

Risk Budgeting

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What is Risk Budgeting?

- Risk budgeting is the process of setting and allocating active (alpha) risk to enhance the returns available from passive management (beta).
- "... separates risk budgeting and VaR measurement from ... asset allocation."
(McCarthy in Rahl)

Literature:

Waring, B., Whitney, Pirone and Castille, “Optimizing Manager Structure and Budgeting Manager Risk,” *Journal of Portfolio Management*, Spring 2000.

Rahl, Leslie, *Risk Budgeting: A New Investment Approach*, Risk Books, 2000, Risk Books

Chow, G. and Kritzman, M., “Risk Budgets,” *Journal of Portfolio Management*, Winter 2001

Blitz, D and Hottinga, A., “Tracking Error Allocation,” *Journal of Portfolio Management*, Summer 2001

Literature, continued:

- Lee, Wai and Lam, D. “Implementing Optimal Risk Budgeting,” *Journal of Portfolio Management*, Fall 2001
- Sharpe, William F. “Budgeting and Monitoring Pension Fund Risk,” *Financial Analyst Journal*, Sept/Oct 2002
- Arnott, Robert D. “Risk Budgeting and Portable Alpha,” *Journal of Investing*, Summer 2002
- Litterman, Bob, Winkelmann, K, et al., “Developing an Optimal Active Risk Budget,” *Modern Investment Management: An Equilibrium Approach*, 2003, Wiley
- Sherer, B. and Martin, D, *Introduction to Modern Portfolio Optimization*, Springer, 2005

Tracking Error Allocation

- The risk budgeting (which Blitz and Hottinga call tracking error allocation) framework is a three-step process:
 1. Identifying the independent investment decisions;
 2. Ranking the forecasting capabilities for the investment decisions; and
 3. Calculating the optimum partial tracking errors, given an overall tracking error limit.
- Target tracking error for each investment decision should be proportional to the corresponding expected information ratio. (This assumes that active risks are uncorrelated)

Allocating Between Market and Active Risk

- Optimizing risk allocation to maximize Portfolio Sharpe Ratio, S_p :

$$S_p = (M \times S_m + A \times S_a) / (M^2 + A^2)^{1/2}$$

M = Market Risk

A = Active Risk

S_m = Market Sharpe Ratio

S_a = Active Sharpe Ratio

- Active and passive (market) risk must be equal if the Sharpe ratio of the market and the Sharpe ratio of the active portfolio are equal.

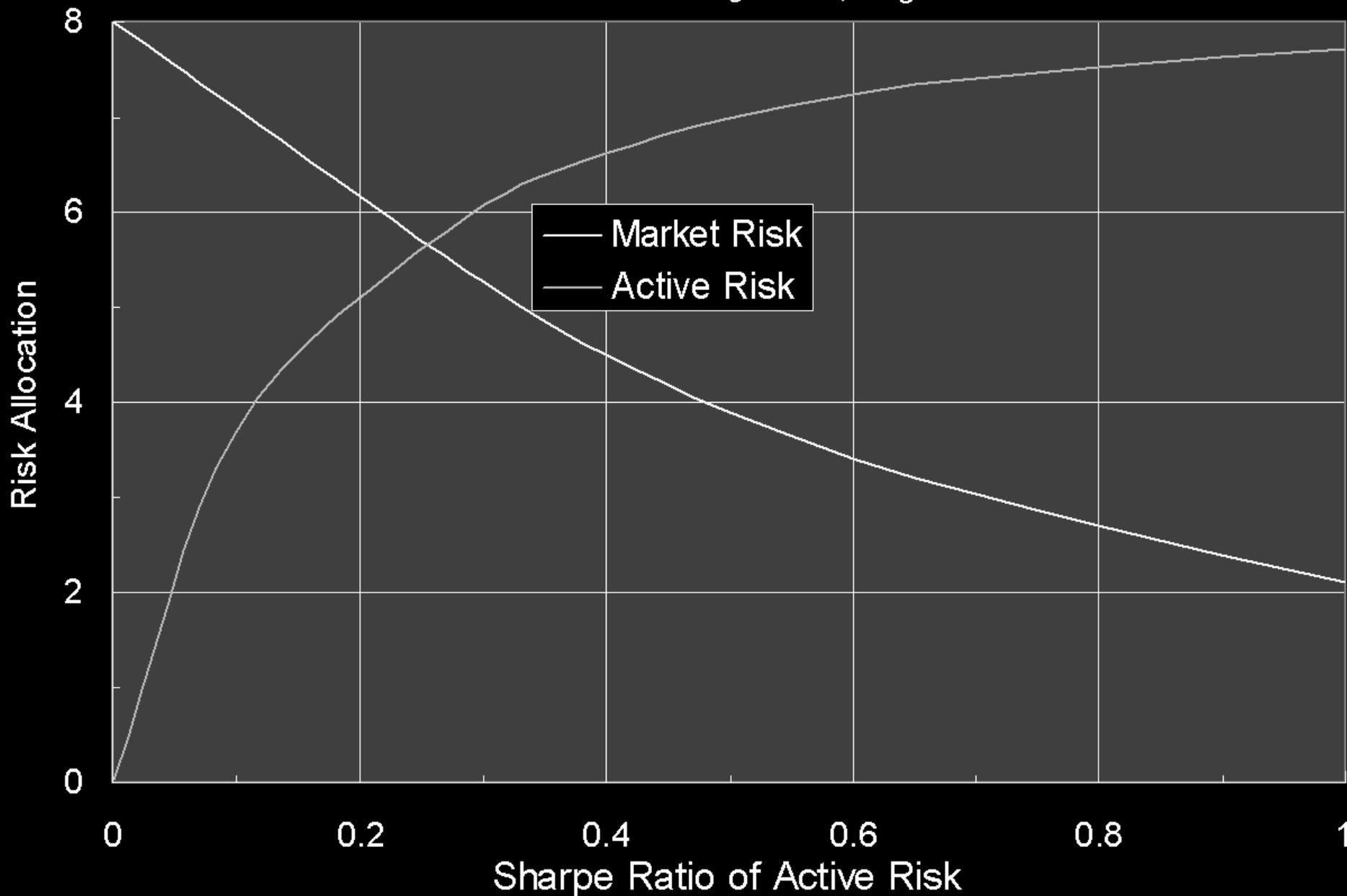
Market Return and Risk

- In order to determine partition the total risk between market risk and active risk, we need to estimate the composition, return and risk characteristics of the market portfolio.
- What is the market portfolio and how should we weight the following asset classes?
 - Domestic Equities
 - Domestic Bonds:
 - ❖ Should treasury and agency bonds be part of the market portfolio?
 - ❖ Rob Fuhman: Probably not (Newport 2004)
 - International Equities: How much home market bias?
 - International Bonds: How much currency hedging?
 - ❖ Black's Universal (77%) Hedging
 - ❖ As home bias decreases, optimal hedging increases
 - ❖ Rule of Thumb: Hedge foreign bonds, don't hedge foreign equity
 - Commodities? Private Equity? Private Real Estate?
- Based on a domestic equity risk premium of 4%, Litterman estimates the expected return of the market portfolio is 2.22% with an annualized volatility of 8.3%, giving a Sharpe ratio of 0.268

Optimal Allocation to Market and Active Risk

Total Risk = 8%, Market Sharpe Ratio = 0.268

Modern Investment Management, Page 158



Why Separate Alpha from Beta?

- Why don't we simply put each manager's expected returns, risk and correlations into an optimizer and use those results?
- We have a higher confidence in the our asset class return predictions than we do for active returns.
 - We can use use economic theory, econometric and Bayesian techniques to improve asset class return and risk estimations.
- Weights are very sensitive to small changes in the risk and return estimates for both asset class and active return expectations.
- Small changes in active return estimates could result in (undesirable) large changes in asset allocation.

Why Do Risk Budgeting?

- Active management is effective because returns that are uncorrelated to market returns require a very low hurdle rate to add value to a portfolio.
- “(It is) an extension of mean-variance optimization that enables us to decouple a portfolio’s allocation from fixed monetary values.” (Chow and Kritzman)

What Risk Budgeting is Not

- Having a different asset allocation than the market portfolio is not risk budgeting.
- Pension liabilities usually differ from the market portfolio.
 - Pension liabilities are usually modeled by a long-term bond index, with a duration of about 10 years vs. 4½ for the Lehman Aggregate.
 - Global diversification is usually preferable for over-funded plans.
 - Domestic equities have a higher correlation with liabilities and may be preferable for under-funded plans, because liabilities are not well correlated with the global equities.
 - Set up the optimization using return and risk estimations that are relative to liabilities.

Active Return

- Markets must be inefficient – rejection of efficient market hypothesis.
- Can You Select Superior Managers?
 - You must be able to identify skill – it does not matter if someone else can, unless that someone else is your consultant.
 - You can efficiently allocate risk among skilled managers.
 - You can identify deterioration in skill and act accordingly.
 - You can rebalance with reasonable transaction costs.

Mutual Fund and Index Sharpe Ratios 1995-2004

Fund Type	75 th Percentile	50 th Percentile	25 th Percentile
Russell 3000		0.42	
Equity, Income	0.54	0.41	0.32
Equity, Growth and Income	0.46	0.40	0.29
Equity, Growth	0.41	0.28	0.16
Equity, Aggressive Growth	0.32	0.20	0.07
Equity, Small Cap	0.58	0.37	0.21
MSCI EAFE		0.09	
Equity, Non US	0.30	0.14	0.02
Lehman Aggregate		0.83	
Bonds, Investment Grade	0.73	0.61	0.49
Lehman High Yield		0.44	
Bonds, High Yield	0.63	0.42	0.25

Hedge Fund Sharpe Ratios

2000-2005, Hedgefund.net

Fund Type	75th Percentile	50th Percentile	25th Percentile
Arbitrage, Other	1.47	0.70	0.38
Convertible Arbitrage	1.95	1.51	1.04
Emerging Markets	1.47	0.79	0.40
Event Driven	1.65	1.11	0.71
Fixed Income	2.60	1.54	0.86
Global Macro	1.00	0.61	0.23
Long/Short Equity	0.93	0.37	-0.01
Managed Futures	0.64	0.36	0.12
Market Neutral Equity	1.21	0.42	0.07
Multi-Strategy	2.30	1.22	0.85
Average	1.52	0.86	0.47
Equally Weighted	2.29	1.44	1.05

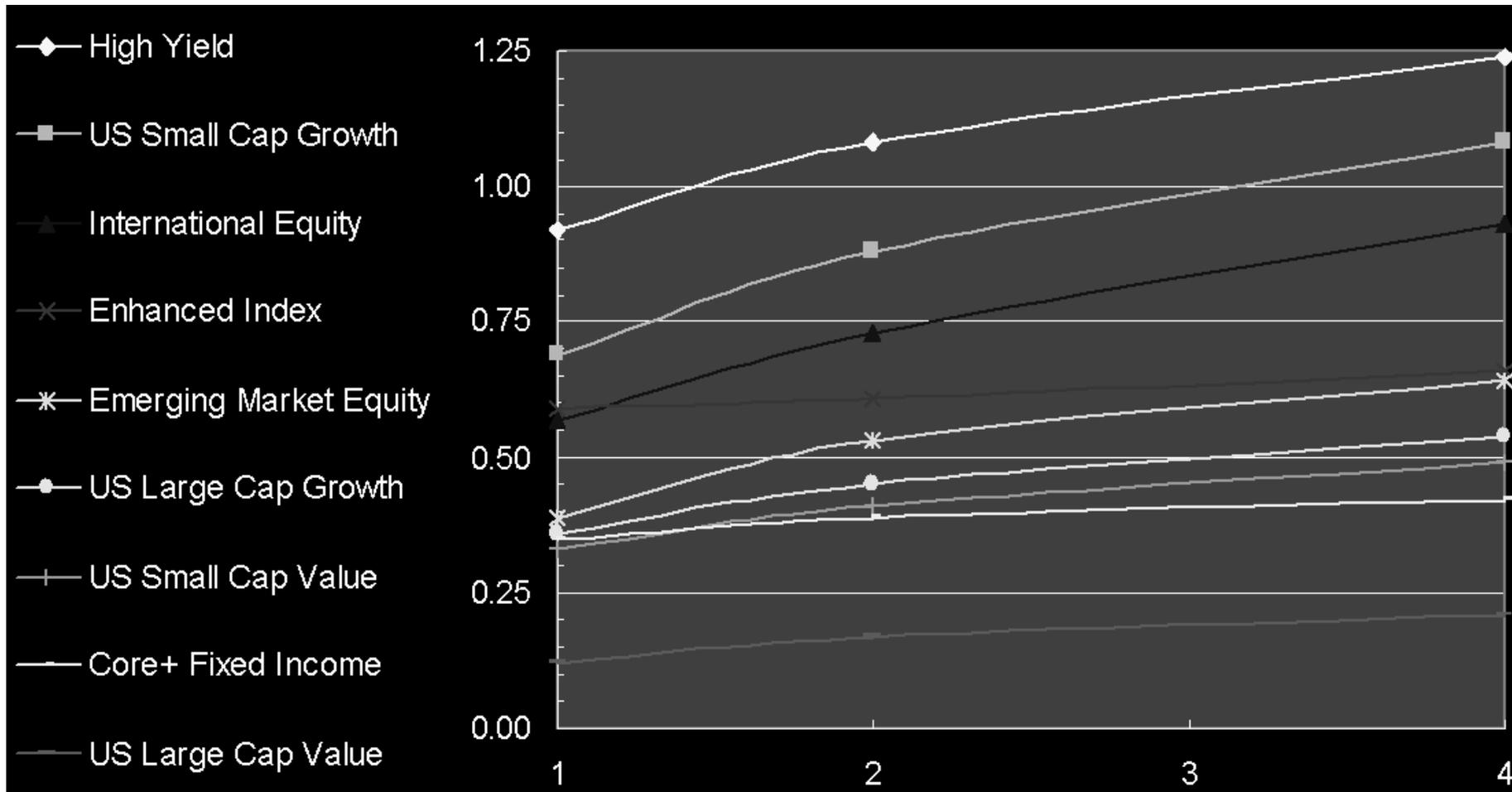
Institutional Managers

Asset Class	Alpha	T.E. 2 Managers	Information Ratio
Enhanced Index	75	145	61%
US Large Cap Growth	230	583	45%
US Large Cap Value	50	460	17%
US Small Cap Growth	720	880	88%
US Small Cap Value	275	710	41%
International Equity	335	460	73%
Emerging Market Equity	340	610	53%
Core+ Fixed Income	25	75	39%
High Yield	255	225	108%

Institutional Manager Data from Previous and Following Slides

- Data from Litterman's *Modern Investment Management* p. 177
- Returns data from Nelson's database, 1992 to 2002
- Table and graph show median gross (before fee) for randomly selected portfolios of managers:
 - Returns
 - Tracking error or residual volatility "adjusted for market directionality"
 - Information ratio.
 - Because this is median data from random 'n manager' portfolios, the information ratio is not equal to the median return divided by the median tracking error.

Information Ratio vs. Number of Managers



Successful Active Management Requires

- Confidence in manager skill and selection
 - “Hope is not a strategy” (Robert Arnott, March/April 2005 *Financial Analyst Journal*)
 - Should not be undertaken simply to match liabilities.
- The ability to optimize the active risk information ratio using *risk budgeting*.

Active Management

- Which asset classes do you want to actively manage?
- What are your return and risk expectations?
 - Information Ratio = $\text{Return}_{\text{active}} / \text{Risk} = E(r_{\text{active}}) / \sigma_{\text{active}}$
- Should you use Tactical Asset Allocation?
- Should you use an Active Currency Overlay?
- How much risk is each manager allowed to take?

Active Management

- How many managers?
- What are the correlations between active strategies?
- How do you monitor their performance and update expectations?
- When do you rebalance managers and implement transition?

Optimizing the Active Risk Budget

Modern Investment Management, Chapter 13

- Select level of active risk, which depends on the relative Sharpe ratio between the market and active portfolios.
- Determine weight of passive vs. active managers
- Allocate active risk across asset classes.
- Allocate active risk active risk to specific manager within each asset class:
 - According to substyles, such as growth/value, large/small
 - According to risk levels such as structured or concentrated
- Frequency of portfolio rebalancing
- Allocation of active risk to overlay (TAA, currency) strategies

Modeling Active Management

- There is no difference between:
 - An active manager with a tracking error of 4%
 - An active manager with a 1% tracking error levered four times by shorting index futures on the benchmark.
- We assume that each active manager has tracking error equal to 1.0.
- We estimate the ideal “leverage” to be associated with each active manager.
- This gearing ratio will be numerically equivalent to the ideal tracking error for each manager.
- In an optimal and unconstrained risk allocation, the marginal contribution to risk is proportional to its expected excess return.

Example: Active Management Risks and Strategic Allocation

Asset Class	Strategic Allocation	Sharpe Ratio	Domestic Equity	Foreign Equity	Bonds	Currency	TAA
Domestic Equity	40	0.3	1.0	0.3	0.2	0.1	0.0
Foreign Equity	10	0.7	0.3	1.0	0.1	0.0	0.0
Bonds	40	1.0	0.2	0.1	1.0	0.1	0.0
Currency	25	1.0	0.1	0.0	0.1	1.0	0.1
TAA	100	0.5	0.0	0.0	0.0	0.1	1.0
Slack	-115	0.0	0.0	0.0	0.0	0.0	0.0

Active Management: Risks and Strategic Allocation

Asset Class	Strategic Allocation	Optimum Allocation	Risk Allocation
Domestic Equity	40	0	0.0%
Foreign Equity	10	40	4.0%
Bonds	40	120	3.0%
Currency	25	156	6.2%
Tactical Asset Allocation	100	0.0	0.0%
Slack	-115	-215	0.0%

Conclusions

- You create a risk budget because you typically will have a difference confidence in your predictions of asset class vs. active return.
- Based on your liabilities and the relative expectations between active and market Sharpe ratio, you can set the portfolio's market exposure, asset class allocations and active risk.
- You can use an optimizer to determine the optimum active risk allocation by:
 - Setting the risk level to 1.
 - Setting the expected return to the manager's Sharpe ratio
 - Using a slack asset class to represent a short position in the benchmark.
 - Setting constraints, if necessary.
 - Optimizing to determine the risk allocation to each asset class.