



UNIVERSITY OF CALIFORNIA

Office of the Treasurer

# 608

# RISK BUDGETING AND INVESTMENT MANAGEMENT

Committee on Investments /  
Investment Advisory Committee  
August 24, 2006

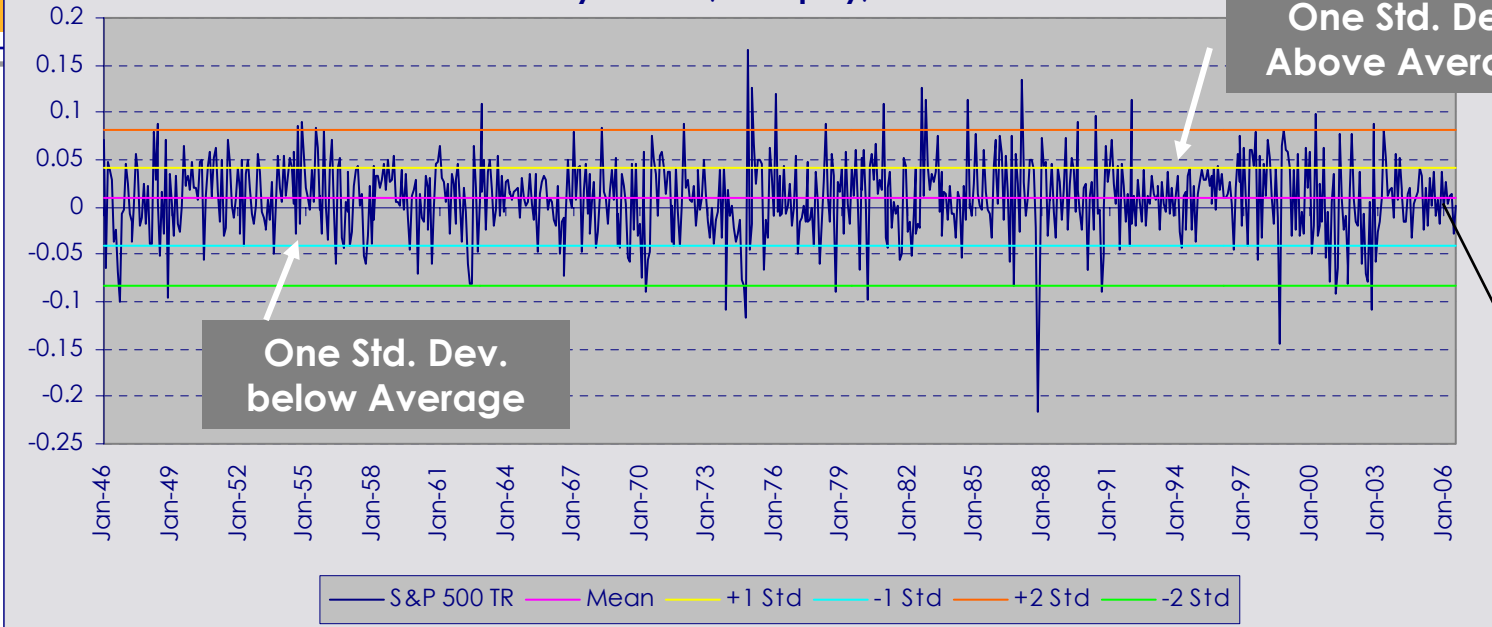
- ◆ **“Measuring” Risk**
- ◆ **Active Risk**
- ◆ **“Budgeting” Risk**
- ◆ **UCRP Risk Budgets**
- ◆ **How Risk Budgets are used**
- ◆ **Appendix 1: A Detailed Example**
- ◆ **Appendix 2: How Risk Budgets are Determined**

- ◆ Risk management is a **critical** part of investment management at UC
- ◆ It is part of managing **each asset class** and the **total fund**
- ◆ The first step is **identifying and quantifying** various risks in the portfolios
- ◆ The second step is to **allocate, or budget risk** to achieve the best expected return

- ◆ Most investors “feel” that **higher risk** – potential for loss – should be **compensated** by higher returns
- ◆ Higher **risk is typically correlated** with higher volatility of returns
- ◆ **Volatility** (std. deviation) is a **proxy** for risk, not a **measure** of risk
- ◆ It is a **good approximation** of loss potential for traditional portfolios (most of the assets)

- ◆ For traditional portfolios, **volatility** tells us the likely **range of outcomes**, e.g.,
- ◆ **U.S. Stocks, 1946-2006**, had a range of  **$\pm 16.9\%$**  around their average annual return of **12.8%**
- ◆ In any **2 out of 3 years**, we **expect** the return on stocks to be between **-4.2%** and **+29.7%**
  - *Actually occurred 62% of those years*

### Monthly Returns, US Equity, 1946-2006

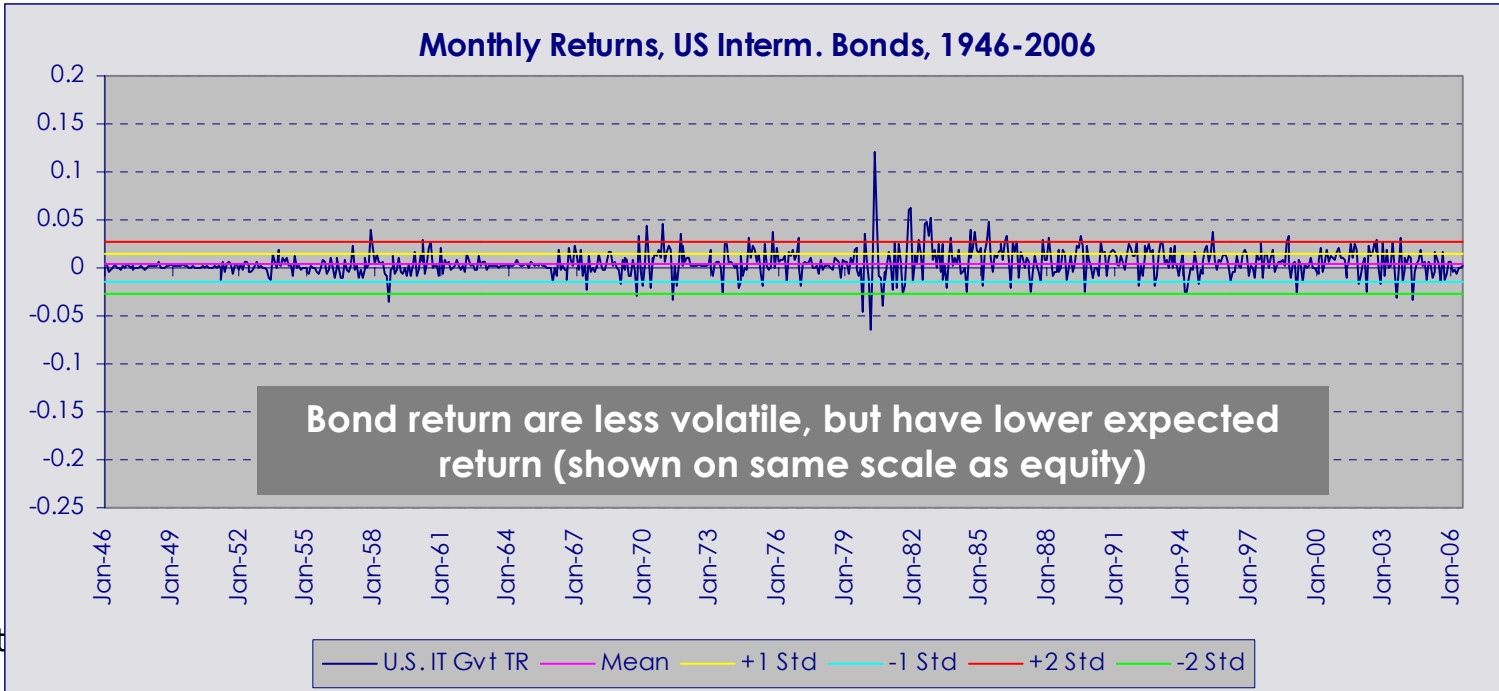


One Std. Dev. Above Average

One Std. Dev. below Average

Average = 1.0% / Month, Std. Dev = 4.1% / Month

### Monthly Returns, US Intern. Bonds, 1946-2006



Bond return are less volatile, but have lower expected return (shown on same scale as equity)

- ◆ For **non-traditional** assets, we use other risk proxies which focus on potential for loss (“**down-side**” volatility)
  - *“Value-at-Risk” measures expected loss given extreme events*
  - *It is used to allocate capital to strategies with option-like returns*
- ◆ Risk measures are **not forecasts of returns**

- ◆ “Active risk” (aka, Tracking Error) is defined as the **volatility of active returns** (= portfolio less benchmark return)
  - *Different than “total risk” (see above)*
- ◆ It is a **measure** of how “**different**” the **portfolio** is from the **benchmark**
- ◆ It gives an indication of the likely **range of active returns** around the benchmark



- ◆ Active risk results from **any difference** between a portfolio and benchmark, e.g.,
- ◆ Over/(under) weight **securities, industries, sectors, countries, regions, currencies, styles, capitalization size, etc.**
- ◆ At the total fund level, it will result from over/(under) weighting an **asset class relative to policy weights**

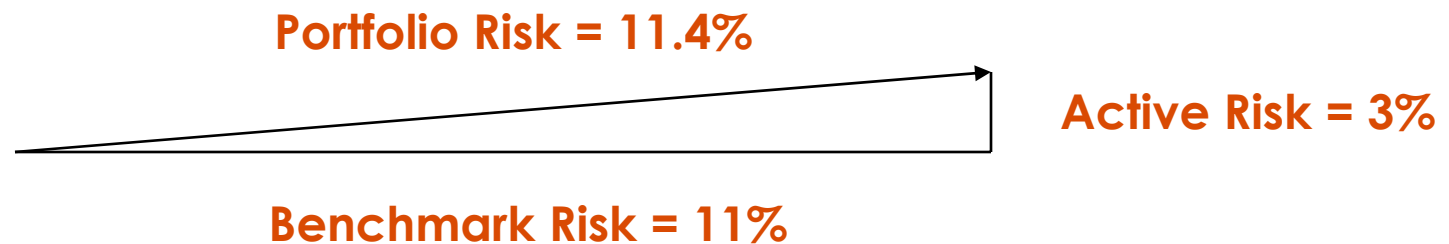
- ◆ Managers **take active risk** – have exposures different than the benchmark – to **earn active returns**
- ◆ All else equal, **expected active return** is a function of active **risk** (the size of the differences)
- ◆ Risk (differences from benchmark) is thus the **“input” to the investment process**, and is carefully managed

- ◆ We manage active risk by **setting a budget for risk** (the investment plan)
- ◆ Similar to any organization which sets a budget for **expenses**
- ◆ Then we **measure risk** and **compare realized risk** to our budgets (plan)
- ◆ We **explain variance** between plan and actual, and **recommend changes** if needed

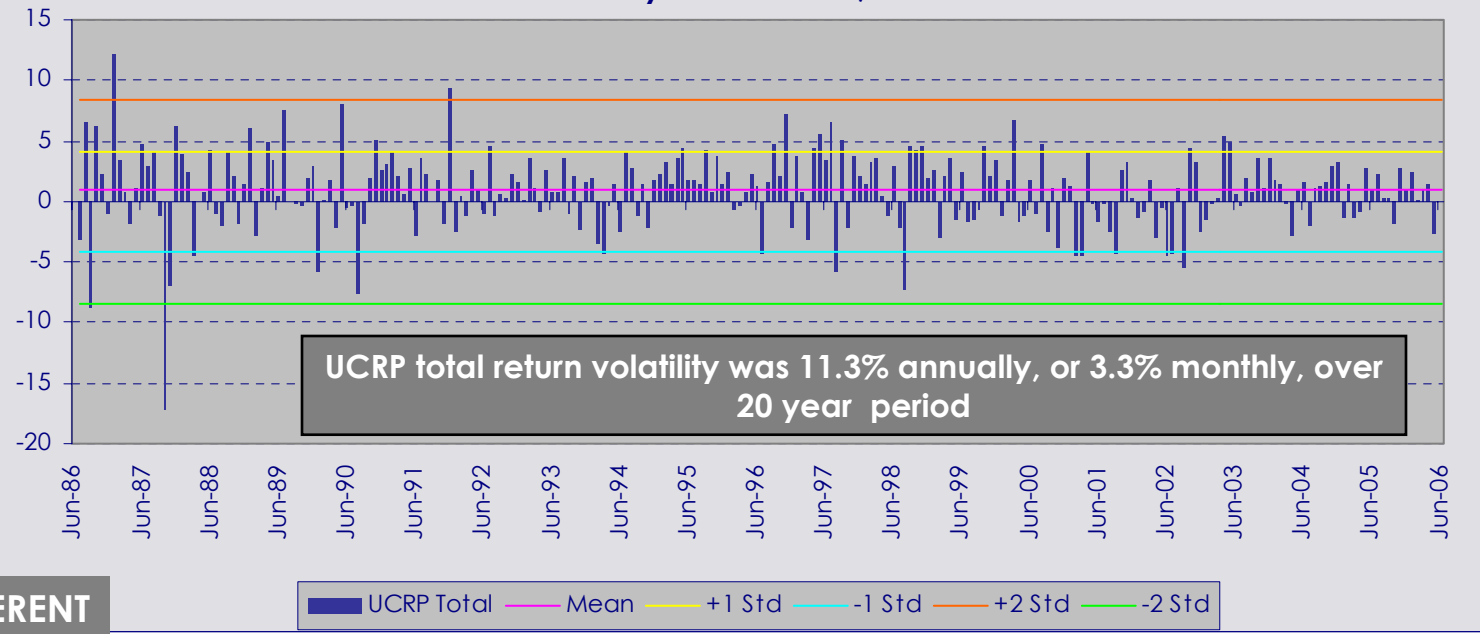
- ◆ The active risk budget for the UCRP is 3% annualized tracking error
  - In every 2 of 3 years, the expected active return will be within +/-3% of the performance benchmark
- ◆ This level of active risk is:
  - Consistent with historical volatility of UCRP
  - Consistent with other pension plans

- ◆ **This level of active risk is:**
  - **Consistent with reasonable budgets for the risk of the **asset classes** which comprise the fund**
  - **Consistent with the **investment objectives** of the fund (modest value added)**
  - **Sufficient to **allow flexibility in allocating risk** to strategies with higher expected return**
  
- ◆ **Note, GEP active risk budget is higher, at 4.5%**

- ◆ This level of active risk adds a **negligible amount** of volatility to the total fund (that is, over benchmark volatility)
  - With benchmark volatility at **11%**, an active risk budget of **3%** results in portfolio volatility of **11.4%**
  - **Only 40 basis points additional volatility**

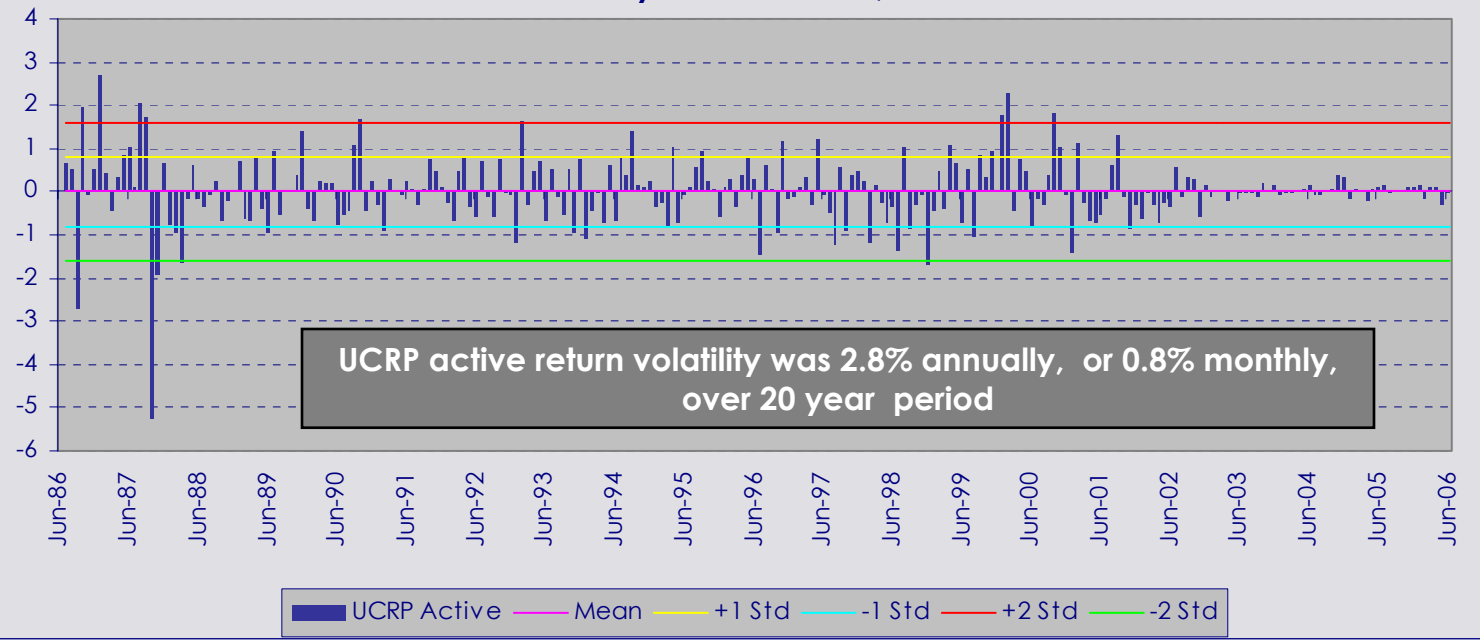


UCRP Monthly Total Returns, 1986-2006



**NOTE DIFFERENT SCALES**

UCRP Monthly Active Returns, 1986-2006





# UC RISK BUDGETS

Asset Class	Active Risk Budget	Realized Active Risk (1,4)	Forecast Active Risk (2,4)
US Equity - passive	0.20	0.04	0.26
US Equity - active	2.50	1.62	1.48
Non US Eq - passive	0.50	0.16	0.54
Non US Eq - active	3.00	1.27	1.59
EM Equity	4.00	2.05	4.14
US Fixed - LPF	1.50	0.25	0.25
US Fixed - LB Agg	1.00	0.24	0.23
High Yield	3.50	NA (6)	1.57
Non US Fixed	2.00	NA (6)	0.03
EM Debt	4.00	NA (6)	1.38
TIPS	0.25	0.16	0.02
Cash (5)	0.75	0.02	0.62
Private RE	NA	NA	NA
Private Eq	NA	NA	NA
Absolute Return (3)	NA	2.44	4.43
<b>TOTAL UCRP</b>	<b>3.00</b>	<b>0.48</b>	<b>0.55</b>
<b>TOTAL GEP</b>	<b>4.50</b>	<b>0.59</b>	<b>1.16</b>

NOTES (1) Realized Risk calculations based on most recent 12 months' returns, equally wtd, as of July 31, 2006 (2) Forecast Risk based on actual holdings and third-party risk models, as of June 30, 2006 (3) Values are for total, not active risk (4) Value is higher of UCRP and GEP asset class composite (5) Forecast active risk using benchmark similar to ML 1-3 Yr Treasury (6) Only 6 months history

Note that both realized and forecast risk are **lower** than the risk budgets, which is partly due to low cross sectional market volatility





- ◆ When would a risk budget change?
- ◆ Overall **risk tolerance** of the Committee changes
- ◆ **Opportunities** in active strategies expand or contract
- ◆ Overall level of **market volatility** or **cross sectional volatility** changes

- ◆ The innovation of risk management is a **common framework** and **uniform metric** to quantify all investment **decisions**
- ◆ Allowing us to **trade-off** risk in one area with risk in another
- ◆ If we have “used up” our risk budget, we must **reduce risk in one** or more strategies in order to **take risk in another one**

- ◆ **50% of US Equity allocation is actively managed**
  - *Assume passive has zero active risk*
- ◆ **Is that the **right amount** for active?**
- ◆ **Depends on the **risk level** of the active portfolios**
  - *Enhanced, risk controlled active*
    - ◆ *3% tracking error → total has 1.5% TE*
  - *Traditional, concentrated active*
    - ◆ *10% tracking error → total has 5.0% TE*

- ◆ **Enable more efficient use of risk, by linking expected return to risk**
  - *Better than traditional guidelines and constraints*
- ◆ **Aid in asset allocation and manager structure decisions**
- ◆ **Ensure risk is used intentionally and compensated adequately**
- ◆ **Quality control for the main input to the investment process**

- ◆ **The essence of investment management is the management of risk, not the management of return**
  - ***Benjamin Graham***



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# APPENDIX 1: EXAMPLE OF RISK BUDGETING

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- ◆ Large institutional investors typically maintain a **passive** (core, low-cost) equity allocation
- ◆ What should be the **percentage** of passive vs. actively managed assets?
- ◆ Better question: what is **desired** amount of **active risk** in the fund?
- ◆ Assumes “amount of risk” can be **quantified**

- ◆ Managing investments has always been about **managing risk**
- ◆ Traditionally done with inefficient **guidelines and constraints**
  - *E.g., position and sector limits; limits on manager size, long only constraint; no derivatives; credit limits*
- ◆ These are all examples of **risk proxies**
- ◆ Why not manage the risk factors **directly**, and link risk to expected return?



# WHY IS THIS INEFFICIENT?

- ◆ Constraints are **proxies** for risk; **crude** (but sometimes effective) risk **controls**
- ◆ They don't account for actual **contribution to risk** of different positions
- ◆ Constraints don't account for **volatility, correlations, or hedges**
- ◆ Constraints cannot be **combined** or **traded off** against each other

- ◆ **Measure** risk using a uniform metric for all types of decisions
- ◆ Set **overall limits** on that metric
- ◆ **Flow-down** to underlying **components** or decisions
  - Based on **contribution** of each component or decision to total risk
- ◆ Allows risk to be **fungible**
  - And for decision makers to **shift risk** exposures to capture expected returns



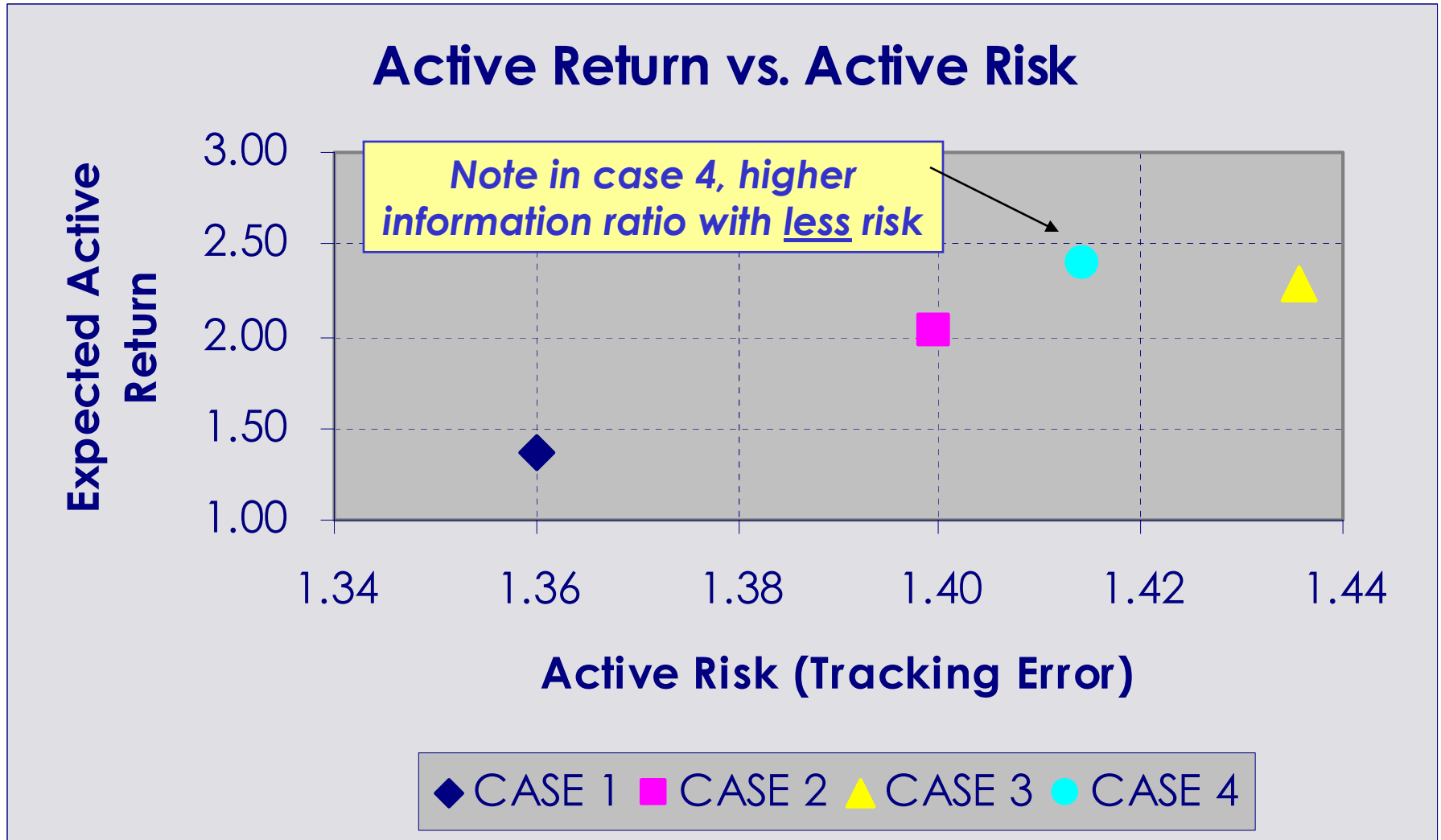
# EXAMPLE: ACTIVE vs. PASSIVE

	CASE 1			CASE 2			CASE 3			CASE 4		
	%	Exp Return	Active Risk	%	Exp Return	Active Risk	%	Exp Return	Active Risk	%	Exp Return	Active Risk
Passive	66	0	0	33	0	0	20	0	0	20	0	0
Enhanced	0	2	2	8.25	2	2	11.5	2	2	10	2	2
Enhanced	0	2	2	8.25	2	2	11.5	2	2	10	2	2
Enhanced	0	2	2	8.25	2	2	11.5	2	2	10	3	4
Enhanced	0	2	2	8.25	2	2	11.5	2	2	10	3	4
Traditional Active	8.5	4	8	8.5	4	8	8.5	4	8	10	3	4
Traditional Active	8.5	4	8	8.5	4	8	8.5	4	8	10	3	4
Traditional Active	8.5	4	8	8.5	4	8	8.5	4	8	10	4	8
Traditional Active	8.5	4	8	8.5	4	8	8.5	4	8	10	4	8
TOTAL	100	1.36	1.36	100	2.02	1.40	100	2.28	1.44	100	2.40	1.41
Information Ratio		1.00			1.44			1.59			1.70	
	Weight	Contrib to Risk		Weight	Contrib to Risk		Weight	Contrib to Risk		Weight	Contrib to Risk	
Passive	66	-		33	-		20	-		20	-	
Enhanced	0	-		33	5.56		46	10.27		60	36.00	
Trad. Active	34	100.00		34	94.44		34	89.73		20	64.00	

**Note in case 4, higher information ratio with less risk**

**Risk controlled, between Enhanced and Traditional**

# EXAMPLE: ACTIVE vs. PASSIVE



- ◆ **Allocate risk to decisions / sectors in proportion to expected returns**
- ◆ **Results in a more efficient use of risk**
  - **Suppose the ratio [return ÷ contrib. to risk] for **first view** is greater than ratio for **second view****
  - **Then we can increase size of first view relative to second view**
  - **And have a **higher expected return per unit of risk** (“information ratio”)**

# STEPS IN RISK BUDGETING

- ◆ Determine **desired active return**
- ◆ Determine **achievable information ratio**
  - Based on *skill in manager / security selection and degree of diversification*
- ◆ Calculate aggregate **active risk budget**
  - *Active risk = Desired active return ÷ IR*
- ◆ Determine degree of **skill in each component** (e.g., asset class) of total fund
- ◆ **Allocate** active risk budget to each component
  - Based on *expected return, risk, and correlations among strategies*

- ◆ Risk relative to benchmark (“active risk”) depends on “active weight” of each security
- ◆ Passive: Port. Wt = Bench. Wt
- ◆ Enhanced 1: active wts < 5bp, wt > 0
- ◆ Enhanced 2: active wts < 20bp, wt > 0
- ◆ Enhanced 3: same as 2, wt may be < 0
- ◆ Enhanced 4: active wts < 1%,  
active sector wts < 5%  
wt may be < 0
- ◆ Traditional 1: active wts < 5%, wt > 0,  
active sector wts < 15%
- ◆ Traditional 2: active wts < 10%, wt > 0



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# APPENDIX 2: HOW RISK BUDGETS ARE DETERMINED

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- ◆ **Total Risk [Total Fund only]**
  - **Start with level of benchmark risk**
  - **This risk level is required to meet the return objectives of the fund, and is chosen by the Committee**
  - **Add active risk budget (assume it is uncorrelated with systematic risk)**
  - **Total risk may be within  $\pm 20\%$  of this value**

## ◆ Active Risk - Asset Class

- Consider **realized volatility** and **correlations** of managers in each asset class over several cycles
- Consider **expected (or actual) number of managers** in each asset class
- Combine **current (or potential) managers' risks and correlations at current (or potential) weights**
- Risk budget of combination will be **smaller than average manager risk**

## ◆ Example: Active Risk – Non US Equity (Developed)

- Selected 11 managers with various levels of active risk
- Median tracking error\* = xx%
- Median correlation\* of active return = xx%
- Combined tracking error = xx%
- Allowing for periods of higher volatility and correlation: set budget at 3.0%

\*based on last 36 months returns and analysis of holdings

- ◆ **Active Risk - Total Fund**
  - Consider **historical** volatility of UCRP
  - Consider **median** volatility of large pension plans
  - **Combine** risk budgets for **each asset class** at **policy** proportions
    - ◆ Assumes active risk is attached to each asset class exposure
  - Add allowance for **misfit risk** of aggregate manager benchmark

- ◆ **Active Risk - Total Fund, contd.**
  - Add allowance for **tactical asset allocation** within approved ranges
  - Resulting overall budget for UCRP is 3% annualized TE
  - Active risk may be within  $\pm 1\%$  of this value
  - Risk budget can fluctuate based on **level of market**