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Go for Gold
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Institute of Actuaries of Australia

UniSuper's Approach to Risk Budgeting

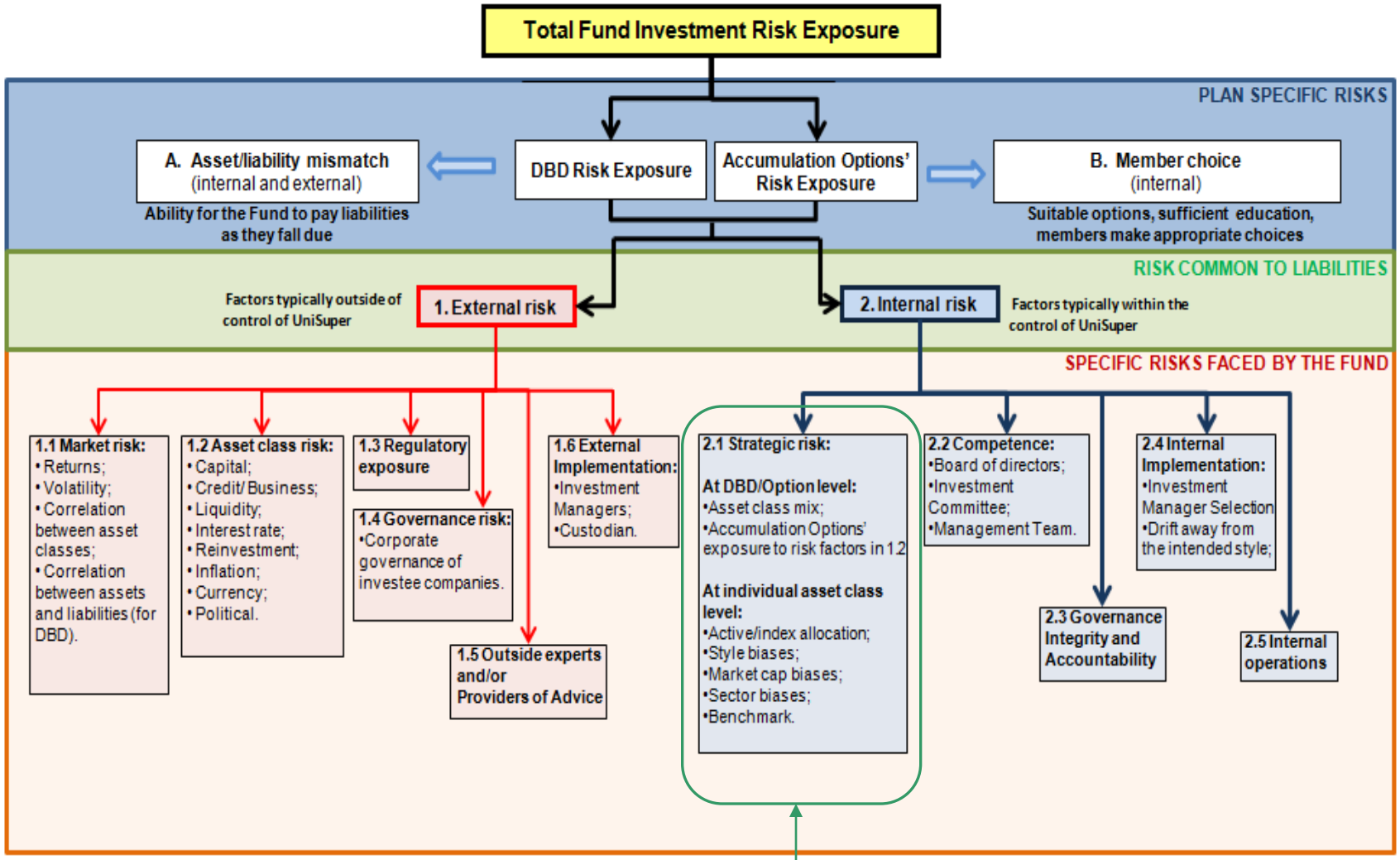
David Schneider

Agenda

- Objective, goals and processes
- Link between SAA and risk budgeting
- Equations
- Framework for discussion
- Questions

Definitions

- Risk budgeting:
  - Set target risk levels by Option
  - Allocating this risk across investments/managers
    - To maximise returns
    - While containing risk within the agreed targets
  - Traditionally via tracking error target
- Ensures that the “risk budget” is efficiently distributed by:
  - Assets
  - Styles
  - Managers


Total Fund Investment Risk Exposure
PLAN SPECIFIC RISKS
A. Asset/liability mismatch (internal and external)
Ability for the Fund to pay liabilities as they fall due
DBD Risk Exposure
Accumulation Options' Risk Exposure
B. Member choice (internal)
Suitable options, sufficient education, members make appropriate choices
RISK COMMON TO LIABILITIES
Factors typically outside of control of UniSuper
1. External risk
2. Internal risk
Factors typically within the control of UniSuper
SPECIFIC RISKS FACED BY THE FUND
1.1 Market risk:
• Returns;
• Volatility;
• Correlation between asset classes;
• Correlation between assets and liabilities (for DBD).
1.2 Asset class risk:
• Capital;
• Credit/ Business;
• Liquidity;
• Interest rate;
• Reinvestment;
• Inflation;
• Currency;
• Political.
1.3 Regulatory exposure
1.4 Governance risk:
•Corporate governance of investee companies.
1.5 Outside experts and/or Providers of Advice
1.6 External Implementation:
•Investment Managers;
•Custodian.
2.1 Strategic risk:
At DBD/Option level:
•Asset class mix;
•Accumulation Options' exposure to risk factors in 1.2
At individual asset class level:
•Active/index allocation;
•Style biases;
•Market cap biases;
•Sector biases;
•Benchmark.
2.2 Competence:
•Board of directors;
•Investment Committee;
•Management Team.
2.3 Governance Integrity and Accountability
2.4 Internal Implementation:
•Investment Manager Selection
•Drift away from the intended style;
2.5 Internal operations
TURBOs

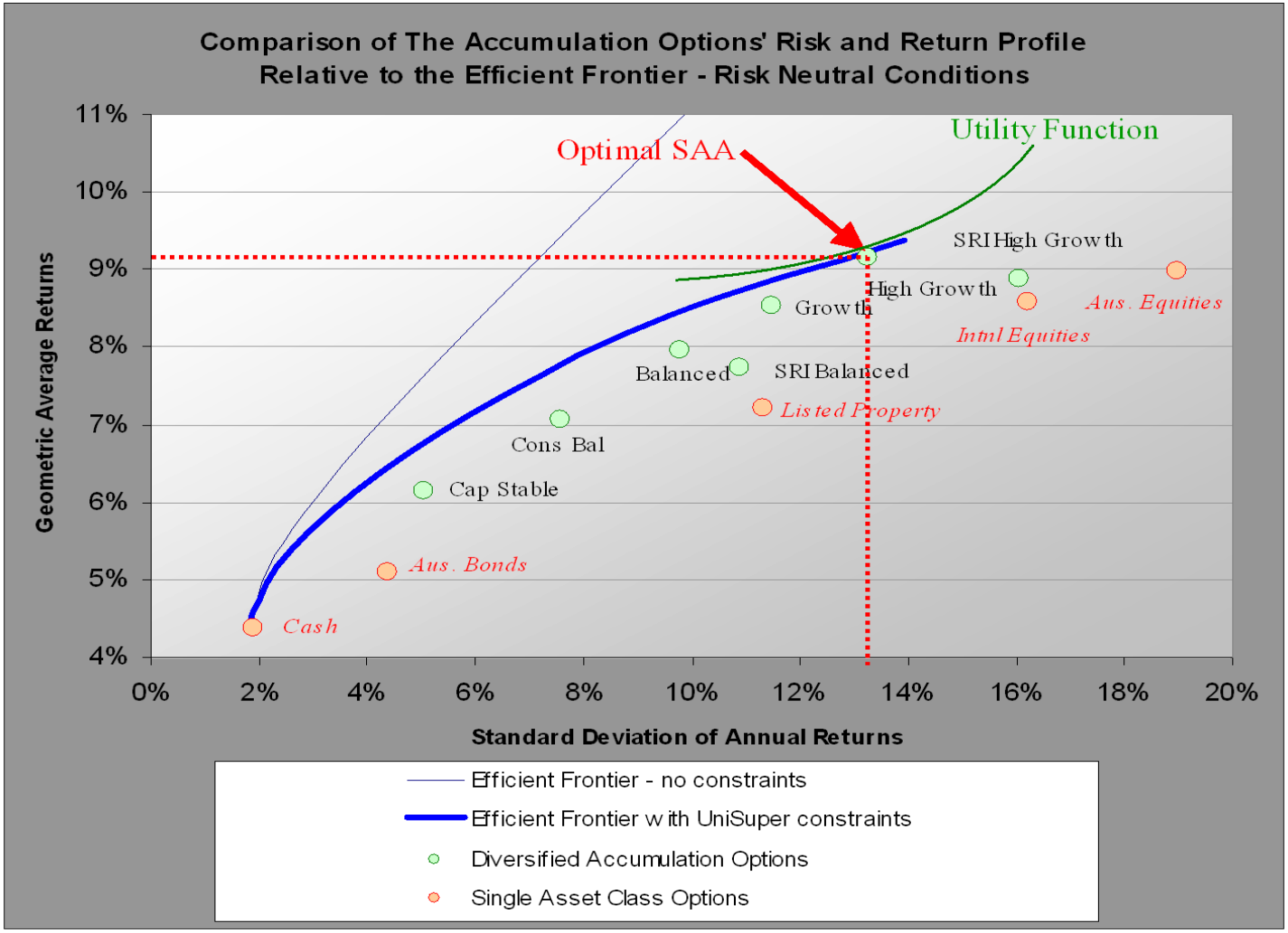
Desired Features

- Key risk: not meeting liabilities as they fall due
- Hence risk budget should be tied to the liabilities
- Must focus on risk allocation not attribution
- Must handle:
  - Alternatives
  - Tilting
  - Operational concerns (rebalancing, tolerance limits etc)
- Must give us insight as to how to change the portfolio

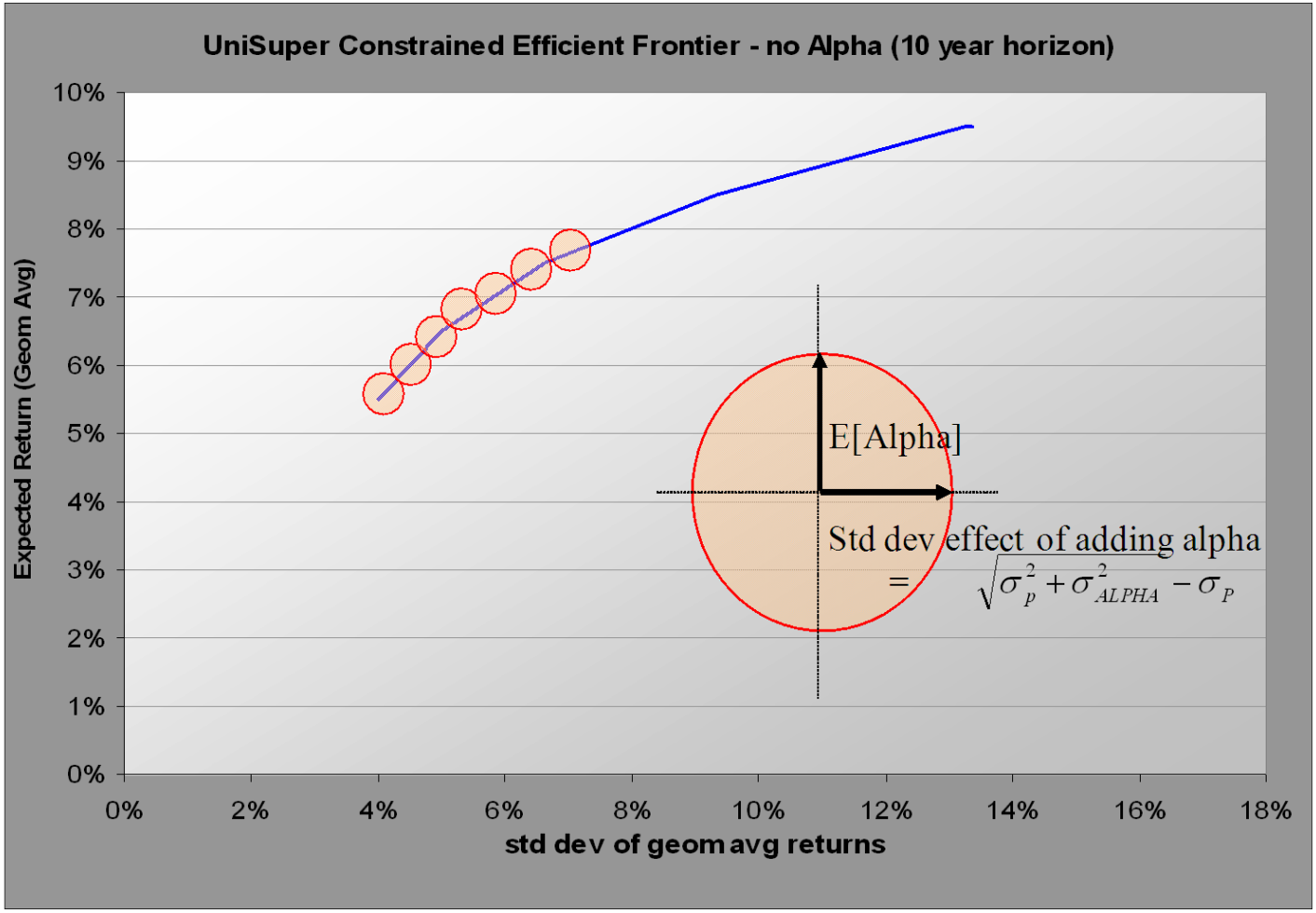
6 Processes Followed by TURBOs

1. Split returns between beta and *ex-post* alpha
2. Compare each Option's beta exposure to the SAA
3. Find historic variance per Option
4. Determine *ex-ante* alpha estimates
5. Set a minimum hurdle for each Option's active risk
6. Find the 'optimal' manager line-up

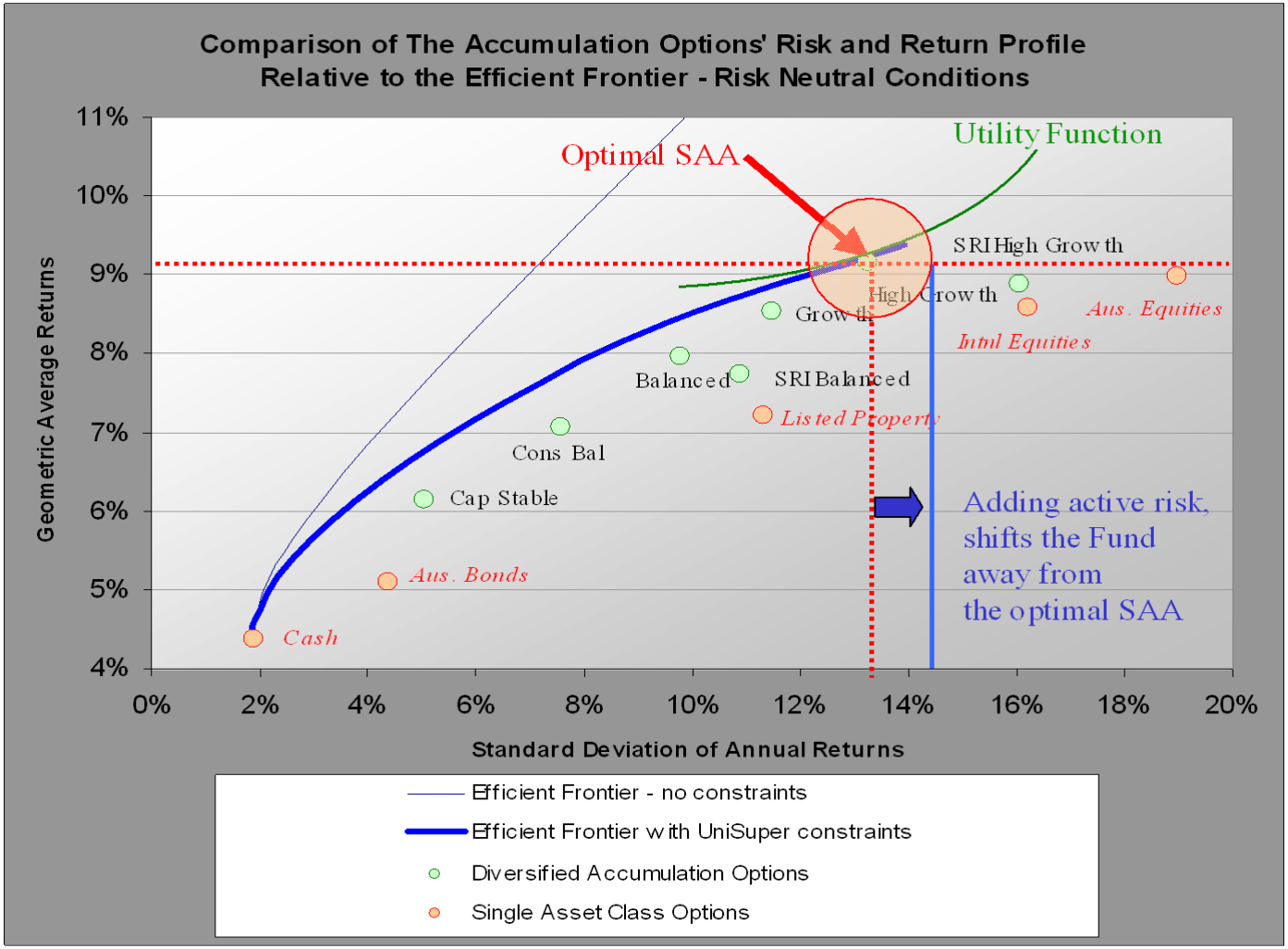
Linking Risk Budgeting to SAA



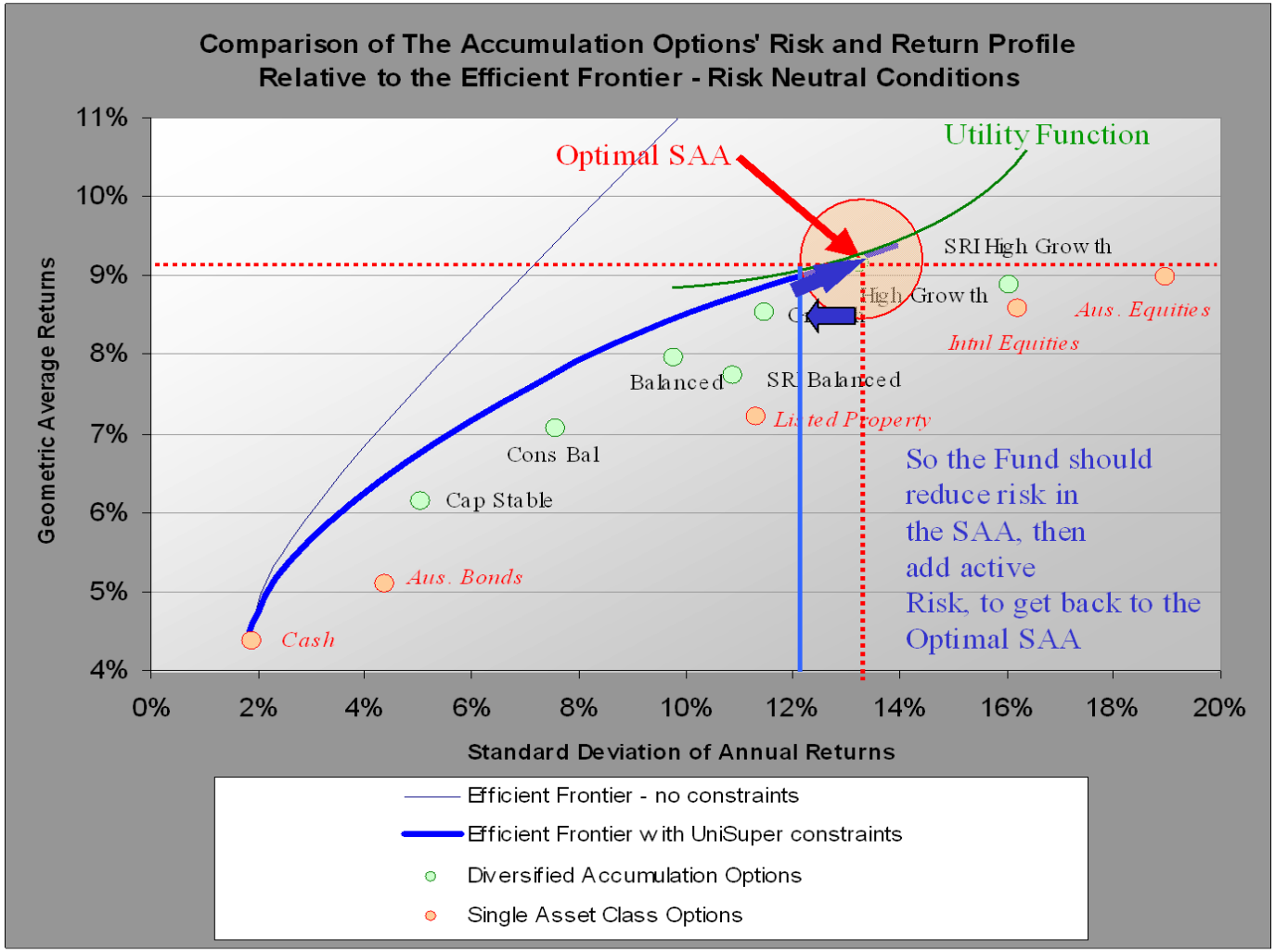
Linking Risk Budgeting to SAA



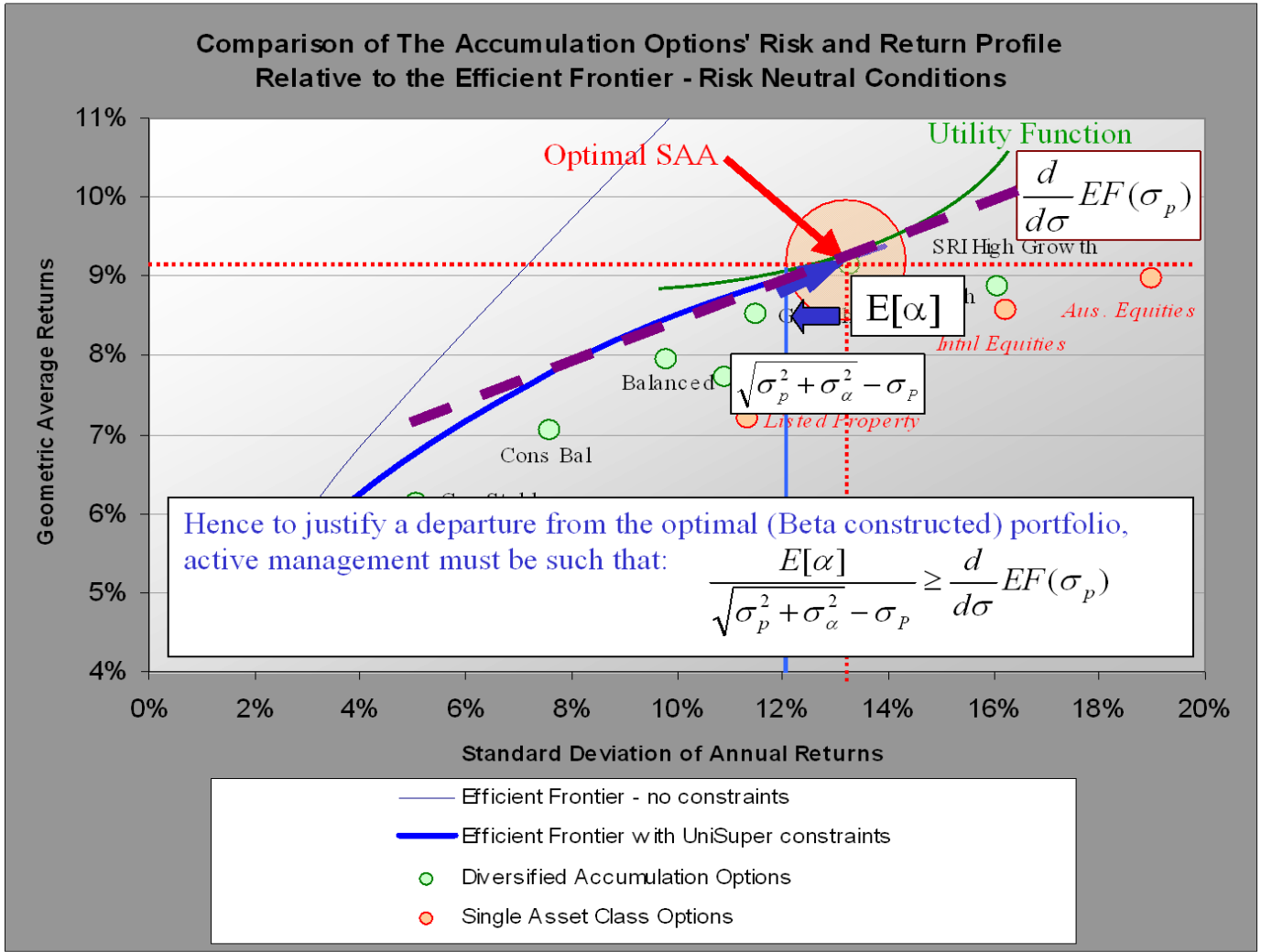
Linking Risk Budgeting to SAA



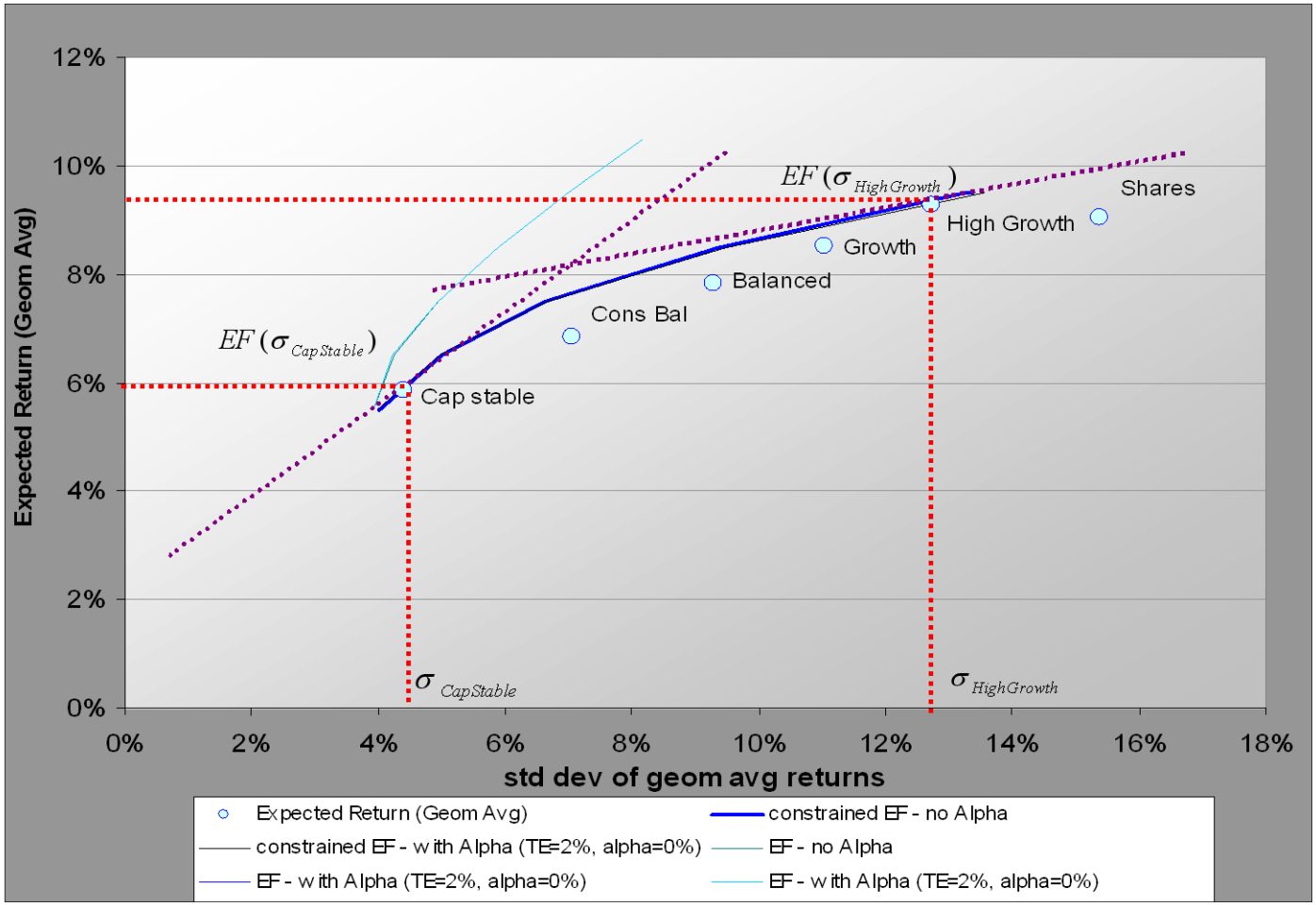
Linking Risk Budgeting to SAA



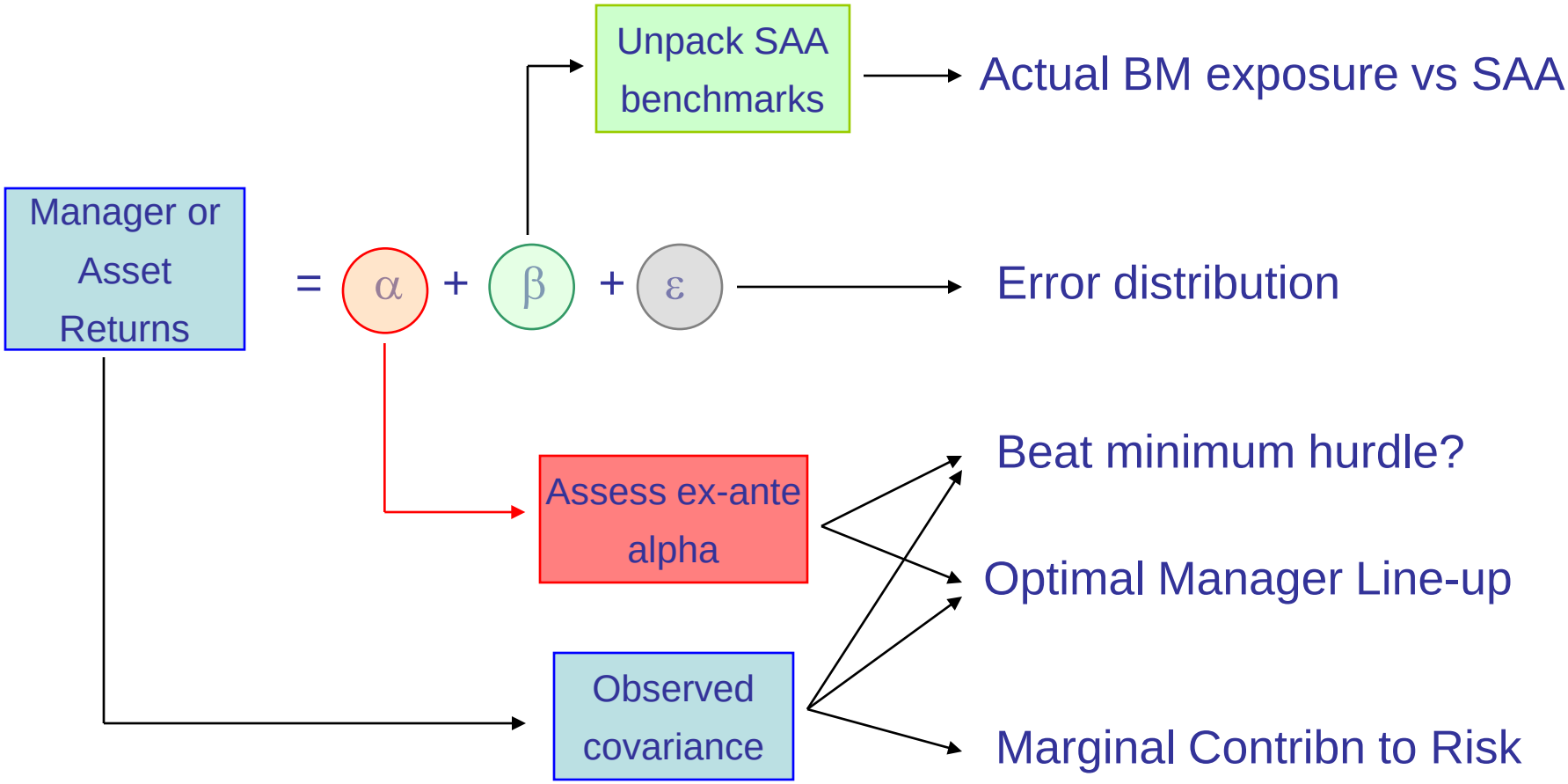
Linking Risk Budgeting to SAA



Practical Example



Graphical Representation



Mathematical Equations
Factor Analysis

$$\mu_{i,t}^{a_i} = \hat{\alpha}_{i,t}^{a_i} + \sum_{k=1}^{K} \hat{\beta}_{i,k,t} F_{k,t} + \varepsilon_{i,t}$$

Manager historic returns

Historic alpha

Beta component to returns

Error Term

Mathematical Equations
Return Attribution

$$\mu_{i,t}^{a_i} = \hat{\alpha}_{i,t}^{a_i} + \sum_{k=1}^{K} \hat{\beta}_{i,k,t} F_{k,t} + \varepsilon_{i,t}$$

$$F_{k,t} = RP_k + \sum_{m=1}^{M} \hat{\gamma}_{m,k} \; BM^*_{m,t} + \nu_{k,t}$$

Factor Returns

Non-SAA Benchmark Risk Premia

UniSuper SAA Benchmark Component to Factor's returns

Error Term

Mathematical Equations
Return Attribution (2)

$$R_t^o = \left\{ \sum_{i=1}^{N} w_{i,t}^{o,a_i} \hat{\alpha}_{i,t}^{a_i} \right\} + \left\{ \left[\sum_{i=1}^{N} \sum_{k=1}^{K} \sum_{m=1}^{M} w_{i,t}^{o,a_i} \hat{\gamma}_{m,k} \hat{\beta}_{i,k,t} BM_{m,t}^{*} \right] \right\} + \left\{ \left[\sum_{i=1}^{N} \sum_{k=1}^{K} w_{i,t}^{o,a_i} \hat{\beta}_{i,k,t} RP_k \right] \right\} + \varepsilon$$

Option's historic returns

Average ex-post Alpha

UniSuper SAA Benchmark Component

Extraneous Beta

Error Term

$$\varepsilon = \left\{ \sum_{i=1}^{N} \sum_{k=1}^{K} w_{i,t}^{o,a_i} \hat{\beta}_{i,k,t} \nu_{k,t} + \sum_{i=1}^{N} w_{i,t}^{o,a_i} \varepsilon_{i,t} \right\}$$

Mathematical Equations
Ex-Ante Alpha Estimation

$$\hat{\bar{\alpha}} = \left[\left(\tau\hat{\bar{\Psi}}\right)^{-1} + \bar{\Omega}_A^{-1}\right]^{-1}\left[\left(\tau\hat{\bar{\Psi}}\right)^{-1}\bar{A} + \bar{\Omega}_A^{-1}\bar{Q}_A\right]$$

Ex-Ante Alpha

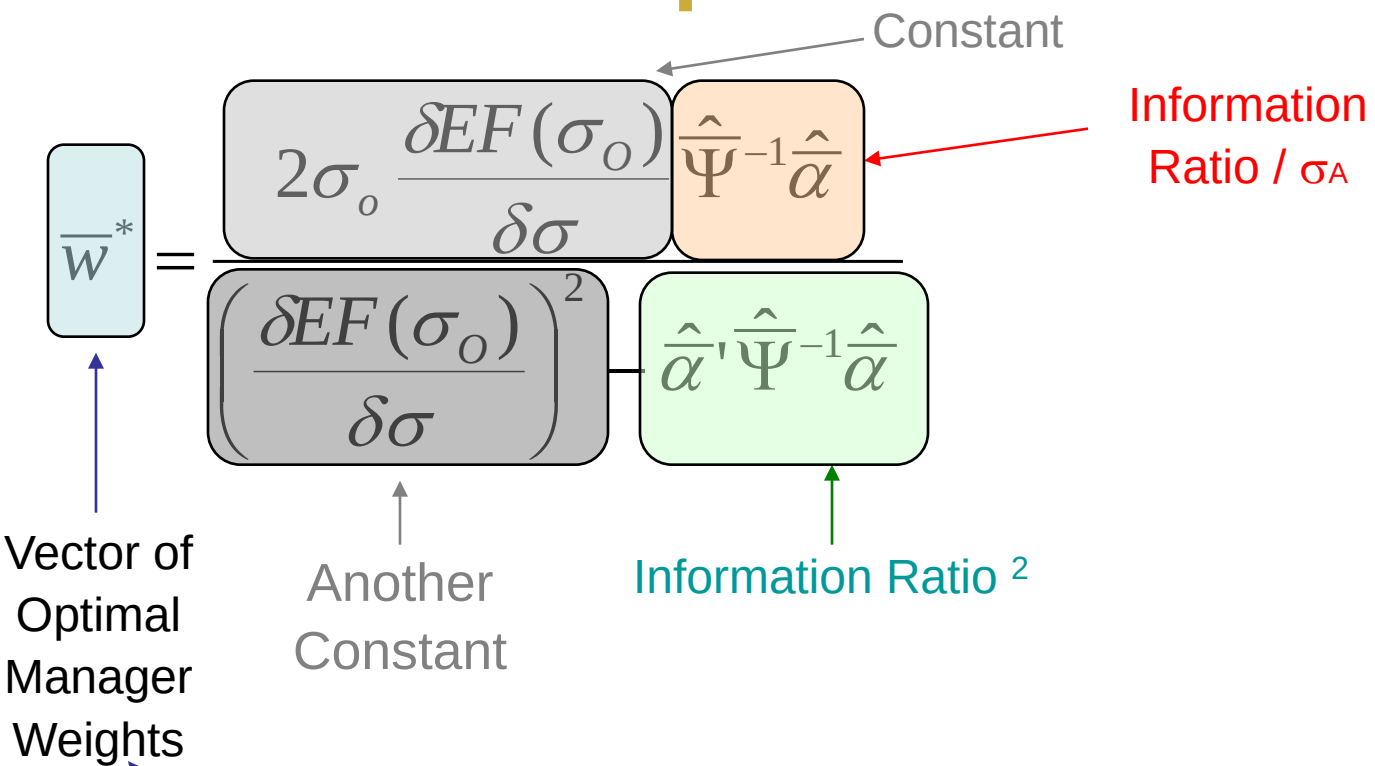
Weights: Scaled Covariance Matrix

Weights: Investor's Confidence

Historic Alpha Vector

Investor's Views

Mathematical Equations Reverse Optimisation



Hence w^* is a function of:

- Actual information ratio
- Minimum required information ratio

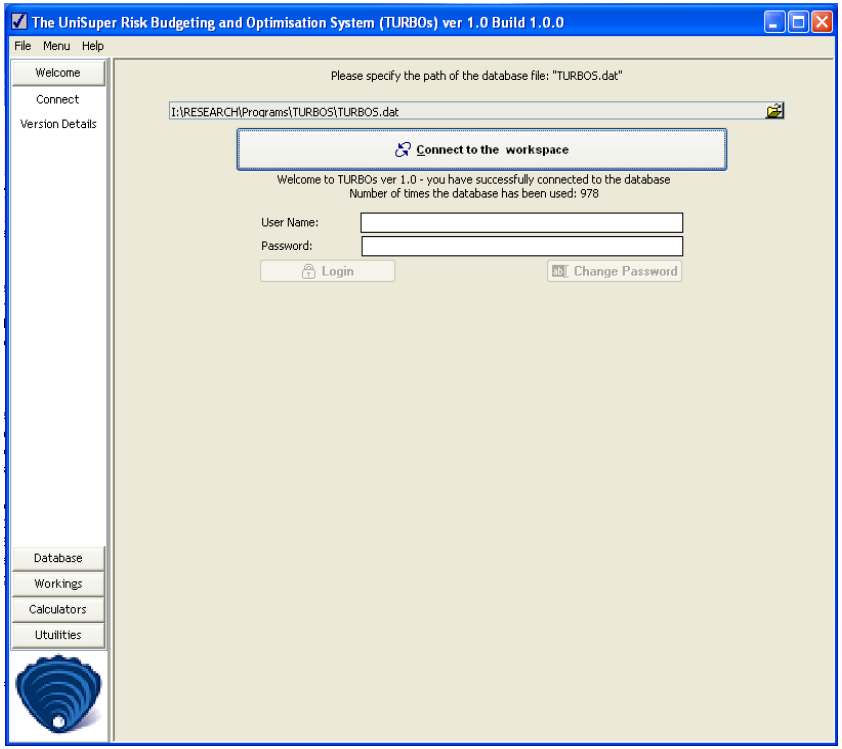
Framework for Discussion

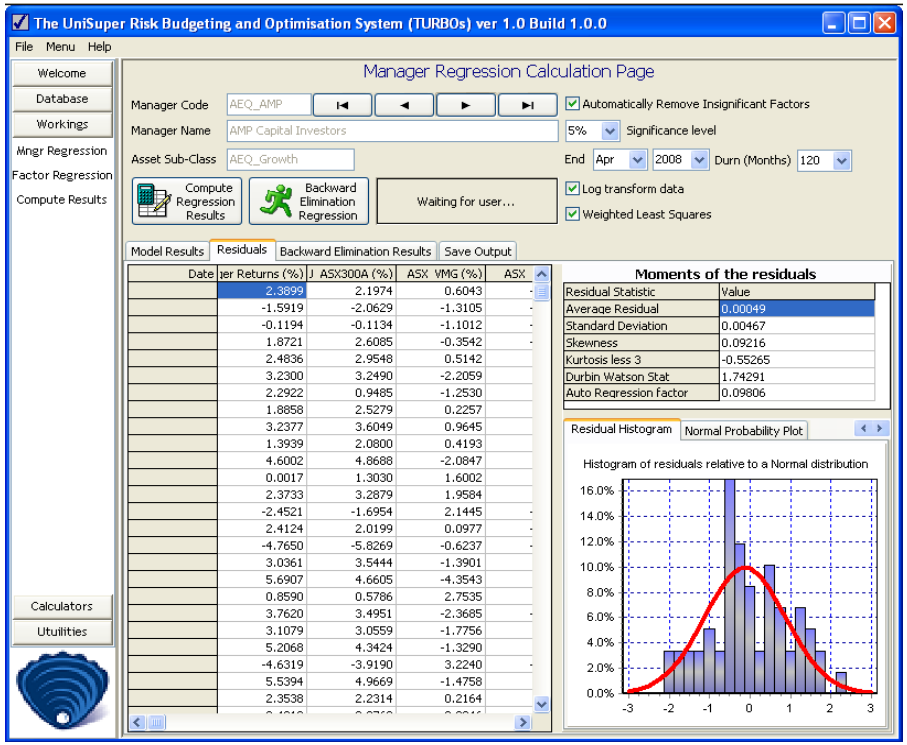
1. *What was the observed Option volatility, and how did each manager contribute to that volatility?*
2. *Is there a danger that a specific manager is holding a negative or short position in a given sector and that this could adversely affect the Fund's SAA?*
3. *Are there any managers who have too little tracking error and are effectively invested passively?*
4. *What levels of alpha do we expect from each manager?*
5. *Are we allocating funds to those managers in which we have the greatest confidence?*
6. *Do we expect to earn sufficient alpha from each manager, to justify active management at the Option level?*
7. *Is there an alternative manager line-up that is expected to produce better risk-adjusted returns for each Option?*

Summary – 7 Step Process

1. Determine the factor exposures by manager/asset
2. Contrast factors to the SAA factor exposures
3. Derive the ex-ante alpha per manager/asset
4. Determine marginal contribution to risk
5. Deduce an alternative “optimal” managers/assets line-up
6. Check
    1. Active program appropriate?
    2. Are we getting the factor exposures aimed for by the SAA?
    3. The error term composition
7. Interpret

Questions?


The UniSuper Risk Budgeting and Optimisation System (TURBOs) ver 1.0 Build 1.0.0
File Menu Help
Welcome
Connect
Version Details
Database
Workings
Calculators
Utuilities
Please specify the path of the database file: "TURBOS.dat"
I:\RESEARCH\Programs\TURBOS\TURBOS.dat
Connect to the workspace
Welcome to TURBOs ver 1.0 - you have successfully connected to the database
Number of times the database has been used: 978
User Name:
Password:
Login
Change Password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File Menu Help
Welcome
Database
Workings
Mngr Regression
Factor Regression
Compute Results
Calculators
Utuilities
Manager Regression Calculation Page
Manager Code AEQ_AMP
Manager Name AMP Capital Investors
Asset Sub-Class AEQ_Growth
Automatically Remove Insignificant Factors
5% Significance level
End Apr 2008 Durn (Months) 120
Compute Regression Results
Backward Elimination Regression
Waiting for user...
Log transform data
Weighted Least Squares
Model Results
Residuals
Backward Elimination Results
Save Output
Date er Returns (%) J ASX300A (%) ASX VMG (%) ASX
2.3899 2.1974 0.6043
-1.5919 -2.0629 -1.3105
-0.1194 -0.1134 -1.1012
1.8721 2.6085 -0.3542
2.4836 2.9548 0.5142
3.2300 3.2490 -2.2059
2.2922 0.9485 -1.2530
1.8858 2.5279 0.2257
3.2377 3.6049 0.9645
1.3939 2.0800 0.4193
4.6002 4.8688 -2.0847
0.0017 1.3030 1.6002
2.3733 3.2879 1.9584
-2.4521 -1.6954 2.1445
2.4124 2.0199 0.0977
-4.7650 -5.8269 -0.6237
3.0361 3.5444 -1.3901
5.6907 4.6605 -4.3543
0.8590 0.5786 2.7535
3.7620 3.4951 -2.3685
3.1079 3.0559 -1.7756
5.2068 4.3424 -1.3290
-4.6319 -3.9190 3.2240
5.5394 4.9669 -1.4758
2.3538 2.2314 0.2164
Moments of the residuals
Residual Statistic Value
Average Residual 0.00049
Standard Deviation 0.00467
Skewness 0.09216
Kurtosis less 3 -0.55265
Durbin Watson Stat 1.74291
Auto Regression factor 0.09806
Residual Histogram
Normal Probability Plot
Histogram of residuals relative to a Normal distribution
16.0%
14.0%
12.0%
10.0%
8.0%
6.0%
4.0%
2.0%
0.0%
-3 -2 -1 0 1 2 3