



Performance attribution

Investment performance under the microscope

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Introduction

When assessing a fund manager's performance, it is common practice to benchmark their performance. Regardless of the benchmark, a fund manager is deemed to have performed well if the excess performance (i.e. difference between the fund's return and that of the benchmark) is positive, while a negative excess performance represents a poor performance.

While consistent positive excess performance is considered the 'Holy Grail' of the fund management industry, too little emphasis is placed on how the excess performance is actually achieved. The focus is typically put on the size of the excess performance and not on how it was achieved by the fund manager.

Was it achieved through superior stock selection or good asset allocation? Simply looking at the size of the excess performance will not answer this question. A more refined tool is needed to break down this excess performance, which is where performance attribution comes in.

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In this article, we propose to review the subject of performance attribution. In the first section, we explain what performance attribution is and is not and show why different models exist to meet different needs.

In the second part, we provide a detailed review of the different attribution models for equity portfolios. We touch up on the issue of linking attribution effects, as it is one of the most challenging steps in practice. In the last part, we show how attribution analysis can be used by fund managers and investors.

What is performance attribution?

Performance attribution can be defined as a set of techniques used to analyse the origin of a portfolio's excess performance. In other words, it answers the following question: *"How was the excess performance achieved?"* It essentially attributes the excess performance to different factors such as stock selection and asset allocation (i.e. portfolio allocation to different asset classes such as equities or fixed-income).

As will be demonstrated, performance attribution brings together different models and techniques with the aim to analyse excess performance in different ways. Some are dedicated to analysing fixed-income

portfolios while others focus on global portfolios and attribute the effects to currencies. There is no such thing as a single performance attribution model. Each performance attribution model must be tailored to the needs of the fund managers or investors concerned.

Performance attribution should not be confused with the calculation of risk-adjusted return statistics. The latter measures how much excess return was achieved per unit of risk. A typical measure of risk-adjusted return is the Sharpe Ratio, where excess return is defined as the difference between portfolio performance and the risk free return, while the risk involved is measured by the volatility of the return. Another common measure of risk-adjusted return is the Information Ratio, which compares excess performance over the volatility of excess performance (i.e. tracking error). Performance attribution will not determine if a fund manager has achieved a higher return per unit of risk (whatever definition of risk is used). In this respect, performance attribution techniques can be seen as an additional tool to analyse a portfolio's performance.

In the next section, we go into more detail regarding the performance attribution techniques used for equity portfolios.

Performance attribution techniques for equity portfolios

Performance attribution techniques fall into two broad categories: arithmetic and geometric models. We will review each of them in turn.

Arithmetic models

A key feature of arithmetic models is that they all define the excess performance as the arithmetic difference between portfolio and benchmark performances. They are by far the most common models found in the industry. Their success lies in the simple and intuitive nature of the way they calculate excess performance. We will discuss and compare two of the commonly used models below. While each of these models belongs to the arithmetic category, they have significant differences, which will be highlighted.

The BHB model

One of the earliest and most commonly used models is known as the BHB model; BHB standing for Brinson, Hood and Beebower. The BHB model breaks down the excess performance into three components:

- *Asset allocation effect*: positive (or negative) when the fund manager has overweighed (or underweighed) a benchmark segment showing positive performance. Here segment is understood as assets belonging to the same bucket (e.g. asset class, sector, geographical area, etc.)
- *Stock selection effect*: positive (or negative) when the fund manager has selected segments performing better (or worse) than the corresponding segment in the benchmark
- *Residual effect*: The remainder of the actual excess performance after deduction of asset allocation and stock selection effects

The excess performance is therefore essentially equal to the sum of these three attribution effects.



The BF model

This second model was developed by Brinson and Fachler. Unlike the BHB model, the BF model breaks down the excess performance into two components:

- *Asset allocation effect*: positive in two cases:
 - When the fund manager has overweighed a benchmark segment with a higher performance than the benchmark's overall performance
 - When the fund manager has underweighed a benchmark segment with a lower performance than the benchmark's overall performance

In all other cases, the asset allocation effect is negative.

- *Stock selection effect*: positive (or negative) when the fund manager has selected segments performing better (or worse) than the corresponding segments in the benchmark

Model comparison

The main difference between the two above arithmetic models lies in the definition and interpretation of the asset allocation effect. In the BHB model, the effect is positive when the fund manager overweighs (or underweighs) a benchmark segment showing positive (or negative) performance. In the BF model, on the other hand, positive performance alone is not enough. Achieving a positive asset allocation effect also requires the segment performance to exceed the overall benchmark return.

In the BHB model the indication of the asset allocation effect is simply the same as that of the return generated by the segment in question. There is no reference to segment performance relative to benchmark performance. This model can therefore typically be used with absolute return strategies. The BF model, on the other hand, does not rely on whether the segment's return is positive or negative; it rather observes how the segment has performed in comparison with the benchmark. Therefore, this model is typically applicable to relative return strategies.

Each performance attribution model must be tailored to the needs of the fund managers or investors concerned



Geometric models

Geometric models are characterised can be identified by the fact that they all define the excess performance using a geometric approach. For example, suppose a portfolio generates a return of 7% and a benchmark return of 5%.

The Geometric Excess performance (GE) is computed calculated as follows:

$$GE = \frac{1+7\%}{1+5\%} - 1 = 1.90\%$$

In comparison, the Arithmetic Excess performance (AE) would be:

$$AE = 7\% - 5\% = 2\%$$

The arithmetic approach calculates excess return as the profit made in excess of the benchmark return. In other words, it is the remainder of the actual performance after deduction of the opportunity cost of not having invested in the benchmark. For example, suppose a portfolio has an initial market value of €1,000 and a growth of 7% over the period (with a final value of €1,070), and that the corresponding benchmark's return is 5%. Had the €1,000 been invested in the benchmark, it would have grown to €1,050. The excess return, from an arithmetic point of view, would therefore be 2%. Another way to consider this is to compare the difference in profit (€70 minus €50).

The difference divided by the starting value provides the same arithmetic excess performance:

$$AE = \frac{70-50}{1,000} = 2\%$$

Similarly, geometric excess return can be considered from the perspective of the profit generated. However, instead of comparing the profit with the starting value of €1,000, in this case it must be made relative to the final value of such an amount invested in the benchmark:

$$GE = \frac{70-50}{1,050} = 1.90\%$$

Geometric excess return looks at the added value we get by investing in the portfolio, relative to the benchmark. In other words, *"How much more money do I have than I would have had if I had invested in the benchmark?"*

In practice, geometric models are not very popular because of the way they calculate excess performance. Geometric excess performance is not intuitive for the investor, and is in particular not as intuitive as the arithmetic model. In general, it is expected that excess return will be defined as portfolio return minus that of the benchmark. Using a fraction-based method of presentation does not make it easy to understand.

Although the interpretation of the results given by geometric models may be counterintuitive, they do have many advantages over arithmetic models. When chaining attribution effects (i.e. linking attribution effects over several periods), no residual effect will appear, making geometric models very appealing. We will touch on this topic in the next section.

For arithmetic models, when linking attribution effects over time, the sum of periodic effects does not correspond to the excess performance generated over the entire period



Chaining rule techniques

So far, only single-period performance techniques have been covered. In practice, attribution effects are typically calculated over several single periods (e.g. on a monthly basis) and aggregated over the entire period (e.g. a quarter). The process of aggregating single-period attribution effects over an entire period is called 'chaining' or 'linking'. Linking attribution effects over time is one of the most challenging steps in performing a performance attribution. For arithmetic models, when linking attribution effects over time, the sum of periodic effects does not correspond to the excess performance generated over the entire period. In other words, excess

performance cannot be fully explained by the different attribution effects. 'Residual' effects appear and tend to grow as the number of single-periods in the chain increases.

This section covers the most common techniques used to link attribution effects for arithmetic models. This is by no means an exhaustive list as literature on the topic is extensive. For the sake of simplicity, we will keep the same illustrative example throughout the different linking methods examined below, and assume that the performance of the portfolio is identical each month.

	Return - portfolio	Return - benchmark	Asset allocation effect	Stock selection effect	Excess performance
Month 1	8.10%	7.20%	-0.25%	1.15%	0.90%
Month 2	8.10%	7.20%	-0.25%	1.15%	0.90%
Month 3	8.10%	7.20%	-0.25%	1.15%	0.90%
Quarter	26.32%	23.19%	?	?	3.13%

The objective of the linking methods is to determine the asset allocation and selection effects for the full quarter. Here we have assumed that the allocation effects are calculated according to the BF model.

Arithmetic linking

This simple method consists in adding the monthly attribution effects together in order to determine the quarterly attribution effects. The results are below:

	Return - portfolio	Return - benchmark	Asset allocation effect	Stock selection effect	Sum of effects	Excess performance
Quarter	26.32%	23.19%	-0.75%	3.45%	2.70%	3.13%

As can be observed, the sum of the quarterly asset allocation and selection effects is not equal to the quarterly excess performance.

Geometric linking

Instead of taking the sum of the monthly attribution effects, the geometric linking method consists in multiplying the attribution effects across time to determine the quarterly attribution effects. The results are below:

	Return - portfolio	Return - benchmark	Asset allocation effect	Stock selection effect	Sum of effects	Excess performance
Quarter	26.32%	23.19%	-0.75%	3.45%	2.74%	3.13%

Again, the sum of the quarterly asset allocation and selection effects is not equal to the quarterly excess performance. Note that the geometric linking method has nothing to do with the geometric attribution models. These two techniques should not be confused.

Logarithmic linking

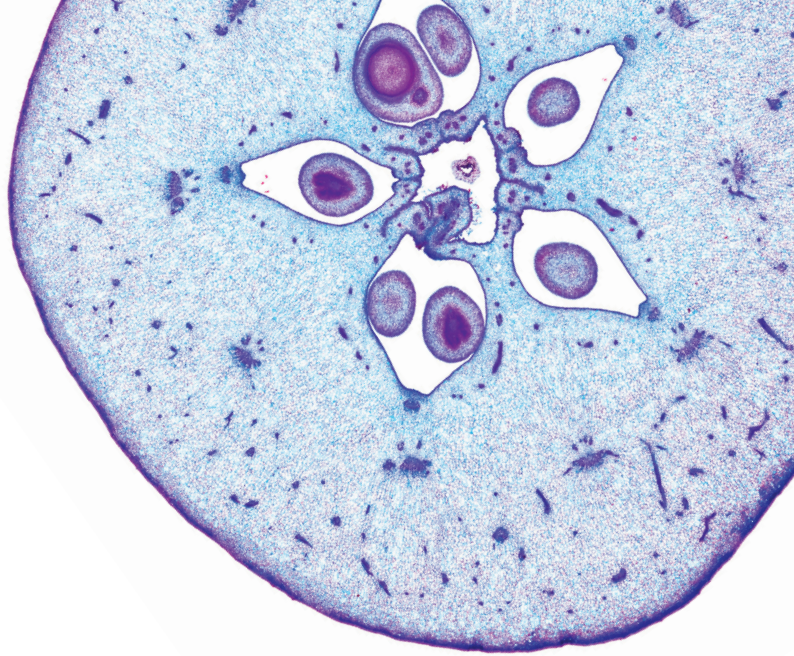
Arithmetic and geometric methods can be viewed as rather simple approaches to linking but neither work in practice. More complex models need to be considered to link the period returns more effectively. These involved models use what may be called an 'agent' or adjustment factors to make the linked effects equal to the linked excess return. There are several more advanced techniques, but only the most common is presented here: the 'logarithmic linking method'.

The logarithmic model for linking was first described by Carriño. This approach distributes a small residual proportionately among all the effects calculated for each period, and proposes mathematical formulae to calculate the factors used to adjust the attribution effects. This means that the sum of the monthly attribution effects should be equal to the quarterly excess performance.

The formulae for the quarterly selection effect take exactly the same form. The results are below:

	Return - portfolio	Return - benchmark	Asset allocation effect	Stock selection effect	Sum of effects	Excess performance
Quarter	26.32%	23.19%	-0.87%	4.00%	3.13%	3.13%

In the logarithmic model, quarterly excess performance is fully explained by the sum of the quarterly adjusted attribution effects.



Use of performance attribution models

In the previous sections, we looked at tools used to analyse the source of the outperformance of a portfolio relative to its benchmark. But how can this information be used in practice? In general, there are two types of individuals likely to make use of this data: fund managers and investors.

- For fund managers, attribution performance analysis provides an effective tool for assessing the performance of their investment strategies. Attribution analysis can be used to assess the quality of security analysis (i.e. how efficient the fund manager is at selecting stocks) by calculating selection effects. It can be used to assess the ability of analysts, whether internal or external. If an analyst suggested a particular stock, the success of his or her recommendation can be measured. If an individual suggested underweighting a sector because of a poor economic outlook, it is possible to determine whether this was a good move or not. Employees may be rewarded based on their recommendations. In the case of internal resources, the different analysts may be monitored over time to determine whether or not they are doing the job for which they were hired. For external analysts, it can be determined whether or not their advice is worth the price that was paid.
- For investors, attribution performance analysis provides an effective tool to assess whether the investment manager is following his or her investment strategy. As a rule, an investment manager can secure an edge by either selecting high-performing asset classes (i.e. top-down approach) or in selecting high-performing stocks (i.e. bottom-up approach). Attribution performance analysis provides a way to check whether the excess performance was actually generated by following the stated investment style. For example, a fund manager may have beaten his benchmark by significantly overweighting a specific industry (i.e. positive asset allocation effect) but failed miserably at selecting stocks (i.e. negative selection effect). His or her competitive advantage was their ability to select over-performing stocks.

Without a proper attribution performance analysis, at first glance it may seem that skill was behind this excess performance, while it was probably simply a matter of luck. Attribution performance analysis also provides a dynamic tool for assessing the performance of a fund manager over time. Does the fund manager beat the benchmark consistently and by following his investment strategy? This is the kind of question typically asked by investors.

Conclusion

Performance attribution analysis provides an excellent tool for analysing the performance of a fund manager. While performance attribution suffers from a large number of pitfalls to overcome in practice, these are far outweighed by the benefits. While producing an attribution analysis is a challenge in itself, it does not tell the whole story. Knowing what it is intended for, what the resulting numbers mean, how to interpret them, and how to use these tools is the most important issue.

To the point:

- There is no such thing as a one-size-fits-all attribution model
- Performance attribution analyses the origin of excess performance and breaks it down into different effects
- Performance attribution can be used as a tool to assess the performance of an investment process
- Performance attribution can be used to check if the fund manager is respecting his or her investment process (i.e. style analysis)
- Linking attribution effects over time is a challenge in practice