Capital Market Assumptions Methodology
Board Education Session

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What are Capital Market Assumptions?

Capital Market Assumptions (CMAs) are beliefs about the future performance of available asset segments that incorporate theories, observations and experience.

Capital Market Assumptions: Asset Segment Components

- Each asset segment is characterized by estimated:
  - expected returns
  - expected volatility (variance, risk)
- The interaction between asset segments is characterized by estimated:
  - expected correlation between returns
What is the Capital Market Assumptions Time Horizon?

- A 10-year horizon is common for the asset side in Asset-Liability-Management

- This time horizon enables a long-term investor to:
  - earn an illiquidity premium in private asset classes
  - invest in opportunities that take longer to realize
  - hold positions during market dislocations

- A 20-year horizon is available, but is less common
Building Portfolios with Capital Market Assumptions

- Utilize Mean Variance Optimization (MVO) to evaluate the CMAs to maximize desired return (mean) for any given level of undesired risk (variance)

- Incorporate allocation constraints into this process to ensure that:
  - pricing discipline is maintained at strategy implementation (maximum constraint on private assets)
  - portfolio has enough protection against drawdown risk (minimum constraint on bonds)

- MVO finds the portfolio with the highest return for any given level of variance or risk

- These portfolios compose the Efficient Frontier
The Efficient Frontier: A Two Asset Segment Example

<table>
<thead>
<tr>
<th>Asset</th>
<th>Compound Return</th>
<th>Volatility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stocks</td>
<td>7%</td>
<td>16%</td>
</tr>
<tr>
<td>Bonds</td>
<td>3%</td>
<td>7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Correlation Matrix</th>
<th>Stocks</th>
<th>Bonds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stocks</td>
<td>1.0</td>
<td>-0.1</td>
</tr>
<tr>
<td>Bonds</td>
<td>-0.1</td>
<td>1.0</td>
</tr>
</tbody>
</table>
Constructing the Efficient Frontier

Each portfolio on the efficient frontier has the highest possible return for that level of risk.
The Efficient Frontier and the Effect of Correlation

The lower the correlation between the asset returns, the greater the diversification benefits.

![Efficient Frontier Diagram]

- 100% Stocks
- 60% Stocks, 40% Bonds
- 18% Stocks, 82% Bonds

Expected Returns vs. Expected Volatility with different correlation levels:
- Correlation=-0.1
- Correlation=1
- Correlation=-1

More Desired
Forecasting Uncertainty using Models & Assumptions

• Financial modeling:
  ◦ provides investors a common analytical framework to share ideas
  ◦ evaluates complex, real world investments with simplified mathematical constructs

• Simplification requires assumptions, such as:
  ◦ asset returns are normally distributed
  ◦ mean, variance, and correlations are constant and known

• To counterbalance assumptions:
  ◦ set constraints to ensure market feasibility of the allocation and guard against drawdown
  ◦ stress-test portfolios using Monte Carlo simulations and historical economic regimes
CMA Methodology

Establishing CMAs is a mix of art and science, as models only approximate reality.

- **Step 1**: Start with internal CMA models that a) reflect our internal knowledge and experience and b) incorporate cutting-edge practices and techniques from leading practitioners in the industry.

- **Step 2**: Add “humility” to the process by including CMA survey results of several asset managers and consultants, and understanding the drivers of significant differences.

- **Step 3**: Build consensus on asset segment CMAs with TLPMI/RSG, asset class experts, actuaries, and the Board Consultants to establish what we think the marketplace has to offer.
The Building Blocks of Expected Returns

- **Equity Returns**
  - Yield + Growth in Yield + Valuation Change

- **Fixed Income Returns**
  - Yield + Roll Return + Valuation Change - Credit Loss
Building Blocks of Expected Returns: Public Equity Example

Yield + Growth in Yield + Valuation Change = Equity Returns

Growth in Yield

Past Growth
- Past 10 Years
- Past Full Business Cycle

Analyst Forecast
- Adjustment for Outlier
- Implied Growth in Earnings
- Long-term Growth Forecast

Macro Economics Growth
- Technology
- Population
Building Blocks of Expected Returns: Private Equity Example

- Public Equity Capital Market Assumption
- Beta & Leverage Impact
- Illiquidity Premium
- Operational Premium
- Fees
Building Blocks of Expected Returns: Real Assets Example

- Capitalization Rate
- Capital Expenditure
- Growth in Net Operating Income
- Valuation Change
- Leverage Adjustment
- Fees
Expected Volatility and Expected Correlation Estimates

• Expected volatility (risk) estimates are primarily based on:
  ◦ observed historical asset class behavior
  ◦ understanding asset class responses to changes in economic factors

• Expected correlation estimates:
  ◦ start with MSCI BarraOne model
  ◦ incorporate beliefs on the future relationship between stocks-bonds given macroeconomic views and conditions
Shocks to the Estimates

• Macroeconomic shocks:
  ◦ inflation (spikes or deflation)
  ◦ interest rates / access to capital
  ◦ growth rates (GDP, corporate earnings, etc.)
  ◦ market levels (“popping of a bubble”)

• Geopolitical shocks:
  ◦ war / terrorism / national unrest / pandemics
  ◦ can trigger macroeconomic shocks

• Unknown risks
Future Developments

The CMA methodology is an evolving process that includes new research and models. Possible future developments include:

• utilizing macroeconomic research to incorporate expectations for future economic growth, inflation, and real interest rates into asset segment CMAs
• utilizing fundamental and thematic research to incorporate expectations for earnings growth potential into asset segment CMAs
• continued enhancement in estimation techniques and statistical models