

LM01 Portfolio Performance Evaluation

The components of performance evaluation

Performance evaluation helps to understand the quality of the investment process. The three components of the performance evaluation are:

- **Performance measurement** - provides an overall indication of the portfolio's performance.
- **Performance attribution** - builds on performance measurement to explain how the performance was achieved.
- **Performance appraisal** - leverages both returns and attribution to infer the quality of the investment process. It helps evaluate if the performance was achieved through manager skill or luck.

Performance attribution

An effective performance attribution process must:

1. account for all of the portfolio's return or risk exposure,
2. reflect the investment decision-making process,
3. quantify the active decisions of the portfolio manager, and
4. provide a complete understanding of the excess return/risk of the portfolio.

Instructor's tip: You can use the acronym 'ARQP' to remember the list.

Performance attribution includes both return attribution and risk attribution.

- **Return attribution** analyzes the impact of investment decisions on the returns.
- **Risk attribution** analyzes the risk consequences of investment decisions.

Performance attribution can be conducted at distinct levels.

- **Macro attribution** considers the decisions of the fund sponsor.
- **Micro attribution** considers the decisions of the individual portfolio manager.

Performance attribution can be returns-based, holdings-based, or transactions-based.

- **Returns-based attribution** uses total portfolio returns over a period to identify the factors that have generated those returns. It is used when information about the underlying holdings is not available. This approach is the easiest to implement, but it is also the least accurate and most vulnerable to data manipulation.
- **Holdings-based attribution** considers the actual portfolio holdings at the beginning of the measurement period and is more accurate than a returns-based attribution approach. This approach works well for passive strategies with low holding turnovers.
- **Transactions-based attribution** uses both the holdings of the portfolio and the transactions that occurred during the evaluation period. Out of the three approaches, this is the most accurate but also the most difficult to implement.

Equity return attribution

The Brinson-Hood-Beebower (BHB) model

According to the BHB model, a portfolio's outperformance/underperformance can be attributed to three sources:

- **Allocation effect:** The allocation effect refers to the value the portfolio manager adds (or subtracts) by having portfolio sector weights that are different from the benchmark sector weights. The contribution to allocation (A_i) for each sector can be expressed as:

$$A_i = (w_i - W_i)B_i$$

- **Selection effect:** The selection effect refers to the value the portfolio manager adds by holding individual securities or instruments within the sector in different-from-benchmark weights. The contribution to selection in the i^{th} sector can be expressed as:

$$S_i = W_i(R_i - B_i)$$

- **Interaction effect:** The interaction effect is the effect resulting from the interaction of the allocation and selection decisions combined. The contribution to interaction in the i^{th} sector can be expressed as:

$$I_i = (w_i - W_i)(R_i - B_i)$$

Brinson-Fachler (BF) model

The only difference between the BF and BHB models is how individual sector allocation effects are calculated. The BF model modifies the asset allocation factor to compare returns with the overall benchmark:

$$A_i = (w_i - W_i)(B_i - B)$$

Factor-based return attribution

The Carhart model explains the excess return on the portfolio in terms of the portfolio's sensitivity to a market index (RMRF), a market-capitalization factor (SMB), a book-value-to-price factor (HML), and a momentum factor (WML).

$$R_p - R_f = a_p + b_{p1}RMRF + b_{p2}SMB + b_{p3}HML + b_{p4}WML + E_p$$

Fixed-income return attribution

Fixed-income attributions consider the unique factors that drive bond returns, including interest rate risk and default risk.

Three typical approaches for fixed-income attribution are:

- Exposure decomposition—duration based
- Yield curve decomposition—duration based
- Yield curve decomposition—full repricing based

Exposure Decomposition—Duration Based

- It is a top-down attribution approach.
- It considers the following active decisions:
 - Portfolio duration bets: the manager can choose a portfolio duration that is different than the duration of the benchmark.
 - Yield curve positioning: refers to allocating according to expected changes in the shape of the Treasury yield curve across different maturities.
 - Sector bets: refers to allocations across different sectors relative to a benchmark.

Yield Curve Decomposition—Duration Based

- It can be executed as a top-down or bottom-up approach.
- The total return is calculated as: % Total return = % Income return + % Price return where % Price return \approx -Duration \times Change in YTM
- It compares the differences between the benchmark's return drivers and the portfolio's return drivers to quantify the effect of active portfolio management decisions.
- This approach requires more data points relative to the exposure decomposition approach and is operationally complex, but it provides better transparency.

Yield Curve Decomposition—Full Repricing

- Instead of estimating price changes from changes in duration and yields to maturity, bonds are repriced based on their cash flows and spot rates.
- This approach provides more precise pricing as compared to the other approaches.
- It also allows for a broader range of instrument types and yield changes.
- However, the approach is costly, complex, and difficult to interpret.

Risk attribution

Risk attribution should reflect the investment-decision making process.

- For absolute mandates, we look at sources of portfolio volatility.
- For benchmark-relative mandates, we look at sources of tracking risk.

The following table recommends the appropriate risk attribution approaches for different types of investment decision-making processes.

Investment Decision-Making Process	Type of Attribution Analysis	
	Relative (vs. Benchmark)	Absolute
Bottom-up	Position's marginal contribution to tracking risk	Position's marginal contribution to total risk

Top-down	Attribute tracking risk to relative allocation and selection decisions	Factor's marginal contribution to total risk and specific risk
Factor-based	Factor's marginal contribution to tracking risk and active specific risk	

Return attribution analysis at multiple levels

Performance attribution can be conducted at distinct levels.

- Macro attribution considers the decisions of the fund sponsor.
- Micro attribution considers the decisions of the individual portfolio manager.

Asset- and liability-based benchmarks

Liability-based benchmarks are used when the assets are required to pay a specific future liability. They focus on the cash flows that the assets are required to generate.

Asset-based benchmarks contain a collection of assets to compare against the portfolio's assets. The seven types of benchmarks are:

- Absolute (including target) return benchmarks - Specify a minimum target return that the manager is expected to beat
- Broad market indexes - Measure broad asset class performances.
- Style indexes - Measure the performance of a particular investment style (e.g., value or growth).
- Factor-model-based benchmarks - Typically constructed by identifying the factors that drive returns for a particular investment process. We then find the sensitivity of the portfolio to these factors using regression analysis.
- Returns-based (Sharpe style analysis) benchmarks - Similar to factor-model-based benchmarks; however, the factors are the returns for various style indexes (e.g., small-cap value, small-cap growth, large-cap value, and large-cap growth).
- Manager universes (peer groups) - A manager universe consists of a broad group of managers with similar investment objectives.
- Custom security-based (strategy) benchmarks - These are built to more precisely follow the investment strategy of an investment manager.

Properties of a valid benchmark

A valid benchmark should be:

- Unambiguous - The individual securities and their weights in a benchmark should be identifiable.
- Investable - Investors should be able to replicate and hold the benchmark to earn its return.

- Measurable - The benchmark's return must be measurable on a reasonably frequent and timely basis.
- Appropriate - The benchmark must be consistent with the manager's investment style or area of expertise.
- Reflective of current investment opinions - The manager should be familiar with the securities that constitute the benchmark and their factor exposures.
- Specified in advance - The benchmark must be constructed before a manager's evaluation period begins.
- Accountable - The manager should be willing to be held accountable to the benchmark.

Importance of choosing the correct benchmark

Choosing the correct benchmark is important. If the benchmark is misspecified, then any subsequent performance measurement will be incorrect. This will invalidate the attribution and appraisal analysis performed.

Benchmarking alternative investments

Alternative investments are typically less liquid, have fewer available market benchmarks, and often lack transparency. Therefore, alternative investments are difficult to benchmark.

Hedge funds:

- A broad market index is not suitable for benchmarking hedge funds since they use leverage, short positions, and derivatives, and follow a variety of investment strategies.
- Some investors use an absolute benchmark such as a risk-free rate plus a spread. This approach assumes there is no systematic risk. However, most hedge funds have some amount of systematic risk.
- Some investors use a hedge fund peer as a benchmark. The limitations of this approach are:
 - The risk/return of a peer group is unlikely to be representative of the strategy used by a single fund.
 - Hedge fund peer groups suffer from survivorship bias and backfill bias.
 - Hedge fund performance data are often self-reported and typically not confirmed by the index provider.

Real estate:

Several private-real estate indexes and sub-indexes for nearly all major developed countries, major sectors, investment styles, and structures exist. The limitations of real estate benchmarks are:

- The benchmarks are based on a subset of the real estate opportunity set.
- Index performance is likely to be highly correlated with the returns of the largest fund data contributors.

- Benchmark returns are based on manager-reported performance and may be inherently biased.
- Benchmarks weighted by fund or asset value may place a disproportionate emphasis on the most expensive cities and asset types.
- Valuations of the underlying properties are typically based on appraisals because there are few transactions to measure.
- Some benchmark returns are unlevered, whereas others contain varying degrees of leverage.
- Real estate indexes do not reflect the high transaction costs, limited transparency, and lack of liquidity that drive performance for actual real estate investments.

Private equity

Private equity performance is generally reported in terms of IRR. Venture capital benchmarks provide IRR estimates for private equity funds. These benchmarks can be used to compare individual funds with an appropriate peer group (defined by a subclass, geography, and vintage year). However, there are several limitations of private equity benchmarks:

- The valuation methodology used by the managers may differ.
- A fund's IRR can be meaningfully influenced by an early year loss or early win in the portfolio.
- The data are from a specific point in time, and the companies in a fund can be at different stages of development.

Commodity

Commodity benchmarks tend to use indexes based on the performance of futures-based commodity investments. Major indexes contain common groups of underlying assets: energy, metals, grains, soft commodities, etc. The limitations of commodity benchmarks are:

- Use of derivatives to represent actual commodity assets,
- Varying degrees of leverage among funds, and
- The discretionary weighting of exposures within the index

Managed derivatives

Since market indexes do not exist for managed derivatives, benchmarks are specific to a single investment strategy.

Some derivatives benchmarks are based on peer groups. But these benchmarks suffer from the same limitations as other peer group-based benchmarks.

Distressed securities

Distressed securities are illiquid and non-marketable at the time of purchase. Therefore, it is difficult to find suitable benchmarks.

Appraisal measures

Important investment performance appraisal ratios are described below.

The **Sharpe ratio** measures the excess return above the risk-free rate, per unit of return volatility.

$$S_A = \frac{\bar{R}_A - \bar{r}_f}{\bar{\sigma}_A}$$

The **Sortino ratio** is a modification of the Sharpe ratio and is expressed as:

$$SR_D = \frac{E(r_p) - r_T}{\sigma_D}$$

Two important differences between the Sortino ratio and Sharpe ratio are:

- The numerator measures excess return over a user-specified threshold rate instead of the risk-free rate.
- The denominator only considers downside deviations. The Sortino ratio does not penalize upside deviations.

The **appraisal ratio** measures the reward of active management relative to the risk of active management.

$$AR = \frac{\alpha}{\sigma_\varepsilon}$$

Both α and σ_ε are based on a factor model. The returns of a portfolio are regressed with various risk factors. The regression output is used to calculate α the portion of return not explained by the factors. The regression output will also include an error term ε_t , which is used to calculate the denominator.

Capture ratios measure a manager's participation in up and down markets.

- Upside capture greater (less) than 100% suggests outperformance (underperformance) relative to the benchmark. Downside capture less (greater) than 100% suggests outperformance (underperformance) relative to the benchmark.
- A capture ratio greater than 1 indicates positive asymmetry i.e. a convex return profile (indicates good performance). Whereas a capture ratio less than 1 indicates negative asymmetry i.e. a concave return profile (indicates poor performance).

Drawdown is measured as the cumulative peak-to-trough loss during a continuous period. Drawdown duration is the total time from the start of the drawdown until the cumulative drawdown recovers to zero.

Limitations of appraisal measures and related metrics

Appraisal ratios must be used with care.

- We should be aware of the assumptions and limitations of each ratio.

- We should know where and when it is appropriate to use a particular ratio based on the investor's investment process, risk tolerance, and time horizon.
- We should also recognize that these ratios are based on investment risk and return data. If the underlying data has issues, then the ratios calculated using this data will not be accurate.

Evaluation of investment manager skill

The evaluation of an investment manager skill requires the use of a broad range of tools.

- Attribution tells us how the outperformance was achieved; appraisal techniques complement the attribution analysis by using past results to compare the performance of managers.
- Both types of analyses have their specific limitations. Thus, within the limits of these analyses, the skill of a manager can be evaluated.