PLENARY 6 – ASSET ALLOCATION

Augmenting the traditional approaches
Theory and Practice

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Focus for Asset Allocation

The Problem: *Investors have two goals -*

1) Grow their assets
2) Limit exposure to significant drawdowns along the way.

***Unfortunately, these two goals conflict with each other*.**

- Policy portfolios/Strategic Asset Allocations serve as an expression of how investors balance these conflicting goals.
- They estimate the exp. returns, risk, and correlations selecting a blend that offers the desired distribution
- The distribution is summarized by its mean and standard deviation
- They estimate the likelihood of various outcomes: Achieving a growth rate or avoiding a certain drawdown
- Given an expectation for returns, risk, and correlations, portfolio of asset classes selected to meet objectives.
- The problem with this approach is that investors want "the distribution" not the portfolio. The portfolio is simply a means to an end.

The theoretical solution: Revise the portfolio to preserve the desired return distribution/ replace the policy portfolio with a flexible investment policy

Operational reality, is somewhat more difficult in real life. ***Risk is hard to estimate, but returns are infinitely harder…***

Focus for Asset Allocation

Four ways to address the challenges –

1. **Rethinking constraints to better optimize outcomes (Portfolio Basis)**
2. **Active/Passive: Identifying optimal allocations across selected managers (Manager Basis)**
3. **Liquid/Illiquid: Determining the optimal exposure to illiquid assets (Alts Basis)**
4. **Layering Scenario Analysis over Traditional Asset Allocation (Process Basis)**

Should return targets be the paramount objective, or is avoiding significant variability of outcomes at the expense of returns the right course of action?

Constraints impact available choices

Q. Do investors constrain their portfolios because they lack conviction in their views?

A. No. It is more likely that investors are averse to being wrong and alone, i.e. peer risk matters

- Investors can derive more efficient portfolios by considering aversion to tracking error as well as aversion to absolute risk.

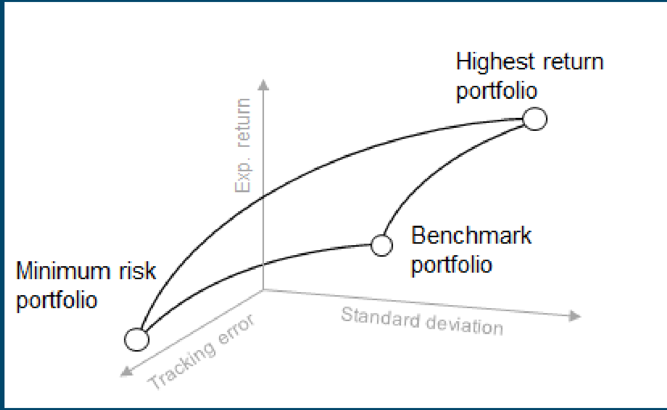
- Mean-variance-tracking-error optimization produces *an efficient surface* in dimensions of expected return, standard deviation, and tracking error.

The bottom line: It is more efficient to use tracking error, rather than ad hoc constraints, to control for the risk of deviating from the norm.

Performance outcomes and the efficient surface

Relative returns:	*Absolute returns:* **Favorable**	**Unfavorable**
Favorable	**Great**	**Tolerable**
Unfavorable	**Tolerable**	**Very unpleasant**

Most investors care about both absolute and relative returns.



Efficient surface:
This stylized exhibit shows the efficient surface in three dimensions. The portfolios at the corners of this surface represent optimality in one particular dimension at the expense of others.

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Identifying optimal allocations across managers

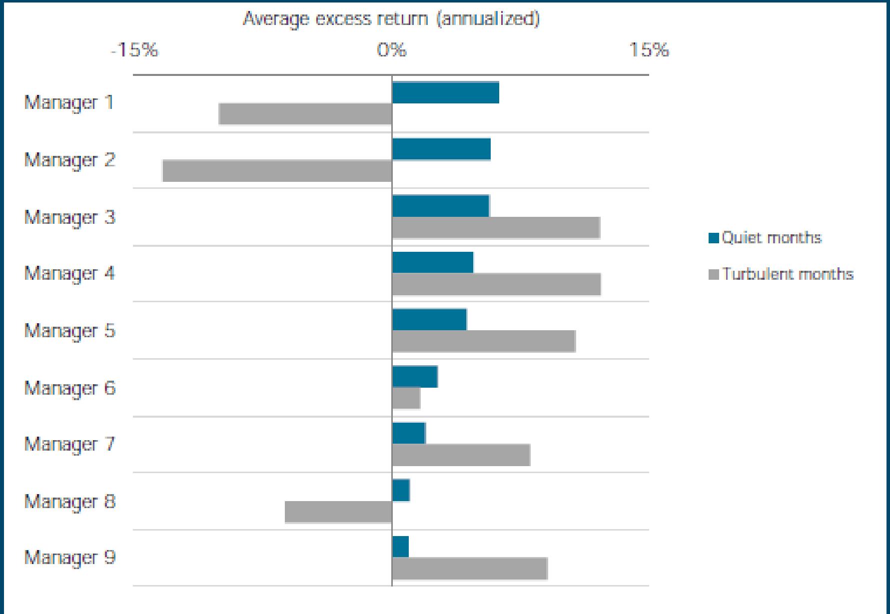
Manager selection and allocation will continue to receive increased attention as investors debate the merits of active versus passive management.

Managing Risk in the Manager Selection and Allocation

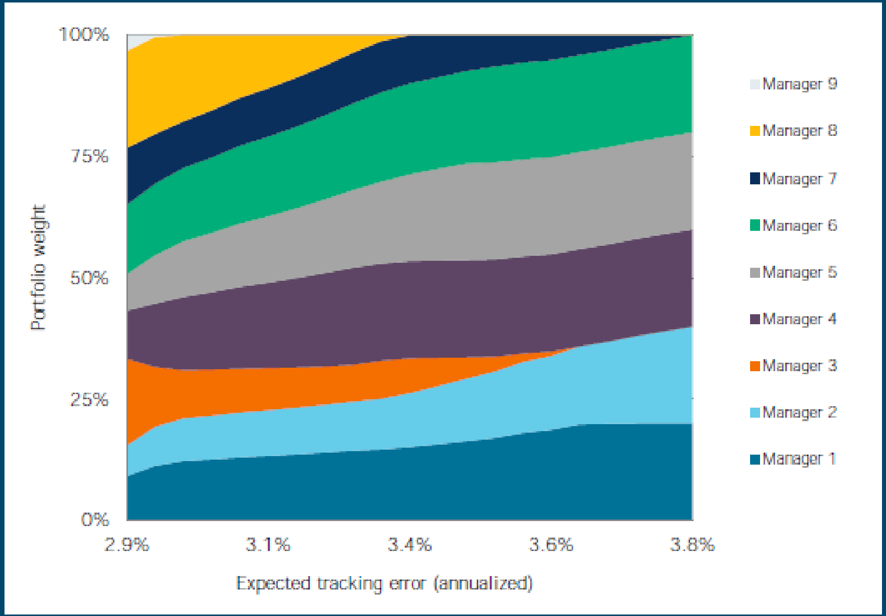
- Understanding factor exposures
- Information Ratio is an incomplete view of performance: Also need to understand impact of risk regimes, risk over short-term vs long-term, and performance asymmetry.
- Avoid over-diversification by understanding not only each managers tracking error and expected alpha, but also how all of these features relate to the other managers and in what regimes.
- Identify allocations for a range of tracking errors
- Incorporate a framework for evaluating and incorporating fee structures (fixed vs performance)

Identifying optimal allocations across managers

Risk regimes and conditional manager alpha (annualized) example



Optimal manager allocations for a range of expected tracking errors



Increasing Illiquid Assets/Private Markets in Asset Allocation

Managing and Understanding Risk in Alternatives Allocations

Most investors recognize there are costs associated with holding illiquid assets, but haven't accounted for them explicitly. They can address this by examining the specific benefits they derive from liquidity as well as the costs they incur from illiquidity.

- Liquidity has utility: Investors rely on liquidity to rebalance, meet cash demands, implement tactical allocation decisions, and more

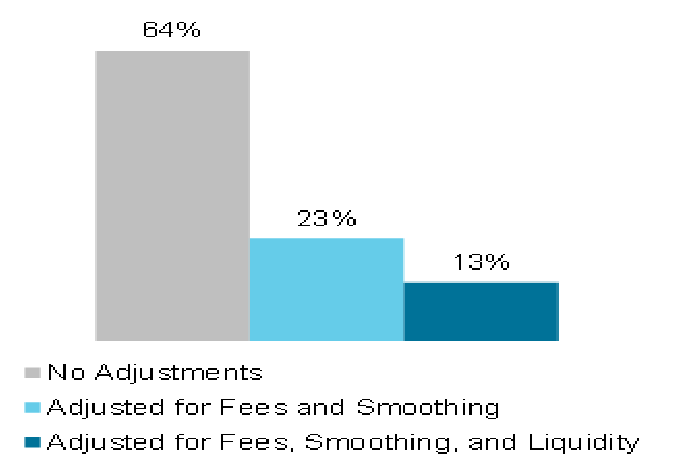
- Attach a shadow asset to liquid assets
- Attach a shadow liability to illiquid asset classes
    - These account for benefits and costs for ability to trade or cost of immobile nature

- Shadow allocations allow investors to address illiquidity within a single, unified framework of expected return and risk.

- Performance fees and appraisal-based pricing cause the observed standard deviation of illiquid assets to understate their risk. We must correct for this bias.

Illiquid Assets/Private Markets and Asset Allocation

	Return	Volatility
Shadow assets (attached to liquid assets)		
Tactical asset allocation	40	80
Shadow liabilities (attached to illiquid assets)		
Sub-optimality: weight drift	16	0
Sub-optimality: cash demands	18	0
Borrowing: cash demands	17	10



Shadow assets and liabilities:

The value of liquidity and cost of illiquidity will differ for each investor. This illustration offers plausible estimates.

Optimal allocation to real estate:

The optimal allocation decreases as we account for incremental complexities

Risk in the process of Asset Allocation

Mean-Variance Analysis

Requires estimates of expected returns, standard deviations, and correlations

Yields efficient portfolios with estimates of their expected returns and standard deviations

Advantages:

- Implicitly accounts for all potential scenarios and their probabilities of occurrence
- Statistically rigorous

Disadvantages:

- Inputs and outputs are unintuitive
- Required inputs are difficult to estimate

Scenario Analysis

Requires specification of prospective scenarios with their probabilities of occurrence

Yields target portfolio

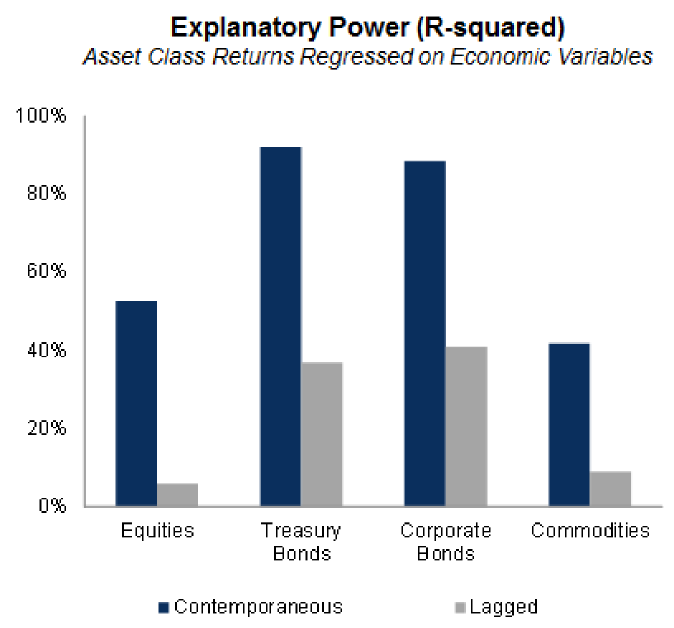
Advantages:

- Intuitive
- Straightforward to implement

Disadvantages:

- Accounts for only a small subset of potential scenarios
- Relies on subjective views
- Lacks statistical rigor

Economic Variables and Asset Class Returns



Economic variables and asset returns are often related…

…But the relationship is not necessarily predictive

We therefore want to predict the joint likelihood of a future state of economic variables

Notes: Chart shows the R-squared of multivariate regressions of asset classes on the collection of economic variables using annual historical observations.

Additional methods for evaluating asset allocation decisions

- Mahalanobis (1927) developed an equation to standardize differences in skull characteristics

$$d_t = \frac{(y_t - \mu)\Sigma^{-1}(y_t - \mu)'}{N}$$

d_t = turbulence score

y_t = vector of cross-sectional asset returns

μ = mean vector of return series *y*

Σ = covariance matrix of return series *y*

N = number of assets

Seven skull characteristics:

- Head length
- Head breadth
- Nasal length
- Nasal breadth
- Cephalic index
- Nasal index
- Stature

Additional methods for evaluating asset allocation decisions

- Using this Mahalanobis equation, we can also measure likelihood of economic scenarios

How unusual is each projected economic variable, given its current value?

$$d = (x - \gamma)'\Sigma^{-1}(x - \gamma)$$

How unusual is the set of projected variable changes, in combination?

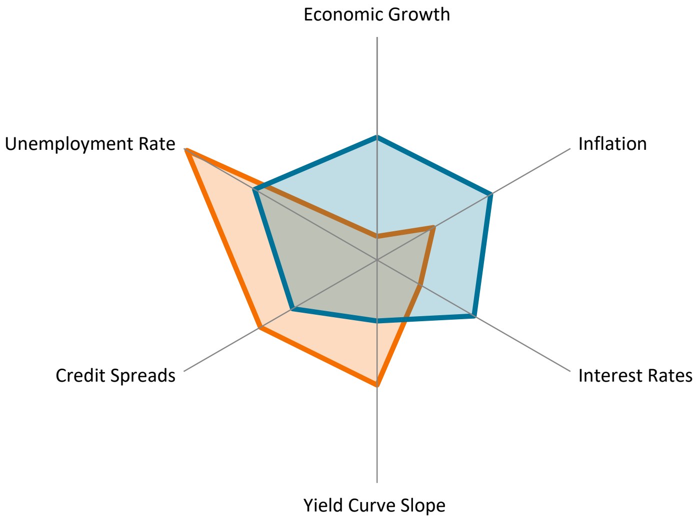
$$d = (x - \gamma)'\Sigma^{-1}(x - \gamma)$$

d = the Mahalanobis distance
x = the values of a set of variables used to characterize a prospective scenario
γ = the prevailing values of the economic variables
Σ = the historical covariance matrix of changes in values for those variables

Economic Variables

- Economic growth
- Unemployment rate
- Inflation
- Interest rates
- Yield curve slope
- Credit spreads

Additional methods for evaluating asset allocation decisions



Current and Prospective Scenarios

Economic Variables	Current	Normal	Weak	Robust
Economic Growth	3.0%	2.6%	0.9%	4.2%
Unemployment Rate	3.7%	5.3%	6.9%	3.7%
Inflation	2.2%	2.0%	0.6%	3.3%
Interest Rates	2.4%	0.1%	0.0%	2.5%
Yield Curve Slope	0.5%	2.0%	3.0%	0.5%
Credit Spreads	2.3%	2.7%	3.4%	1.9%

Additional methods for evaluating asset allocation decisions

Scenario Probabilities

	Normal	Weak	Robust
Probability based on Current	11%	0%	89%
Probability based on Normal	79%	6%	15%
Probability based on 50/50 Blend	53%	1%	46%

Asset Class Regression Results

	Intercept	Economic Growth	Unemployment Rate	Inflation	Interest Rates	Yield Curve Slope	Credit Spreads	R-squared
Equities	**7.4%**	0.7	**-7.7**	-1.3	-4.7	-3.6	**-13.3**	53%
p-value	**0.00**	0.23	**0.00**	0.06	0.06	0.10	**0.00**	
Treasury Bonds	**2.0%**	**0.2**	**0.4**	-0.1	**-5.2**	**-5.1**	-0.1	92%
p-value	**0.00**	**0.02**	**0.05**	0.07	**0.00**	**0.00**	0.42	
Corporate Bonds	**2.6%**	0.2	0.4	**-0.5**	**-7.3**	**-6.9**	**-6.6**	89%
p-value	**0.00**	0.07	0.16	**0.00**	**0.00**	**0.00**	**0.00**	
Commodities	4.0%	0.5	3.3	**9.9**	1.6	1.1	-1.4	42%
p-value	0.13	0.37	0.24	**0.00**	0.31	0.34	0.34	

Additional methods for evaluating asset allocation decisions

Scenario-Dependent Asset Class Returns and Probability-Weighted Returns

	Scenario-Dependent Returns			Probability Weighted Returns		
	Normal	Weak	Robust	Current	Normal	50/50 Blend
Equities	-3.9%	-28.7%	12.6%	10.7%	-3.1%	3.4%
Treasury Bonds	8.4%	4.0%	3.4%	4.0%	7.4%	6.1%
Corporate Bonds	8.6%	-2.2%	5.8%	6.1%	7.5%	7.2%
Commodities	5.7%	-3.2%	17.9%	16.5%	6.9%	11.2%
Cash Equivalents	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%

Candidate Portfolios

	Portfolio Weights		
	Conservative	Moderate	Aggressive
Equities	20%	40%	60%
Treasury Bonds	30%	15%	0%
Corporate Bonds	10%	15%	20%
Commodities	10%	15%	20%
Cash Equivalents	30%	15%	0%
Expected Return based on Current	6.3%	8.6%	10.9%
Expected Return based on Normal	3.8%	2.4%	1.0%
Expected Return based on 50/50 Blend	5.0%	5.4%	5.7%

Additional methods for evaluating asset allocation decisions

PROCESS

- Specify scenarios as projections of economic variables (normal, weak, robust)
    - Assign probabilities to prospective scenarios
        - Map economic variables onto asset expected returns
            - Compute probability-weighted expected returns for each asset
                - Specify alternative portfolio choices
                    - Compute each portfolio's probability-weighted expected return
                        - Select the best portfolio

Additional methods for evaluating asset allocation decisions

CONCLUSION

- Some investors use scenario analysis as an alternative to mean-variance analysis because they find it more intuitive.
- Intuition comes at the expense of quantitative rigor: Prospective scenarios limited and assigning probabilities to their occurrence is often subjective.
- An alternative would remove much of the subjectivity of scenario analysis.
- This is mathematically more complex….
- ….But this complexity arises in the construction of the statistical process. Once a process is in place its implementation and the assessment of its output is as intuitive as any subjective approach to scenario analysis.

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