Arun Muralidhar, Managing Director

Innovations in Pension Fund Management

Agenda

- **Market outlook and impact on clients**

- Keys to success for a plan sponsor

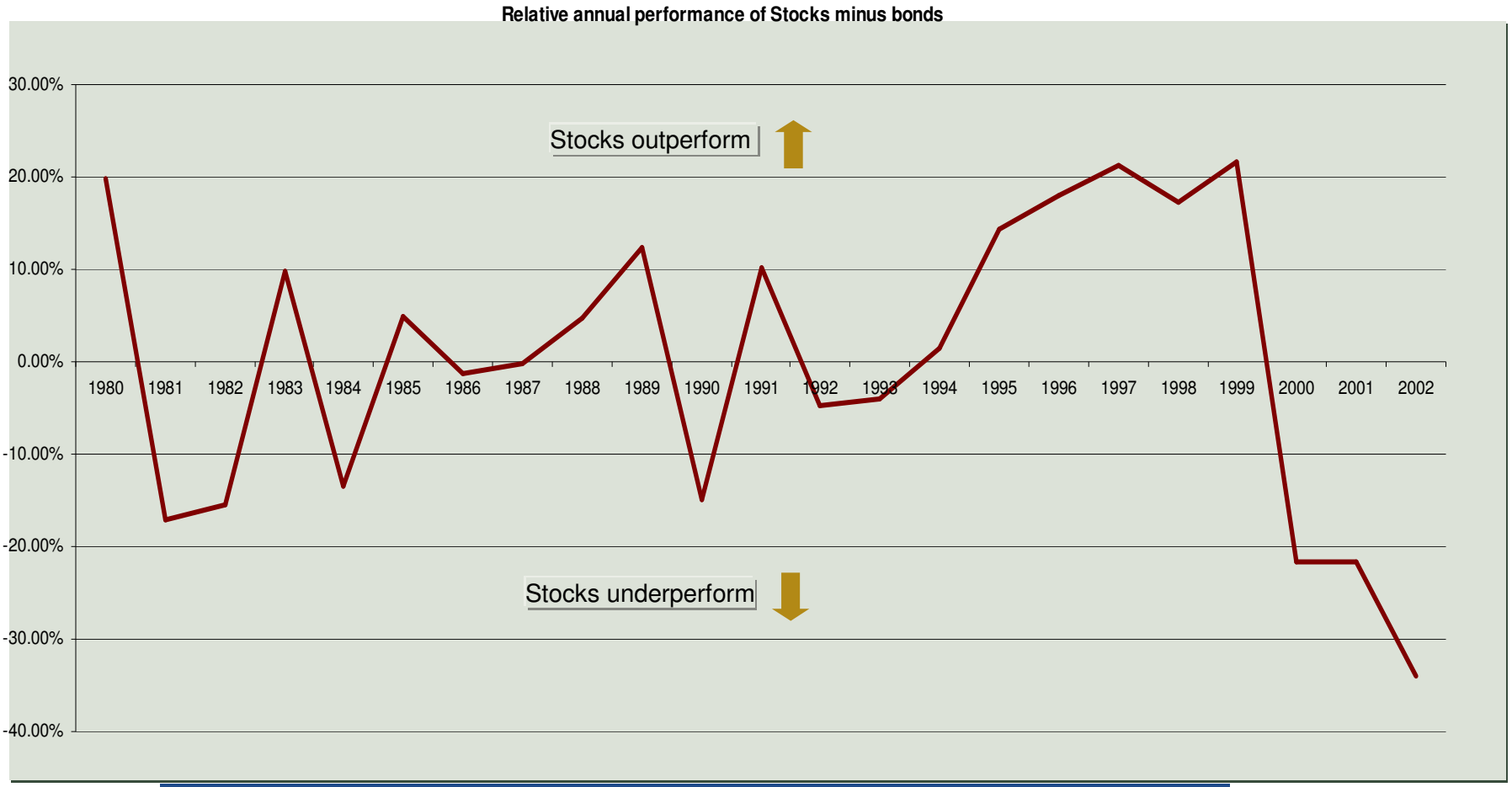
- Asset allocation case studies
  - Inclusion of hedge funds and leverage (asset-only)
  - asset-liability studies (comparison with mean-variance analysis)
  - managing under-funded schemes (importance of contribution policies)

- Risk measurement versus risk management

- Performance
  - attribution
  - risk-adjustment
  - manager selection

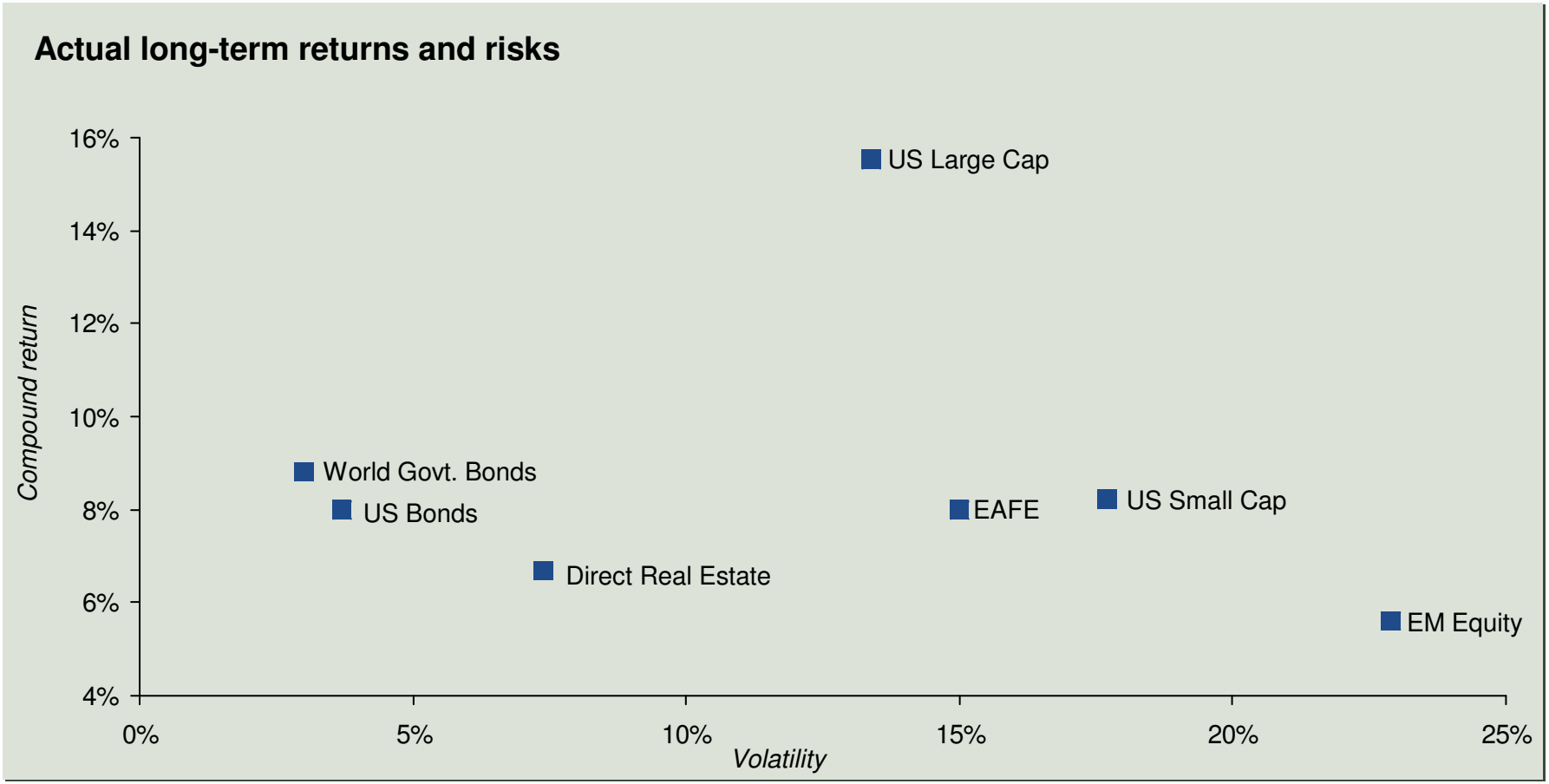
An adverse pension event of historic proportions

S&P 500 vs. Citibank Government/Corporate (trailing 1 year excess return)



2003 was good but pension plans are still recovering

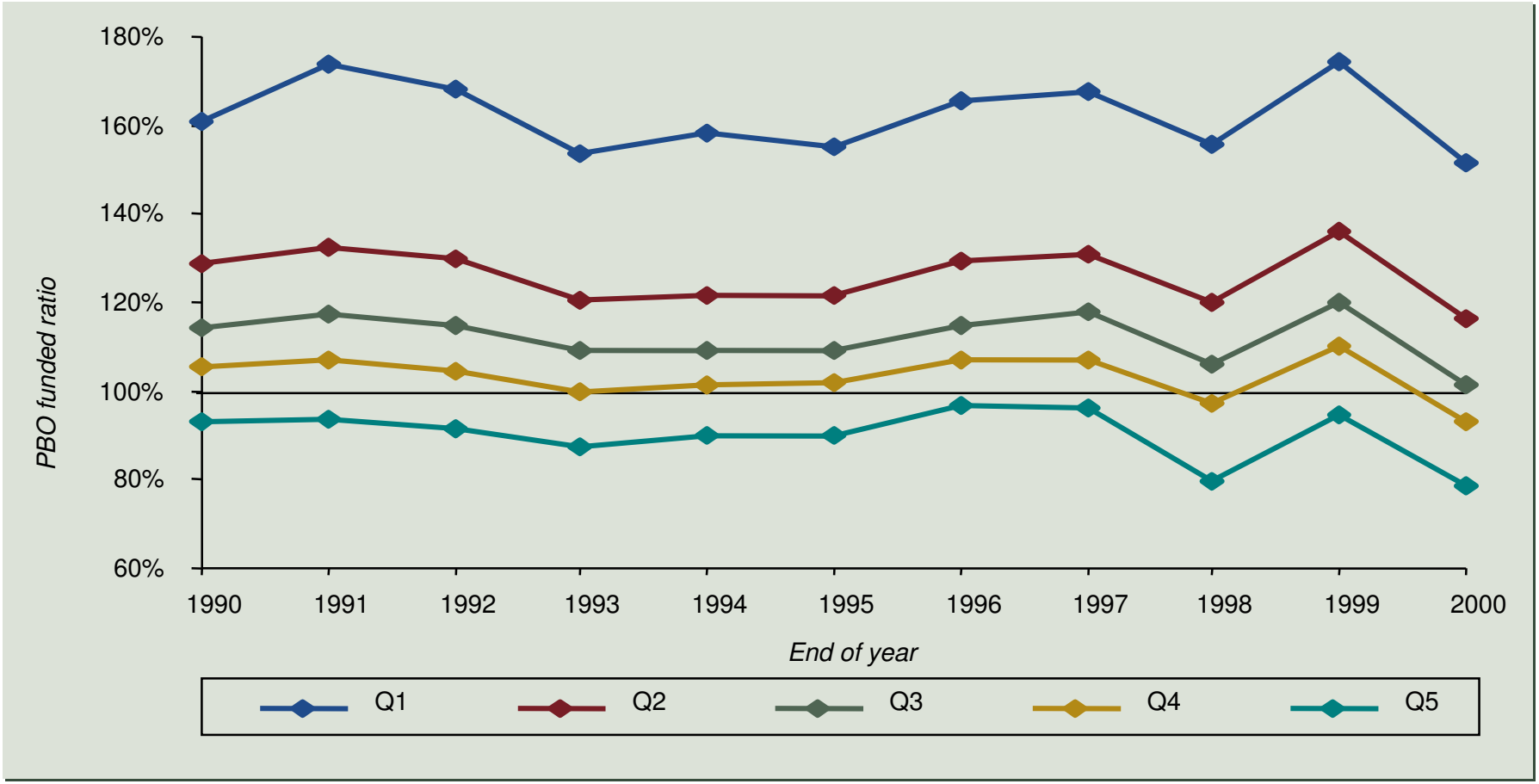
The largely domestic bias helped U.S. clients through 2000



Ten years ended December 2000.

Funded status fell in the U.S.A. before the market collapsed

Average funded ratio for corporate pension plans with assets between $400 million and $1 billion



Source: Compustat/JP Morgan Investment Management

Historical and future returns in Japan – difficult times ahead

Historical Index Return/Risk (*in JPY*)
(Period: 1994/1-2003/12)

Asset Class	*Annualized Return*	*Expected Return(*)*	*Annualized Risk*
Inflation	-0.01%	0.37%	1.2%
Domestic Cash	0.50%	0.50%	0.7%
Domestic Bond	3.23%	1.00%	3.8%
Domestic Equity	-0.83%	6.00%	17.5%
Foreign Bonds (Unhedged)	7.91%	3.00%	12.2%
Foreign Bonds (Hedged)	2.64%	2.00%	3.7%
Foreign Equity (Unhedged)	10.44%	7.00%	18.3%
Foreign Equity (Hedged)	9.95%	4.61%	15.4%
US High Yield Bond (Unhedged)	7.72%	4.48%	15.0%
Emerging Bond (Unhedged)	12.98%	6.56%	22.0%
Emerging Equity (Unhedged)	3.28%	7.81%	26.1%

(*) These Expected Returns are hypothetical estimates.

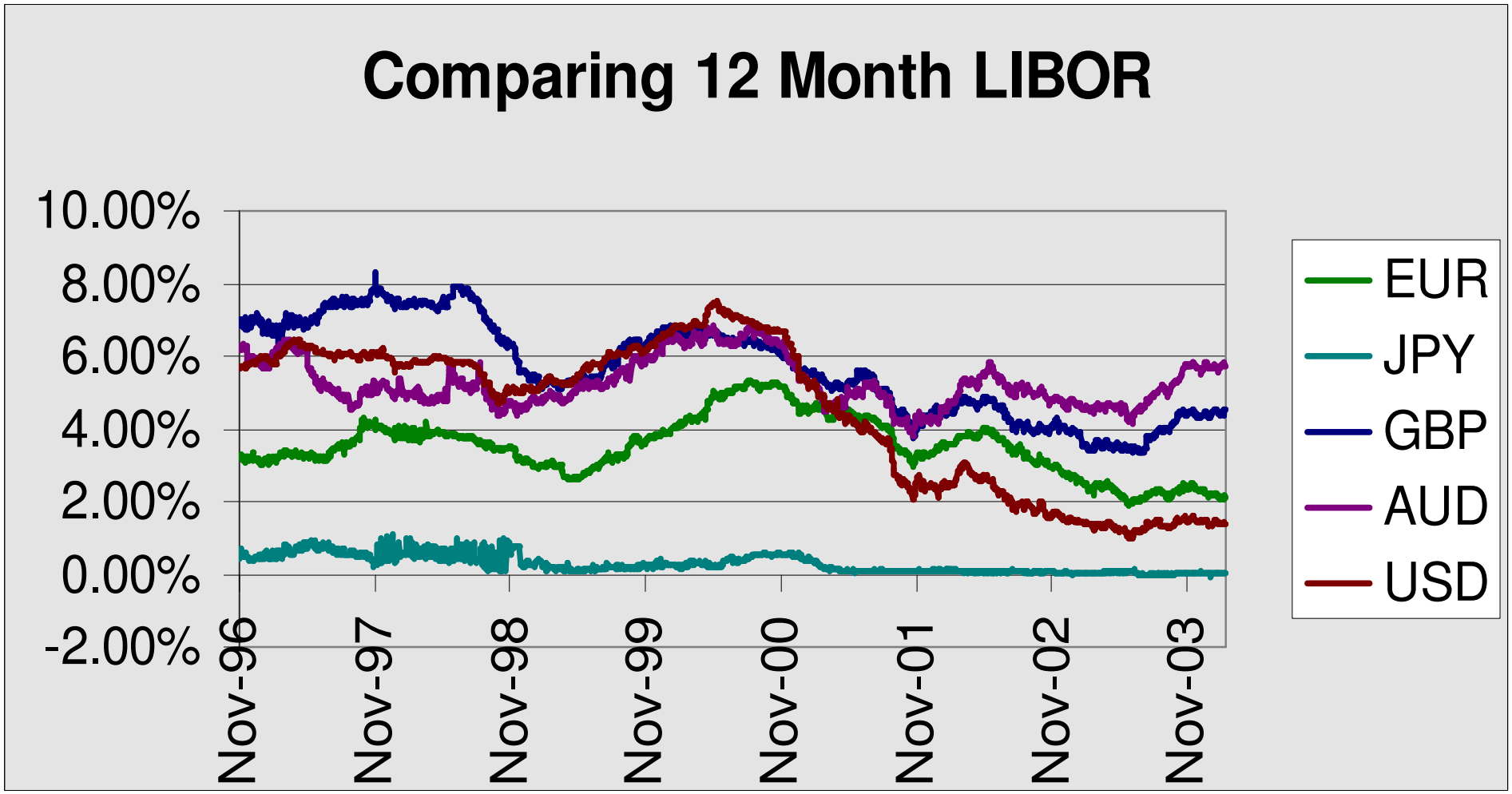
Some are based on Japanese Pension Fund Association's estimates which are obtained by Building Block calculation. In this calculation, the risk premium of each asset class is estimated from historical average return of last 32 years. And some modifications are made to this PFA's estimates.

Others are estimated assuming that price of risk is constant.

(**)Hedged index is not available, so local index is alternatively used in calculating statistics of Foreign Equity Hedged).

Source: SGPM

Future looks less attractive for the US and Japan



Source: Bloomberg

Funds will need to be innovative to meet obligations

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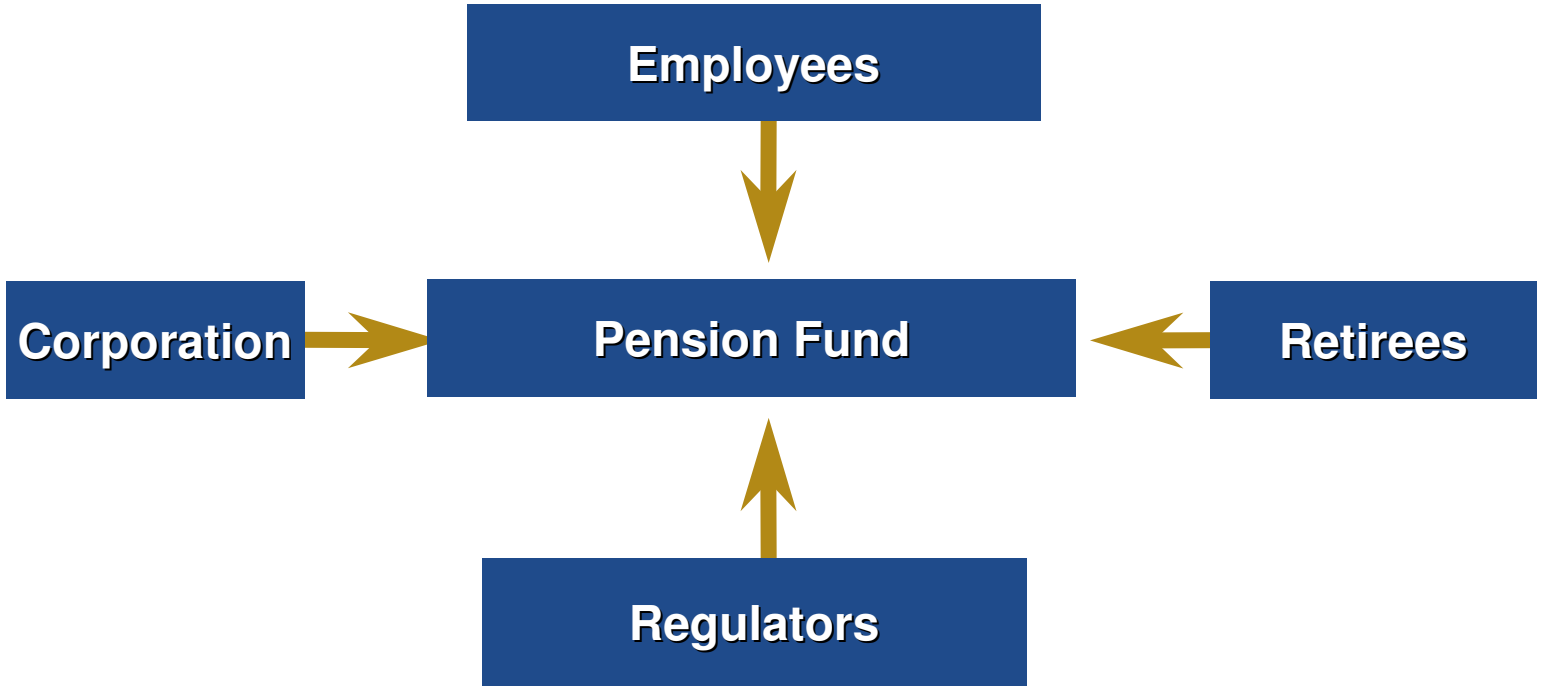
A pension fund is a very complex entity



Raises many issues about risk, contributions, surplus and objectives

Keys to success – good process

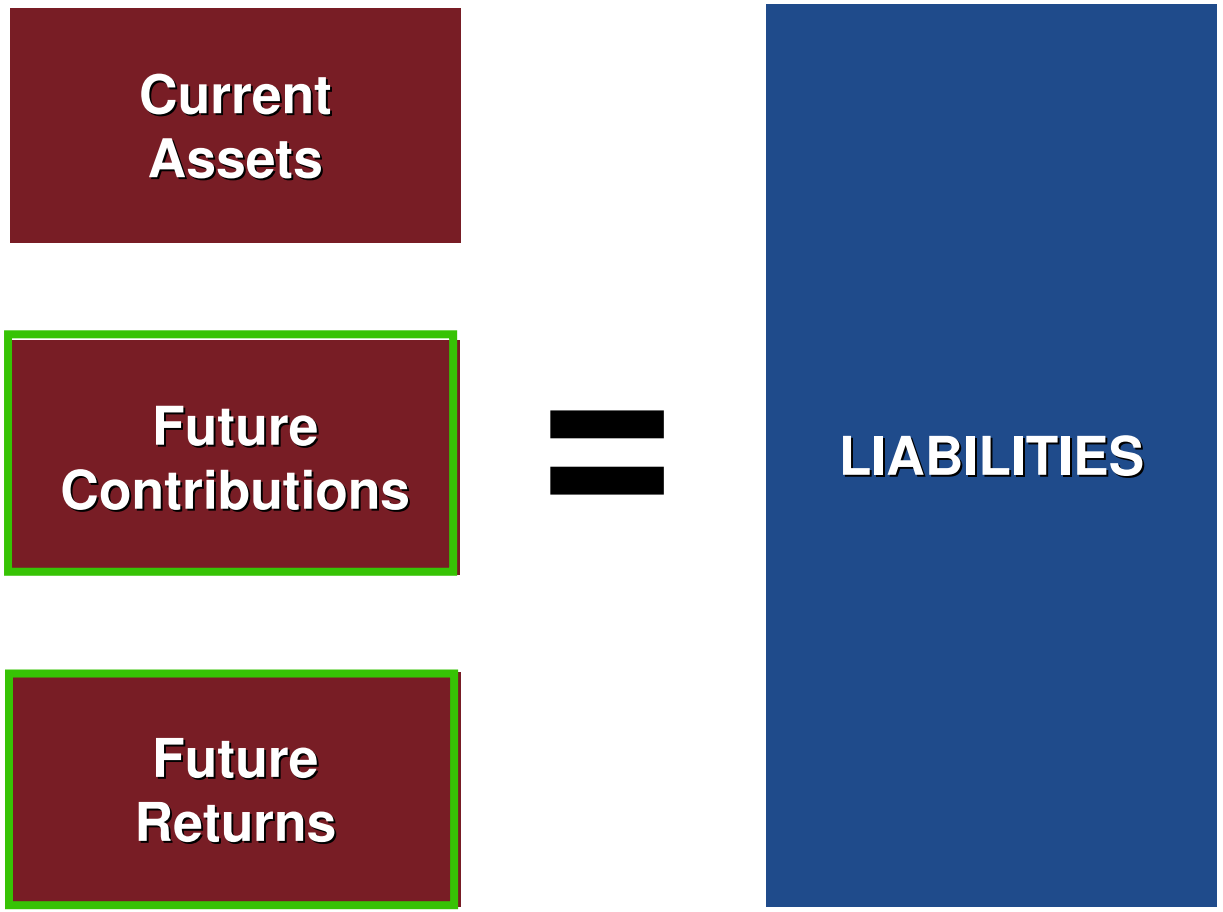
What do pension plans struggle with?

Barriers to excellence	Cited
Poor process	98%
Inadequate resources	48
Lack of focus or of clear mission	43
Conservatism	35
Insufficient skills	35
Inadequate technology	13

Important to have good investment and research staff

Source: Financial Analysts Journal, Nov/Dec, 1998 – a survey of 50 pension CEOs

The pension fund balance sheet



Funded ratio = assets/liabilities

Pension fund objectives – can be very complex

- Funding policy
  - funded ratio (level and volatility)
  - contribution rate (level and volatility)

- Investment policy
  - expected return and risk
  - performance relative to benchmarks
  - performance relative to peers
  - guaranteed rate of return
  - impact on net income, net equity etc.

Simple mean-variance analysis will struggle

Plan's key objectives and the associated potential risks

Plan objectives

- Minimize required contributions
- Preserve funded status
- Minimize income statement impact

Potential risks

- Funded status may deteriorate
- Increased contributions help
- Long-run return may be sacrificed

Some objectives can conflict with others

Identifying and ranking objectives – an example

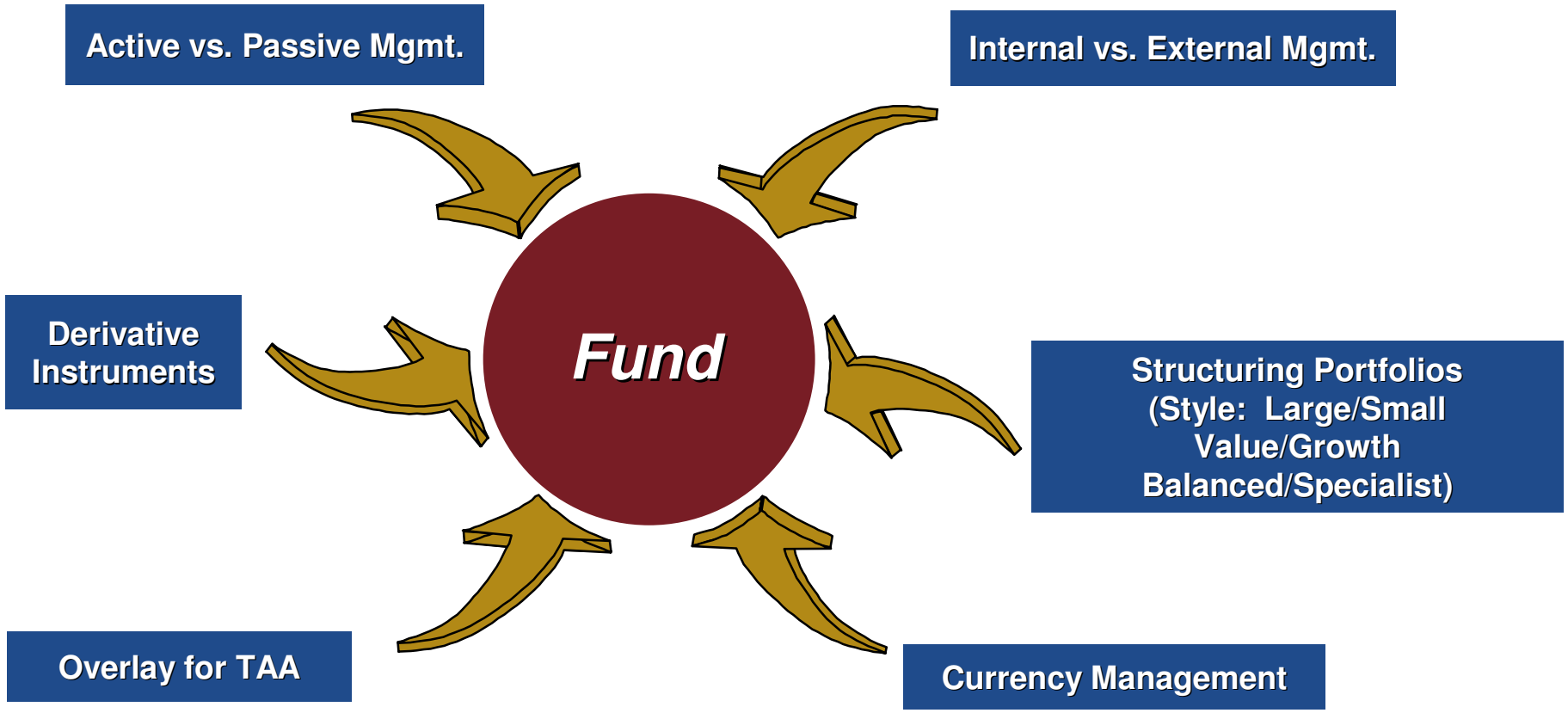
Objective	Relative importance	Targets
Maximize expected return	First	10%
Asset-liability management		
- Funded ratio	Second	100%
- Contribution rate and volatility	Third	10%
- Pension income	Fourth	maintain
- Real rate of return	Fifth	4%
Performance		
- Relative to peers	Sixth	+/- 2% pa
- Relative to benchmark	Seventh	+/- 3% pa

Example of a good benchmark – clear specification

Asset class	Benchmark	Target (%)	Range (%)
U.S. Equities	Wilshire 5000	50	40-60
Non-U.S. Equities	MSCI EAFE	20	10-30
U.S. Fixed Income	Salomon BIG	10	5-15
Non-U.S. Fixed Income	Salomon World	5	0-10
Private Equities	Brinson Partners	6	2-8
Real Estate	NCREIF Property	6	3-10
Cash	6 Month LIBOR	3	0-5

The benchmark provides the "beta" relative to liabilities!

Implementation of an investment policy

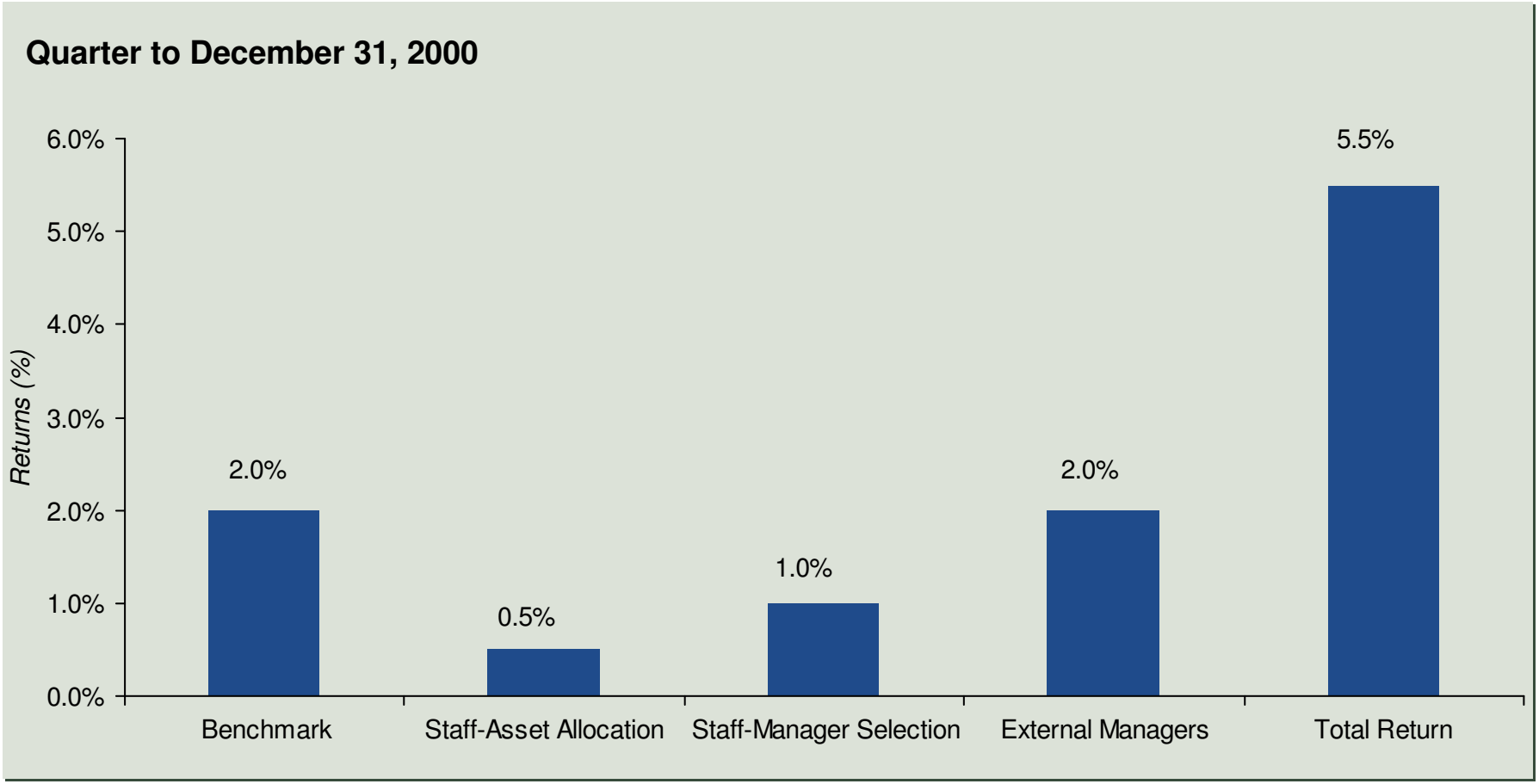


Clients need to be creative to meet return targets

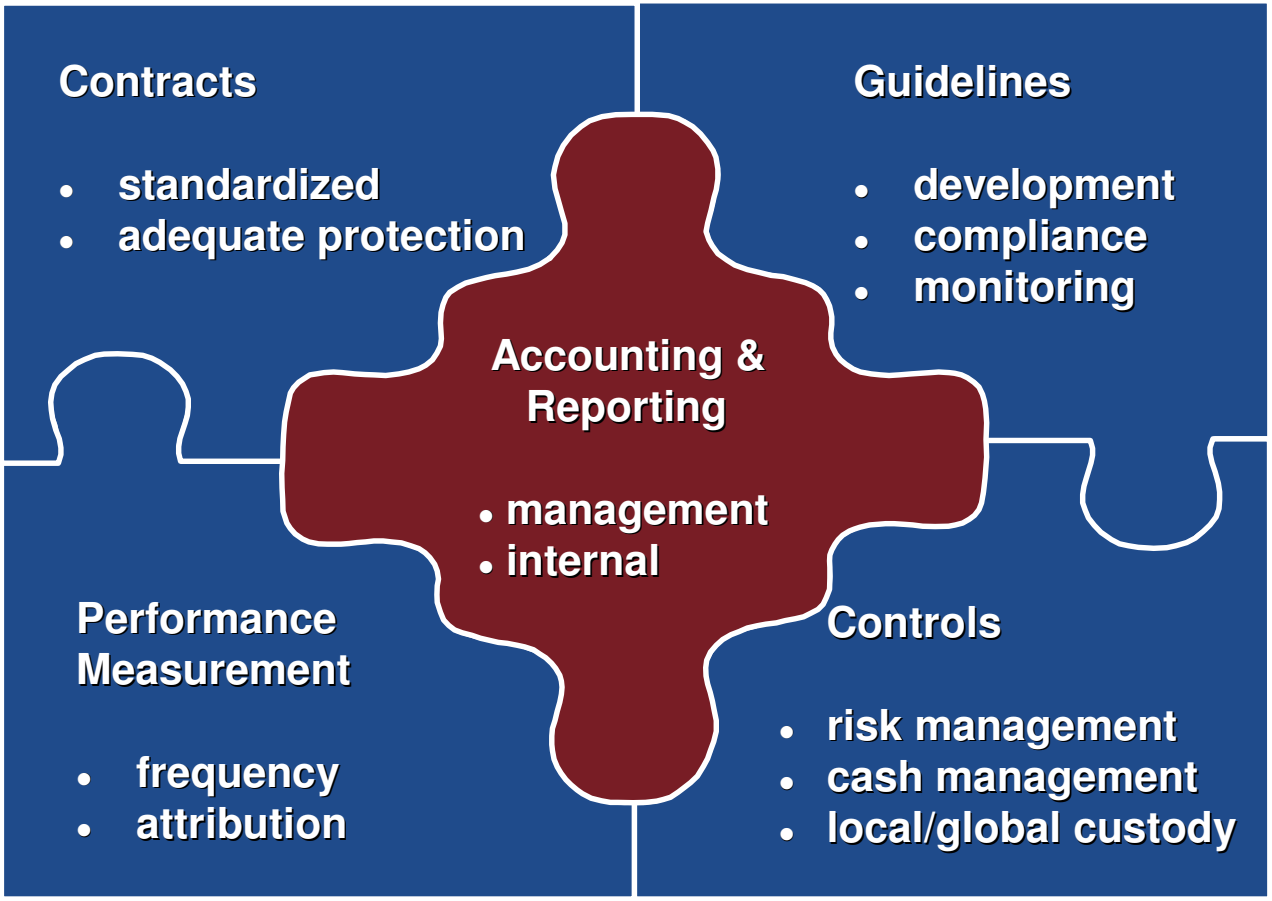
The M^3 of pension fund risks – Measure, Monitor & Manage

	Asset-liability risk (Committee)	Tactical risk (Staff)	Active risk (Managers)
Measure	Funded ratio/ contribution rate	Tracking error or Value-at-Risk	Tracking error or Value-at-Risk
Monitor	Annually	Monthly/Daily	Monthly
Manage	Strategic allocations and funding policy	Asset allocations	Manager allocations

Attribution – should reflect how decisions are made



Implementation issues – strong controls are necessary

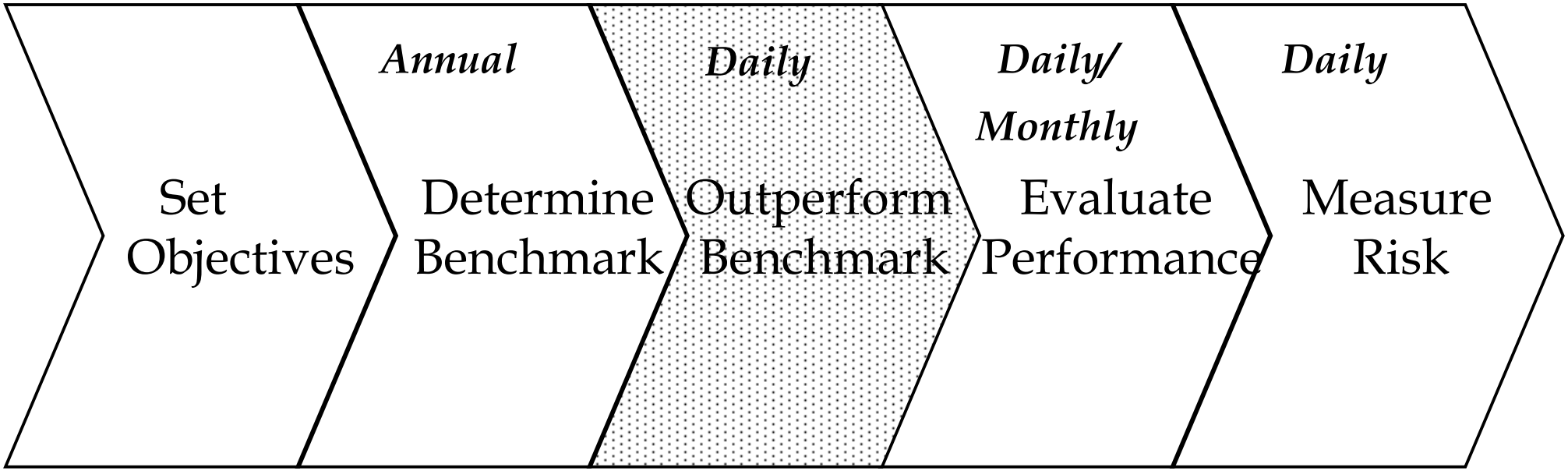


Challenges – many decisions need good process

- Manage cash inflows and outflows
  - Contributions, benefits, dividends, coupons etc.
- Evaluate and improve rebalancing strategies
- Decide on manager allocations
- Tactical asset, country, sector or style allocation

Good decisions can add value;
Unmanaged decisions can increase risk and lower returns

Process for effective management of pension assets

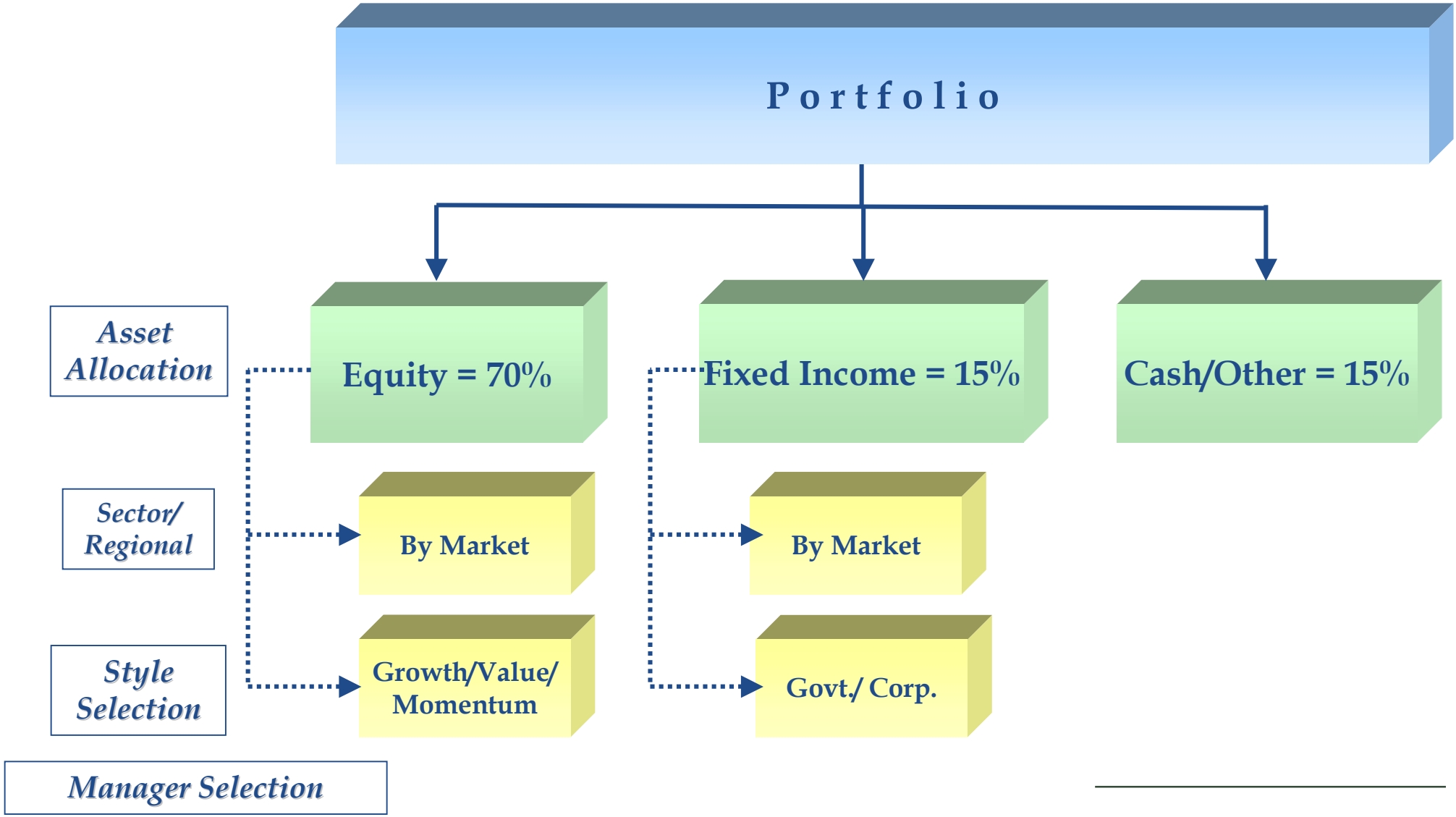


- Establish rules for managing assets (rebalancing, asset allocation etc.)
- Periodically monitor rules and update
- Have transparency to allow for good governance/oversight of decisions

Beta (benchmark) risk is managed annually; alpha daily

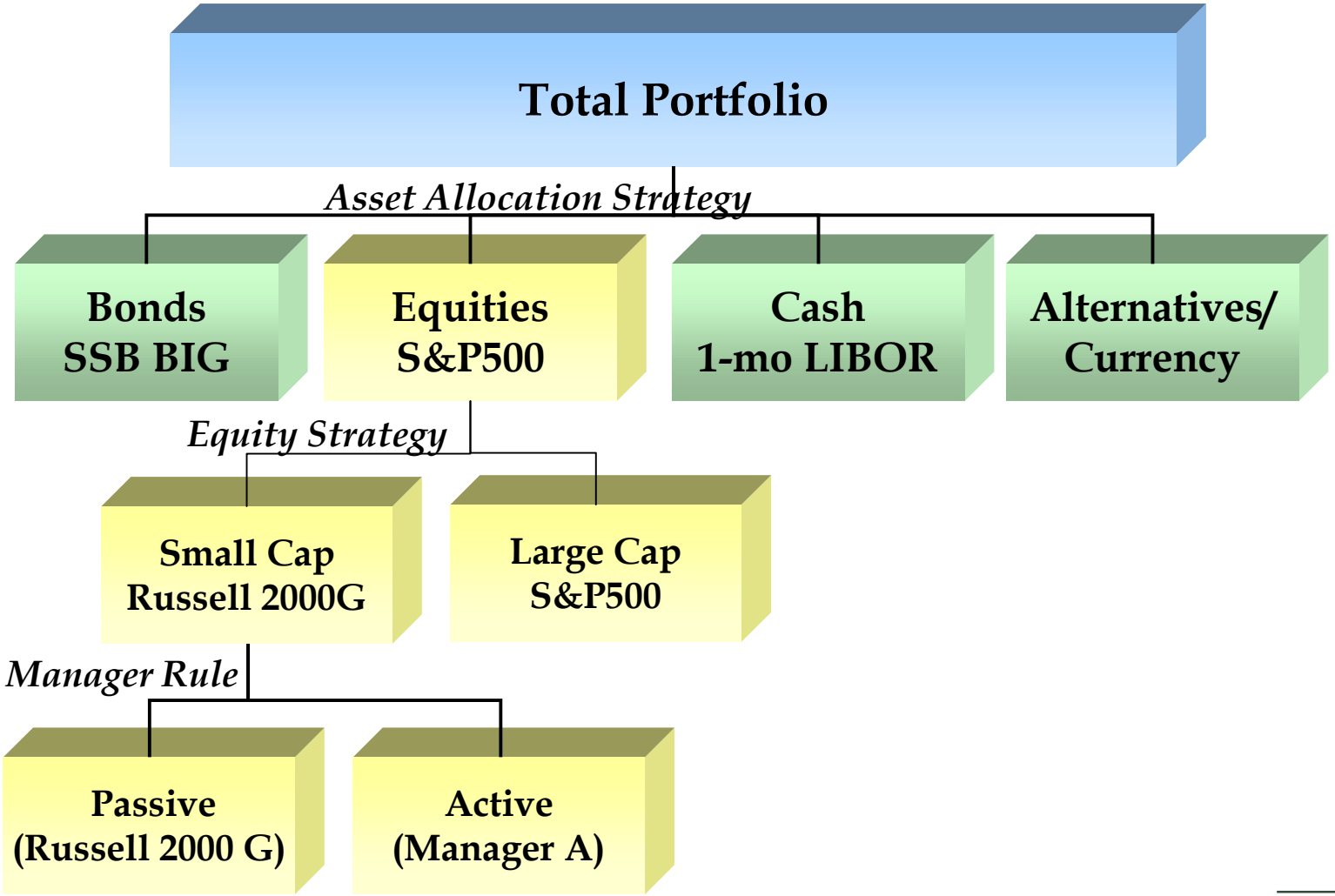
Source: Mcube Investment Technologies

Clearly identify the internal hierarchy of decision making



Source: Mcube Investment Technologies

Want to create "alpha" from all levels of decision making



Alpha = 2.75%

Alpha = 2%

Alpha = 0.5%

Alpha = 1%

Source: Mcube Investment Technologies

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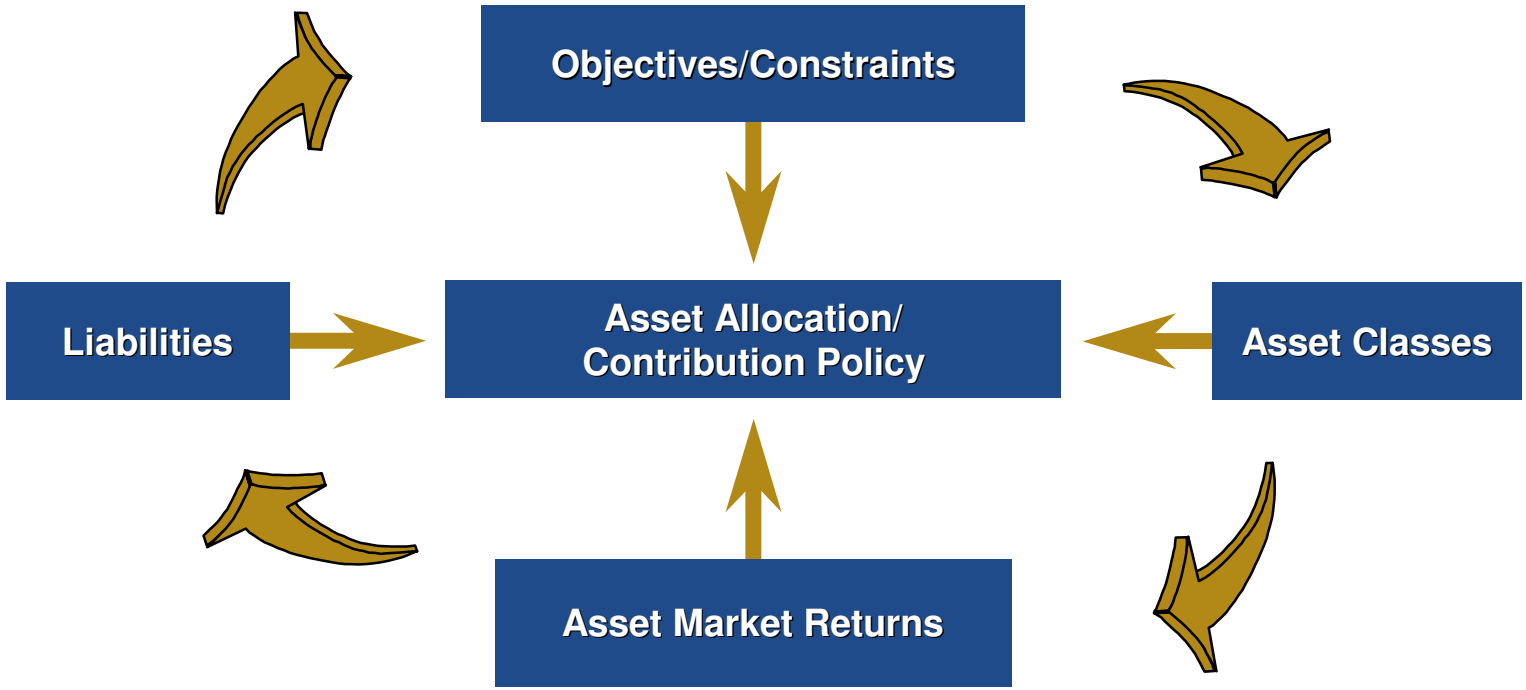
Two choice variables – asset allocation and contribution policy



A very dynamic inter-active process – jointly optimize asset allocation and contribution policy

Mean-variance analysis is deficient

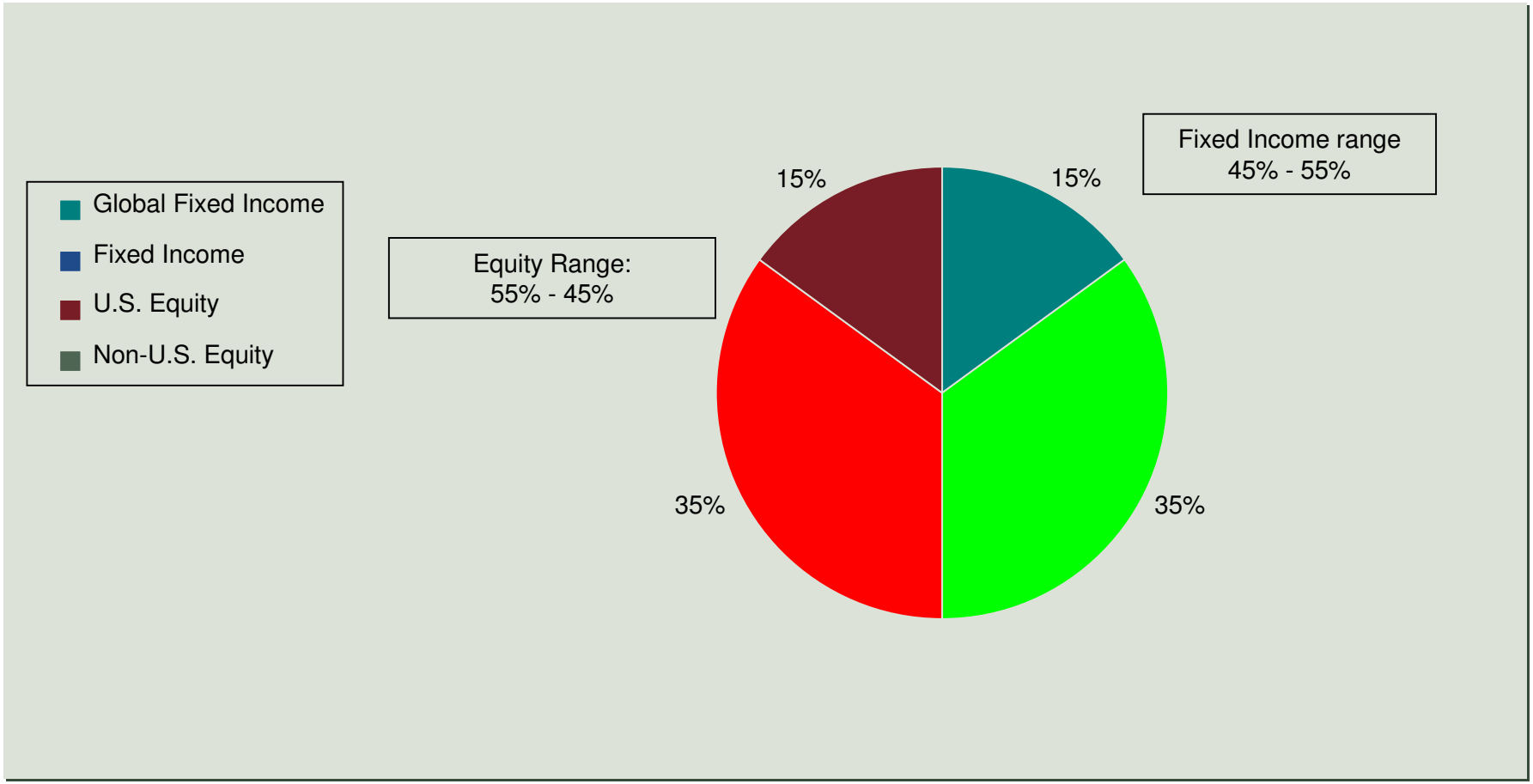
- Naïve approach of maximizing return for given risk is clearly wrong
- Changing the objective to maximize surplus (Assets – Liabilities) ignores the complexity of the pension fund objectives
- Analyses are extremely sensitive to parameter choice (two portfolios near each other on an efficient frontier can be very different in composition).
- Unable to handle objectives over long and short horizons
- Unable to jointly optimize asset allocation and contribution policy
- Unable to develop dynamic asset allocation and contribution policy strategies
- Unable to handle derivatives

Case Study 1 (role of hedge funds) - Initial client objectives

- Objective is to maximize return for benchmark risk
- 11% annual standard deviation is benchmark investment board is comfortable with (return of 8-9%)
- No leverage
- Liquidity not a key consideration
- Emerging markets, high yield, currency overlay and other alternative investments are tactical at investment manager level and not part of strategic allocation

In this case, we ignore liabilities

Target benchmark



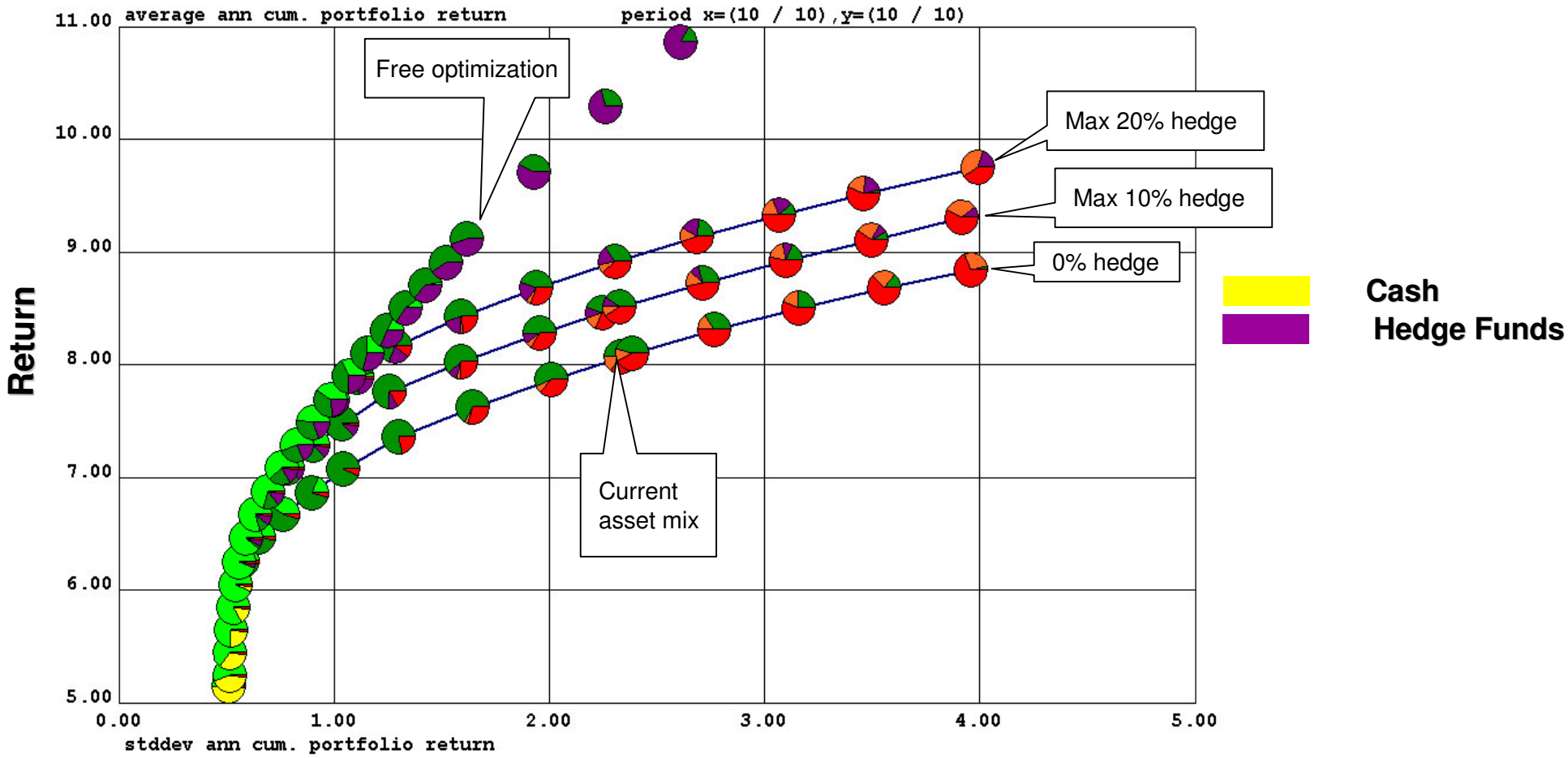
Source: ORTEC Consultants

Revised objectives

- Maximize return subject to risk
- **Minimize the probability of annualized return < 3% (inflation) over the 10 year horizon = RISK**
- Try to keep asset allocations within class consistent (i.e., equities)
- Consider hedge funds
- Consider leverage

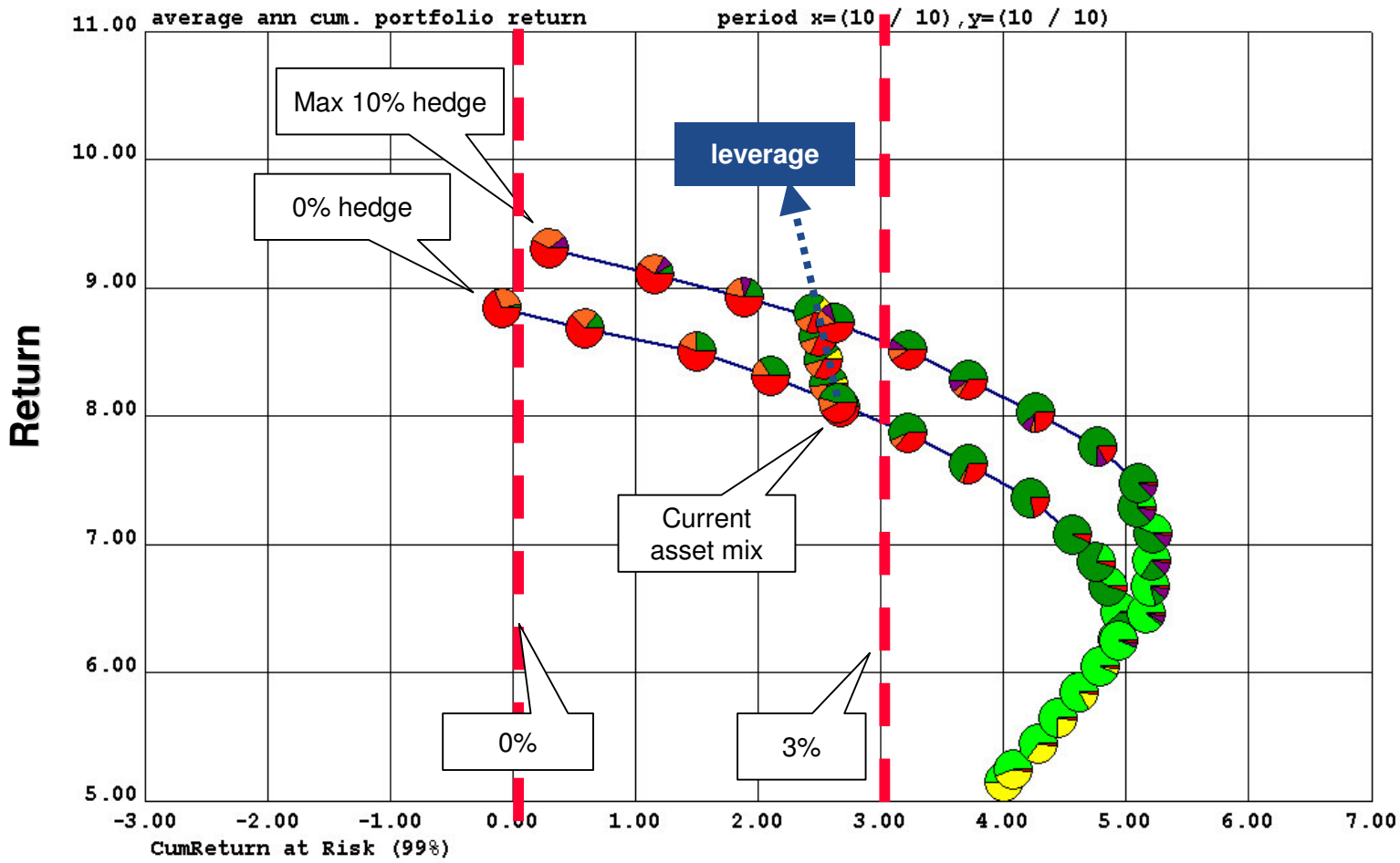
Hedge fund = generic reference to uncorrelated alpha strategies

Efficient frontiers with hedge funds – more is better



Source: ORTEC Consultants

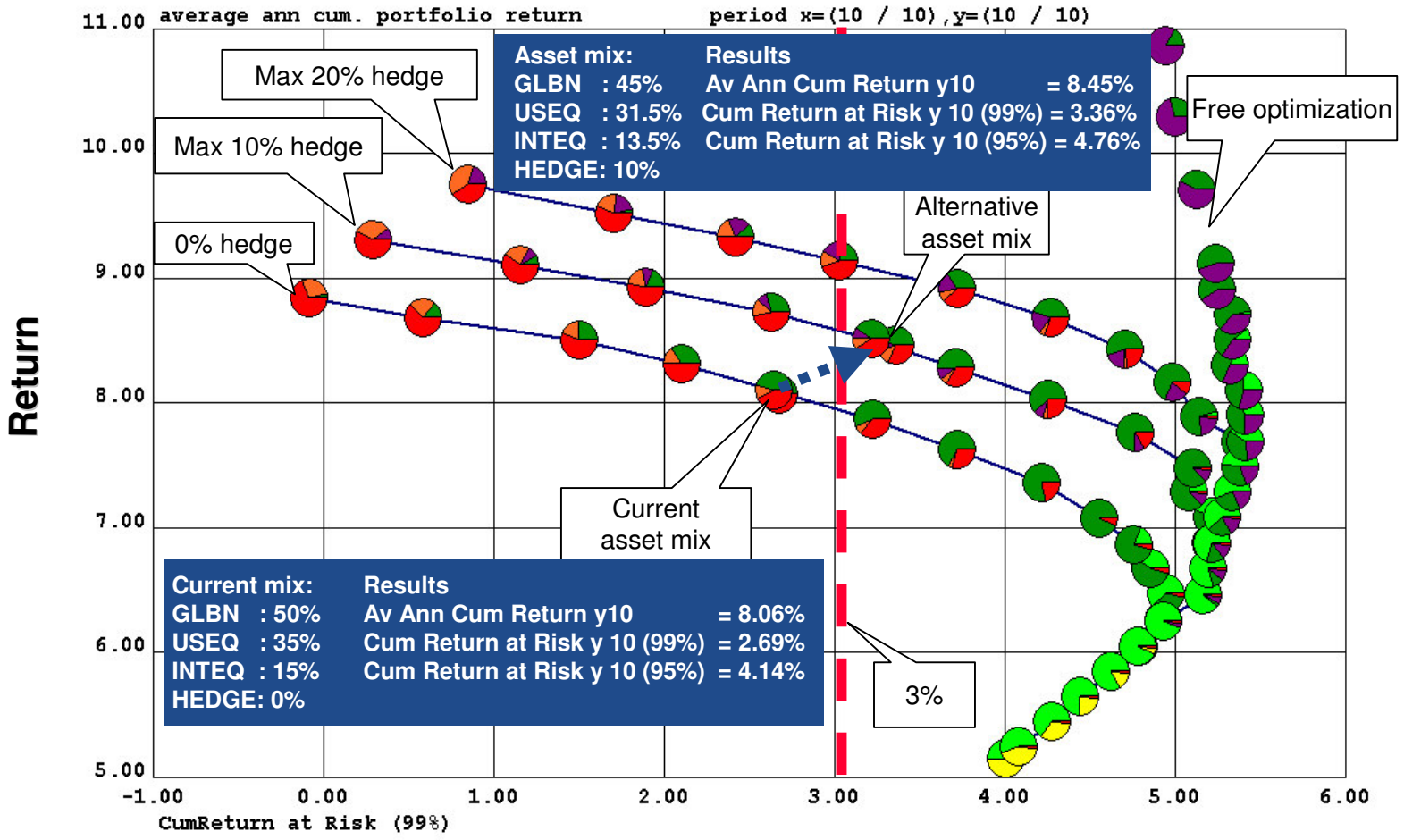
Leverage could be beneficial – could deliver same value as HFs (but does not help with risk)



Client's Risk Measure

Source: ORTEC Consultants

Improve efficiency by adding hedge funds

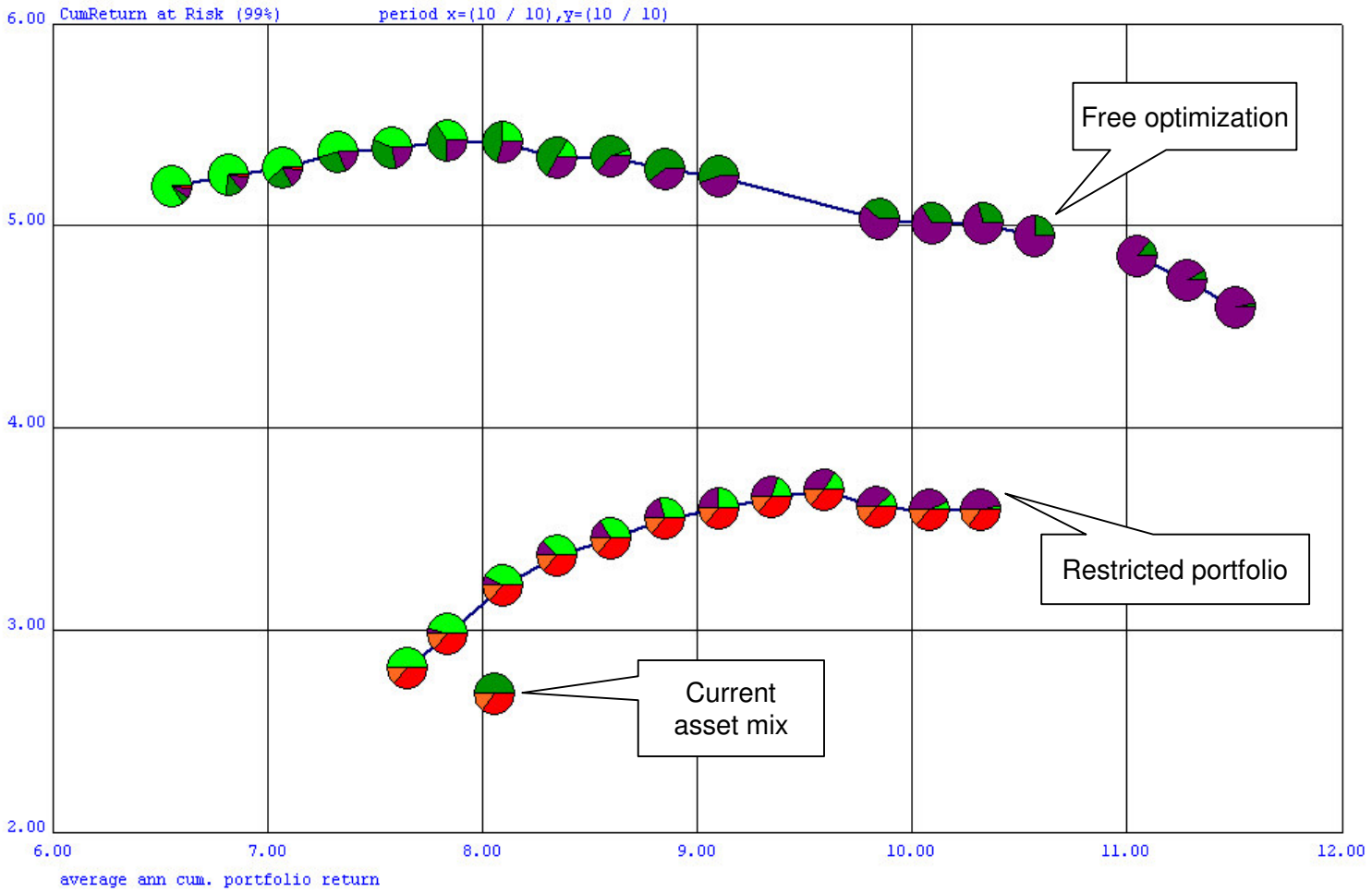


Client's Risk Measure

Source: ORTEC Consultants

Restrictions can be harmful – prevents risk reduction

(e.g., US Equity>=35%, Int'l Equity>=15%)



Restrictions limit the upside on achievable rate of return

Source: ORTEC Consultants

Conclusions for Case Study 1

- Client's current asset mix is on, or near, the Markowitz-efficient frontier if hedge funds are not taken into account
- Client can increase the return on their portfolio without increasing the risk by introducing uncorrelated alpha strategies
- Alternative asset allocation has lower risk profile and a higher expected return
- Leverage can also improve to a higher efficient frontier. To achieve the effect of 10% hedge funds you have to leverage 20%

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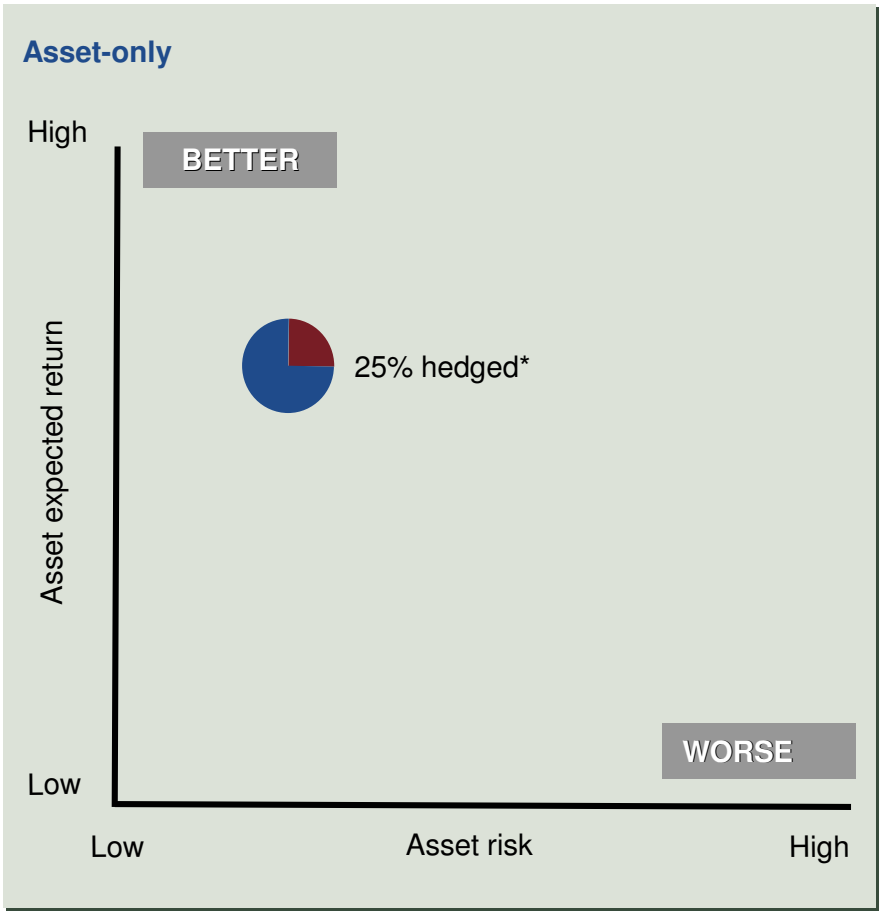
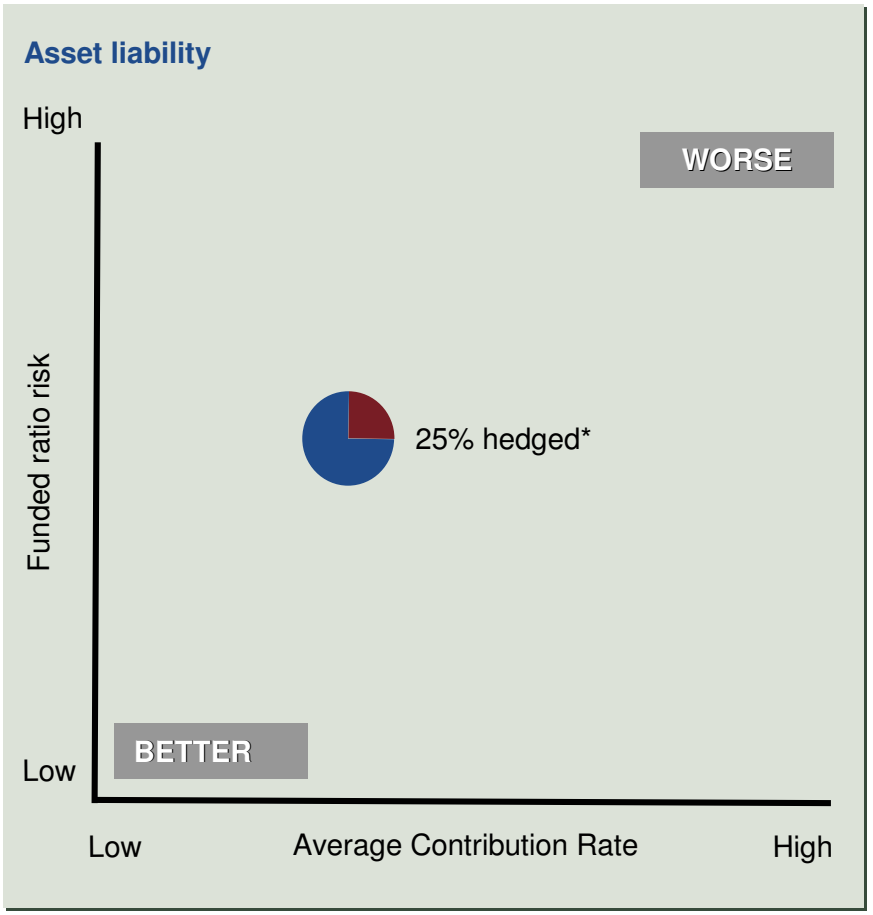
Objectives, targets, risk measures, and weaknesses

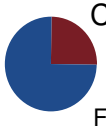
Objective	Target level	Risk measure	Weaknesses
Asset perspective	Maximize return	Minimize volatility	Uncoupled assets and liabilities
Preserve funded status	Expected funded ratio	Mean of funded ratio in lowest quintile	Increased contributions help meet this goal
Minimize contributions	50^{th} percentile of present Value of contributions	Mean contribution in highest quintile	Funded status may deteriorate over time
Minimize income Statement impact	Expected pension expense	Mean pension expense of highest quintile	Long-run return may be sacrificed
Minimize Net Equity Impact	Funded ratio	ABO Funded Ratio versus PBO	Increase contributions

Framework for analysis – case study on foreign exposures

Looking only at the international component





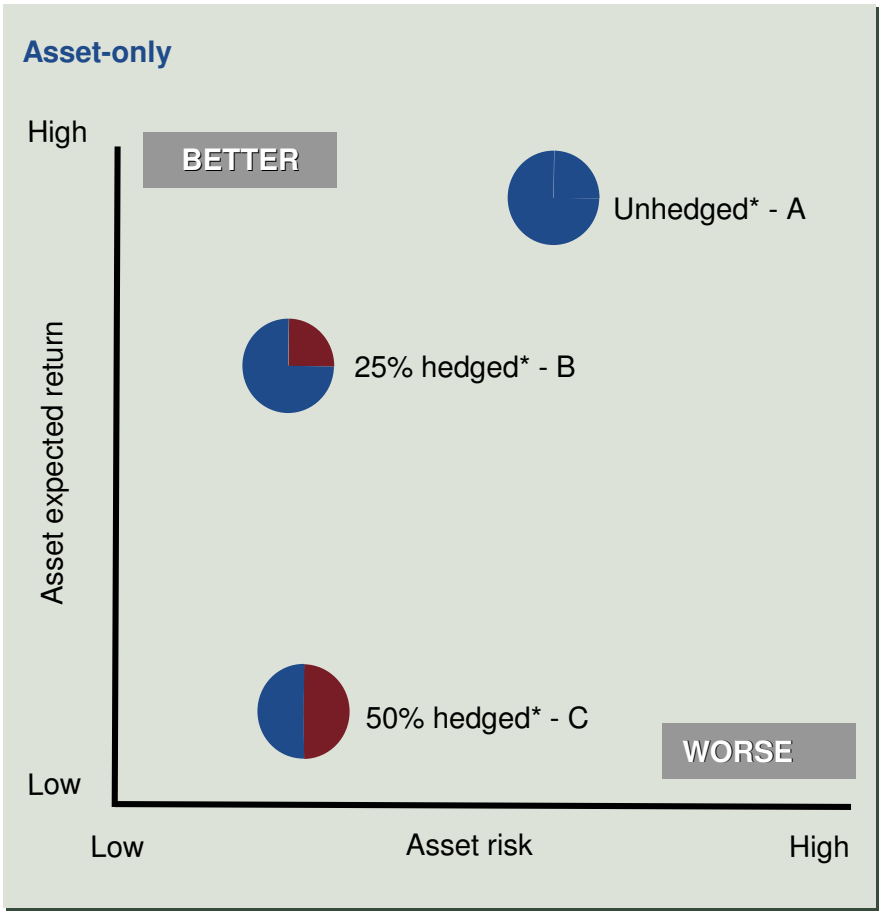


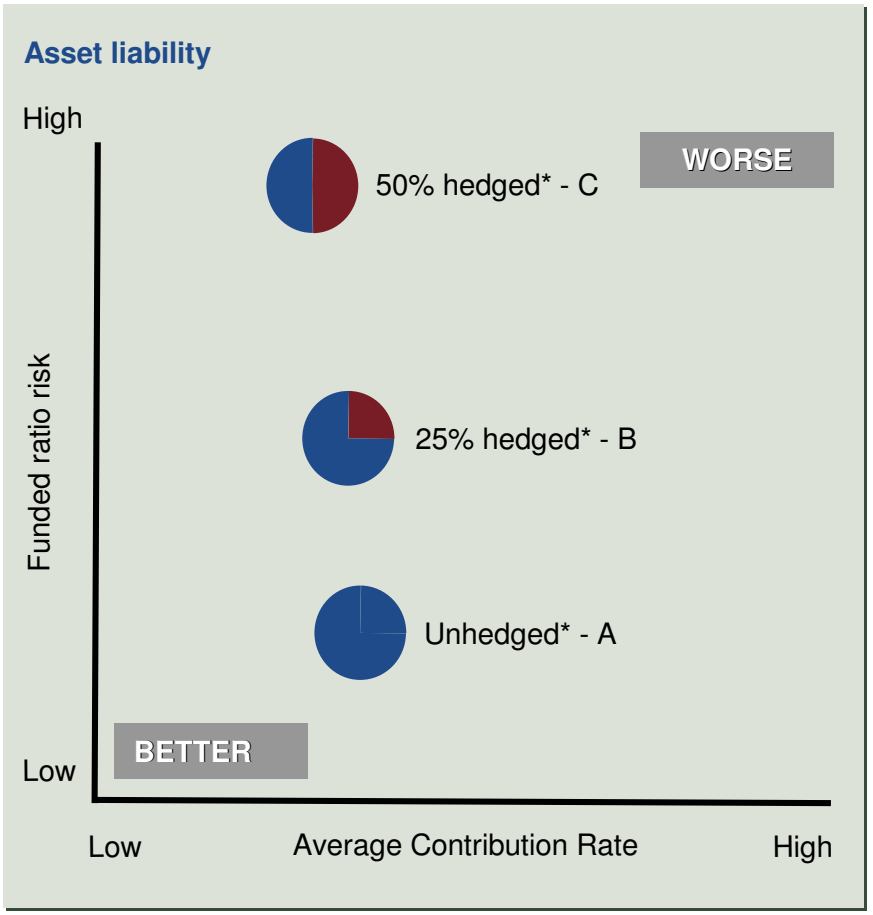
CAD

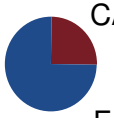
Foreign Exposures

Comparing asset-only to asset-liability analyses – could get different results

Looking only at the international component

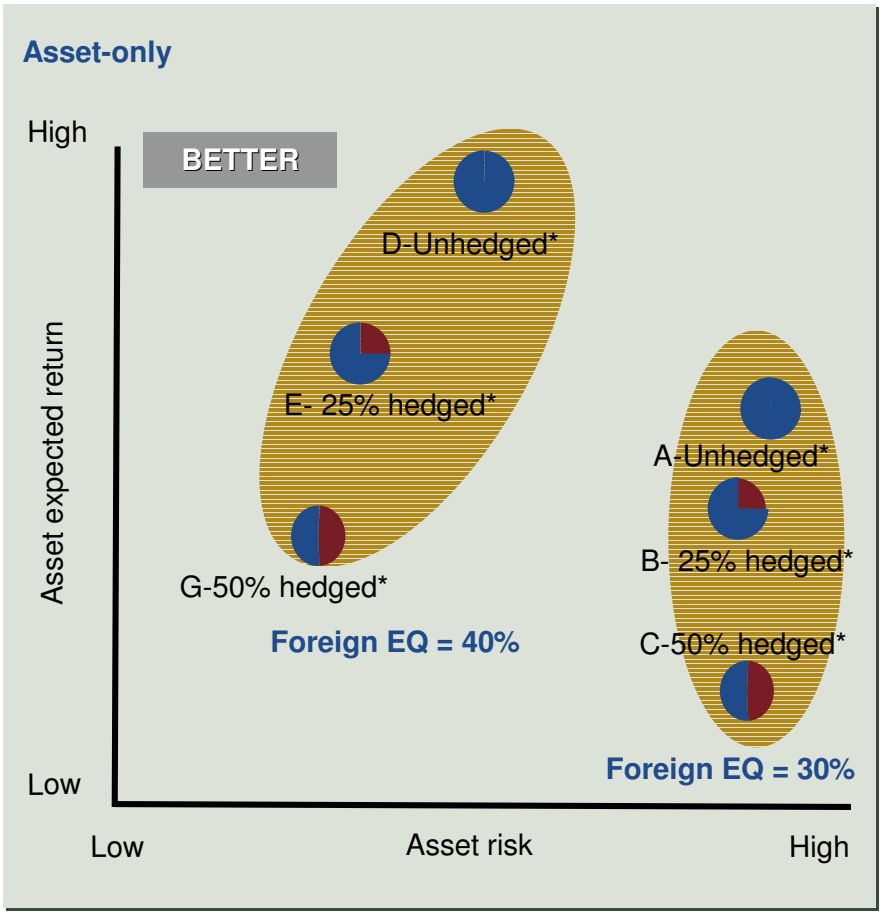


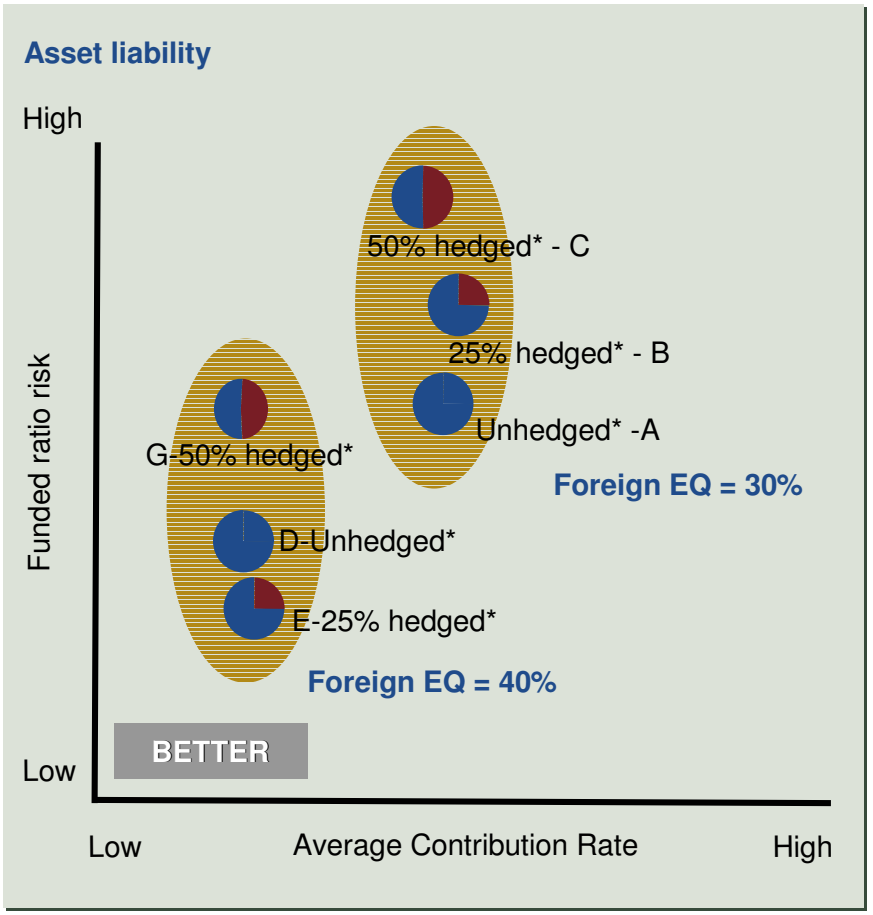


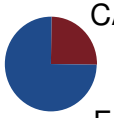


More than 30% abroad is beneficial, but different hedge ratios

Looking only at the international component





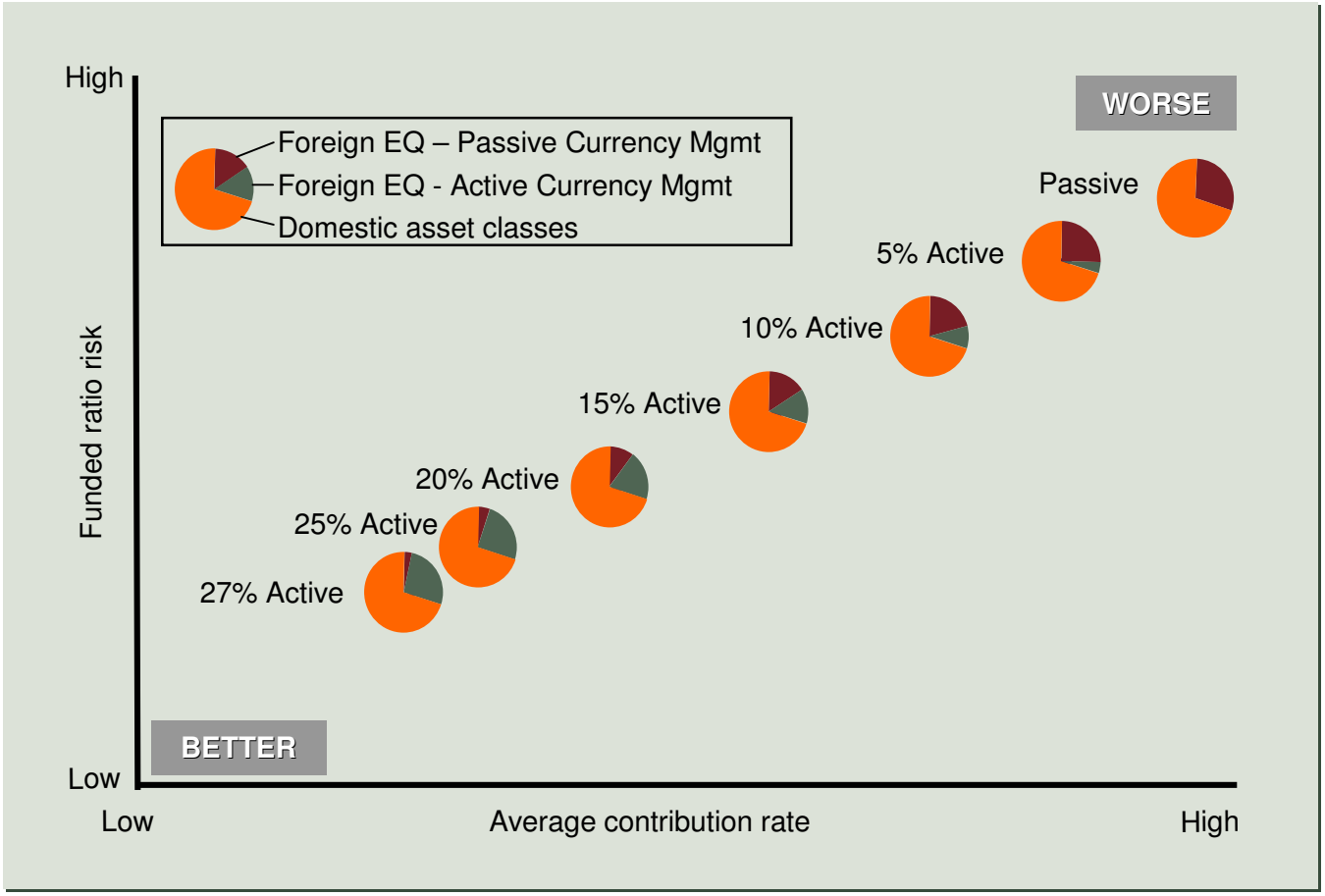


CAD

Foreign Exposures

Active currency management benefits from ALM perspective

Complete portfolio perspective

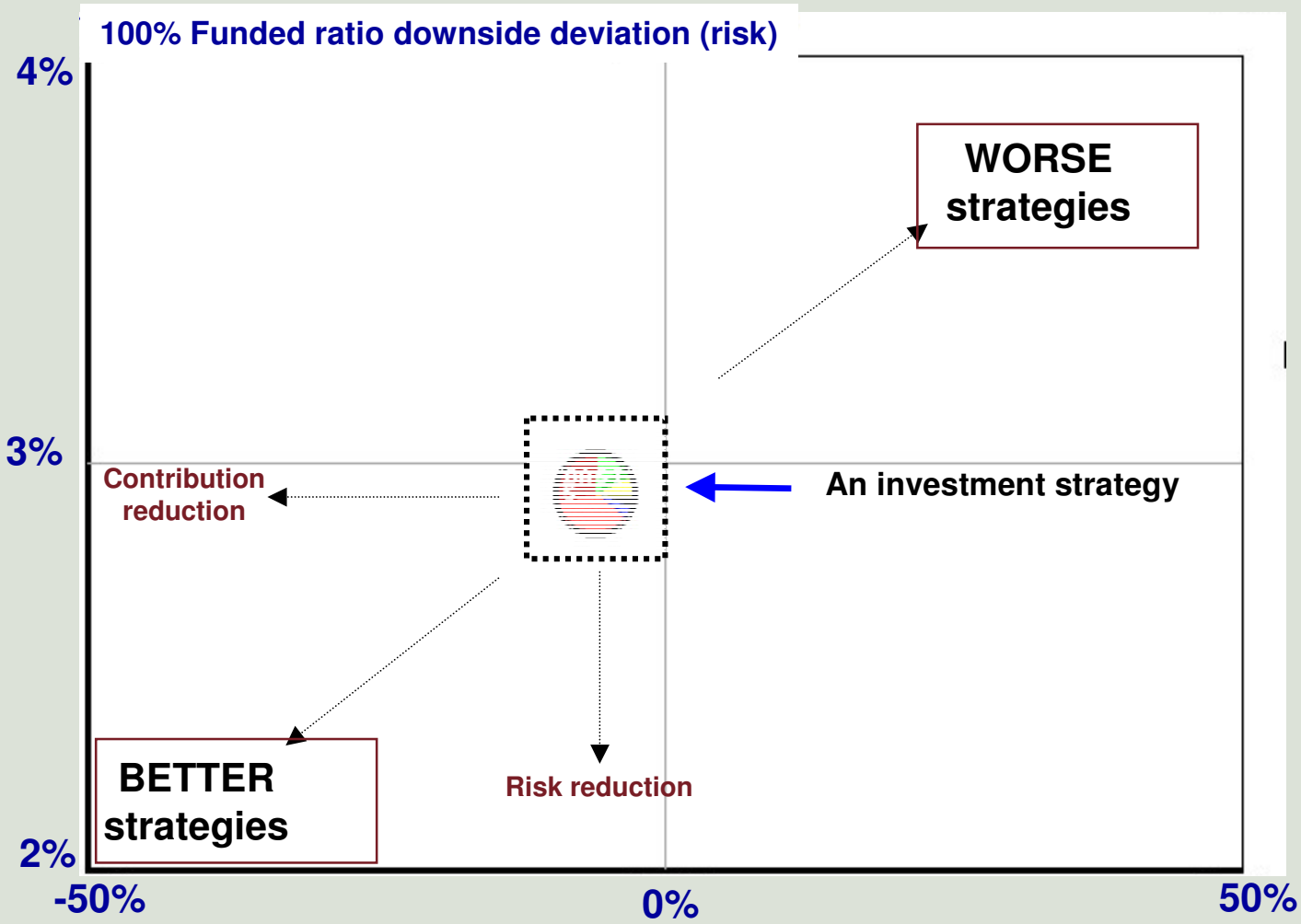


Important to look at "alpha" relative to liabilities!

Extensions in ALM studies – derivatives, leverage, dynamism

- World Bank studied extending standard techniques by using derivatives, allowing for leverage and making dynamic asset allocation (or contributions)
- Derivatives were used to try to guarantee a funded status at year end
  - Looked at both static and dynamic derivative strategies
- Allowed for leverage (constraints on asset limits are arbitrary)
- Alternatively, change asset allocation (view-neutral) and contribution policy based on funded status
  - Example: Allocation to equities = 15% + 0.2*Funded Status in previous period

Framework for strategy comparison

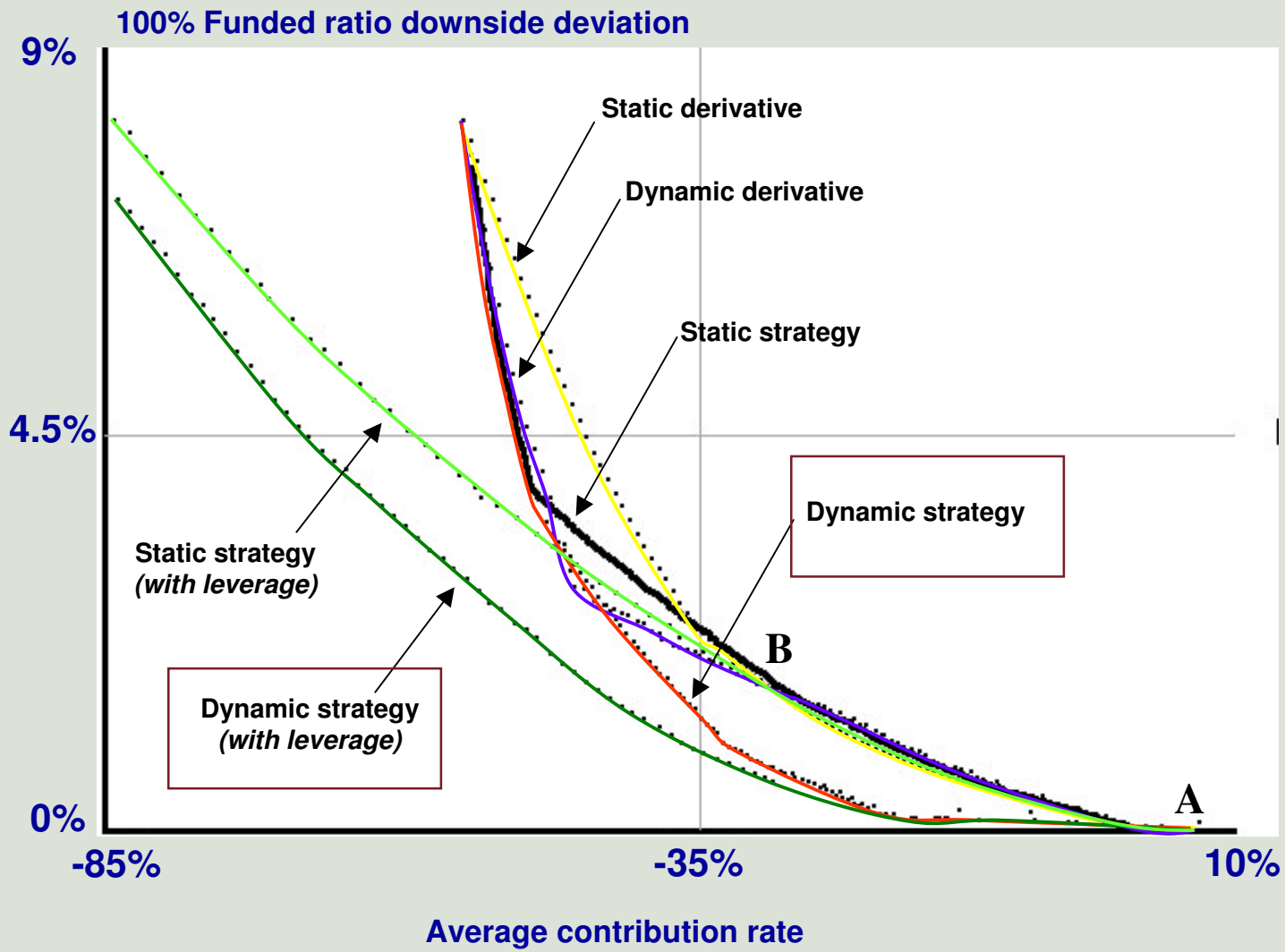


Extensions in ALM studies – derivatives, leverage, dynamism

- Static allocation: Fixed portfolio allocation over the simulation window
- Dynamic allocation: allocation to equity depends on funded ratio
- Static derivative: buy annual put on equity at-the-money
- Dynamic derivative: buy annual put – strike price set to ensure a return on equity to target full funding (limit to 10% of the equity allocation)
- Leverage: allow allocations of assets/cash to be as low as –100%

Dynamic asset allocation policies are best

Dynamic allocation is better than derivatives



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Case study of an under-funded European fund

- Initial position
  - Funded ratio = 63% on a Projected Benefit Obligation basis
  - Approximately 50% in Equity
  - Assumed equity risk premium = 2.5%; bond return = 4.7%

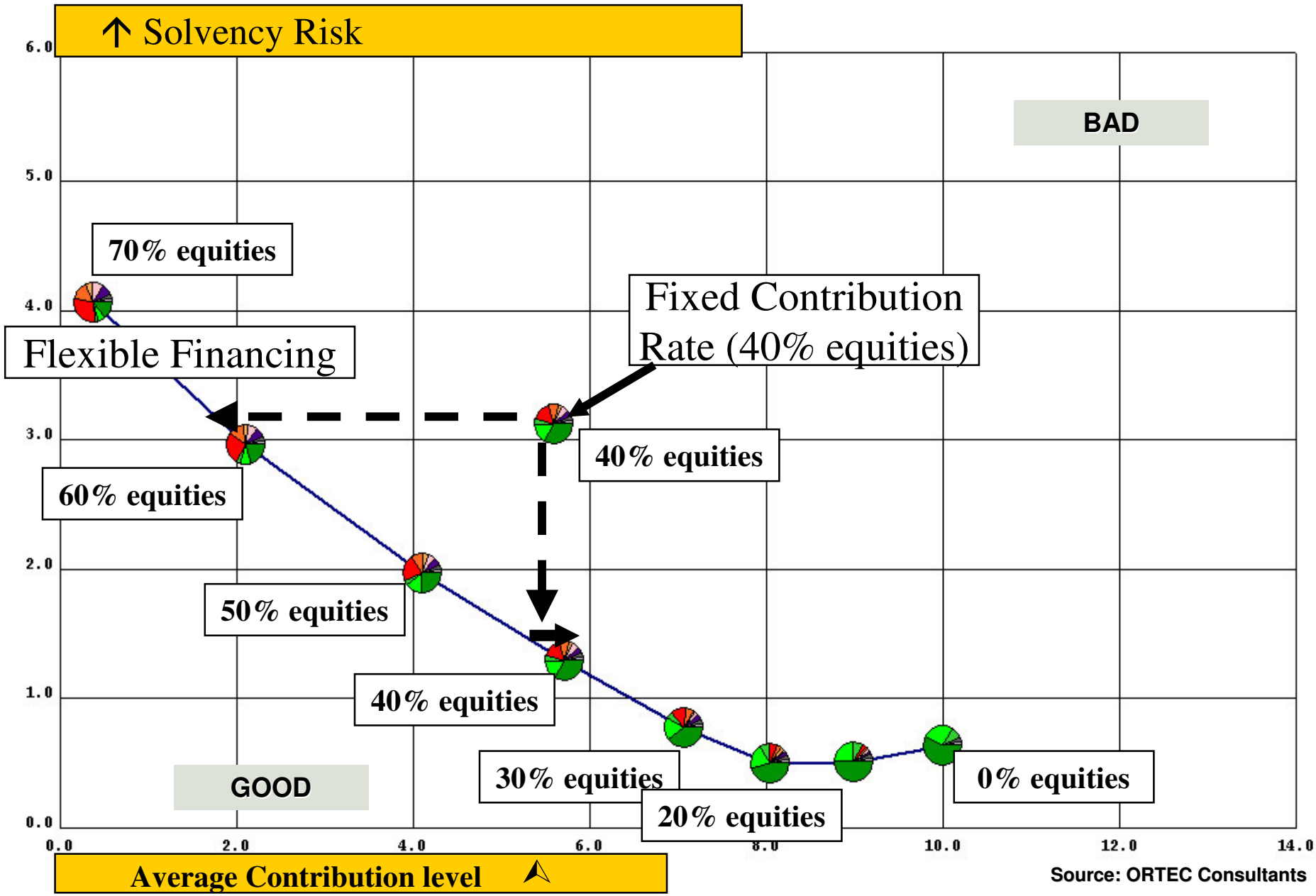
- Three contribution policy options
  - (A) base case or FIXED LEVEL : 176 mio E per year from 2003 till 2010
  - (B) alternative or HIGH: 603 mio E in 2002, plus 203 E per year till 2010
  - (C) flexible or DYNAMIC: from 2003 till 2010: max 406 mio E; min 0 E

- Risk is defined as follows:
  - Want a probability of 5% PBO at Risk in 2010 (%PBO)
  - Minimize the probability that funded ratio in 2010 smaller than 90%

In severe underfunding, contribution policy is more important than asset allocation

Source: ORTEC Consultants

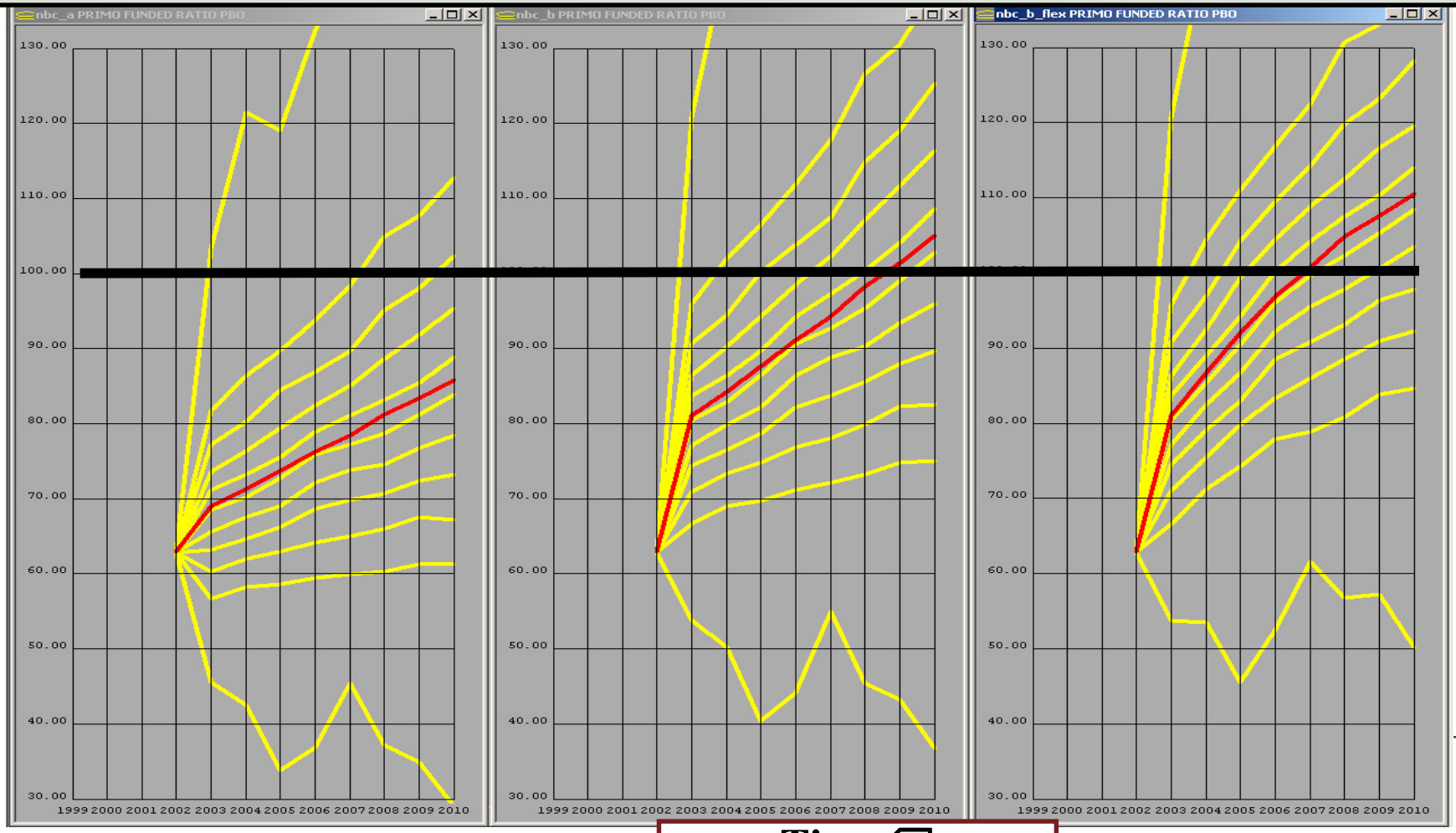
How flexible contributions can be beneficial



Source: ORTEC Consultants

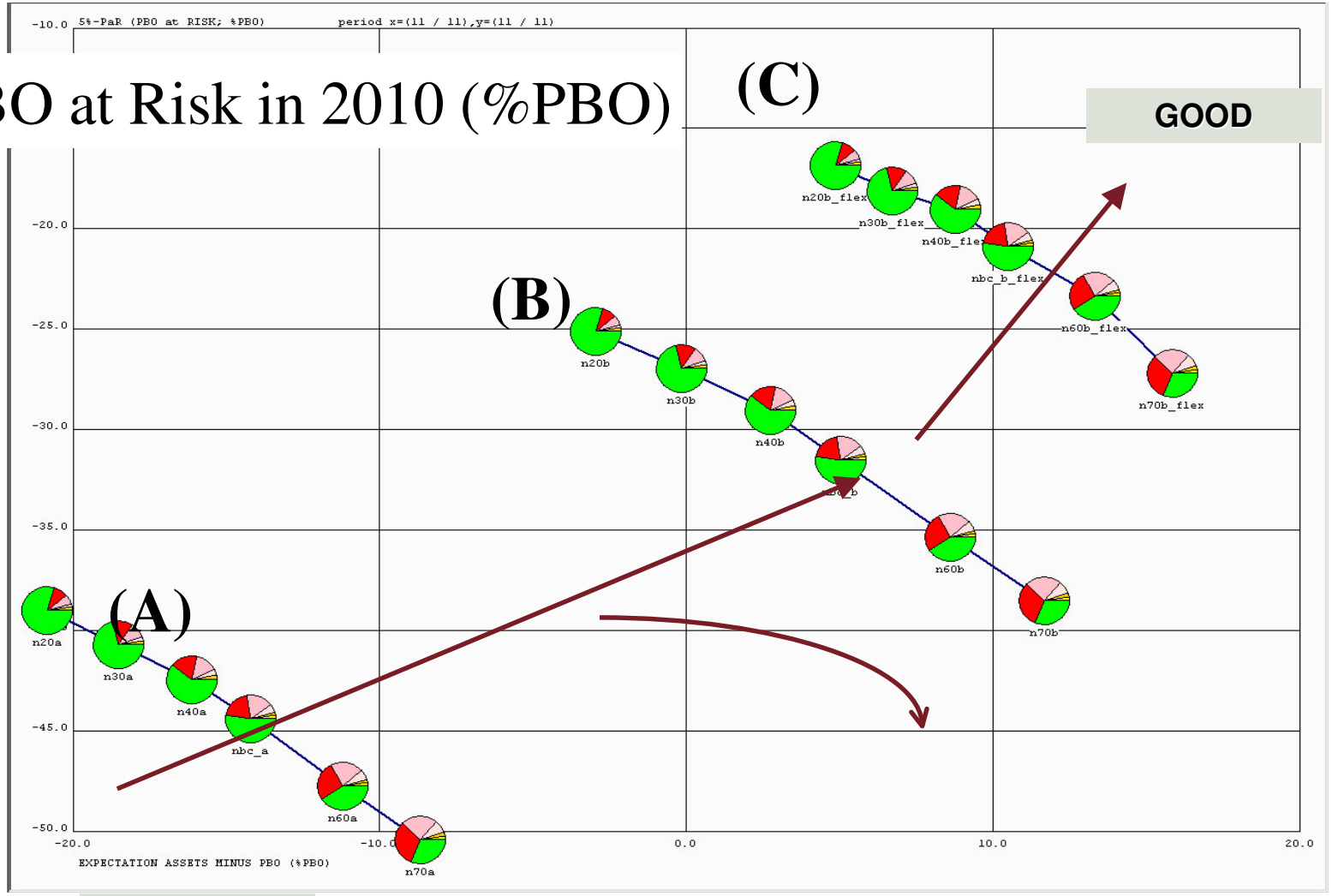
Flexibile contributions important to improve funded status

Contribution policy: A: base or FIXED (left); B: HIGH (mid); C: flexible or DYNAMIC (right)



Source: ORTEC Consultants

Flexibile contributions important to reduce risk



Source: ORTEC Consultants

Summary of asset allocation case studies

- Must integrate assets and liabilities; objectives are critical
- Dynamic asset allocation policies are critical to the success of funds
- Leverage can also be beneficial, but may not be permitted because of regulations
- While higher contributions is possible, it is expensive for companies. Instead, flexible contribution policies will also lead to efficiency gains, especially if underfunded
- Some derivative strategies can be helpful in protecting surplus
- Uncorrelated alpha strategies can lower asset-liability risk

Mean-variance models are deficient for this analysis

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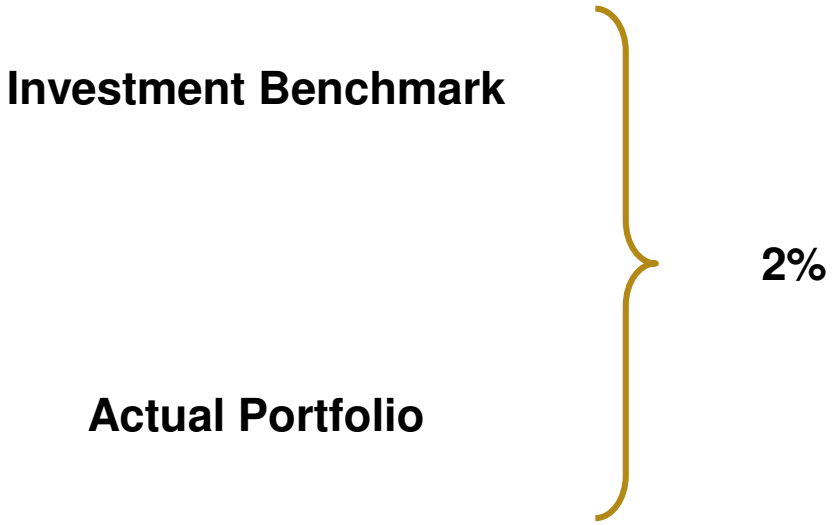
Pension fund risks – measurement and management

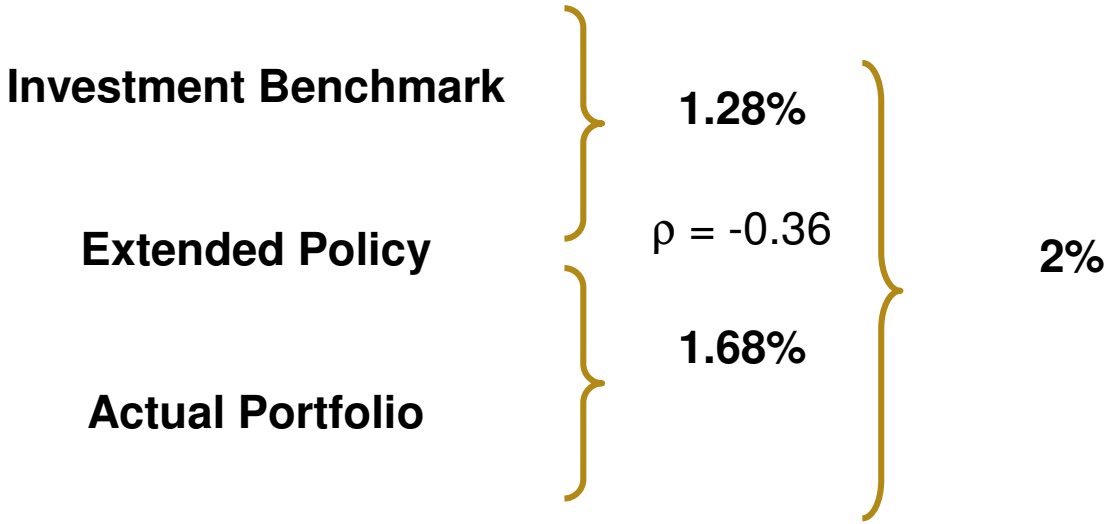
	Asset-Liability Risk	Tactical & Benchmark Risk	Manager/ Active Risk
Responsibility	Oversight Committee	Internal Staff	Managers
Monitor	Annually	Monthly	Monthly
Manage	Strategic Allocations & Funding Policy	Tactical Allocations	Manager Allocations

The tracking error tree (standard deviation of excess returns)



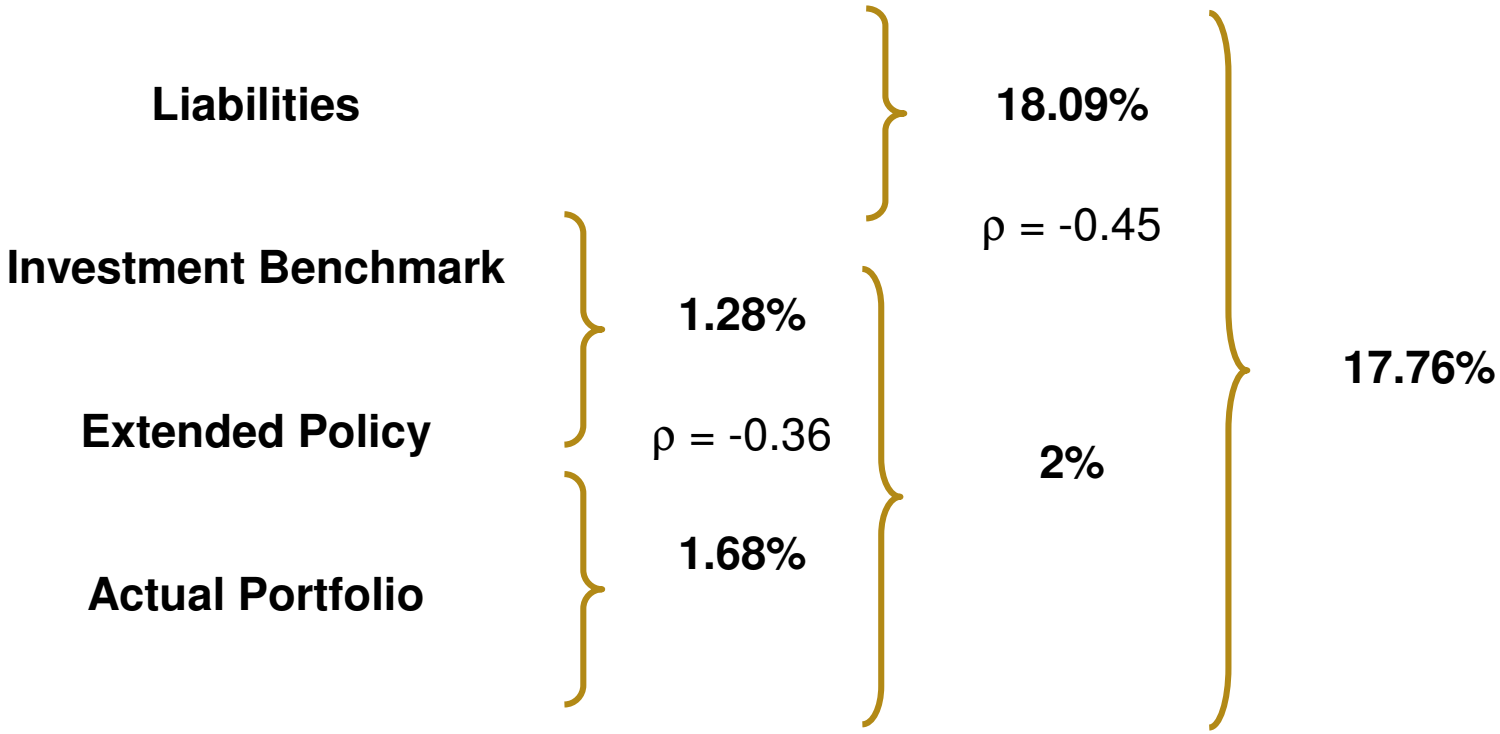
Tracking error = risk relative to benchmark (standard deviation of excess returns)

The risk tree – evaluating the decisions of internal staff



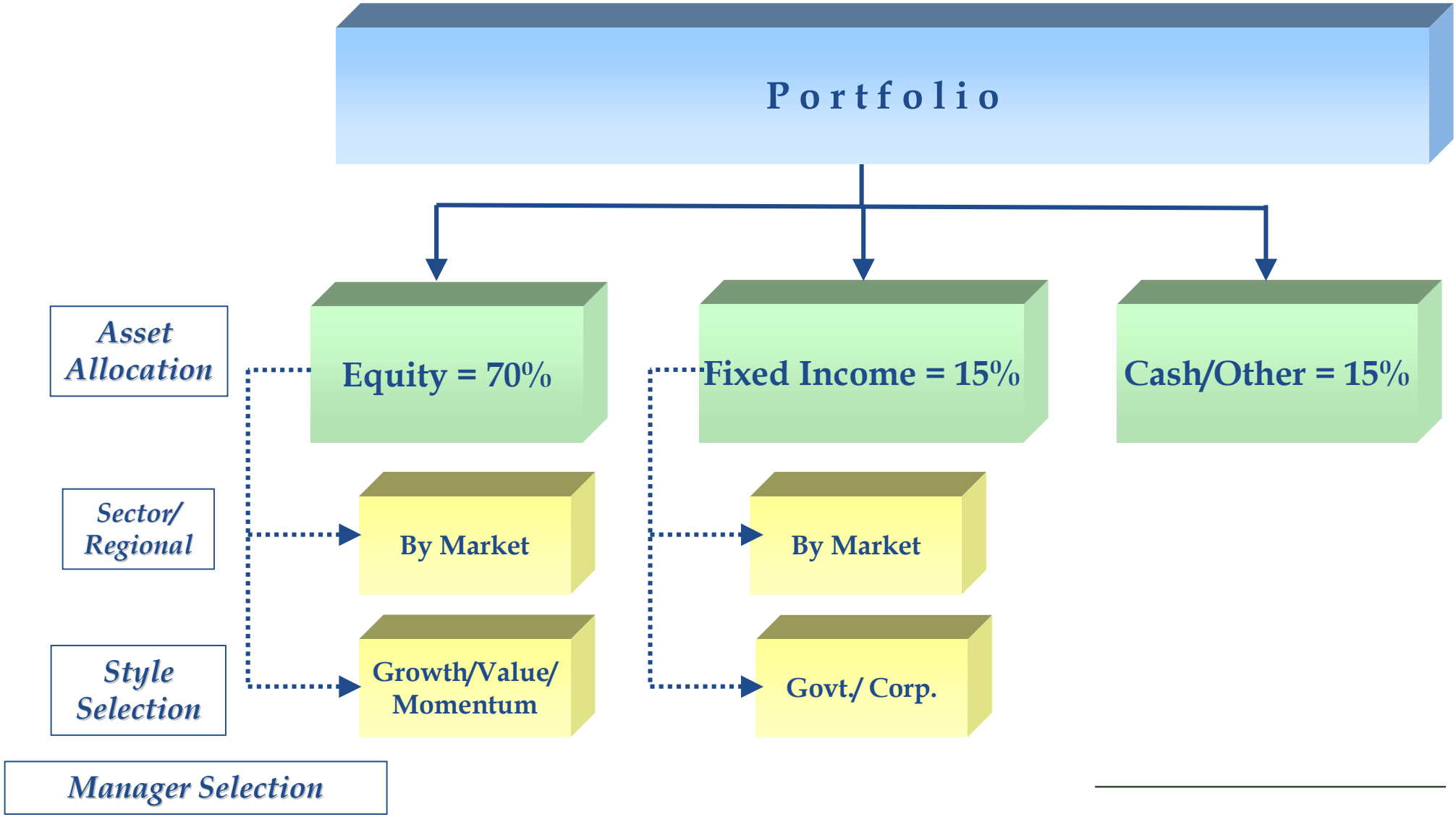
Staff decisions were negatively correlated to external managers

The risk tree – liability risk is most critical



Active management can lower asset-liability risk; what about returns?

Risk management is about making conscious decisions



Source: Mcube Investment Technologies

Risk management = good decisions going forward

- An Investment Rule is a criteria that is established to drive ongoing investment decisions
- Rules are often based upon an economic rationale
- Rules are validated based on historical behaviour of assets and relevant economic variables
- Establishes a discipline in investment decisions, removing emotion, and implicit decision making
- Rules can be extremely simple – need not be complex to add/save alpha

Rules improve process and performance

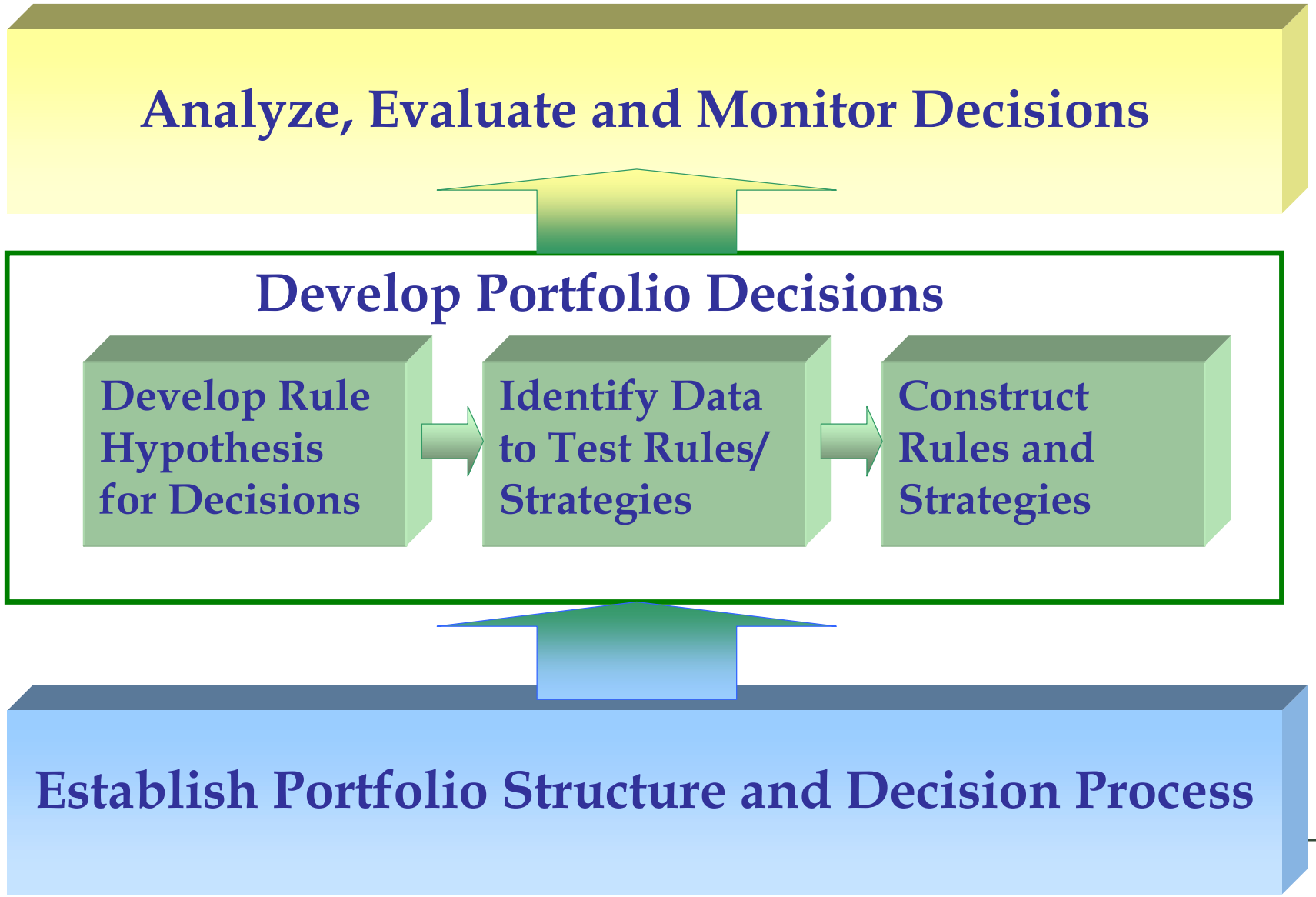
- A Rule involves 3 key aspects:
  - What to Do: Rebalance, Buy, Sell, Hold or Allocate
  - When to Do It: Timing Based on Condition
  - How Much to Do: A Little or Lot
- Typically, look to see If a condition is met, Then take an action to either Buy or Sell
  - If allocation to stocks exceeds benchmark weight by 5%; Then rebalance immediately to benchmark weight
  - If market goes up by 1%/day, Then buy 2% more stocks, Else If it goes up by 2%/day- Then buy 5%

Types of investment rules

- Rebalancing rules
- Technical rules
- Fundamental rules
- Technical variations of fundamental rules
- Other Rules (e.g. Timing/Seasonality, etc.)

Need good process to capture alpha or not lose alpha

Combining portfolio structure with (bottom up) rules



Source: Mcube Investment Technologies

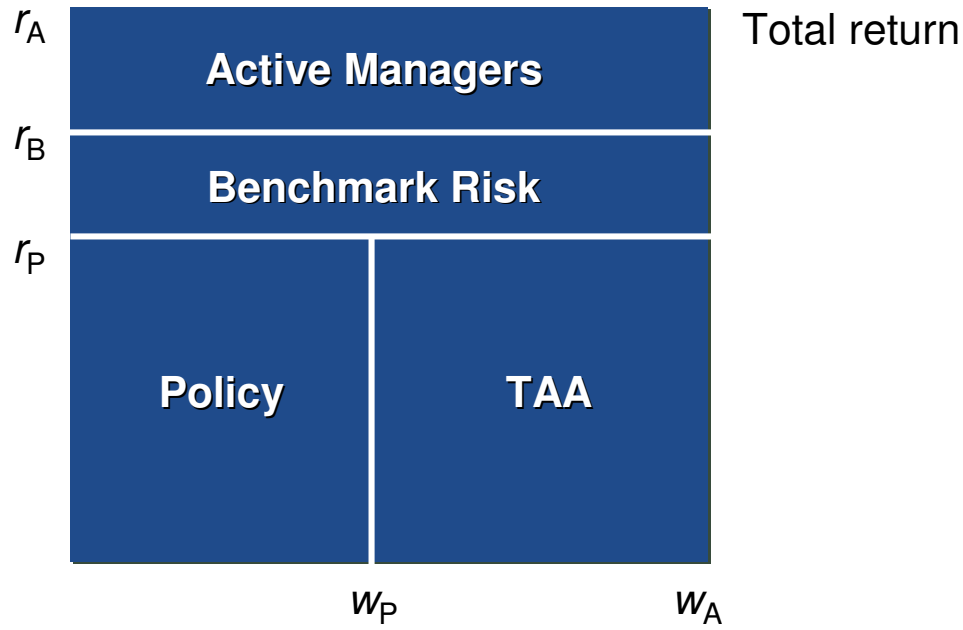
Agenda

- Market outlook and impact on clients
- Keys to success for a plan sponsor
- Asset allocation case studies
  - Inclusion of hedge funds and leverage (asset-only)
  - asset-liability studies (comparison with mean-variance analysis)
  - the case of underfunded plans
- Risk measurement and management
- **Performance**
  - attribution
  - risk-adjustment
  - manager selection

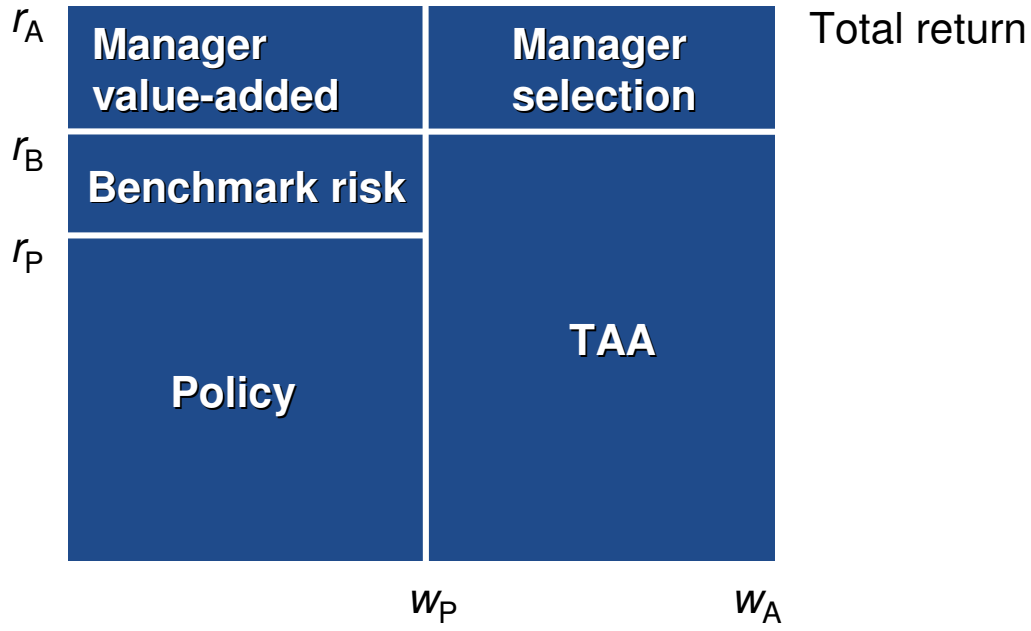
Performance attribution

- Helps understand sources of return
- Evaluate if these contributors are commensurate with risks
- Facilitate decision-making on
  - tactical asset allocation (i.e., stocks versus bonds, international versus domestic)
  - benchmark decisions (small cap or value bias)
  - manager selection
  - manager allocations

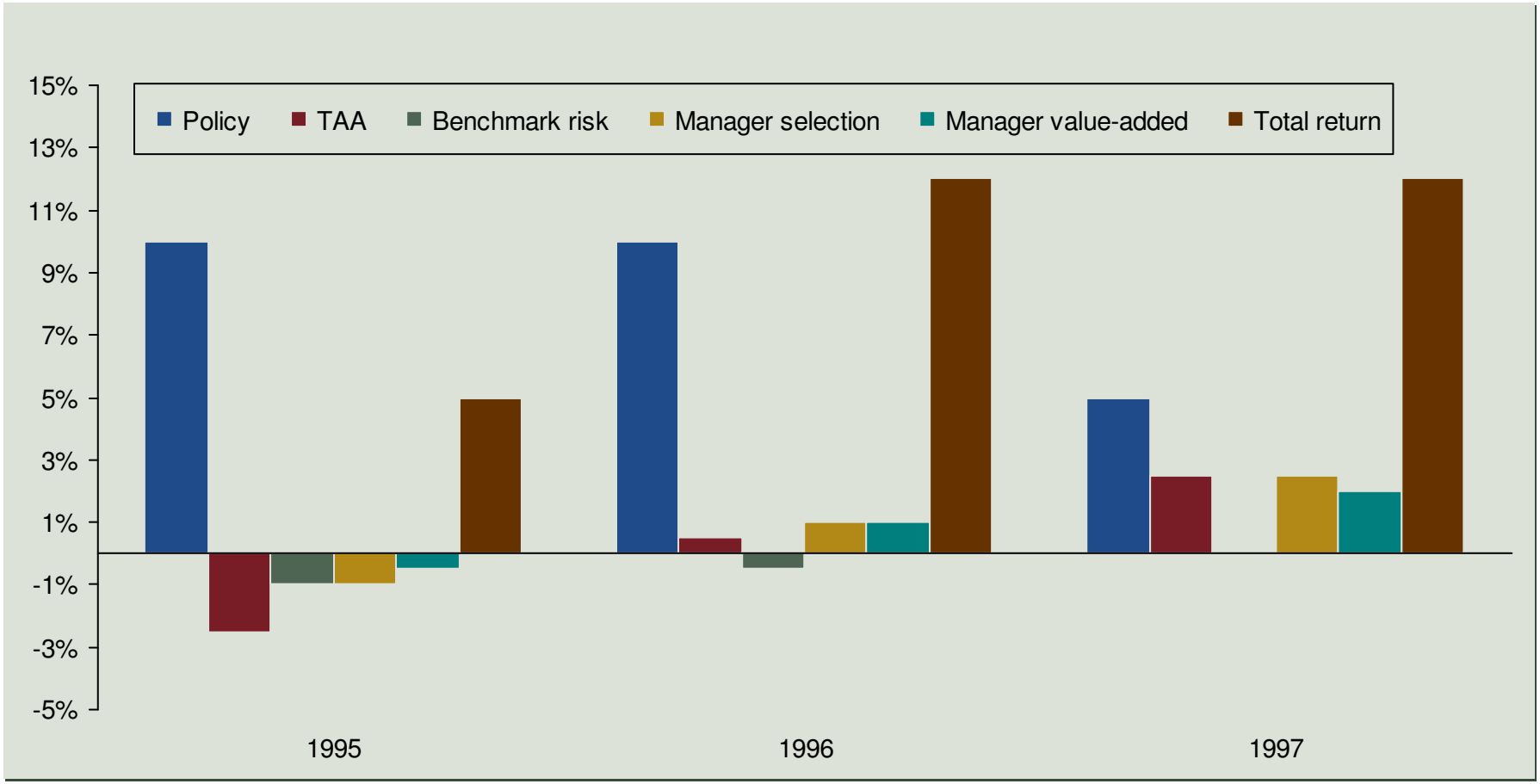
Traditional attribution method



A more effective method – a decision-based approach



How attribution can help improve performance



Measures of performance

- Unadjusted measures
  - portfolio return
  - benchmark return
  - excess return

- Risk-adjusted measures
  - Sharpe ratio
  - information ratio
  - M^2 performance
  - M^3 performance
  - SHARAD measure

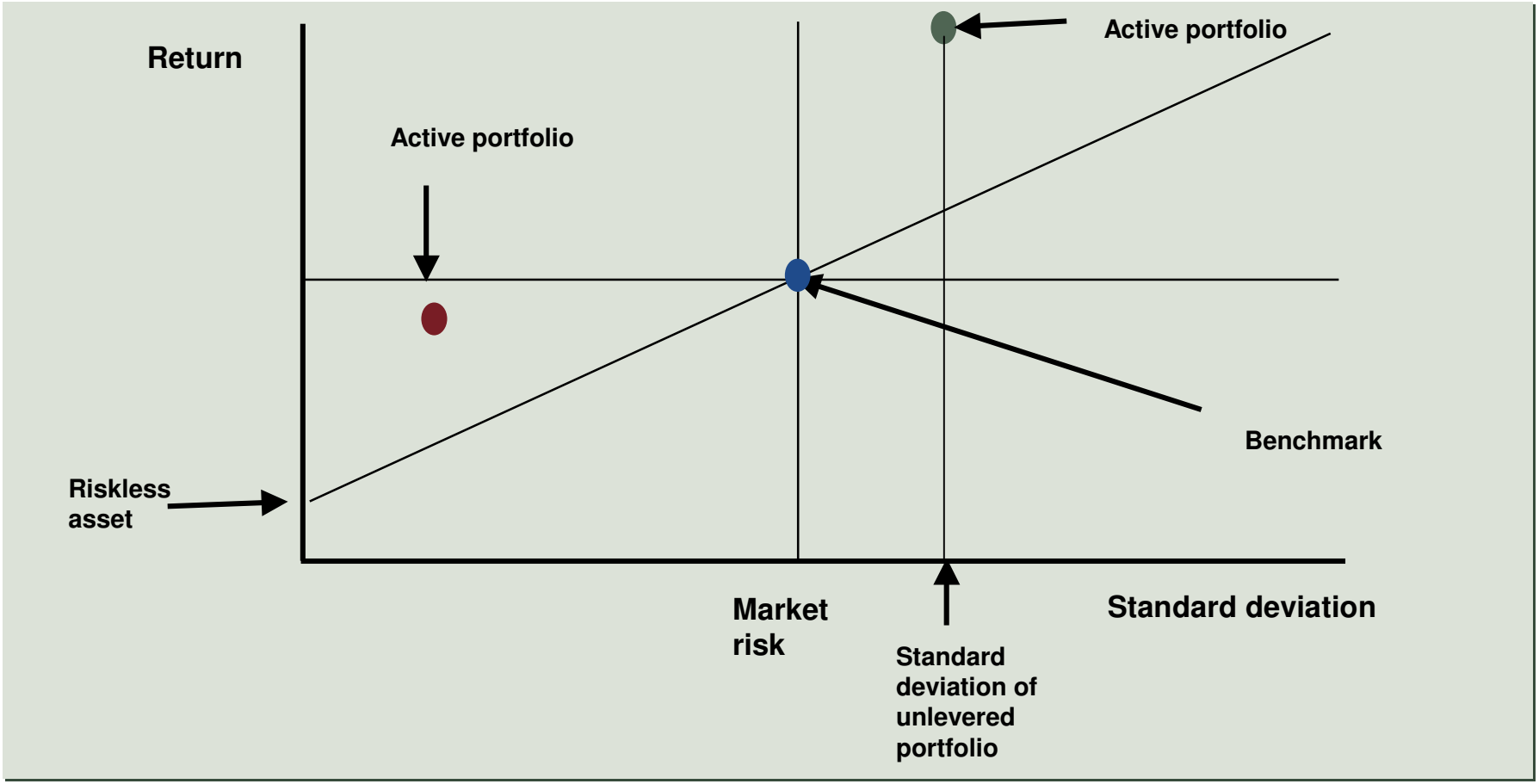
How to calculate these measures

- Unadjusted measures
  - Excess return = Portfolio return - Benchmark return

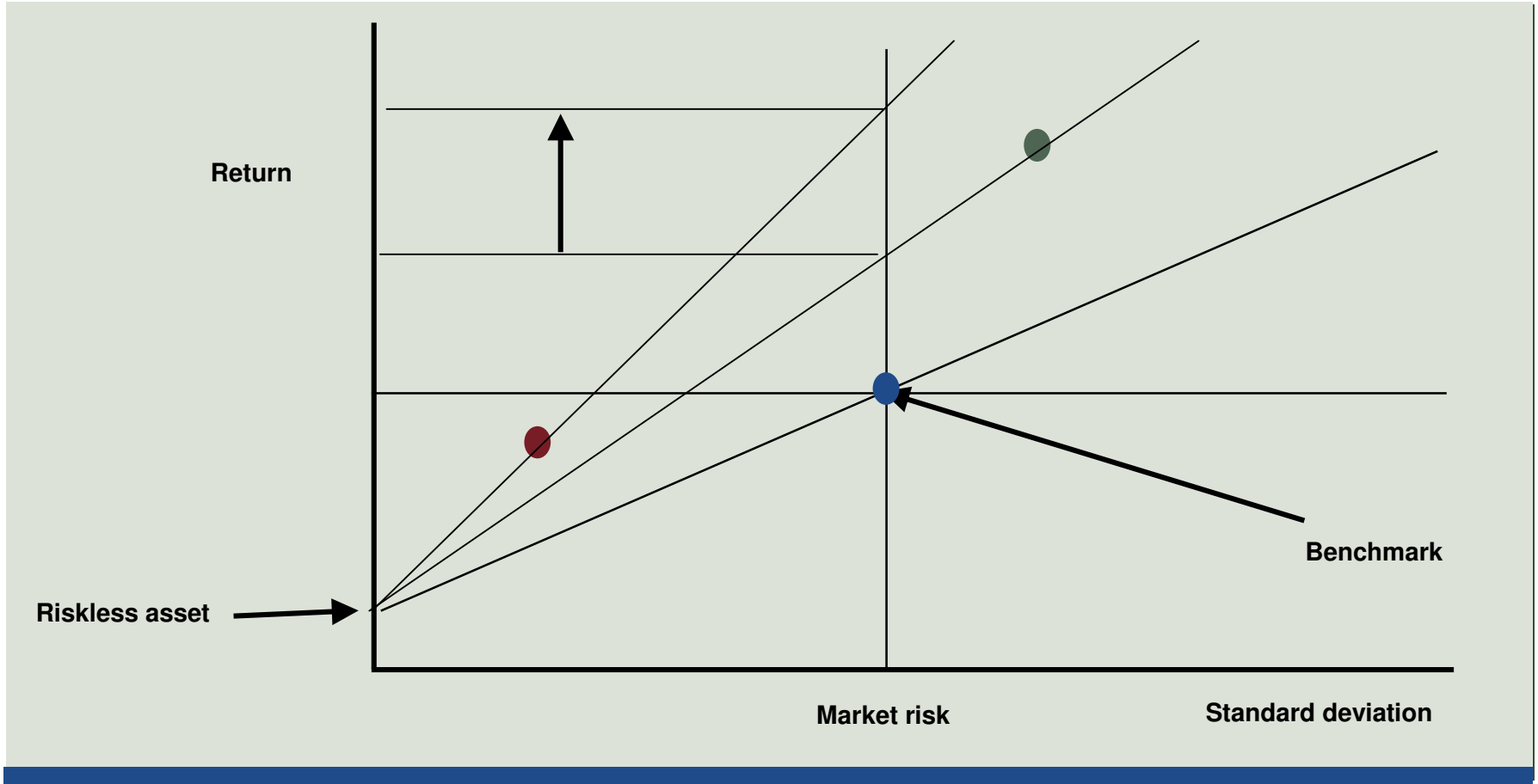
- Risk-adjusted measures
  - Sharpe ratio = Excess over risk free rate/standard deviation of portfolio
    - higher the ratio, the better the investment opportunity
  - Information ratio = Excess over benchmark/standard deviation of excess returns
    - higher the ratio, better the manager
  - M^2 return = extended Sharpe ratio (expressed in basis points)
  - M^3 return = extended M^2 ratio; corrects for degree of correlation

M^2 and M^3 are in %; provide information about portfolio construction

An evaluation of the M^2 measure

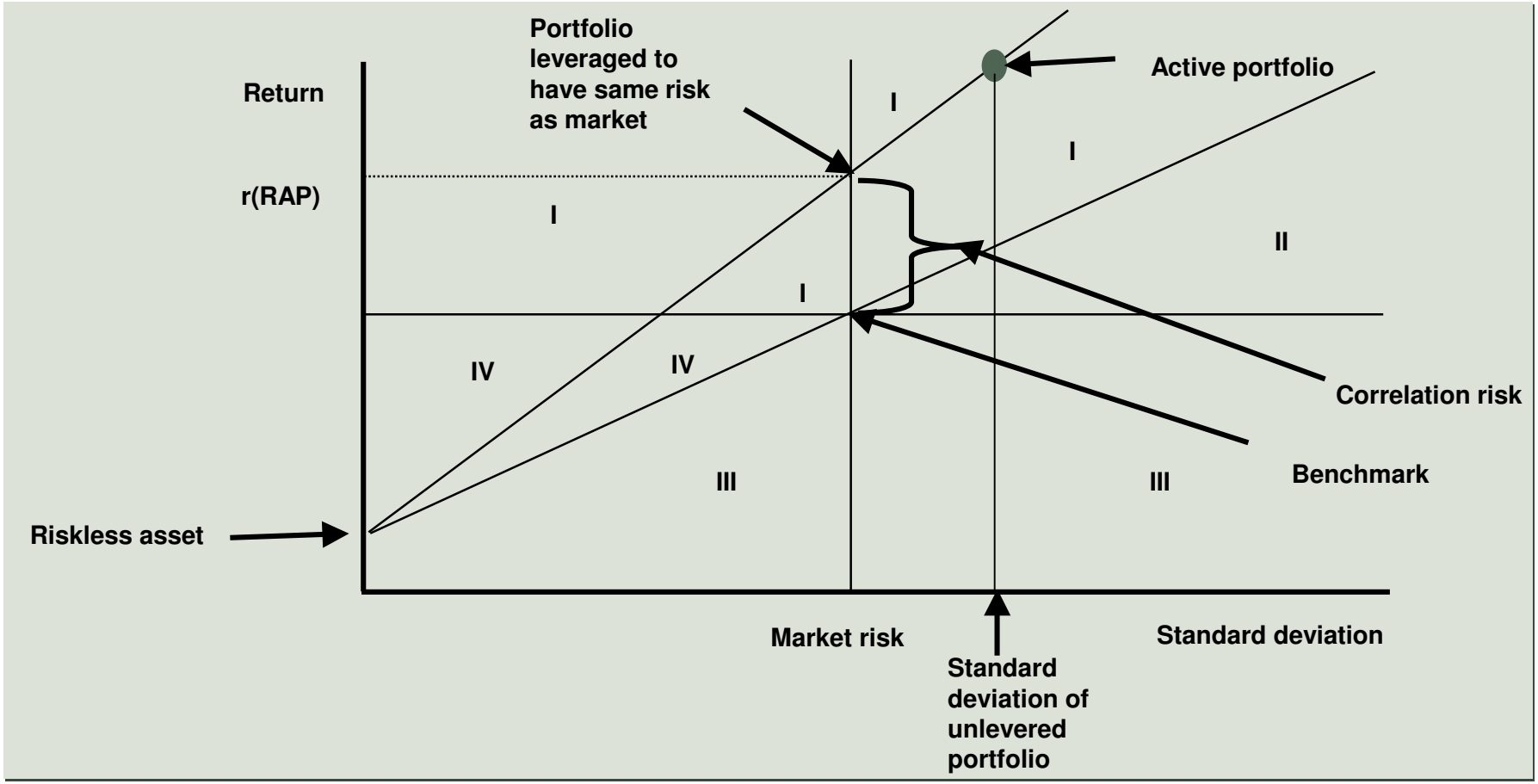


An underperforming portfolio has a higher risk adjusted return



Information ratio is a bad measure of performance!!

Normalize for differences in standard deviation



Must normalize appropriately for risk or make bad decisions

The correlation-adjustment – normalize for tracking error

Fund	Return (%)	Standard deviation (%)	ρ	r(RAP) (%)	TE(basic) (%)	TE(RAP) (%)	r(CAP) (%)
(1)	(2)	(3)	(4)	(6)	(7)	(8)	(12)
F	5.50	0.00	0.00				
B	17.09	13.27	1.00	17.09			
1	33.24	27.57	0.71	18.85	20.45	10.14	18.43
2	25.63	24.93	0.77	16.21	17.02	9.04	17.43
3	25.04	25.02	0.73	15.86	17.74	9.68	17.41
4	24.08	21.33	0.80	17.06	13.34	8.38	17.65
5	21.95	21.75	0.59	15.53	17.52	11.97	17.68
6	21.90	13.84	0.84	21.21	7.76	7.57	19.26
7	21.61	14.37	0.83	20.37	8.13	7.74	18.91
8	20.89	23.06	0.79	14.36	15.07	8.69	16.70
9	20.77	14.00	0.89	19.97	6.53	6.32	18.83
10	20.56	14.79	0.92	19.00	5.74	5.24	18.43

Get a totally different ranking of external managers

Ranking portfolios using different methods

Ranking	Unadjusted	Skill using raw returns	M^2 or Sharpe	Skill using M^2	M^3	Skill using M^3	Information ratio
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
First	1	6	6	6	6	6	1
Second	2	9	7	9	7	7	6
Third	3	7	9	7	9	9	10
Fourth	4	10	10	10	1	1	9
Fifth	5	1	1	1	10	10	7
Sixth	6	4	4	4	5	5	4
Seventh	7	2	2	2	4	4	2
Eighth	8	3	3	3	2	2	3
Ninth	9	5	5	5	3	3	5
Tenth	10	8	8	8	8	8	8

Many different methods of risk-adjustment

- Manage portfolio yourself – Sharpe, information ratio or M^2
- Have someone else manage and you have a tracking error budget – M^3
- Worried about skill – M^3
- None of these measure tell you much about consistency. No clear pattern emerges if you select managers on this basis (using a 5 year period) and test on the next 5 years

How should clients select managers given different objectives?

Manager selection – a new approach

- Problems with current rating systems
- A new rating framework
- Benefits of the new approach

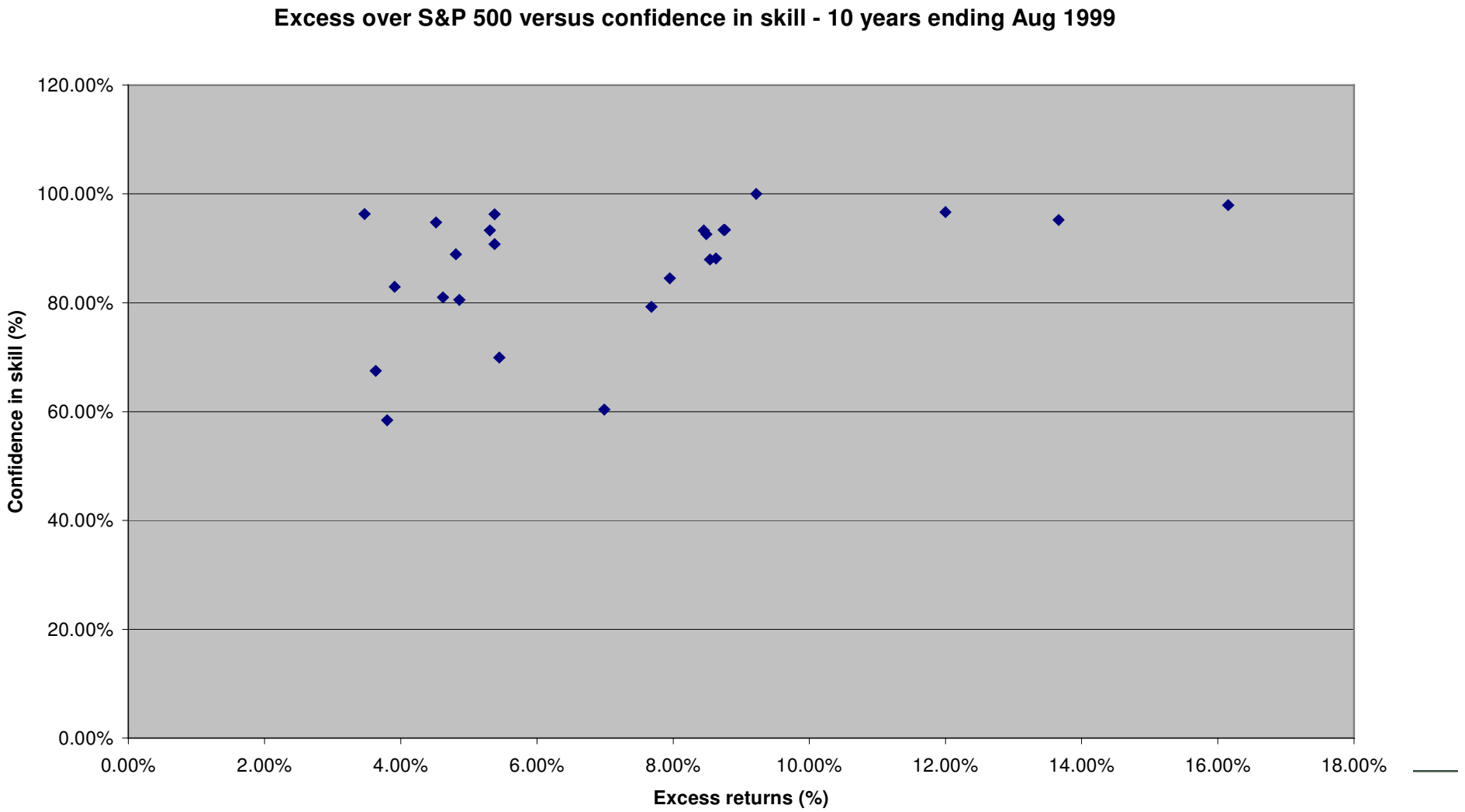
Source: Mcube Investment Technologies

Problems with current rating systems

- Risk adjustment not intuitive
- Not adaptable to individual investment objectives
- Cannot adapt rating system to portfolio of funds
- Do not evaluate luck vs. skill of fund managers
- Multiple investment horizons not transparent

Source: Mcube Investment Technologies

Wide disparity in skill across similarly rated funds



Source: Mcube Investment Technologies

A new rating framework

- 3 Alphabet rating system ranking 3 separate performance measure.
- A rating is best; F rating is worst for each measure
- Incorporates ratings assigned to multiple time horizons
- Separate rating for “confidence in skill” measure
- Proprietary adjustment for risk – better than other measures
- Can evaluate multiple fund portfolios

Source: Mcube Investment Technologies

Can rate on performance and skill over multiple horizons or…

		Criteria 1	Criteria 2	Criteria 3
Fund No.	Inception	Performance		Luck vs Skill
		3-year	Since inception	Since inception
6	Sep-79	A	A	B
9	Dec-87	A	A	C
2	Aug-85	A	A	D
4	Mar-82	A	B	E
5	Mar-85	A	C	C
1	Aug-85	A	C	E
3	Aug-85	A	C	E
13	Feb-84	A	D	D
14	Sep-79	A	F	F
7	Aug-85	B	B	D
8	Oct-87	E	A	B
11	Aug-81	F	A	A
12	Mar-88	F	B	A
10	Jun-84	F	B	A
15	Jan-88	F	C	B

Source: Mcube Investment Technologies

Risk-adjusted performance and skill or…

		Criteria 1	Criteria 2	Criteria 3
Fund No.	Inception	Risk-adjusted Performance		Luck vs Skill
		3-year	10-year	Since inception
10	Jun-84	A	B	A
5	Mar-85	A	E	F
13	Feb-84	B	E	C
2	Aug-85	D	D	F
3	Aug-85	D	D	F
11	Aug-81	E	D	C
12	Mar-88	F	C	A
15	Jan-88	F	C	E
1	Aug-85	F	C	F
8	Oct-87	F	E	D
4	Mar-82	F	E	F
7	Aug-85	F	E	F
6	Sep-79	F	F	F
9	Dec-87	F	F	F
14	Sep-79	F	F	F

Source: Mcube Investment Technologies

Skill and risk-adjusted performance

		Criteria 1	Criteria 2	Criteria 3
Fund No.	Inception	Luck vs Skill Since inception	Risk-adjusted Performance 3-year	10-year
10	Jun-84	A	A	B
12	Mar-88	A	F	C
13	Feb-84	C	B	E
11	Aug-81	C	E	D
8	Oct-87	D	F	E
15	Jan-88	E	F	C
5	Mar-85	F	A	E
2	Aug-85	F	D	D
3	Aug-85	F	D	D
1	Aug-85	F	F	C
4	Mar-82	F	F	E
7	Aug-85	F	F	E
6	Sep-79	F	F	F
9	Dec-87	F	F	F
14	Sep-79	F	F	F

Source: Mcube Investment Technologies

And multiple fund portfolios (combining with fund 5 and 10)

Base		Unadjusted			M^3 Score			Skill-Raw Returns		
Fund No.	Inception	3-Yr	5-Yr	10-year	3-Yr	5-Yr	10-year	3-Yr	5-Yr	10-year
1	Aug-85	A	A	A	B	C	B	A	A	A
2	Aug-85	A	A	A	A	C	B	A	A	A
3	Aug-85	A	A	A	A	D	C	A	A	A
4	Mar-82	A	A	A	D	D	D	B	A	A
5	Mar-85	A	A	A	A	B	C	A	A	A
6	Sep-79	A	A	A	F	F	F	E	E	E
7	Aug-85	A	A	A	D	D	C	B	A	A
8	Oct-87	A	A	A	F	D	C	C	A	A
9	Dec-87	A	A	A	C	E	D	A	B	A
10	Jun-84	A	A	A	A	A	B	C	A	A
11	Aug-81	A	A	A	A	A	C	B	A	A
12	Mar-88	C	C	A	B	C	B	C	C	A
13	Feb-84	A	A	A	A	C	B	A	A	A
14	Sep-79	A	A	A	F	F	D	B	B	A
15	Jan-88	A	C	A	F	F	B	C	C	A

Multiple manager portfolios have better characteristics

Source: Mcube Investment Technologies

Benefits of new rating system

- Simple for investor - allows for user-specified objectives
- Shows the evolution of performance over different time horizons
- Shows the critical confidence in skill of fund manager
- Allows for selection of multiple funds within context of portfolio

Source: Mcube Investment Technologies

Summary – focus on the keys to success and good process

Appendix

Thanks to:

Arikawa-san (SGPM)

Tsumagari-san (World Bank)

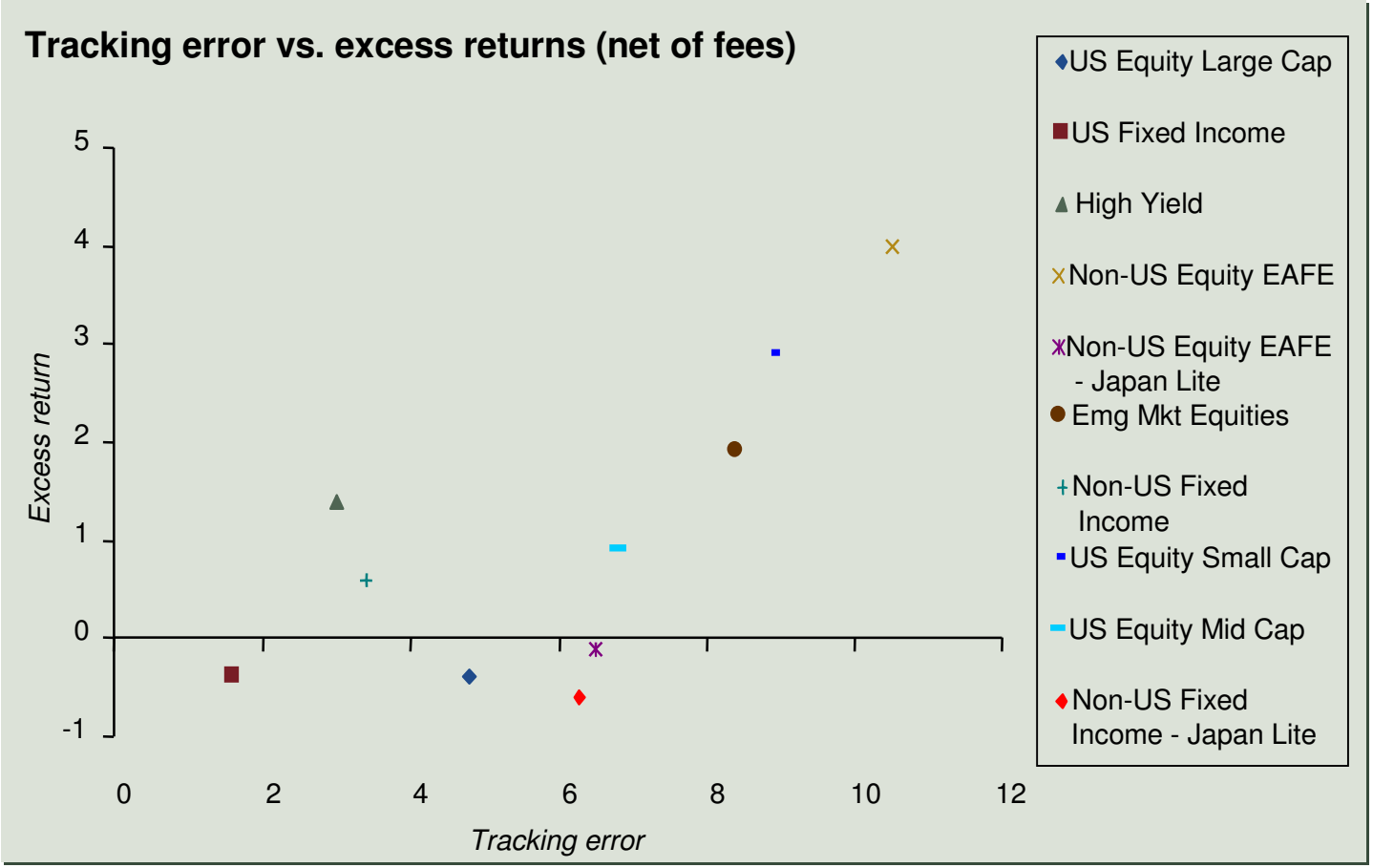
Yabuuchi-san (RSAM)

And other staff at SGPM, FX Concepts, World Bank and RSAM

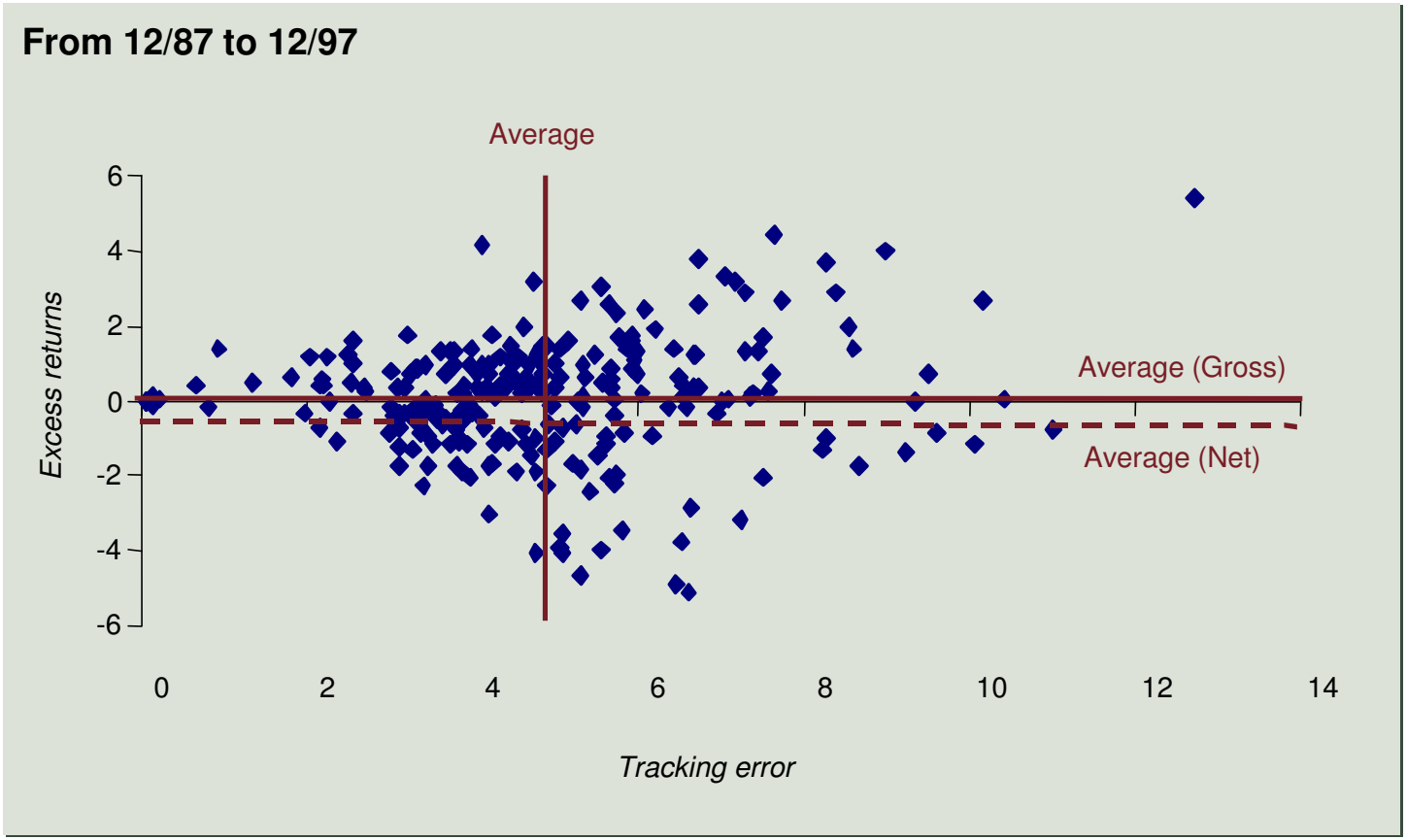
Where should a fund take risk?

- Which asset class *on average* provides the best alpha?
- Should managers be constrained?
- What bets have paid off?
- The Greater Fool Theory of Asset Management

Where should a fund take risk?

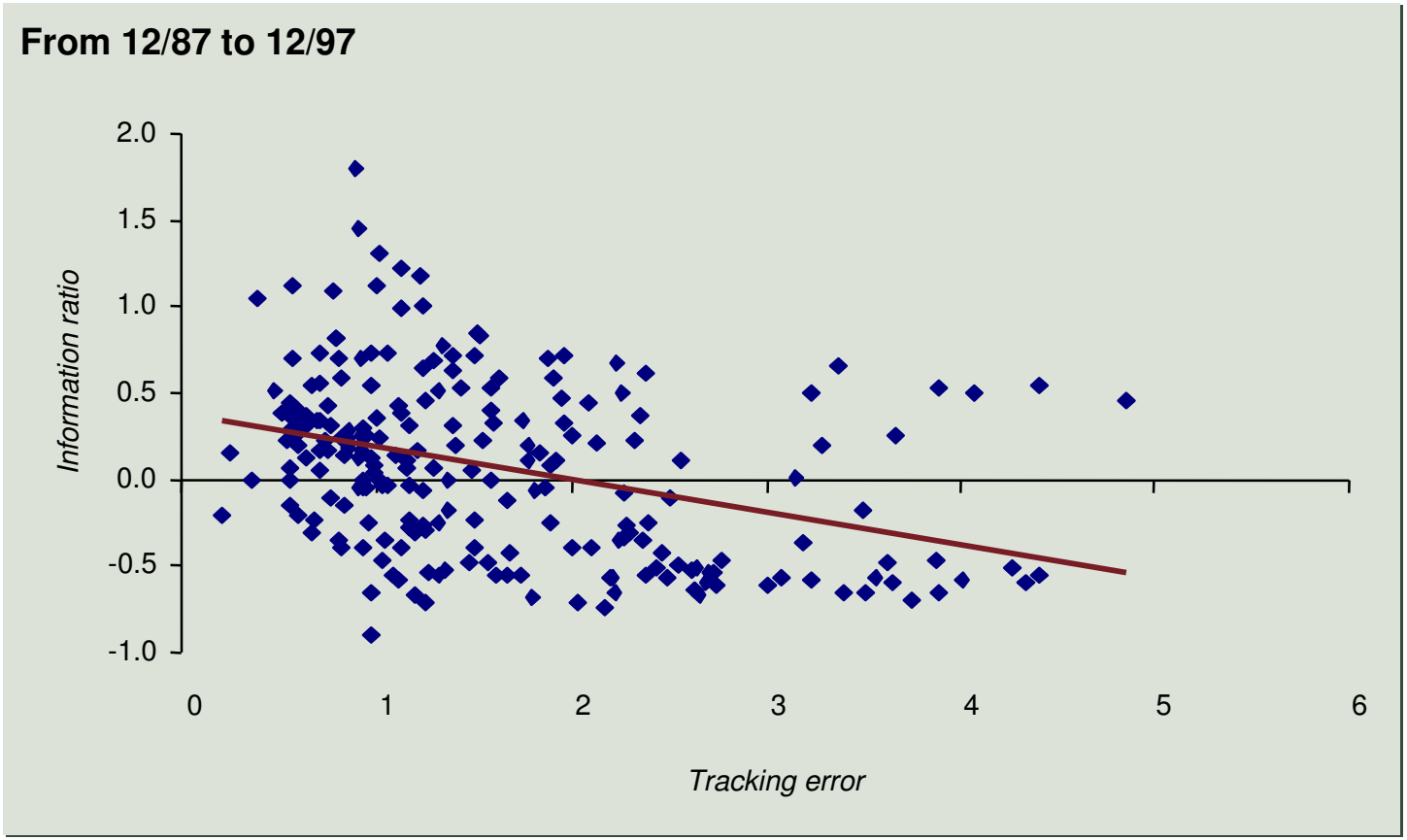


The Wilshire U.S. large cap universe – zero average alpha



Should managers be constrained?
The case for conservative management

Wilshire U.S. Fixed Income Universe



The Greater Fool Theory of Asset Management

- If average alpha is zero, must believe that another sponsor is selecting a bad manager if you think you are selecting a good manager
- The average alpha in international came from a bet on Japan – will the markets give the same opportunity in the future?
- Does not negate the case for active management – just need to be careful about managing managers
- Results hold across countries and databases