ASSET-LIABILITY MODELLING: WHAT IS IT AND HOW DOES IT WORK?
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:
  \[
  \text{Claim Payments} = \text{Contributions} + \text{Investment returns}
  \]
- This multigenerational process is monitored and adjusted through the valuation of balance sheet items.
Why Asset Liability Modelling?

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

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

More realistic approach provides more robust strategies
Modelling of Asset/Liability Linkages

ECONOMIC SCENARIOS

- Asset Class Returns
- Sukuk Yields
- Inflation, Productivity
- Takaful Obligations
- Mortality/Lapse Assumptions

Asset Liability RISK MEASURES

- Probability of not meeting risk objectives
- Cash Flow Projection from Actuary

06 December 2012
Overview of Asset/Liability Methodology

Demographic Variables
Takaful Obligations

Long-term Economic Variables

Cash Flow Projection Model

Economic Scenario Generator

Models

Simulates economic variables, sukuk yields and asset class returns

Liability Cash Flow Projections

Results

Asset Weights

ALM Model

Check w/ Objectives

Simulates economic variables, sukuk yields and asset class returns

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Stochastic Simulations

- Now
- Initial Value
- X years later
- Large number of different possible values after X years
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
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

<table>
<thead>
<tr>
<th>Asset Liability Model</th>
<th>Function</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk budgeting</strong></td>
<td>▪ Liability benchmarking (i.e. long assets, short liabilities)</td>
<td>▪ Broad strategic asset allocation</td>
</tr>
<tr>
<td>(A-L duration)</td>
<td></td>
<td>▪ Portfolio structuring</td>
</tr>
<tr>
<td>ALM (1)</td>
<td>▪ Accumulation of fixed cashflows</td>
<td>▪ Broad strategic asset allocation.</td>
</tr>
<tr>
<td>Fixed cash flows</td>
<td>▪ Fixed liabilities projection</td>
<td></td>
</tr>
<tr>
<td>ALM (2)</td>
<td>▪ Accumulation of cashflows, feedback of investment returns into future</td>
<td>▪ Detailed strategic asset allocation for</td>
</tr>
<tr>
<td>Feedback on A,</td>
<td>asset related cashflows</td>
<td>insurance funds</td>
</tr>
<tr>
<td>Static L</td>
<td>▪ Projected liabilities valued at a constant discount rate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Discount rate can vary by asset allocation</td>
<td></td>
</tr>
<tr>
<td>ALM (3)</td>
<td>▪ Accumulation of cashflows</td>
<td>▪ Detailed strategic asset allocation for</td>
</tr>
<tr>
<td>Feedback on A,</td>
<td>▪ Feedback of investment returns into future asset and liability cashflows</td>
<td>insurance funds</td>
</tr>
<tr>
<td>Stochastic L</td>
<td>▪ Adjustment of liabilities for stochastic economic variables (bond yields, inflation)</td>
<td>▪ Detailed strategic asset allocation for shareholder funds</td>
</tr>
<tr>
<td>ALM (4)</td>
<td>▪ Accumulation of cash flows</td>
<td>▪ Complex strategic asset allocation</td>
</tr>
<tr>
<td>Feedback on A,</td>
<td>▪ Feedback of investment returns into future cash flows</td>
<td></td>
</tr>
<tr>
<td>Stochastic L²</td>
<td>▪ Adjustment of liabilities for both stochastic economic and demographic variables</td>
<td></td>
</tr>
</tbody>
</table>
Mercer has been refining its asset allocation tools/processes.

Portfolio Structuring Toolkit (PST)
- Optimization and efficient frontier
- Alpha beta separation

Assumptions
- Returns, Risks, Correlations
- 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.

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

Mean-variance approach (PST) high parameter risk and assumes normality. Also less suitable for alternative asset classes or multi-period analysis.
Overview of Capital Market Simulator (Mercer’s Economic Scenario Generator)

Step 1 and 2. Generate:
- Inflation
- Economic growth

Step 3 and 4. Generate:
- Nominal yield curve
- Real yield curve
- Equity yields, dividend yields
- Corporate bond spreads

Step 5 and 6. Compute:
- Bond returns
- Equity returns

Step 7. Determine change in exchange rates.

Step 8. Determine Int’l returns
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

Economic Outlook

Longer-Term “Equilibrium”

“Steady State” Assumptions

Expected Transition from Current Conditions to “Equilibrium”

“Market Aware” Assumptions (10 year timeframe)

Economic Scenario Generator
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:

  \[
  \text{Expected Return} = \text{Dividend Yield} + \text{Expected Growth of Earnings/Dividends} + \text{Changes to Earnings/Dividend Yield} \times \text{Expected Inflation}
  \]

• 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

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Insignificant</th>
<th>Minor</th>
<th>Moderate</th>
<th>Major</th>
<th>Catastrophic</th>
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</thead>
<tbody>
<tr>
<td>Rare</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
<td>High</td>
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<tr>
<td>Unlikely</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
<td>Extreme</td>
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<tr>
<td>Possible</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
<td>Extreme</td>
<td>Extreme</td>
</tr>
<tr>
<td>Likely</td>
<td>Moderate</td>
<td>High</td>
<td>High</td>
<td>Extreme</td>
<td>Extreme</td>
</tr>
<tr>
<td>Almost Certain</td>
<td>High</td>
<td>High</td>
<td>Extreme</td>
<td>Extreme</td>
<td>Extreme</td>
</tr>
</tbody>
</table>
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 ....

Rates for 5 Year Maturity

Rates for 10 Year Maturity
… 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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