

Performance Attribution Analysis

Preface

Performance attribution interprets how investors achieve their performance and measures the sources of value added to a portfolio. This guide describes how returns, relative to a benchmark, are broken down into attribution effects to determine how investors achieve performance and measure the sources of value added to a portfolio.

About Performance Attribution

For investment managers to evaluate their job performance, they need to know how they achieved their performance results. In particular, they need to know whether their success is the result of their ability to effectively allocate their portfolio's assets to various segments, their ability to effectively select securities within a given segment or the combined effect of their selection and allocation within a segment. Performance attribution interprets how investors achieve their performance and measures the sources of value added to a portfolio. To determine success, investors establish a benchmark, which they seek to outperform. Value added is the amount the return achieves in excess of the benchmark.

Different Attribution Methods

There are generally considered to be three basic forms of attribution. These include multi-factor analysis, style analysis and return decomposition analysis. The highlights of each are as follows:

Multi-Factor Analysis

- Attributes performance to factors such as P/E ratio, economy, bond durations, etc
- Used by academics and sophisticated firms
- More difficult to calculate
- Requires a great deal of data (economic/fundamental)
- Difficult to explain
- Not widely accepted in industry

Style Analysis

- Developed by noble laureate William Sharpe (Sharpe ratio)
- Uses portfolio rates of return to determine investment style
- Easy to calculate (requires benchmark and portfolio returns)
- Easy to explain (uses regression analysis)
- Not widely accepted in industry

Return Decomposition Analysis

- Attributes performance vs. benchmarks
- Can focus on allocation (top/down approach) or selection (bottom up approach)
- Easy to calculate (requires benchmark and portfolio returns and weights)
- Easy to understand and explain
- Used by large portion of investment community
- Widely accepted in industry

As the return decomposition analysis is most widely used and accepted, this is the model we will examine.

About Attribution Effects

In a return decomposition analysis model, value added to a portfolio's return is commonly referred to as the active management effect. The active management effect is the difference between the total portfolio return and total benchmark return. It is also the sum of the following investment decisions or effects:

- Allocation
- Selection
- Interaction

Defining the Allocation Effect

The allocation effect measures an investment manager's ability to effectively allocate their portfolio's assets to various segments. A segment refers to assets or securities that are grouped within a certain classification such as Equity, Fixed, or Technology. The allocation effect determines whether the overweighting or underweighting of segments relative to a benchmark contributes positively or negatively to the overall portfolio return. Positive allocation occurs when the portfolio is overweighted in a segment that outperforms the benchmark and underweighted in a segment that underperforms the benchmark. Negative allocation occurs when the portfolio is overweighted in a segment that underperforms the benchmark and underweighted in a segment that outperforms the benchmark.

Segment Weight	Benchmark Return	
	Segment > Total	Segment < Total
Portfolio > Benchmark	+ (scenario 1)	- (scenario 2)
Portfolio < Benchmark	- (scenario 3)	+ (scenario 4)

Scenario 1

A positive allocation effect occurred because the portfolio weight was greater than the benchmark weight and the benchmark return was greater than the total benchmark return. The investment manager overallocated assets to a segment that outperformed the total benchmark.

Scenario 2

A negative allocation effect occurred because the portfolio weight was greater than the benchmark weight and the benchmark return was less than the total benchmark return. The investment manager overallocated assets to a segment that underperformed the total benchmark.

Scenario 3

A negative allocation effect occurred because the portfolio weight was less than the benchmark weight and the benchmark return was greater than the total benchmark return. The investment manager underallocated assets to a segment that outperformed the total benchmark.

Scenario 4

A positive allocation effect occurred because the portfolio weight was less than the benchmark weight and the benchmark return was less than the total benchmark return. The investment manager underallocated assets to a segment that underperformed the benchmark.

Calculating the Allocation Effect

The following calculation is used to calculate a portfolio's allocation effect.

$$\frac{[(\text{portfolio weight}) - (\text{benchmark weight})]}{[(\text{benchmark return}) - (\text{benchmark total return})]}$$

The following example shows how return decomposition analysis calculates the portfolio's allocation effect.

Example:

Benchmark = S&P 500

Benchmark segment = S&P 500 Technology

Benchmark return = 9%

Benchmark weight = 7%

Portfolio technology return = 8%

Portfolio technology weight = 15%

Total benchmark return = 7%

The allocation effect can be expressed in percentages or basis points (bps) as follows:

$$\begin{aligned} & [(15\%) - (7\%)] * [(9\%) - (7\%)] \\ & [8\%] * [2\%] = .0016\% (.16 \text{ or } 16 \text{ bps}) \end{aligned}$$

The allocation effect in this example is positive because the manager overweighted the Portfolio Technology segment, which performed better than the total benchmark for the portfolio.

Defining the Selection Effect

The selection effect measures the investment manager's ability to select securities within a given segment relative to a benchmark. The over or underperformance of the portfolio is weighted by the benchmark weight, therefore, selection is not affected by the manager's allocation to the segment. The weight of the segment in the portfolio determines the size of the effect—the larger the segment, the larger the effect is, positive or negative.

The table that follows displays two possible scenarios for the selection effect:

Selection Effects Table

Segment Return

Portfolio >
Benchmark

Portfolio <
Benchmark

+	-
(scenario 1)	(scenario 2)

Scenario 1

A positive selection effect occurred because the portfolio return was greater than the benchmark return. The investment manager made good decisions in selecting securities that, as a whole, outperformed similar securities in the benchmark.

Scenario 2

A negative selection effect occurred because the portfolio return was less than the benchmark return. The investment manager made poor decisions in selecting securities that, as a whole, underperformed similar securities in the benchmark.

Calculating the Selection Effect

The return decomposition model uses the following calculation to calculate a portfolio's selection effect:

$$[(\text{benchmark weight})] \\ * \\ [(\text{portfolio return}) - (\text{benchmark return})]$$

The following example shows how a portfolio's selection effect is calculated.

Example:

Benchmark = S&P 500

Benchmark segment = S&P 500 Technology

Benchmark return = 9%

Benchmark weight = 7%

Portfolio technology return = 8%

Portfolio technology weight = 15%

Total benchmark return = 7%

The selection effect can be expressed in percentages or basis points (bps) as follows:

$$[(15\%)] - [(8\%) - (9\%)]$$

$$[(15\%)] - [(-1\%)] = -.0015\% (-.15 \text{ or } -15 \text{ bps})$$

There is a negative selection effect in this example because the manager selected securities that did not perform as well as the securities in the benchmark for the same segment.

Defining the Interaction Effect

The interaction effect measures the combined impact of an investment manager's selection and allocation decisions within a segment. For example, if an investment manager had superior selection and overweighted that particular segment, the interaction effect is positive. If an investment manager had superior selection, but underweighted that segment, the interaction effect is negative. In this case, the investment manager did not take advantage of the superior selection by allocating more assets to that segment.

Since many investment managers consider the interaction effect to be part of the selection or the allocation, it is often combined with the either effect.

The table that follows displays four possible scenarios for the interaction effect:

Interaction Effects Table

Segment Weight	Segment Return	
	Portfolio > Benchmark	Portfolio < Benchmark
Portfolio > Benchmark	+ (scenario 1)	- (scenario 2)
Portfolio < Benchmark	- (scenario 3)	+ (scenario 4)

Scenario 1

A positive interaction effect occurred because the portfolio weight was greater than the benchmark weight and the portfolio return was greater than the benchmark return. The investment manager exercised good selection and overallocated assets to that segment.

Scenario 2

A negative interaction effect occurred because the portfolio weight was greater than the benchmark weight and the portfolio return was less than the benchmark return. While the investment manager overweighted the portfolio securities for a given segment, that segment underperformed against the benchmark return for the same segment.

Scenario 3

A negative interaction effect occurred because the portfolio's weight was less than the benchmark weight and the portfolio's return was greater than the benchmark return. The investment manager underweighted the segment with good selection. The manager exercised good selection but poor allocation.

Scenario 4

A positive interaction effect occurred because the portfolio weight was less than the benchmark weight and the portfolio return was less than the benchmark return. The impact of the joint effects is positive because the manager's decision to underweight a poor performing segment was a good decision.

Calculating the Interaction Effect

The Performance Attribution module uses the following calculation to calculate a portfolio's interaction effect:

$$\frac{[(\text{portfolio weight}) - (\text{benchmark weight})]}{[(\text{portfolio return}) - (\text{benchmark return})]}$$

The following example shows how the return decomposition model calculates a portfolio's interaction effect.

Example:

Benchmark = S&P 500
Benchmark segment = S&P 500 Technology
Benchmark return = 9%
Benchmark weight = 7%
Portfolio technology return = 8%
Portfolio technology weight = 15%
Total benchmark return = 7%

The interaction effect can be expressed in percentages or basis points (bps) as follows:

$$\frac{[(15\%) - (7\%)]}{[(8\%) - (9\%)]} = \frac{[8\%]}{[-1\%]} = -.0008\% \text{ (-.08 or -8 bps)}$$

There is a negative interaction effect in this example because the manager overallocated securities for a segment that performed poorly relative to the benchmark.

Defining the Active Management Effect

The active management effect is the sum of the selection, allocation, and interaction effects. It is also the difference between the total portfolio return and the total benchmark return. You can use the active management effect to determine the amount the investment manager has added to a portfolio's return. If the active management effect is positive, the investment manager has contributed positively to the portfolio's return. If the active management effect is negative, the investment manager has not contributed positively to the portfolio's return.

The return decomposition model uses the following calculation to calculate the active management effect:

$$\text{allocation} + \text{selection} + \text{interaction} = \text{active management effect}$$

Attribution Analysis - Text
ATTRIBUTION DEMO PORTFOLIO

	Month Ending 10/31/99	Month Ending 09/30/99	Month Ending 08/31/99	Month Ending 07/31/99	Month Ending 06/30/99	Month Ending 05/31/99	Quarter to Date	Year to Date
Total Portfolio								
Time Weighted Return (%)	5.22	5.92	6.44	-3.20	0.33	6.18	18.62	22.33
Policy Return	4.44	6.09	6.11	-4.13	0.72	6.22	17.57	20.60
Allocation Effect (bps)	41.00	0.08	-4.04	6.28	-7.12	-3.01	35.89	39.81
Selection Effect (bps)	-12.54	-10.85	24.95	71.25	-37.75	-2.20	-1.49	34.26
Interaction Effect (bps)	49.41	-5.86	11.27	14.96	6.09	1.25	70.54	99.10
Basic Materials								
Time Weighted Return (%)	4.96	6.50	3.20	-5.70	2.70	3.50	15.36	15.63
Policy Return (%)	4.46	6.11	2.62	-4.34	2.60	2.00	13.76	13.89
Allocation Effect (bps)	0.04	-0.01	-2.34	0.04	-0.20	-2.35	-1.23	5.14
Selection Effect (bps)	2.69	2.13	3.39	-7.94	0.56	8.68	9.33	11.66
Interaction Effect (bps)	0.70	-0.15	0.39	0.26	-0.01	0.84	0.52	-1.34
Capital Goods								
Time Weighted Return (%)	10.21	8.90	7.50	-2.50	0.50	4.50	29.02	32.11
Policy Return (%)	6.14	7.98	6.20	-2.85	-0.15	3.35	21.72	22.03
Allocation Effect (bps)	12.85	9.14	0.35	2.59	0.55	0.23	25.35	6.19
Selection Effect (bps)	39.39	8.80	12.45	3.28	6.40	11.62	68.11	88.42
Interaction Effect (bps)	30.89	4.41	5.31	0.70	-0.41	-0.09	44.68	43.75
Consumer Staples								
Time Weighted Return (%)					2.20	4.90	12.27	17.35
Policy Return (%)					3.88	5.40	15.59	21.04
Allocation Effect (bps)	3.40	-1.03	0.94	0.11	-3.67	0.89	1.90	0.36
Selection Effect (bps)	-29.46	0.21	-18.23	29.59	-25.13	-8.08	-54.17	-51.98
Interaction Effect (bps)	3.97	.01	-0.88	-0.91	1.95	0.55	3.16	-2.99
Consumer Cyclical								
Time Weighted Return (%)					2.80	2.10	11.32	13.92
Policy Return (%)	4.78	5.18	3.08	-1.92	3.82	2.76	13.60	18.86
Allocation Effect (bps)	-0.61	1.22	9.08	-8.35	-7.29	3.49	9.65	7.00
Selection Effect (bps)	-5.13	-8.55	-5.47	-5.02	-8.77	-6.55	-21.43	-53.34
Interaction Effect (bps)	1.05	1.27	1.74	2.18	2.40	0.66	5.54	19.91

For Capital Goods, positive allocation, selection and interaction resulted due to the managers ability to overweight or underweight the segment, in addition to selecting good securities.

For Consumer Staples and Consumer Cyclical, a negative selection trend could help identify poor research and/or managers inability to select good securities.

Rates of return for periods greater than one year are annualized.

Attribution Analysis - Last Month
ATTRIBUTION DEMO PORTFOLIO

Month Ending 10/31/99

For Capital Goods, a positive allocation effect resulted due to the portfolio's overweighting (17.25 vs. 9.67) in this segment which, in comparison to the total benchmark, performed well (6.14 vs. 4.44). The selection effect 39.93 was achieved because the portfolio's return was better than that of the policy (10.21 vs. 6.14).

	Time Weighted Return (%)	Weight (%)	Allocation Effect (bps)	Selection Effect (bps)	Interaction Effect (bps)
Total Portfolio	5.22	100.00	41.00	-12.54	49.41
Policy Index	4.44	100.00			
Basic Materials	4.96	6.85	0.04	2.69	0.70
S&P 500 Basic Materials	4.46	5.44			
Capital Goods	10.21	17.25	12.85	39.39	30.89
S&P 500 Capital Goods	6.14	9.67			
Communications Services	-1.76	6.18	0.19	-29.41	0.57
S&P 500 Communications Services	2.91	6.30			
Consumer Cyclical	4.20	7.04	-0.61	-5.13	1.05
S&P 500 Consumer Cyclical	4.78	8.84			
Consumer Staples	1.00	13.77	3.40	-29.46	3.97
S&P 500 Consumer Staples	2.85	15.91			
Energy	4.20	7.86	1.01	5.56	-0.73
S&P 500 Energy	3.59	9.04			
Health Care	11.00	13.20	13.03	15.04	3.56
S&P 500 Health Care	9.59	10.67			
Technology	1.30	9.53	14.22	-5.24	1.83
S&P 500 Technology	1.66	14.64			
Transportation	0.00	1.21	3.66	-8.55	5.35
S&P 500 Transportation	2.64	3.24			
Utilities	3.87	4.47	-4.26	1.03	2.46
S&P 500 Utilities	3.09	1.32			
Financials	5.65	12.64	-2.53	1.55	-0.24
S&P 500 Financials	5.55	14.93			

Active Management Effect:
41.00 + (12.54) + 49.41 = 77.87

Allocation Effect:
[(17.25 - 9.67) * (6.14 - 4.44)] = 12.85

Selection Effect:
[(10.21 - 6.14) * (9.67)] = 39.39

Interaction Effect:
[(17.25 - 9.67) * (10.21 - 6.14)] = 30.89

For Communication Services, a negative selection effect resulted because the portfolio's return was worse than that of the segment benchmark (-1.76 vs. 2.91).

For Health Care, a positive allocation effect resulted due to the portfolio's overweighting (13.20 vs. 10.67) in this segment which, in comparison to the total benchmark, performed well (9.59 vs. 4.44).

For Technology, a positive allocation effect resulted due to the portfolio's underweighting (9.53 vs. 14.64) in this segment which, in comparison to the total benchmark, performed worse (1.66 vs. 4.44).

Rates of return for periods greater than one year are annualized.