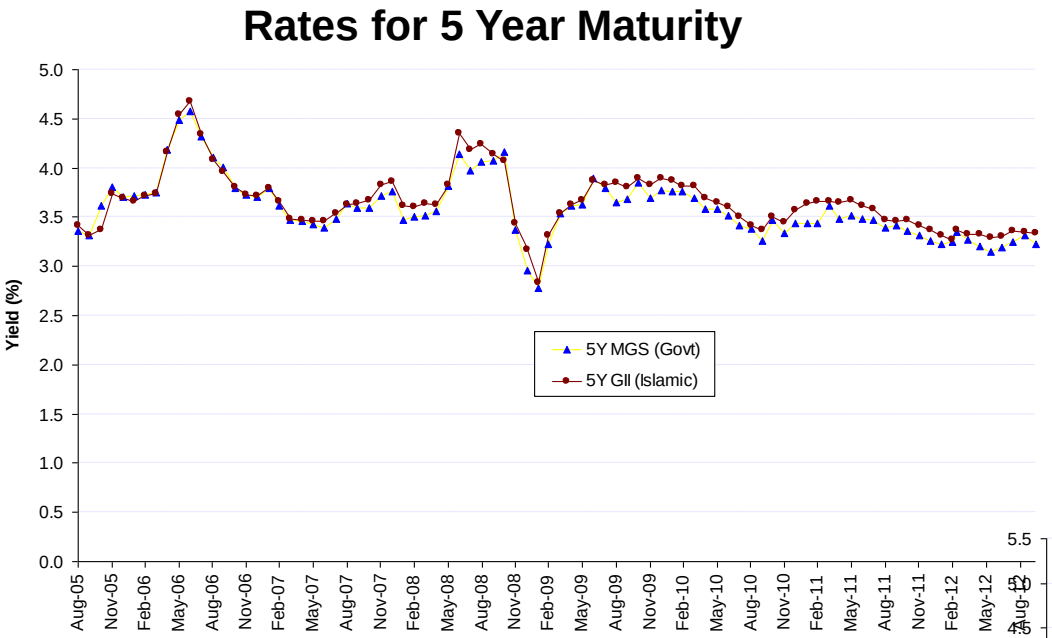
Deterministic Scenario Generation

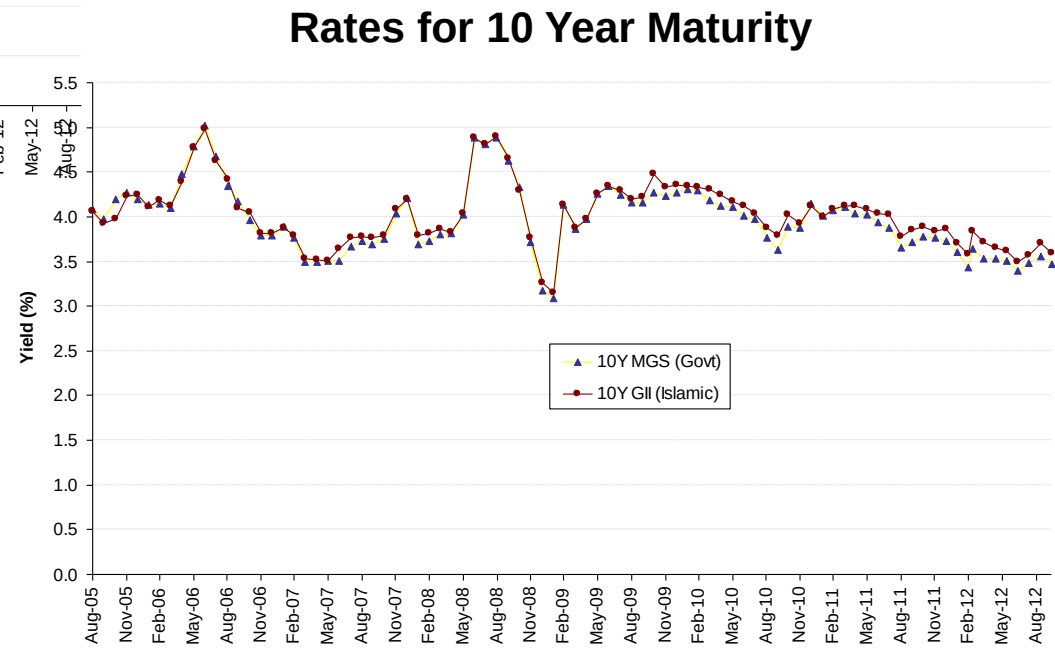
- Output from the qualitative risk assessment can be linked with generation of scenarios to examine impact of different capital market outcomes over the planning horizon
- Deterministic risk scenarios are established to take into account more extreme economic/market conditions:
  - Recession, with a more extreme Depression scenario also being considered
  - Stagflation, with a more extreme 10% Inflation Spike scenario also being considered
  - Ideal Growth
  - Inflationary Growth



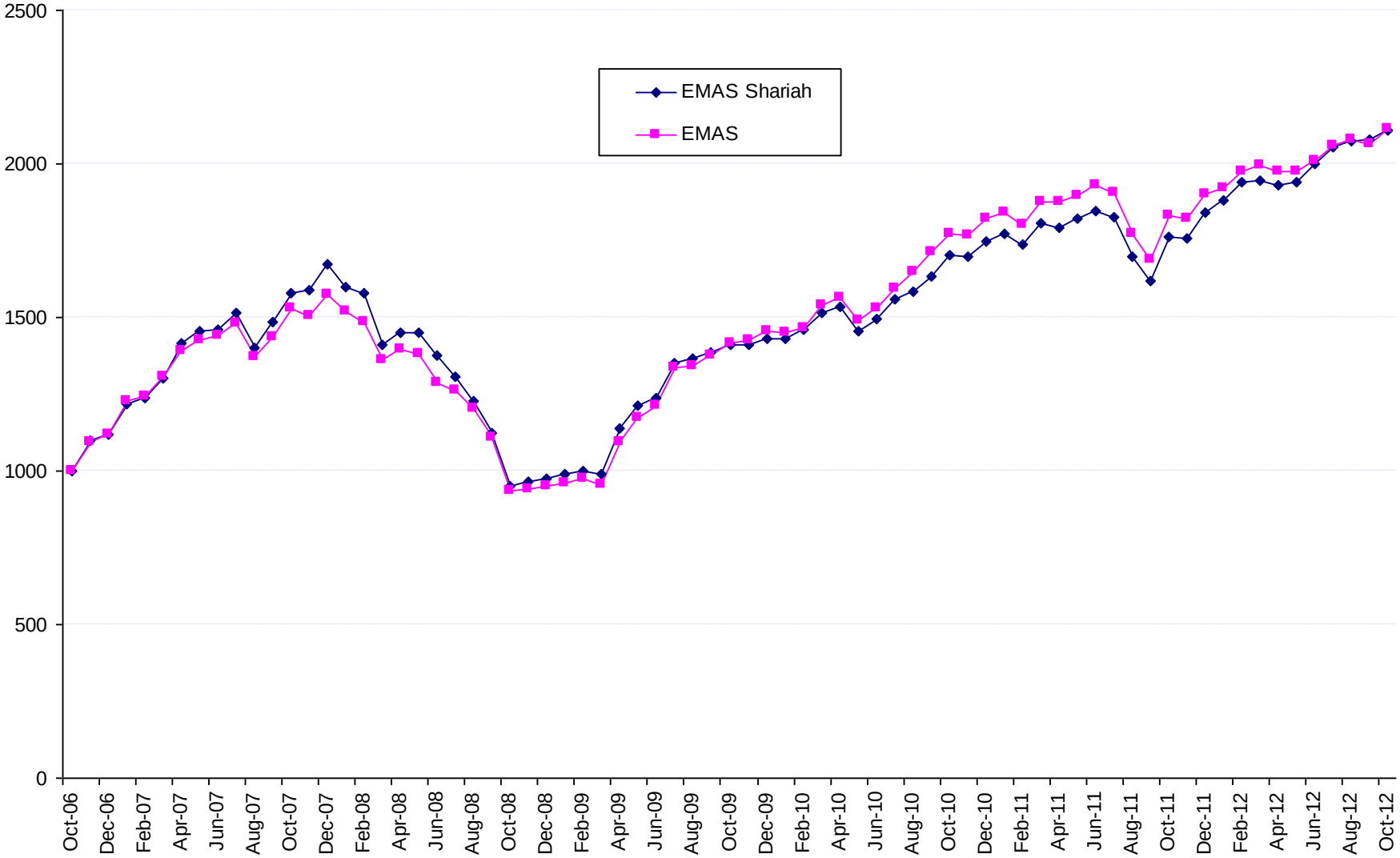
Applicability for Shariah Asset Classes

There is a very close relationship between MGS and GIS rates ….





… and between Shariah equities and the broad market



Applicability to Shariah investing

GIS and Sukuk rates driven by same economic drivers as conventional rates

Shariah equity returns perform similarly to broad market, but possible adjustments in simulations to reflect different characteristics

ALM approaches can be applied for Takaful companies

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