Module 16:
Active Equity Investing: Portfolio Construction

Active Return:

$$R_A = \sum \Delta w_i R_i$$

↑ active weights, diff b/w port & BM. weight.

Sources of active returns:

1. Iv. of strategic long-term exposures to rewarded factors (risks widely accepted as offering long-term risk premiums (e.g. market risk / beta, size, value, liquidity))

2. Tactical exposures to mispriced securities/sectors & reward risk that generate alpha (return that cannot be explained by long-term exposure to rewarded factors)

3. Idiosyncratic risk (i.e. luck)

Decomposition of realized (ex post) active return:

$$R_A = \sum (\beta_{pk} - \beta_{bk.}) \times F_k + (\alpha + \varepsilon)$$

β_{pk} = sensitivity of portfolio to each rewarded factor
β_{bk} = sensitivity of the BM to each rewarded factor
F_k = return of each rewarded factor
$(\alpha + \varepsilon)$ = return not explained by exposure to rewarded factor

Building Blocks in Portfolio Construction

1. Factor weightings.
2. Alpha skills.
3. Position sizing

Integrating the building blocks : Breadth of experience

$$E(R_A) = IC\sqrt{BR}\ \sigma_{R_A}\ TC$$

IC = expected info coefficient

BR = breadth - no. of truly indep. decision made by the manager each year.

TC = transfer coefficient, the level to which the manager is constrained $0 < TC < 1$, 1 if no contraint

σ_{R_A} = the manager's active risk (the volatility of active return)

Approaches to Portfolio Construction

Majority can be classified as :

- Systematic or discretionary
- Bottom-up or top-down

Top-Down

- Emphasizes macro rewarded factors.
- Factor timing possible but rare
- Diversified a/c broad universe
- Formal port. optimization used
- Few managers in this category

- Emphasizes macro rewarded factors.
- Most likely to use factor timing
- Diversified a/c broad universe or concentrated on smaller subset

Systematic — Discretionary

- Emphasizes security-specific. factors.
- No factor timing
- Diversified a/c broad universe

- Emphasizes security-specific. factors.
- Potential factor timing
- Diversified a/c broad universe or concentrated on smaller subset
- less formal portfolio construction

Bottom-up

Objectives & Constraints

Objectives Functions & Constraints of Port Constructions.

	Absolute Framework	Relative Framework
Objectives	Maximize Sharpe Ratio	Maximize Info Ratio
CONSTRAINTS		
Sector/security weights	Max size in portfolio	Max deviation from BM
risk	Max portfolio volatility	Max tracking error
Market Cap	Min/Max set by mandate.	

Other approaches include:
- Specifying objectives in terms of risk.
- maximizing exposure to rewarded factors
- maximizing exposure to securities w/ specific custom characteristics defined by manager
- Heuristic approaches such as basing weighting on the ranking

MODULE QUIZ 16.1

1. An active equity manager makes 10 independent decisions per month with an information coefficient of 0.1, active risk of 5% and a transfer coefficient of 0.5. The expected active annual return of this manager is *closest* to:
   A. 0.8%.
   B. 2.5%.
   C. 2.7%.
2. Which of the following managers is *most likely* to use an approach which uses factor timing techniques?
   A. Systematic bottom-up.
   B. Discretionary bottom-up.
   C. Discretionary top-down.

1. A ($5\% \cdot \sqrt{10} \cdot 0.5 \cdot 0.1$)
2. A

Module 16.2: Active Share & Risk.

$$\text{Active Share} = \frac{1}{2} \sum^{n} | W_{p,i} - W_{b,i} |$$

$0 <$ active shares < 1

(1 - Active Share) can be seen as portfolio overlap & used to assess fees paid per unit of active management

$$\text{active risk } (\sigma_{R_A}) = \sqrt{\frac{\Sigma (R_{A_t})^2}{T-1}}$$

rearranged,

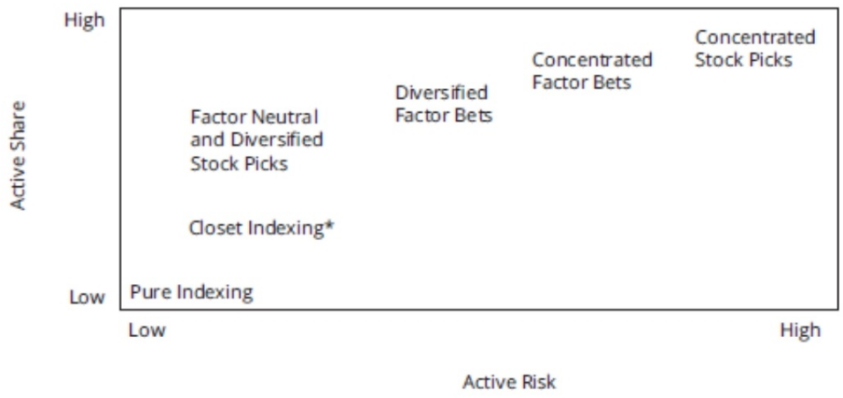
$$\sigma_{R_A} = \sqrt{\sigma^2\left(\sum(\beta_{pk} - \beta_{bk}) \times F_k\right) + \sigma^2 e}$$

↑ which includes variance of alpha

Distinguishing b/w Diff Port Mgt Approaches

Inv. Style	Description	Active Shares & Risk.
Pure indexing	No active positions	0 active share & active risk.
Factor Neutral	No active factor bets. - idiosyncratic risk low if diversified	Low active risk - active share low if diversified
Factor diversified	Balanced exposure to risk factors & minimized idiosyncratic risk through high no. of securities in portfolio	Reasonably low active risk.
Concentrated factor bets	Targeted factor bets. - idiosyncratic risk likely high	High Active share & High Active risk.
Concentrated stock picker	Target individual stock bets	High Active share & High Active risk.

Figure 16.3: Approaches and Their Use of Building Blocks



Manager makes factor bets. when the portfolio's exposure to one or more risk factors. differ from BM.

Active risk measure the extent to which the active return varies. from period to period.

Can also identify manager style thru sector & security-specific weights.

EXAMPLE: Portfolio construction—approaches and return drivers

Based on the following information regarding four managers benchmarked against the same index, **identify** and **justify** the manager most likely to be:

- A concentrated stock picker.
- A diversified multi-factor investor.
- A closet indexer.
- A sector rotator.

Use each category *only once* in your answer.

Manager Constraints:	A	B	C	D
Target active risk	8%	5%	1%	9%
Maximum sector deviations	20%	8%	2%	0%
Maximum risk contribution, single security	3%	1%	1%	6%

A: Sector Rotator (high sector deviation)

B: multi-factor investor (moderate active risk, moderate sector deviations)

C: closet indexer (low targeted active risk, low deviation)

D: stock picker (high indiv. security contribution & NO sector deviation)

MODULE QUIZ 16.2

1. A manager that substitutes a benchmark holding in their portfolio with a similar security not held in the benchmark will *most likely*:
   A. increase Active Share but not substantially increase active risk.
   B. increase active risk but not substantially increase Active Share.
   C. decrease Active Share and increase active risk.

1. A

Module 16.3: Allocating Risk Budget

Steps of Risk Management Process:

1. Determine the type of risk measure:
   - Absolute risk measures are used when objective is to expressed in terms of total returns
   - Relative risk measures are used when objective is to outperform a market index.

2. Understand how each aspect of the strategy contributes to risk. (i.e. does risk come to exposure to rewarded factors or allocations to sectors / securities)

3. Determine the appropriate of risk budget

4. Properly allocate risk

Causes & Sources of Absolute Risk

Contribution of Asset i to portfolio variance (CV_i)

$$CV_i = \sum_{j=1}^{N} W_i W_j C_{ij} = W_i C_{ip}$$

W_i = weight of asset i
C_{ij} = covariance of returns b/w asset i and j
C_{ip} = covariance of returns b/w asset i and the portfolio
$(= \sum W_j C_{ij})$

EXAMPLE: Absolute risk attribution

A portfolio has the following characteristics:

	Portfolio Weight	Standard Deviation
Asset A	20%	22%
Asset B	30%	12%
Asset C	50%	10%
Portfolio	100%	8.6%

	Covariance		
	Asset A	Asset B	Asset C
Asset A	0.050000	0.006700	0.001300
Asset B	0.006700	0.014400	0.002000
Asset C	0.001300	0.002000	0.009800

1. **Calculate** the absolute contribution to portfolio variance of Asset A.
2. Given that the absolute contribution to portfolio variance of Assets B and C are 0.001998 and 0.002880 respectively, **calculate** the relative contribution to portfolio variance of Asset A.

1. Absolute contribution of asset A:

$= \sum W_A W_i C_{Ai}$

$= 20\% \cdot 20\% \cdot 0.05 + 20\% \cdot 30\% \cdot 0.0067$

$+ 20\% \cdot 50\% \cdot 0.0013$

$= 0.002532$

2. Total port var $= 0.002532 + 0.001998 + 0.00288$

$= 0.007411$

Relative Contribution $= 0.002532 \div 0.007411$

$\approx 34\%$

Contribution of Factor to portfolio variance (CV_i)

$$CV_i = \sum_{j=1}^{N} \beta_i \beta_j C_{ij} = \beta_i C_{ip}$$

w_i = weight of asset i
C_{ij} = covariance of returns b/w Factor i and j
C_{ip} = covariance of returns b/w Factor i and the portfolio
$(= \sum \beta_j C_{ij})$

EXAMPLE: Factor-based risk budgeting

The following table presents the risk-factor coefficients and variance/covariance matrix for a manager running a portfolio using a two-factor model (market and size).

		Variance/Covariance of Returns	
	Coefficients	Market	Size
Market	0.892	0.00178	0.00042
Size	–0.283	0.00042	0.00048

The standard deviation of the manager's return is 3.74%.

1. **Calculate** the proportion of the total portfolio variance explained by the market factor.
2. If the contribution to portfolio variance of the size factor is –0.00007, **calculate** the proportion of total portfolio variance that is unexplained.

1. Variance attributed to the market factor:
   = coefficient of Factor 1 × coefficient of Factor 1 × covariance of Factor 1 with Factor 1
   + coefficient of Factor 1 × coefficient of Factor 1 × covariance of Factor 1 with Factor 1
   $= (0.892 \cdot 0.892 \cdot 0.00178) + (0.892 \cdot -0.283 \cdot 0.00042)$
   $= 0.00131$
   Proportion of total port variance explained by mkt factor
   $= 0.00131 / 3.74\%^2 = 93.7\%$
2. $100\% - (93.7\% + (-0.0007 \div 3.74\%^2)$
   $\approx 100\% - (93.7\% - 5\%)$
   $= 11.3\%$

Causes & Sources of Relative / Active Risk

Contribution of Asset i to portfolio active variance (CAV_i):

$$CAV_i = (W_{pi} - W_{bi}) RC_{ip}.$$

W_{pi} = weight of asset i in the portfolio
W_{bi} = weight of asset i in the benchmark
RC_{ip} = covariance b/w active return of asset i & active return of the portfolio (which reflects the covariance b/w active return of asset i & active return for each of n assets in the portfolio)

$$\sum_{i=0}^{n} CAV_i = AV_p$$

Figure 16.4: Relative Risk Attribution

	Benchmark Weight	Portfolio Weight	Standard Deviation	Active Risk	Correlation of Active Returns			Variance of Active Returns Attributed to Each Asset (%)
					Index A	Index B	Cash	
Index A	50%	35%	15%	6%	1.00	−1.00	−0.72	18%
Index B	50%	35%	9%	6%	−1.00	1.00	0.72	−18%
Cash	0%	30%	0.25%	12%	−0.72	0.72	1.00	100%
Total				3.60%	−0.72	0.72	1.00	100%

$RC_{A,A} = 6\% \cdot 6\% \cdot 1 = 0.036.$

$RC_{A,B} = 6\% \cdot 6\% \cdot -1 = -0.036$

$RC_{A,cash} = 6\% \cdot 12\% \cdot -0.72 = -0.005184$

$RC_{A,portfolio} = (-0.15 \times RC_{A,A}) + (-0.15 \cdot RC_{A,B}) + (0.3 \times RC_{A,cash})$

$= (-0.15 \times 0.036) + (-0.15 \cdot -0.036) + (0.3 \times -0.005184)$

$= -0.0015552$

$$CAV_{index\ A} = (35\% - 50\%) \cdot RC_{A,\ portfolio}$$
$$= -15\% \cdot -0.001558$$
$$= 0.0002338$$

Important to note:

- Contribution to active variance is a function of active risk., NOT ABSOLUTE S.D. (e.g. cash can have low abs. S.D but high active risk due to LOW CORRELATION OF CASH VS. BM.)
- Correlation of index A & B is -1 b/c the BM is an equally weighted avg. of the 2 indices => when one index is outperforming the benchmark (i.e. positive active returns), the other must be underperforming (i.e. negative active returns)

Determining the appropriate level of risk.

1. Implementation constraint

2. Limited Diversification opportunities

3. Leverage & its implication for risk.

$$R_g = R_a - \frac{\sigma^2}{2}$$

R_g = geometric compounded return
R_a = arithmetic compounded return
σ = port volatility

Allocating the Risk Budget

Comparative Sources of Risk., Driver of Return

Figure 16.5: Comparative Sources of Risk, Drivers of Return

	Factor Diversified	Sector Rotator
Number of securities	High (in the hundreds)	Low (in the tens)
Position concentration	Low	High
Cash positions	Very low	High when allocated to cash
Market beta	Close to one (diversified)	Higher/lower than one depending on risk targets
Absolute risk	Lower	Higher, though tempered by large allocation to cash
Active risk	Lower	Higher due to large idiosyncratic risks coming from concentrated positions and sector bets
Active Share	Lower	Higher, consistent with higher security concentration
Average sector deviation	Lower	Higher, consistent with willingness to take sector bets
Source of risk: market	Higher	Lower, consistent with higher security concentration
Source of risk: sectors	Lower	Higher, consistent with sector bets
Source of risk: styles	Lower	Higher, consistent with concentrated positions
Source of risk: unexplained	Lower	Higher, consistent with sector rotation and concentrated positions

Additional Risk Measures

Heuristic risk constraints are based on experience or general ideas of good practices (e.g. limit on exposure to individual positions)

Formal Risk constraint. often statistical in nature (e.g. CVaR, IVaR, MVaR)

MODULE QUIZ 16.3

1. The contribution to total variance of a geographical country allocation is *best* defined as:
   A. the weight of the country in the portfolio multiplied by the covariance of the country returns with the global market portfolio returns.
   B. the weight of the country in the portfolio multiplied by the correlation of the country returns with the portfolio returns.
   C. the weight of the country in the portfolio multiplied by the covariance of the country returns with the portfolio returns.
2. Forecasting of return distributions is *most likely* required by:
   A. heuristic risk constraints only.
   B. formal risk constraints only.
   C. both heuristic and formal risk constraints.

1. B
2. C

16.4: Implicit Cost-Related Considerations in Portfolio Construction

Factors of market impact costs:

- AUM vs. Market Cap:
  - lower absolute level of trading volume for smaller cap securities can be a liquidity barriers to managers w/ higher AUM.
- Higher portfolio T/O & shorter investment horizons lead to higher market impact costs
- Manager whose trades include information (where the trade acts as a signal) will have a higher market impact costs.

Market Impact Costs is often measured by "slippage", i.e. diff b/w exec. price & midpoint of quoted market bid/ask spread @ the time the trade was first entered

4 observations based on recent emprical data:

- slippage costs are usually higher than explicit costs
- slippage costs are greater for small-cap securities than for large-cap.
- slippage costs are not necessarily greater for emerging markets.
- slippage costs are usually higher for times w/ high vol.

Successful small-cap focused strategies may be impaired w/ increasing slippage costs as AUM grows. (would either have to change strategy or close fund from new contributions)

Funds w/ a focus on large cap can support a higher AUM than similar-strategy small cap fund.

EXAMPLE: Issues of scale

A diversified multi-factor fund has a size of $200 million and 350 individual positions. The benchmark is a large/mid cap index with 1000 constituents and total market cap of approximately $20 trillion. The smaller securities in the index trade about 1.5% of shares outstanding daily. The strategy has the following constraints:

1. No investment can be made in any security that has an index weight of less than 0.02%.
2. The maximum fund position percentage holding is equal to the lesser of 10 × index weight or index weight plus 100 bps.
3. Absolute position sizes cannot exceed 5% of the security's average daily trading volume (ADV) over the trailing 12 months.

Based on the three constraints listed previously, **calculate** the level of AUM, which the fund's ability to execute this strategy is likely to be impaired.

Constraint 1 & 3: limit on absolute size of a stock w/ smallest market cap position

Constraint 1 indicates the maneger cannot invest in stocks whose market cap is below ~ 0.0002×20 Trillion = 4 billion

Constraint 3 implies the max absolute position size for this smallest cap holding is $0.05 \times 60MM = 3MM$

Constraint 2 implies the max position for the smallest cap security is the lesser of $10 \times 0.02\% = 0.2\%$ & $0.02\% + 100bps = 1.02\% \Rightarrow$ the max position size in the fund is 0.2%

The ability to carry out the strategy is impaired when AUM = $3MM \div 0.002 = \$1.5$ billion.

MODULE QUIZ 16.4

1. All else equal, higher market impact cost is *most likely* associated with:
   A. lower AUM.
   B. investing in large cap securities.
   C. higher portfolio turnover.

1. B

Module 16.5. The well-constructed portfolio

Criteria of a well-constructed portfolio:
- clear investment philosophy
- risk & structural characteristics as promised to investors.
- achieved desired risk exposure
- low operating costs.

1. Funds that achieve desired risk exposure w/ fewer positions are more likely to have better risk management

2. if 2 portfolios have similar risk exposure, the portfolio w/ lower vol. & active risk is pretered.

3. if 2 portfolios have similar active & absolute risk, similar costs, similar manager alpha skills then the portfolio w/ higher active shares. is preferable.

Long/Short, Long Extension & Market-Neutral Portfolio Construction

Reasons for Long-Only Investing
- long-term risk premiums (are earned by net long securities)
- higher scalability / capacity (shorting is limited by the availability of security to borrow)
- limited legal liability on going long
- Regulation restricting short-selling
- Transactional complexity
- Costs
- personal ideology

Long/Short Portfolio Construction

Long extension: net exposure 100%
(e.g. 130% long, 30% short)

Market Neutral: Net Market Beta of 0.

Benefits of L/S Strat:

- Greater ability to express negative ideas.
- Able to use the leverage generated by short positions
- Able to remove market risk & act as a diversifying investment.
- Greater control on risk factors.

Drawbacks of L/S Strat:

- potential unlimited loss
- leverage magnifies Ps. & also Ls.
- cost of borrowing securities can become too high
- losses on short position will increase collateral demand from stock lender

MODULE QUIZ 16.5

1. If two portfolios have similar active and absolute risks, similar costs, and similar manager alpha skills, then:
   A. the portfolios must have equal Active Share.
   B. the portfolio with highest Active Share would be preferred.
   C. the portfolio with lowest Active Share would be preferred.
2. In general, which of the following statements best describes a benefit regarding long/short hedge fund strategies?
   A. The ability to use the leverage generated by short positions to gear into high conviction long ideas.
   B. The reduction of the long-term exposure to the market risk premium.
   C. The high leverage used by some market neutral strategies to generate investor returns.

1. C
2. A

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