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PERFORMANCE ATTRIBUTION USING THE BRINSON MODEL

Evidence from Finnish Institutional Investors

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ABSTRACT

The main purpose of this study is to examine how well the Finnish institutional investors have been able to perform. Hypotheses propose that Finnish institutional investors have been able to achieve excess return in relation to their benchmark, and that asset allocation has been the main cause for the excess return.

The data for the study is provided by Investment Research Finland Ltd. The company is the leading provider of investment portfolio performance measurement and consolidated reporting services for Finnish institutional investors. Data is transactions based data and consists of daily returns for 24 institutional investors and benchmarks for their portfolios between 31.12.2011-31.12.2015. The Brinson model is used to calculate performance attribution on all investments, equities and fixed income, as well as the sector level results.

The results contradict with some of the earlier studies on performance attribution. The results imply that Finnish institutional investors have not been able to achieve excess return. Asset allocation, although more positive than selection effect, could not be seen as the main effect on portfolio performance. The study also finds that there are significant differences between equities and fixed income. Equities had a more positive contribution to total attribution results than fixed income. The results also indicate that the Brinson model may not be a suitable model for calculating fixed income performance attribution, as also criticized by previous researchers.

KEYWORDS: Performance attribution, Brinson model, portfolio analysis

1. INTRODUCTION

“You have to know the past to understand the present.”

This quote by astronomer Carl Sagan summarizes the basis of performance attribution to its core. Carl Bacon (2008) defines that performance attribution answers the what, why and how of portfolio performance. In the world of investments and performance analysis, researchers have forever tried to find better ways to analyze portfolio performance. Understanding past portfolio performance is the key to a successful future.

One aspect portfolio managers always look at is whether they have been able to earn excess return. How has the portfolio performed in relation to its benchmark? Portfolios are carefully constructed and the security selection process is crucial for portfolio performance, and the most important question we can ask is what role all of this played in the final result. The performance attribution is an effective analysis tool to help answer this question.

Whenever trying to find information or previous research on performance attribution, one issue came up: this topic hasn’t been much researched. Even though the first studies on performance attribution go back to 1980’s and 1990’s, the overall conception on performance attribution is that it is still an evolving discipline. When writing one’s thesis that can either be an obstacle or a challenge. I decided to look at it as a challenge. The true challenge with performance attribution is not the models that can be used in calculations but mainly the lack of, or no access to, proper data. This thesis was in a fortunate position to have access to data that is not widely accessible which concludes detailed data of institutional investors’ investment portfolios. Most studies previously conducted on performance attribution have used data on equity or pension funds that are widely available, but data on institutional investors is not required by any authorities to be made public. Nor is the daily data that this thesis had access to.

1.1 Purpose of the study

The primary goal of this study is to examine whether Finnish institutional investors have been able to achieve excess return. Investment strategies and investment policies play a significant role in portfolio manager choice and in the costs investors pay for the services provided by portfolio managers. In general, for performance attribution to bring the best value possible, the investments decisions that affect portfolio performance should be divided between several portfolio managers. There should be a different portfolio manager for asset allocation and security selection and separate managers for equities and fixed income for analysts to be able to analyze the results of performance attribution and determine which portfolio manager was able to have superior performance. What attributes of investment strategy led to excess return? Which portfolio manager was able to beat the benchmark portfolio? Were there large differences between asset classes?

Brinson et al. (1991) infamously showed that over 90 percent of the excess return on equity portfolios was due to asset allocation. Although performance attribution is not a new concept, it is often described as yet evolving. However, several studies have been conducted on the performance attribution of equities in the US and Australia (Gallagher 2001; Brinson and Fachler 1985; Binay 2005) and on the market timing of mutual funds in the UK and Australia (Sinclair 1990; Cuthbertson, Nitzsche and O'Sullivan 2010). It is important to acknowledge that the void in previous literature on performance attribution of institutional investors is due to lack of availability of data. Most previous research concerns the performance attribution of mutual or pension funds that are required by legislation to provide detailed holdings of their investments. This thesis, however, was in a fortunate position to have access to a unique data set that is not widely available which enabled for the study to conduct more detailed performance attribution of Finnish institutional investors and is able to fill that gap in the literature.

1.2 Hypothesis

The main purpose of this paper is to analyze the performance attribution results from 24 Finnish institutional investors using the Brinson model. The hypotheses of this thesis are constructed on the basis of previous literature and their findings.

Binay (2008) studied performance attribution of US institutional investors in 1981-2002 and found that institutional investors have been able to achieve excess return when managing their clients' money. Gallagher (2001) studied performance attribution of Australian pooled superannuation funds over the years 1991-1998. The author studies the performance attribution in three asset classes: Australian equity, international equity, and Australian fixed income. He finds that, in general, the Australian superannuation funds are not able to outperform their benchmarks. Overall, there have been contradictory findings on whether portfolio managers are able to perform better than plan investment policy. On the basis of these studies, the first hypothesis is constructed as follows:

H_1: Finnish institutional investors have been able to achieve excess return.

The second hypothesis on performance attribution is based on Brinson, Hood, and Beebower (1991) study. They find that asset allocation in itself explains over 90 percent of the total return variance, and the total return on investment portfolios is dominated by decisions made by investment policy. Binay's (2008) study supports the findings of Brinson et al. (1991) as he also finds that large portion of the excess return was due to asset allocation, although stock selection also contributed to the excess return. Faff, Gallagher and Wu (2005) find that active managers have not been able to achieve excess return through tactical asset allocation. Although the Australian domestic equities have had a positive effect on excess return, this has been diminished by the negative performance of international shares and domestic fixed interest. Although Faff et al. (2005) study's results contradict with the findings of Brinson et al. (1991) and Binay (2008), the results of Brinson et al. (1991) are considered as a core principle for performance attribution, and based on this the second hypothesis has been formed as follows:

H_2: Asset allocation has been the main cause for excess return.

1.3 Structure of the thesis

The remainder of this thesis is constructed as follows: theoretical, empirical and conclusive. The following chapter looks more closely on the previous literature conducted on performance attribution. The next two chapters consist of the theoretical part of this thesis. Chapter three summarizes the process of investment portfolio formation. In the following chapter, chapter four, the theory of the performance attribution and the Brinson model are discussed more in detail. The empirical part begins in chapter five. The data used and empirical results are introduced in this chapter. The last chapter summarizes and concludes the findings of this thesis.

2. LITERATURE REVIEW

Previous studies on performance attribution are all linked to studies conducted by Brinson, Hood and Beebower (1991) and Brinson and Fachler (1985). Their research is better known collectively as the Brinson model. The Brinson model paved the way for performance attribution and studies conducted later on all either find ways to support the findings of the Brinson model or try to prove its faultiness.

2.1 Previous studies on performance attribution using the Brinson model

Brinson et al. (1991 & 1995) aimed to determine what affected the excess return on investments portfolios the most and developed a framework that enables to decompose the portfolio return into three components. They aimed to place the investment decisions in order from the most to the least important and then measure how important these decisions are to the actual performance of the investment portfolio. The framework built by Brinson et al. (1991) differentiates the investment policy and investment strategy and aims to decompose the investment strategy to asset allocation, selection and interaction components. They find that asset allocation in itself explains over 90 percent of the total return variance, and the total return on investment portfolios is dominated by decisions made in investment policy.

Karnosky & Singer (1994) recognized in their paper the need for performance attribution in an international context to isolate the effects of market allocation, currency management, and security selection. Most previous studies, including the Brinson model, only took into account performance attribution in single-country markets, and Karnosky et al. (1994) extended these models to global markets. The purpose of their paper is to provide a framework for measures of the market and currency components of global asset returns. Karnosky et al. (1994) construct a framework for performance attribution to decompose the market and currency allocation decisions from overall excess return and the returns that are attributable to security selection within each market. They address the issue of currency selection when calculating portfolio returns and modified the original Brinson model by adding a separate calculation for currency attribution. The framework presented by the authors, aims to take into account more multi-layered approach to portfolio managers' decision making process compared to the Brinson model.

Hsu, Kalesnik and Myers (2010) created a generalized framework for performance attribution to divide the allocation effect of performance attribution into statistic and dynamic components to provide additional information on sources of portfolio managers' excess return. The authors state that the multi-period attribution models weren't designed to measure portfolio managers' ability to allocate the portion of value/growth stocks relative to market changes which they name static factor allocation and dynamic factor allocation. Hsu et al. (2010) state that dynamic strategy can be one reason to justify active management fees because dynamic strategy is less replicable than static strategy. Hsu et al. (2010) argue that neither multi-period nor single-period original Brinson models are able to characterize portfolio managers' dynamic or market timing abilities. They apply their model to equity holdings of several large mutual funds to show how their framework can be utilized. In their example, they find that dynamic allocation associated with value and growth stock is weak - managers were only able to create 26 basis points of excess return from value and growth style timing. They also found that dynamic allocation to small-cap and large-cap stocks is on average negative. The authors state that static allocation to size had a significant negative impact on portfolio performance. In their limited sample, Hsu et al. (2010) found that portfolio managers were more able to generate excess return from security selection than asset allocation.

Xiong, Ibbotson, Idzorek and Chen (2010) study the importance of equal asset allocation and active management. They examine why different peer groups have different returns. They use the Brinson model and another previous study that examined the high explanatory power of the Brinson model's asset allocation in relation to portfolio return, as basis of their research. The authors decomposed portfolio return into three components: market return, asset allocation return that exceeds the market return, and return from active portfolio management. They find that together the market return and asset allocation return that exceeds the market return are the dominant explanatory variables for portfolio return variations. When authors studied the causes for different returns within peer groups, they found that active portfolio management and asset allocation have equal impact on portfolio return.

Frongello (2002) challenges the Brinson model for calculating multi-period cumulative attribution effects and provides mathematical proof for performance and attribution linking. He provides empirical evidence on the faultiness of the Brinson model. The author states that the Brinson model is incapable of calculating sector level results, and he proves that the method leaves selection and allocation misstated while the interaction term serves merely as a vague number. He also shows that cumulative attribution results are order dependent and that the Brinson multi-period model is weak linking algorithm. Gyger (2005) tests the multi-period performance attribution against single-period attribution. Using Monte Carlo simulations, they estimate that the Frongello algorithm corrects the original single period attribution effects by a factor that is 13 times as large as the time residual would be even in the best case scenario.

Stuart Morgan (2014) extended performance attribution to include stock options and studied performance attribution in a portfolio that included single-stock options. The author takes into consideration four option strategies: long calls, naked puts, covered calls and protective puts. The basic principle behind the study is that the portfolio manager’s investment style should be reflected in the calculations for performance attribution. The study has two hypothesis: i) how a single-stock option should be treated in attribution analyzes, and ii) how the various attribution effects are affected by the investment decisions. Morgan (2014) finds that the selection effect from the option’s parent company will give an indication of how effective the portfolio manager’s option strategy is. The put and call effects in asset allocation effects give insight about the effectiveness of the portfolio manager’s investment strategy. The cash effect gives more information on how beneficial it was as a strategy not to be fully invested in the market.

Fooladi and Rumsey (2011) study the problems of performance attribution. They base their research on Brinson model and how excess return can be divided into asset allocation and security selection components. They conclude that the excess return cannot be decomposed uniquely into asset allocation and security selection effect, and hey separate the excess return in their research into three components; asset allocation, security selection and a term that is due to both asset allocation and security selection. According to Fooladi et al. (2011), excluding the third component from decomposition of excess return means that the return achieved solely from asset allocation and security selection does not equal to the difference between total portfolio return and benchmark return which can lead to a false picture of portfolio managers' accomplishments.

Lu and Kane (2013) compared the performance attribution for equity portfolios when calculated with Brinson model and a regression approach. These two approaches are the most common methods used by portfolio managers to evaluate their performance. Their study shows that the Brinson model is just an extension of a regression approach.

Faff, Gallagher and Wu (2005) study the effects of tactical asset allocation, strategies, and behavior of Australian portfolio managers. The study uses monthly return from 51 funds and their benchmarks between December 1989 and February 2001. The authors find that active managers have not been able to achieve excess return through tactical asset allocation. Although the Australian domestic equities have had a positive effect on excess return, this has been diminished by the negative performance of international shares and domestic fixed interest.

2.2 Previous studies on performance attribution using other models

Murat Binay (2008) studied the performance attribution of US institutional investors in 1981-2002 and found that institutional investors have been able to achieve excess return when managing their clients' money. Binay's (2008) study supports the findings of Brinson et al. (1991) as he also finds that large portion of the excess return was due to asset allocation, although stock selection contributed to the excess return as well. The author states that the investment structures, as well as the nature of the legal entity of the investor, affect the investors' investment style. He finds that pension funds, endowments, and bank trusts earned the highest risk-adjusted return while investment advisors, investment companies, and bank trust departments were able to achieve the highest figures in stock selection. The author finds that especially in the turn of the market conditions, in this case, in the year 2000 when markets began the downfall, superior stock selection skills helped investors reduce the overall market effect on the portfolio.

David Gallagher (2001) studied performance attribution of Australian pooled superannuation funds over the years 1991-1998. The author studies the performance attribution in three asset classes: Australian equity, international equity, and Australian fixed income. He finds that collectively the Australian superannuation funds were unable to achieve excess return. Funds were able to achieve better results in security selection performance in Australian equities although around 75 percent of funds had a negative timing coefficient in domestic equities. In domestic fixed income, 14 of 15 funds present negative timing ability. The return on international equities for superannuation funds is worst in all sectors, and the performance shows no ability in market timing in international equities. Gallagher (2001) finds that in general, the Australian superannuation funds are not able to outperform their benchmarks.

Biglova & Rachev (2007) further developed performance attribution methods and applied the attribution method to evaluate the performance of the portfolio. They strived to determine the best model for a portfolio to beat the benchmark portfolio, and the purpose of the study is to find what the causes for portfolio’s excess return were. Biglova et al. (2007) built a portfolio that includes 30 German stocks that are included in the DAX30-index and an equally weighted benchmark portfolio. The authors analyze the excess return this portfolio has in relation to its benchmark. According to their study, the optimal portfolio is based on minimizing the downside risk (Expected Tail Loss) of the investment portfolio from the benchmark portfolio subject to constraints from asset allocation, selection effect and the total value added by the portfolio managers. Biglova et al. (2007) also study the distributional properties of asset allocation, security selection and total expected value added by portfolio managers.

They reject for those series in the normality assumption for the stable Parenthesis Hypothesis.

Bertrand (2005) proposes to take risk into account in performance attribution calculations. The author claims that portfolio managers need to take into consideration risk when making decision to under- or overweigh an asset class as well as security selection. He suggests that a good measure of risk, in this case, would be tracking error variance (TEV) and proves that the decomposition of the standard error of the tracking error is the base for risk attribution. The author proves in his study that both asset allocation factor and security selection factor have the same information ratios. This result shows that the equilibrium between relative return and relative risk has been achieved.

Menchero (2004) examines frameworks for multi-period arithmetic attribution. He defines qualitative characteristics and quantitative properties that are desirable to multi-period attribution linking. These include intuitiveness, transparency, and robustness. Menchero (2004) examined several published algorithms to determine their suitability for multi-period attribution and rejects logarithmic method, the compounded notional portfolio method, recursive methodologies as well as ad hoc smoothing algorithms because even though they might fulfill some of the desirable characteristics, they lack in others. The author finds that the only method that has all the desirable quantitative properties is the optimized linking algorithm as it offers the most accurate method for multi-period attribution.

3. MODERN PORTFOLIO THEORY

In this chapter, capital allocation, and modern portfolio theory is discussed. The process of portfolio management can be divided into security analysis, portfolio analysis and portfolio selection (Francis & Kim 2013: 1). Most commonly the asset allocation decisions are made before security selection. The process of capital allocation and security selection can be considered to be identical, as they aim for the same result – the optimal risky portfolio. The capital allocation will first be discussed in more detail which after the Markowitz model will be presented.

3.1 Capital Allocation

Capital allocation is considered to be the most important part of constructing an investment portfolio, and it is usually performed before security selection. By capital allocation, or also called asset allocation, is referred to the process of how much of the portfolio will be invested in the risk-free asset versus the portion invested in risky assets. The assumption is that portfolio should at least earn the risk-free rate. Any expected return above this rate is considered as risk premium that depends on the portion of risky assets. Since risk-free assets have a standard deviation of zero, the standard deviation of that risk-return trade-off will be the standard deviation of the risky assets times their weight. In this case, the expected return and portfolio standard deviation can be shown mathematically as:

(1.0) $$E(r_P) = r_f + y(E(r_P) - r_f)$$

(1.1) $$\sigma_P = y\sigma_P$$

Where $E(r_P)$ is the expected return, r_f is the risk-free rate and y the weight of risky assets. σ_P presents the portfolio standard deviation. (Bodie, Kane & Marcus 2011: 170-

171.) Increasing the weight of risky assets in the portfolio might increase the expected return, but it also increases the standard deviation, the risk, of the portfolio. Adding portfolios with a lower standard deviation than one to a diversified portfolio lowers the portfolio's standard deviation (Markowitz 1952) and makes diversification profitable. The expected return-standard deviation plane of a complete portfolio can be graphed as a straight line that intercepts at the risk-free rate. The slope of this line can be calculated as:

(1.2) $$S = \frac{E(r_P)-r_f}{\sigma_p}$$

The return-standard deviation plane is called the investment opportunity set, and the linear line is the capital allocation line (CAL). CAL presents the risk-return combinations available for the investor. The slope of the straight line, CAL, is the Sharpe ratio, also known as the reward-to-volatility-ratio. (Bodie et al. 2011: 171.) Sharpe ratio depicts how well the portfolio manager has performed – the higher the Sharpe ratio, the better the performance of the portfolio manager.

Investors' ability to bear risk will affect their choice of the optimal portfolio from the investment opportunity set. The utility can be shown as a function of allocation to the risky assets. By maximizing the utility, investors are able to choose the best allocation to the risky assets. The function of utility is

(1.3) $$U = E(r) - \frac{1}{2}A\sigma^2$$

where A denotes the investor's risk aversion. Utility is not a linear function but as the portion of risky assets grows, the expected return grows as well as, as does the volatility, which means that the utility might either increase or decrease. (Bodie et al.

2011: 174.) The optimal portion for risky assets may then be derived from the equation below:

(1.4) $$y = \frac{E(r_p) - r_f}{A\,\sigma_P^2}$$

As equation (1.4) presents, the portion of risky assets is inversely proportional to investor's risk aversion and portfolio variance but directly proportional to risk premium. This can be presented graphically by the indifference curve (see figure 2) – the steeper the indifference curve, the higher the risk premium investors require for the increase in risk. Higher indifference curve also depicts a higher level of utility from the investor. The indifference curve is combined with the opportunity set, CAL, where that point where indifference curve is tangent to CAL (point *C* in figure 2) is the optimal complete portfolio. (Bodie et al. 2011: 174-178.)

3.2 The Markowitz Model for Portfolio Selection

Portfolio theory and portfolio analysis were first introduced by Harry Markowitz in 1952 in his Nobel Prize winning article "Portfolio Selection". Markowitz' model for optimal risky portfolio uses the expected return for each selected underlying security in the portfolio, standard deviation of returns for each security, and correlation coefficients between all chosen securities, to form an optimal risky portfolio that will produce the chosen expected rate of return. The Markowitz model produces portfolio weights for selected securities with the given expected return and variance. (Francis et al. 2013: 3.)

The first step in forming an optimal risky portfolio is to determine the risk-return opportunities that are available for the investor that are summarized by the minimum-variance frontier. Figure 1 presents the minimum-variance frontier of a portfolio with a given expected rate of return and lowest variance possible. The minimum-variance frontier figure presents the core importance of diversification and why single asset portfolios are not efficient. Diversifying portfolios will lead to higher returns with lower risk. Portfolios that are positioned on the minimum-variance frontier from the global minimum-variance portfolio and upward represent possibilities for the best return-risk trade-off. Global minimum variance portfolio is the portfolio that lies on the efficient frontier. Those portfolios that are positioned on the lower part of the minimum-variance frontier have a similar portfolio with an equal risk but higher return, which makes the portfolios on the lower part of the minimum-variance frontier undesirable for the investor. (Bodie, Kane & Marcus 2011: 211.)

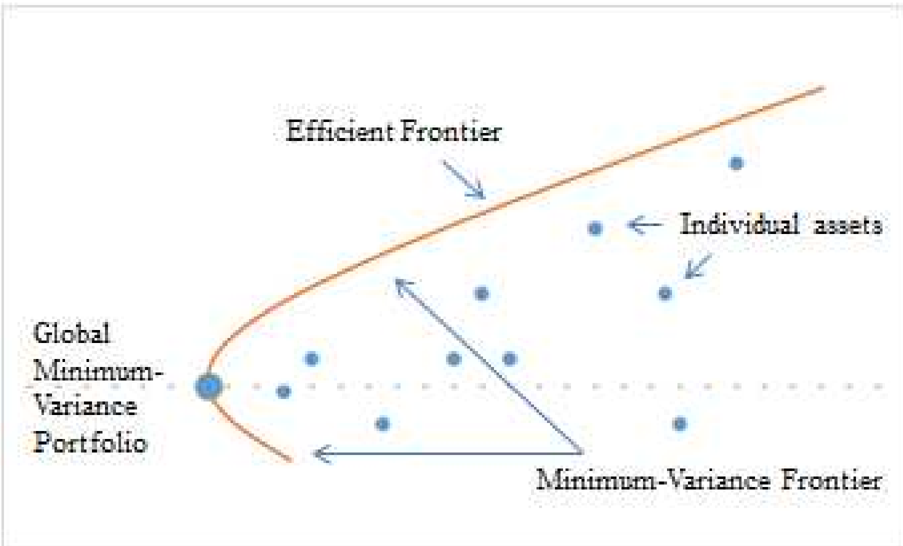

Figure 1. Minimum-variance frontier.

Risk-free assets are an essential part of portfolio optimization. The point, where the steepest capital allocation line (CAL) is tangent to the efficient frontier, defines the risky optimal portfolio. The last step includes determining the suitable ratio for risk-free and risky assets. Figure 2 presents this process. The point, *P*, represents the optimal risky portfolio that lies on the efficient frontier and is tangent to CAL. Markowitz (1952) states in his study that portfolio, *P*, has the lowest possible variance for that given expected return. With the given securities, there is no other portfolio with a lower variance for the given or greater expected return. This refers that portfolios with a lower expected return would be inefficient.

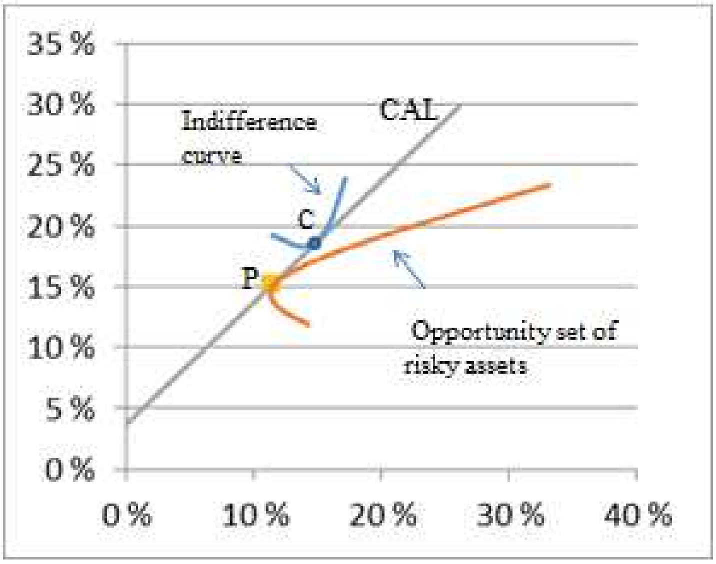

Figure 2. Optimal risky portfolio and optimal complete portfolio.

The model created by Markowitz (1952) forms a covariance matrix which enables the calculation of expected returns and variance of each security with their portfolio weights. The following equations can be used:

(1.5) $$E(r_P) = \sum_{i=1}^{n} w_i \, E(r_i)$$

(1.6) $$\sigma_p^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} w_i w_j \, Cov(r_i, r_j)$$

where $E(r_p)$ = Expected return for the portfolio

$E(r_i)$ = Expected return for the security i

w_i = weight on security i

w_j = weight on security j

r_i = return on security i

r_j = return on security j. (Bodie et al 2011: 213.)

Markowitz (1952) was able to create a model for portfolio selection that paved the way for portfolio diversification. Markowitz' model showed that for any given risk level the investor should be able to choose a diversified portfolio with the highest return instead of selecting a non-diversified portfolio. The author points out in his paper that the reason for diversification is to invest in securities that have a low covariance among themselves as this means that the securities will most likely not move in the same direction as the market conditions change, which sums the core of portfolio diversification. Diversification will lead to lower variance for the given expected rate of return.

4. PERFORMANCE ATTRIBUTION

In this chapter, the concept of performance attribution is more thoroughly discussed.

4.1 The Definition

One definition to performance attribution is that it is a method to search the cause for portfolio performance. Attribution attempts to explain total portfolio performance and take into consideration investment strategy and changes in market conditions (Spaulding 2003:2). Tim Lord (1997) stated that "the purpose of performance attribution is to measure total return performance and to explain that performance in terms of investment strategy and changes in market conditions. Attribution models are designed to identify the relevant factors that impact performance, and to assess the contribution of each factor to the final result." Portfolio managers make conscious decisions and hope that these decisions affect the portfolio performance in a positive way. However, part of excess return is caused by factors that managers have no control over, such as market conditions. Spaulding (2002: 3) presumes that factors that portfolio managers have no control over are grouped in the benchmarks that the investment portfolio is measured against.

We try to reason the excess return on the portfolio and see if the active management has paid-off. Menchero (2004: 1) describes performance attribution as an extremely powerful analysis tool for investors to analyze which decision added or reduced value to the investment portfolio. This makes performance attribution analysis a valuable asset in evaluating the investment process. He also defines the importance of the Brinson model through its intuitiveness and transparency. Carl Bacon (2008:117) describes performance attribution in his book as "-- a technique used to quantify the excess return of a portfolio against its benchmark into the active decisions of investment decision process."

Spaulding (2002: 9-13) formulates the laws of performance attribution in his book. The first law suggests that the attribution model should denote the decisions and actions that an active portfolio manager makes. It describes the portfolio manager's style of investing. The attribution model used and its results should be attributed to those responsible for the investment decisions. The second law of performance attribution by Spaulding states that the excess return on the total portfolio should equal the sum of attribution effects. This can be written as:

(1.7) $$\sum_{i=1}^{n} AE_i = r - b$$

where AE = attribution effect

r = portfolio return

b = benchmark return

i = individual effect

n = the number of effects in the model (Spaulding 2002: 12).

Performance attribution is divided into three effects: asset allocation, security selection, and interaction. Asset allocation considers the value the portfolio manager is able to bring either by underweighting or overweighting asset classes in relation to investment policy. It considers the role of active portfolio management to passive investment policy. Stock selection measures how well the portfolio manager was able pick the securities within asset allocation and what the actual contribution of stock selection was to overall portfolio performance. The concept behind stock selection term is to keep benchmark weights constant. The term relies on the returns within the actual portfolio and compares this to benchmark return which is then applied to the benchmark weight. (Bacon 2008: 119-120.) Interaction is a combination of the previous two effects. Asset allocation and selection were not able to fully explain the excess return, so a third component was needed. Therefore, interaction is the difference between excess return and asset allocation and selection.

4.2 Arithmetic Attribution

Brinson, Hood and Beebower (1991) and Brinson and Fachler (1985) laid the foundation for performance attribution in their articles that are now better known as the Brinson model. There are two ways to calculate performance attribution – geometric and arithmetic. This thesis presents the arithmetic performance attribution calculations as it is also used in the calculations in the empirical part. The Brinson model assumes that the returns of both portfolio and benchmark are the sum of their parts (Bacon 2008: 118) which defines that

(1.8) Portfolio return $r = \sum_{i=1}^{i=n} w_i \, x \, r_i$

where w_i = portfolio weight in i^{th} asset class
r_i = portfolio return in the i^{th} asset class

Benchmark return follows the same pattern:

(1.9) Benchmark return $b = \sum_{i=1}^{i=n} W_i x \, b_i$

where W_i = benchmark weight in the i^{th} asset class
b_i = benchmark return in the i^{th} asset class.

Arithmetically the excess return on a portfolio equals the difference between total portfolio return and total benchmark return:

(2.0) $$ER_A = r - b$$

where ER_A = Arithmetic excess return
r = portfolio return
b = benchmark return. (Spaulding 2002: 6.)

Now this is where performance attribution comes into the picture. What caused the difference between *b* and *r*? What active decisions did the portfolio manager make so that *r* does not equal *b*? Did these decisions yield well enough for the difference between *r* and *b* to be positive?

4.3 Equity Attribution

4.3.1 Brinson, Hood and Beebower

Brinson, Hood, and Beebower (1991) wrote an article on the determinants of portfolio performance that consisted of three effects: asset allocation, security selection, and interaction. The original article built a framework to present the overall performance attribution:

	Security Selection: Actual	Security Selection: Passive	
Asset Allocation	IV Actual Portfolio Return	II Policy and Active Asset Allocation Return	Actual
	III Policy and Security Selection Return	I Policy Return (Passive Portfolio Benchmark)	Passive

Figure 3. Brinson, Hood and Beebower framework for performance attribution (Brinson et al 1991).

Brinson et al (1991) separated analyzing portfolio returns to four different quadrants. Quadrant I represents the total passive return on the investment policy. The policy portfolio represents the portfolio defined in investor's investment strategy, the benchmark portfolio. Quadrant II represents the effects of asset allocation in relation to investment policy. It reflects the effects of over- or underweighting asset classes due to market conditions or fundamental analysis to either achieve superior return in relation to benchmark portfolio or to reduce risk. Quadrant III represents the security selection of performance attribution, and it defines the excess return accountable to security selection within an asset class due to active portfolio management. Quadrant IV represents the actual realized portfolio return that results from the actual asset class weights interacting with actual asset class returns as represented in equation (1.8).

The calculations for the four quadrants require the returns for the investment portfolio as well as the returns for the benchmark portfolio. The calculations are shown in figure 4. Quadrant I equals the equation (1.9) for benchmark return, and quadrant IV equals equation (1.8) for portfolio return. Quadrant II combines the active weights for asset allocation, and passive return for investment policy as quadrant III combines the passive weight of investment policy to active return.

		Security Selection	
		Actual	Passive
Asset Allocation	Actual	IV $\sum_{i=1}^{i=n} w_i \, x \, r_i$	II $\sum_{i=1}^{i=n} w_i x \, b_i$
	Passive	III $\sum_{i=1}^{i=n} W_i x \, r_i$	I $\sum_{i=1}^{i=n} W_i x \, b_i$

Figure 4. Brinson, Hood and Beebower calculation requirements for return accountability (Brinson et al 1991).

The model by Brinson et al. (1991) divides performance attribution to selection, asset allocation, and interaction effects. Asset allocation effect (A) is defined by Brinson et al. (1991) mathematically as quadrant II minus quadrant I, or as

(2.1) $$A = \sum_{i=1}^{i=n} w_i x\, b_i - \sum_{i=1}^{i=n} W_i\, x\, b_i$$

which can be simplified to the sum of individual component benchmark returns times the difference between actual portfolio weight and benchmark weight:

(2.2) $$\mathrm{A} = \sum b_i\, x\, (w_i - W_i)$$

The asset allocation effect in Brinson et al. (1991) model suggests that an underweight position in a positive market will lead to negative contribution to performance attribution and an overweight in a negative market will lead to a negative contribution (Bacon 2008: 122).

Selection effect (S), or otherwise known as the security selection effect, is defined by Brinson et al. (1991) as the difference between quadrant III and quadrant I. This is defined mathematically as,

(2.3) $$S = \sum_{i=1}^{i=n} W_i x\, r_i - \sum_{i=1}^{i=n} w_i\, x\, r_i$$

and can be simplified to:

(2.4) $$S = W_i\, x\, (r_i - b_i)$$

Security selection effect keeps the benchmark weight stable and is multiplied by the difference between the active return on the portfolio and the passive return on investment policy. This effect reflects the portfolio manager's ability to pick the right securities since real returns are applied to benchmark weights leaving out any contribution from asset allocation (Bacon 2008: 118). Clearly, as can be seen from the equation (2.4), if the portfolio's performance is superior to its benchmark, it will lead to a positive contribution, but if the portfolio underperforms in relation to its benchmark, the contribution will be negative.

Solely the asset allocation and security selection effects do not equal the excess return on an investment portfolio which is why a third component is required. This effect is referred to as interaction (I) or in some cases 'other', and it is a component of both asset allocation and security selection. It can be defined as quadrant IV minus quadrant III minus quadrant II plus quadrant I, or

(2.5) $$I = \sum_{i=1}^{i=n} w_i \, x \, r_i - \sum_{i=1}^{i=n} W_i \, x \, r_i - \sum_{i=1}^{i=n} w_i \, x \, b_i + \sum_{i=1}^{i=n} W_i \, x \, b_i$$

And for a single sector, the interaction effect is

(2.6) $$I = (w_i - W_i) \, x \, (r_i - b_i)$$

The interaction term is the most difficult to clarify. It is a combination of both stock selection and asset allocation. The interaction effect compares the weights of the actual portfolio to the weights in investment policy and active return to passive return. The interaction term gives the overweighed asset class, but that has underperformed a further negative contribution. It also gives credit to portfolio managers for being able to underweight asset classes that underperform as it gives these asset classes a positive contribution factor. There has been debate on whether the interaction effect is necessary and if it is actually part of the portfolio manager’s decision process. Bacon (2008: 127 - 128) argues in his book that portfolio managers do not add any value through interaction, and it is therefore often either left out of performance attribution analysis or divided equally between stock selection and asset allocation falsifying the results of performance attribution analysis. Fooladi et al. (2011) concluded in their study that alone the asset allocation and security selection effects are not able to explain the excess return which is why a third component is needed.

4.3.2 Brinson and Fachler

The model created by Brinson et al. (1991) gave all overweight positions in positive markets a positive asset allocation contribution, but it has been criticized for failing to take into consideration the overall benchmark return. Bacon (2008: 125) states that if the asset allocation has an overweight in a market that yielded a negative return but had a superior performance to its benchmark, the contribution to performance attribution should be positive. The model created by Brinson and Fachler (1985) modifies the asset allocation factor so that the differences in weights of investment policy in i^{th} asset class and overall benchmark and the difference in actual return and the return of investment policy are multiplied. More mathematically,

(2.7) $$A = \sum_{i=1}^{i=n}(w_i - W_i)\ x\ (b_i - b)$$

where w_i = sector’s weight in the benchmark

W_i = sector’s weight in the portfolio

b_i = the benchmark’s return for the sector

b = the benchmark’s overall return. (Bacon 2008: 125.)

The contribution to asset allocation in the underlying sector will then be

(2.8) $$A_i = (w_i - W_i)\ x\ (b_i - b)$$

The model that was created by Brinson and Fachler (1985) will yield different results than the model presented by the Brinson et al. (1991). If the benchmark sector return is less than the overall benchmark return and the portfolio manager's weighting was positive, then the Brinson and Fachler model gives a negative attribution factor. These results suggest that the portfolio manager gets a negative score for investing more in an asset class that underperformed the benchmark. If we overweight an asset class that has a negative return and yield a lower return than the overall benchmark, then the attribution effect would also be negative. Again, if we have a superior return to the benchmark, the attribution effect would be positive. (Spaulding 2002: 44.)

Even though the Brinson and Fachler model gives very different results for each sector compared to Brinson et al. (1991) model, the overall asset allocation effect is same for the both models – even though the individual sectors will yield different results using these two models, the sum of the sectors will equal for both models. It is important to realize that the difference between models lies between the individual asset classes. The Brinson et al. (1991) model's asset allocation lays its foundation on the core idea whether or not the asset class has been under- or overweighed, leaving out the overall benchmark return. The Brinson and Fachler model takes a deeper look at how the asset class performed in relation to the overall benchmark and leaves out the consideration of the sign of the return. The Brinson and Fachler model is based on relative asset class return relative to the benchmark. (Spaulding 2002; Bacon 2008.)

4.4 Fixed Income Attribution

Fixed income attribution isn't as straightforward and well developed as equity attribution is considered to be. Fixed income securities are more complex instruments than equities, and their performance is driven by changes in the yield curve (Bacon 2008: 171). The portfolio manager's decision process for fixed income differs from equities, and some argue that this makes the use of the Brinson model unsuitable for fixed income securities. However, the model used to calculate performance attribution for equity portfolios can, and often is, also applied to fixed income – as it is in this thesis. It is to be noted that there are controversial opinions on the calculation of performance attribution for fixed income securities as fixed income attribution is considered to be more of a specialist form of risk-adjusted attribution (Bacon 2008: 171).

One of the models for fixed income performance attribution was created by Stephen Campisi (2000). Fixed income performance attribution differs from equity performance attribution in the sense that it takes into consideration not only price changes but income return as well. The Campisi framework divides the total return of the portfolio into income return and price change. Income return is defined simply as the annual coupon rate divided by the beginning market price. Price return, on the other hand, is the effect of yield changes. More specifically it is the sum of treasury effect, spread effect and selection effect. The treasury effect takes into consideration the duration and changes in interest rate while the spread effect assumes that any return contribution that is not due to either income or treasury effect must be accounted for the spread effect. (Bacon 2008: 181 – 187.)

Both Bacon (2008: 185) and Spaulding (2002: 74) argue that using the original Brinson model for fixed income performance attribution gives misleading results especially in stock selection effect as the Brinson model will mostly likely produce results that give higher portion of total performance attribution results to stock selection. Campisi (2011) proved in his study that using the Brinson model, which was originally designed for equity portfolios, for fixed income portfolio the manager was penalized for security selection decisions more than the results would be if a fixed-income performance attribution model would be used. These arguments will be considered in the analysis of the results from the empirical part of this thesis, although in the empirical research the Brinson model will be applied to both equities and fixed income.

4.5 Multi-Period Attribution

The daily or monthly performance attribution results need to be linked across time. Spaulding (2002: 119) states the third law of performance attribution to be “the sum of the linked attribution effects must equal the sum of the linked excess return.” There are several ways to link multi-period attribution effects, but Spaulding (2002:120-125) shows that neither of the simple models, arithmetic nor geometric linking, work as the linked sum of attribution effects does not equal the sum of the linked excess return.

There are several smoothing algorithms for performance attribution. This thesis focuses on describing the logarithmic linking first studied by David Cariño (1999). Cariño (1999) suggests that single-period attribution results can be transformed into cumulated attribution results by a method that is known nowadays as Cariño smoothing. The objective of Cariño smoothing is to achieve annual attribution effects that equal the arithmetic excess return (Bacon 2008: 192). Cariño (1999) demonstrates that using the continuously compounded return can be summed as follows:

(2.9) $$\ln(1+r) = \ln(1+r_1) + \ln(1+r_2) + \cdots + \ln(1+r_n)$$

The same equals for the benchmark:

(3.0) $$\ln(1+b) = \ln(1+b_1) + \ln(1+b_2) + \cdots + \ln(1+b_n)$$

Cariño’s (1999) objective is to apply factors (k) that adjust the single-period attribution effects so that they equal the arithmetic excess return (Spaulding 2002: 127). The factor is calculated as:

(3.1) $$k_t = \frac{\ln\ (1 + r_t) - \ln\ (1 + b_t)}{r_t - b_t}$$

The excess return on the portfolio is demonstrated in the numerator in the form of natural logarithm as the denominator represents the monthly excess return. Factors are calculated for each period, *t*. (Spaulding 2002: 127.) If portfolio return equals the benchmark return, meaning that the portfolio alpha was zero, then the factor would be

(3.2) $$k_t = \frac{1}{1 + r_t}$$

(Bacon 2008: 191). The previous factor equation was meant for daily or monthly attribution effects, and Cariño (1999) presents a similar equation for calculating the factor for the entire period:

(3.3) $$k = \frac{\ln\ (1 + r) - \ln\ (1 + b)}{\mathrm{r} - b}$$

The periodic and overall period factors are used to calculate revised attribution factors that sum to the arithmetic excess return (Bacon 2008: 193). Bacon (2008: 192) demonstrates this as follows:

(3.4) $$r - b = \sum_{t=1}^{t=n} \frac{k_t}{k}\ x\ (r_t - b_t)$$

Which follows that all three attribution effects, asset allocation (A), selection (S) and interaction (I), are multiplied by the sum of their factors and added together which will equal the excess return on the portfolio (r – b):

(3.5) $$r - b = \sum_{t=1}^{t=n} \frac{k_t}{k} \; x \; A_t + \sum_{t=1}^{t=n} \frac{k_t}{k} \; x \; S_t + \sum_{t=1}^{t=n} \frac{k_t}{k} \; x \; I_t$$

The Cariño smoothing and factors Cariño (1999) presented in his paper enabled the calculations of multi-period performance attribution. Factors are used to modify each period's attribution results so that they can be added up and so that they equal the portfolio's annual excess return.

5. DATA AND METHODOLOGY

This chapter introduces the data used in the study.

The data for the study is provided by Investment Research Finland Ltd. The company is the leading provider of investment portfolio performance measurement and consolidated reporting services for Finnish institutional investors. In 2011, the client base of Investment Research Finland Ltd. constituted of 75 large institutional investors. The data is unique in the sense that there is no other data available of such detail for a large amount of Finnish institutional investors' investment portfolios to be found from any other source.

Data is calculated with true performance measures that is provided and collected by the company monthly. Data is transactions based data and consists of daily returns for 24 institutional investors and benchmarks for their portfolios between 31.12.2011-31.12.2015. This time span was chosen due to the fact that data availability was largest from this point onwards, and by the time the empirical part of this thesis was performed the year end data of 2015 was also validated. Benchmarks in the performance attribution calculations are those that are used in the consolidated reporting performed by Investment Research Finland Ltd. for their clients and approved by the investors. This thesis aims to provide true results of performance attribution on the underlying investment portfolios which requires that the benchmarks used are those that the investors themselves use in the performance evaluation of their investment portfolios. Changing the benchmarks to match for each portfolio wouldn't serve the purpose of this thesis as the benchmarks are the actual benchmarks used by the investors and those that the investors themselves reflect their portfolio performance on, and are part of investors' investment strategy.

Table 1 lists the benchmarks used in the performance attribution calculations for equities. Most commonly used index for domestic equities was the OMX Helsinki CAP Index. MSCI Europe was used by 87,5 % of the investors for European stocks, one investor used the Dow Jones EURO STOXX 50 index and one investor the total return index for MSCI Europe. Two indices dominated the North American stocks – the S&P 500 index and MSCI North America. MSCI World Index was the most popular index for world stocks, as well as the MSCI Emerging Markets index for emerging markets equities.

Table 1. List of Benchmarks for Equities.

Equity	Count
OMX Helsinki Cap Index GI (total return)	1
OMX Helsinki CAP GI	21
Dow Jones EURO STOXX 50 Return Index	1
MSCI Europe TR	1
MSCI Europe	21
MSCI North America	6
S&P 500	3
S&P 500 EUR TR	1
MSCI World Index	1
MSCI World	18
MSCI World ex Europe (TR USD Net)	1
MSCI Emerging Markets	15
MSCI Emerging Markets (free)	2
MSCI Japan (Daily TR JPY Net)	2
MSCI Pacific	1

Benchmarks for fixed income are presented in table 2. Money market instruments were commonly benchmarked with either 1 month Euribor index or 3 month Euribor index. Only two investors chose to use JP Morgan cash index. JP Morgan Government bonds index was widely used as a benchmark for government bonds. For corporate bonds, the Merrill Lynch EMU Corporate Bond index was most common for investment grade bonds while there was more variation in the choice of a benchmark for high yield bonds. Merrill Lynch Euro High Yield index was the most common index but hedged and currency versions of this index were also used. There was large variation in benchmark used for emerging market bonds as well. Merrill Lynch Emerging Markets and JP Morgan Emerging Markets indices were most common indices.

Table 2. List of Benchmarks for Fixed Income.

Fixed income	Count
1 month Euribor Index	11
3 month Euribor Index	8
JP Morgan Cash Index Euro Currency 3 Months	2
Merrill Lynch EMU Direct Government Bond Index	2
JPM EMU Government Bond Index	17
JPM EMU Bond Index	2
Barclays Euro Aggregate Corporates Index	1
Merrill Lynch EMU Corporate Bond Index	21
Merrill Lynch Euro High Yield Index	13
Merrill Euro High Yield Constrained	2
Merrill Lynch European Currency High Yield (Tot.Ret Ind. Hedged - EUR)	2
Merrill Lynch Global High Yield Constrained (EUR Hedged)	3
Merrill Lynch Global High Yield BB-B Constrained Index (EUR Hedged)	2
Merrill Lynch Emerging Markets External Debt Sovereign Index	1
Merrill Lynch Emerging Markets Sovereign & Credit TR	3
JP Morgan Emerging Markets Bond Global	5
JPMorgan Emerging Markets Bond Index Global EUR Hedged	2
JPMorgan Emerging Markets Bond Index Plus (EMBI+)	3
JP Morgan Emerging Markets EMBI+ Composite, EUR hedged	1
JPMorgan Emerging Markets EMBIG Diversified Hedged in EURO	1

It is important to acknowledge that not all neutral allocations are updated yearly by the investors, and this at times reflected greatly in the results of this study. Some portfolio managers have the same neutral allocation for several years even though the market conditions change. Even though portfolio managers make changes in their investment portfolios as market conditions change, they fail to update the neutral allocation and only act within the set allocation limits. This cannot be condemned to be wrong but clearly affects the results of this study. Performance attribution calculation can only be seen to be valid for fixed income securities and equities due to the lack of proper benchmarks and calculation models for other asset classes that are usually involved in the consolidated reporting performed by Investment Research Finland Ltd. – for example, properties and alternative investments. For this reason, only equities, and fixed income have been included in the performance attribution calculations of this study.

Figure 5 presents the average asset allocations for institutional investors' all investments during 31.12.2011-31.12.2015. On average, 57 percent of funds were allocated to fixed income and 43 percent of funds to equity. Fixed income is more variable in its risk profile than equities are considered to be, as money market and government bonds are considered to be almost riskless. Those investors who have a higher asset allocation in equities than fixed income can be on average considered to be less risk averse.

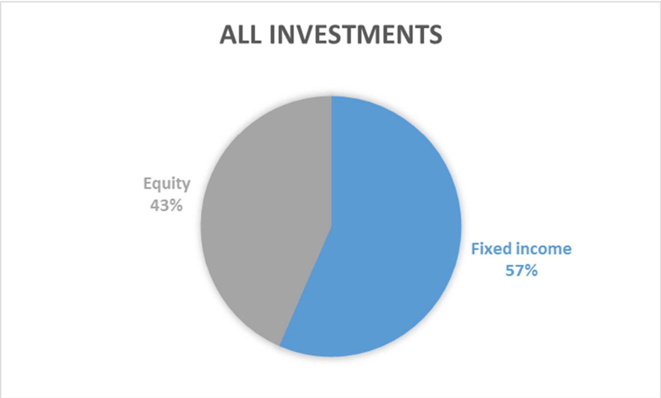

Figure 5. Average Asset Allocation

More accurate allocation of fixed income and equities is presented in figure 6. Neither fixed income nor equities sum to 100 percent due to differences in asset allocations in the underlying portfolios. On average, the largest asset class within fixed income was investment grade bonds with 27 percent. From all the funds allocated to fixed income, on average 23 percent is allocated to money market instruments, and 22 percent to government bonds. These three asset classes - investment grade bonds, money market, and government bonds - are less risky than the two asset classes left with smaller allocations. On average, 15 percent of all funds allocated to fixed income are allocated to high yield bonds and 13 percent to emerging market bonds. Emerging market bonds and high yield bonds have higher risk but might produce better return when market conditions are favorable.

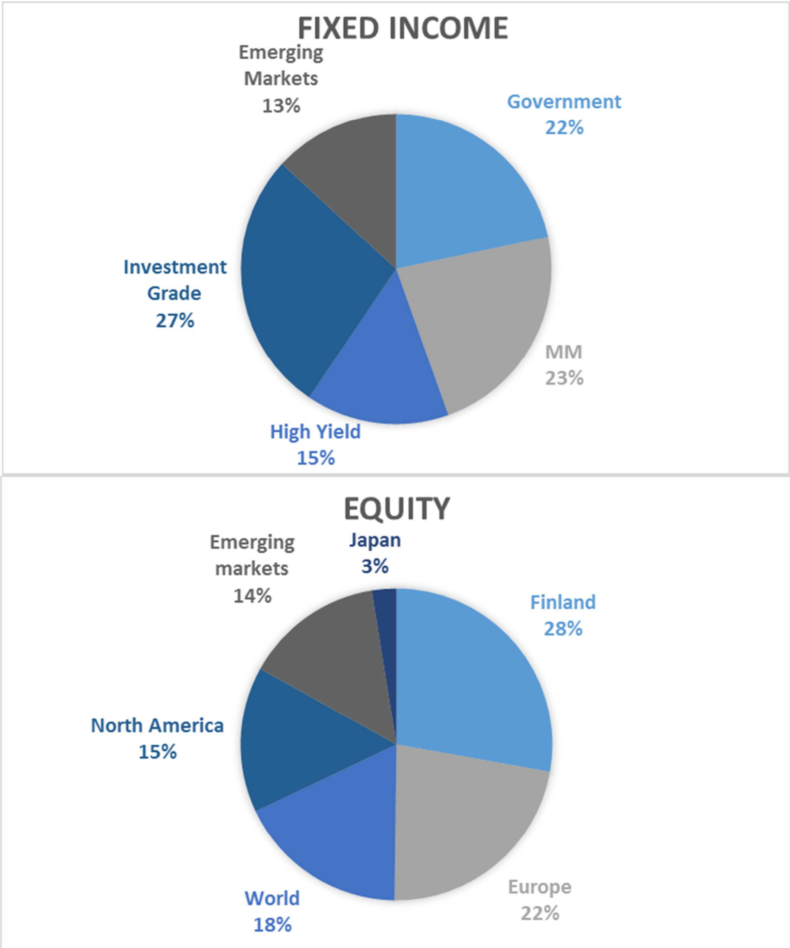

Figure 6. Average Asset Allocation for Fixed Income and Equities

The largest asset class within equities is the domestic market with 28 percent of equity funds allocated to Finnish stocks. The second largest on average is the European stock market with 22 percent. This result is not surprising. Faff et al (2005) suggest in their study that the weights in domestic equities are increased when the yield curve for that market is upward sloping, and when there are no apparent changes expected to happen. The total net assets in domestic equity funds in Finland increased by 42 billion euros between 2011 and 2015 which also proves the faith investors had in domestic markets during that time (Suomen Sijoitustutkimus 2015). Faff et al (2005) also suggest that the same pattern can be seen in international equities. European equities have performed well in 2011-2015 and the average annualized five year return at the end of 2015 for European equity funds was 8% and the annualized three year return was 11.5% (Suomen Sijoitustutkimus 2015).

On average, 14 percent of equity funds were allocated to emerging markets and 15 to North America. The average allocation to Japan was only 3 percent, and only a few investors chose to separate this in their allocation. The allocation to global stocks differs largely among investors. Some investors consider global stocks or equity funds only to include those officially classified as global and have a separate index for it in their benchmark; however, some investors only specify one index in their neutral allocation to cover all world stocks in a larger scale.

Table 3. Performance Attribution Averages: All investments, Equities, and Fixed Income

	Allocation (BF)	**Selection**	**Interaction**	**Sum of Performance attribution (BF)**
All investments	0.45%	-1.30%	0.22%	-0.63%
Equities	0.17%	1.60%	0.30%	2.07%
Fixed Income	0.28%	-2.90%	-0.08%	-2.70%

Table 3 concludes the performance attribution results for entire investment portfolios. On average, the portfolio managers underperformed in relation to their benchmark. The average sum of performance attribution for all portfolios was -0.63%. The underperformance was mainly due to stock selection within the portfolios which supports the results of Brinson et al (1995). The average selection term was -1.3% while the average allocation term was 0.45% and the average interaction term was 0.22%. The sum of performance attribution for equities was 2.07%. All three terms, allocation, selection, and interaction, were positive for equities but the largest impact was due to selection. The sum of performance attribution for fixed income was -2.7%. The allocation term in fixed income was positive, 0.28%, while the selection and interaction term were both negative. The stock selection within fixed income seemed to cause the biggest underperformance in total portfolio return, and the biggest success was down to stock selection in equities. The positive effect of asset allocation was, however, diminished mostly by the effects of security selection. On average, portfolio managers were able to get excess return from equities by picking better securities for equity portfolios but this was also diminished by the poor performance for selection within fixed income securities. Using the Brinson model for fixed income securities has been criticized and especially its results for security selection on fixed income. So these results should be looked at with utmost care.

More accurate table on performance attribution for top level is listed in appendix 1. The results show that 17 of all 24 portfolios had a negative sum of return attribution referring that in most cases portfolio managers were not able to beat the benchmark. 11 portfolios were able to over-perform the benchmark in equities and while only 4 portfolio managers were able to perform better than the benchmarks in fixed income. These results show that in 2012-2015 the most of the excess return on portfolio came from equities and not fixed income. In fixed income, 20 portfolios had a superior attribution term in asset allocation than selection referring that allocation of funds within fixed income seems to produce better returns than selection of securities.

Table 4. Performance Attribution Averages: Equities

	Allocation (BF)	Selection	Interaction	Sum of Performance attribution (BF)
Equities	-0.19%	-2.08%	3.46%	1.19%

Table 4 presents the results for performance attribution for equities. Results show that on average level, portfolio managers were able to provide excess return on equities. The average sum of performance attribution for equities was 1.19% referring that equity portfolio managers were able to get excess return of 1.19%. The average allocation term for all equity portfolios was -0.19%, the average selection term -2.08% and average interaction term 3.46%. Stock selection seemed to be the largest underperforming factor, although the average asset allocation term was negative as well. The positive sum of performance attribution was due to the positive interaction term, which shows that the combination of asset allocation and stock selection led to a positive impact. Some portfolios could differentiate themselves from others by performing extremely well at sector level. This was mainly due to less diversification within the portfolio compared to the benchmark which had led to better security selection and therefore superior return in relation to the benchmark. Based on these results, on average, portfolio managers' biggest disadvantage was choosing well-performing stocks in their portfolios while allocation factor was only mildly negative. However, the combination of these two factors caused the portfolios to yield excess return.

Table 5. Average Performance Attribution for Equities in Sector Level

	Allocation (BF)	Selection	Interaction	Sum of Performance attribution (BF)
Emerging markets	-0,21 %	0,71 %	0,29 %	0,79 %
Europe	0,12 %	1,40 %	2,50 %	4,01 %
Finland	0,11 %	0,25 %	-0,28 %	0,07 %
Global	0,08 %	-4,02 %	0,59 %	-3,36 %
North America	-0,74 %	-1,58 %	1,55 %	-0,77 %

Performance attribution for all equity portfolios is presented in appendix 2 while table 5 presents the average performance attribution results for equities in sector level. One of the portfolios in the study had inconclusive results for its equity portfolio, so it had to be left out of this part of the thesis. Results show that 12 out of 23 portfolios had a negative sum of performance attribution for equity portfolio. Half of the portfolio managers were able to achieve excess return while the other half of the portfolios underperformed in relation to their benchmark.

Portfolios differ in their neutral allocation, and 21 portfolios had Finnish stocks separated in the asset allocation. On average the asset allocation effect for domestic equity was positive (+0.07%) but 15 of 23 portfolios had a negative allocation term. Of all domestic equity portfolios, 14 had a negative selection term while the average selection term was 0.25%%, and 13 had a positive interaction term while the average interaction term was -0.28%. As previously mentioned, investors tend to weigh more on those asset classes that have a upward sloping yield curve and this is shown in the results of this study. The well-performing asset classes, Finland and Europe, also had a positive asset allocation and security selection factors.

Europe, alongside domestic equities, was the most common in neutral allocation, present in 21 of all 23 portfolios. The average sum of performance attribution for European equities was positive (+4.01%), as were all three attribution effects. European equities were also the largest contributor to the positive sum of performance attribution for equities. The sum of portfolio performance was positive for 16 portfolios which equals 69.6 percent. The markets in Europe yielded fairly well in 2012-2015. After the sovereign debt crisis, there has been an upward trend in European stock markets. Especially in early 2015 the index, as well as stock prices, came up quite steeply, but China's financial news affected the European stock markets as well and cause a steep downward slope in the markets in August 2015.

All in all, 16 portfolios had emerging markets equities separated in their neutral allocation, and 9 of these portfolios had a negative sum of performance attribution. The average sum of performance attribution was positive for emerging market equities (+0.79). The asset allocation term for emerging markets was negative in 8 portfolios, 11 of the emerging markets portfolios had a positive selection term, and 9 had a positive interaction term. North America was separated in 10 neutral allocations, and 6 of these underperformed and had a negative sum of performance attribution. Allocation term was negative for eight of the ten portfolios, selection term was negative in six cases and interaction was negative in five portfolios. For North American equities portfolio managers were not able to create excess return from asset allocation but the biggest negative contributor was selection.

Table 6. Performance attribution averages: Fixed income

	Allocation (BF)	Selection	Interaction	Sum of Performance attribution (BF)
Fixed income	-0.17%	-8.80%	3.24%	-5.74%

Table 6 presents the average performance attribution results for fixed income. The utmost care must be taken while analyzing these results, as Bacon (2008) and Spaulding (2002) both argued, the results for fixed income might be misleading when using the Brinson model. For fixed income, the average sum of performance attribution was -5.74% referring that on average fixed income portfolios underperformed during 2012-2015. Like in equities, also in fixed income the average allocation factors and average selection factors were negative. The selection term was the biggest cause for the overall negative performance attribution while the interaction term was positive. As Spaulding (2002: 74) argued in his example, the issue selection effect was the biggest contributor to the total effect when using the Brinson model for fixed income. This pattern can be seen in the empirical results of this thesis as well. On average portfolio managers were unable to select good securities for their portfolios, the average selection effect being quite large (-8.80%) but the combined effect of allocation and security selection, the portfolio managers' ability to underweight the portfolio in underperforming asset categories, led to a positive interaction term and brings the overall sum of performance attribution up by 3.24%. More detailed performance attribution for all fixed income portfolios is presented in appendix 3. Based on the results of this study, fixed income securities underperformed in 2012-2015 and 87% of the portfolios had a negative sum of performance attribution. Worth noting is also that 87% of the portfolios had a negative selection term.

Table 7. Average performance attribution figures for fixed income in sector level

	Allocation (BF)	Selection	Interaction	Sum of Performance attribution (BF)
Bonds, Emerging markets	0.03%	-4.37%	0.03%	-4.32%
Bonds, Government	-1.27%	-5.60%	4.78%	-2.09%
Bonds, High Yield	1.31%	-2.35%	-0.41%	-1.45%
Bonds, Investment Grade	0.14%	0.62%	-0.87%	-0.11%
Money Market	-0.55%	1.06%	-0.04%	0.48%

Portfolios differ in the neutral allocation within fixed income as well. Table 7 presents the average performance attribution results for the sector level for fixed income. All in all, 21 portfolios of all 23 portfolios had government bonds specified in their neutral allocation. Only one of these portfolios had a positive sum of performance attribution for government bonds, 15 had a negative allocation term, all portfolios had a negative selection term. Some of the selection terms were quite large which can be explained by the fact that some government bond portfolios had a weight in neutral allocation but were in fact empty and some of the portfolios did not diversify their government bond portfolios which led to the result that portfolio return was not as well-diversified as the index return is. Again, the critique on using the Brinson model should be taken into consideration. Based on this can be concluded that most portfolios included in this study, portfolio managers do not diversify their government bonds as widely as other fixed income classes.

Money markets were specified in 91% of the neutral allocations. Money markets often include the cash the investor holds on bank accounts and other low-risk securities and is often considered a good way to balance the riskiness of the investment portfolio. For this reason, the common index used for money market instruments is often either the three month or one month Euribor-index. The sum of portfolio performance was positive for 15 of all 21 portfolios, ten portfolios had a positive allocation term and 19 had a positive selection term. The interaction term was positive in 14 money market portfolios. In most of the portfolios that had a negative sum of performance attribution for money markets, it was due to negative allocation effect. In these portfolios, overweight in money markets caused an underweight in another asset allocation class that would have yielded a higher return. It also has to be considered as cash is often part of money market allocation, cash doesn’t produce any return although might at times contribute to a large portion of the money market instruments.

Corporate bonds have been specified in all of the neutral allocations. In most of the neutral allocations corporate bonds have been separated into high yield bonds and investment grade bonds. Only one portfolio had left investment grade bonds out of the neutral allocation and one had only specified corporate bonds to include both investment grade bonds and high yield bonds together. The average sum of performance attribution for high yield bonds was -1.45% and the average sum of performance attribution for investment grade bonds was -0.11%. The average allocation term for high yield bonds was positive (1.31%), while the average selection term was negative (-2.35%). The average interaction term was -0.41%. Altogether, 17 of all high yield portfolios had a negative sum of performance attribution. For all high yield portfolios, 16 of 24 had a positive allocation factor and 19 had a negative selection effect. For investment grade bonds the average allocation term was positive (0.14%), while the average selection term was also positive (0.62%). The average interaction term was -0.87%. The sum of performance attribution was positive for eight investment grade bond portfolios, the asset allocation effect was positive for 13 portfolios while the selection effect was negative for also 13 portfolios. Based on these results, portfolio managers were not able to have a positive effect on portfolio return through corporate bonds. The asset allocation effect seemed to yield most excess return on corporate bonds but this was again diminished by selection term. The selection term was highly positive for some portfolios which were due to either illiquidity or lack of daily prices for bonds which may yield high daily returns that are not considered in the benchmark or empty portfolios even though they had a weight in portfolio’s neutral allocation. The selection term may also be influence by the complexity of bond calculations. Fixed income securities, unlike equities, may have several prices and finding an index that uses the same price as the actual security does, is a challenge. This may also have an impact on the performance attribution results.

5. CONCLUSION

This study examines the performance attribution of Finnish institutional investors using the Brinson model. The data is provided by Investment Research Finland Ltd. who is the leading provider of investment portfolio performance measurement and consolidated reporting services for Finnish institutional investors. The company provides consolidated reporting for over 70 Finnish institutional investors and out of those investors 24 were eligible for performance attribution calculations using the Brinson model at their current state of investment policies and neutral allocations. The time period is spanning from 31.12.2011-31.12.2015.

This thesis is based on two main hypotheses. First, Finnish institutional investors have been able to achieve excess return. Second, asset allocation has been the main cause for the excess return. The results reject the first hypothesis. On average, the sum of performance attribution for Finnish institutional investors was -0.63% and 70.8% of all portfolios had a negative sum of performance attribution. This supports the findings of Gallagher (2001). However the findings are not in line with the findings of Binay (2005). In previous studies, the results have been mixed on whether investors are able to create excess return so the results of this study are not contradictory. However, it needs to be acknowledged that the data set for the study, although unique, is limited, and cannot be generalized.

The first profound study and the model that this thesis is based on, by Brinson et al. (1991) found that over 90 percent of excess return on investment portfolios was due to asset allocation. The results of this study indicate that in 70.8% of the portfolios asset allocation effect was higher than selection effect. This study cannot fully support the second hypothesis. Although the asset allocation had a more positive effect on total attribution results, it cannot be said that asset allocation was the main cause for excess return. On this basis, the second hypothesis is rejected. The results of this thesis are mostly not supported by previous studies, but it has to be noted that previous studies mostly used data on equities as this study concluded fixed income as well. This has had an impact on the results.

On average level, equities had a more positive contribution to total performance attribution result than fixed income. Especially the selection effect was negative for great amount of fixed income portfolios. The results of this thesis are contradictory to Faff et al. (2005) and Gallagher (2001). Although the average asset allocation effect and selection effect for domestic equities were positive, the result was diminished by negative interaction term. The positive contribution from European equities was diminished by negative contribution from other international equities, which supports the findings of Faff et al. (2005). The results are in line with Gallagher (2001) as this study also shows that between 2012 - 2015 investors were not able to do well in international markets.

Fixed income results should be looked at with utmost care due to critique on the usage of Brinson model on fixed income portfolios. The average sum of performance attribution for fixed income was highly negative which was due to high negative selection effects. These results are in line with Faff et al. (2005). These findings support the arguments of Spaulding (2002) and Bacon (2008) and provide proof for further research. Conducting this study with different models for fixed income could give more precise results on the performance of fixed income.

Furthermore, this study could be extended by adjusting the data period to see how investors have performed when looking over a longer period of time. This study could also be conducted in different markets as well, if only suitable data would be available.

REFERENCES

Bacon, Carl R. (2008). Practical Performance Measurement and Attribution. 2nd Edition. Chicester, GB: John Wiley & Sons. ISBN 978-0-470-05928-9.

Bertrand, P. (2005). A note on portfolio performance attribution: Taking risk into account. Journal of Asset Management, 5:6, 428-437.

Biglova, A., & Rachev, S. (2007). Portfolio performance attribution. Investment management and Financial innovations, *4*:3, 7-22.

Binay, M. (2005). Performance Attribution of US Institutional Investors. Financial Management, 34:2, 127–152.

Bodie Z., Kane, A. & Marcus, A. (2011). Investments. 9th Edition. New York ect.: McGraw-Hill Inc. ISBN 978-0-07-353070-3.

Brinson, G. P., & Fachler, N. (1985). Measuring non-US. Equity Portfolio performance. The Journal of Portfolio Management, 11:3, 73-76.

Brinson, G. P., Hood, L. R., & Beebower, G. L. (1991). Determinants of portfolio performance II: An Update. Financial Analysts Journal, 47(3), 40-48.

Brinson, G. P., Hood, L. R., & Beebower, G. L. (1995). Determinants of portfolio performance. Financial Analysts Journal, 51(1), 133-138.

Campisi, S. (2000). Primer on Fixed Income Performance Attribution. Journal of Performance Measurement, 4:4, 14-25.

Campisi, Stephen (2011). A Sector Based Approach to Fixed Income Performance Attribution. Journal of Performance Measurement, 15:3, 23-42.

Cariño, D. (1999). Combining Attribution Effects over Time. Journal of Performance Measurement, 3:4, 5-14.

Cuthbertson, K., Nitzsche, D., & O'Sullivan, N. (2010). The market timing ability of UK mutual funds. Journal of Business Finance & Accounting, 37:1-2, 270-289.

Faff, R., Gallagher D. R. & Wu E. (2005). Tactical Asset Allocation: Australian Evidence. Australian Journal of Management, 30:2, 261-282.

Fooladi, I. & Rumsey, J. (2011). Problems in Performance Attribution. Quarterly Journal of Finance & Accounting, 50:1, 5-22.

Francis J. C. & Kim D. (2013). Modern Portfolio Theory: Foundations, Analysis, and New Developments. Chicester, GB: John Wiley & Sons. ISBN 978-1-118-37052-0.

Frongello, A., S., B. (2002). Linking Single Period Attribution Results. Journal of Performance Measurement, 6:3, 10-22.

Gallagher, D. R. (2001). Attribution of investment performance: an analysis of Australian pooled superannuation funds. Accounting & Finance, 41:1-2, 41-62.

Gyger, S. (2005). Multi-Period Performance Attribution: A Refreshing Perspective. Available at SSRN 861844.

Hsu, J. C., Kalesnik, V., & Myers, B. W. (2010). Performance attribution: Measuring dynamic allocation skill. Financial Analysts Journal, 66:6, 17-26.

Lu, Y., & Kane, D. (2013). Performance Attribution for Equity Portfolios. R Journal, 5:2.

Karnosky, D. S., & Singer, B. D. (1994). General Framework for Global Investment Management and Performance Attribution. Journal of Portfolio Management, 21:2, 84-92.

Lord, T. (1997). The Attribution of Portfolio and Index Returns in Fixed Income. Journal of Performance Measurement, 2:1, 45–57.

Markowitz, H. M. (1952). Portfolio selection. Journal of Finance, 7:1, 77-91.

Menchero, J. (2004). “An Optimized Approach to Linking Attribution Effects over Time. Journal of Performance Measurement, 5:2, 55-80.

Morgan, S. (2014). Performance attribution of options: Defining Single-Stock Option Exposures and Understanding the Brinson-Fachler Effects. Journal of Portfolio Management, 40:2, 103-111, 16-17.

Sinclair, N. A. (1990). Market timing ability of pooled superannuation funds January 1981 to December 1987. Accounting & Finance, 30:1, 51-65.

Spaulding, David (2003). Investment performance attribution. A guide to what it is, how to calculate it and how to use it. 1st Edition. New York ect.: McGraw-Hill Inc. ISBN 0-07-140885-1.

Suomen Sijoitustutkimus (2015). Mutual Fund Report – December 2015. [online] [cited 2016-09-07]. Available from Internet: <URL: http://www.sijoitustutkimus.fi/wp-content/uploads/2016/01/Fundreport_201512.pdf>.

Xiong, J. X., Ibbotson, R. G., Idzorek, T. M., & Chen, P. (2010). The equal importance of asset allocation and active management. Financial Analysts Journal, 66:2, 22-30.

APPENDICES

APPENDIX 1

		Allocation (BF)	Selection	Interaction	Sum of Performance attribution (BF)
Client A	**All investments**	**-2.85%**	**-11.35%**	**-0.59%**	**-14.80%**
	Equities	-1.42%	-2.48%	-0.34%	-4.24%
	Fixed Income	-1.44%	-8.87%	-0.25%	-10.56%
Client B	**All investments**	**1.84%**	**-0.33%**	**2.08%**	**3.59%**
	Equities	0.49%	3.70%	1.32%	5.52%
	Fixed Income	1.35%	-4.04%	0.76%	-1.93%
Client C	**All investments**	**-1.25%**	**-10.27%**	**-0.11%**	**-11.63%**
	Equities	-0.86%	-2.60%	0.19%	-3.27%
	Fixed Income	-0.39%	-7.66%	-0.30%	-8.35%
Client D	**All investments**	**7.28%**	**21.06%**	**9.01%**	**37.34%**
	Equities	2.81%	28.92%	5.86%	37.59%
	Fixed Income	4.47%	-7.85%	3.14%	-0.24%
Client E	**All investments**	**-1.79%**	**-10.45%**	**3.14%**	**-9.10%**
	Equities	-1.59%	-4.06%	4.05%	-1.59%
	Fixed Income	-0.20%	-6.39%	-0.91%	-7.50%
Client F	**All investments**	**-4.67%**	**18.26%**	**1.45%**	**15.05%**
	Equities	-1.48%	12.99%	-0.35%	11.17%
	Fixed Income	-3.18%	5.27%	1.79%	3.88%
Client I	**All investments**	**1.31%**	**-7.58%**	**2.46%**	**-3.81%**
	Equities	0.46%	0.46%	0.42%	1.34%
	Fixed Income	0.85%	-8.04%	2.04%	-5.15%
Client J	**All investments**	**-2.76%**	**-6.11%**	**2.24%**	**-6.63%**
	Equities	-1.23%	-0.78%	1.87%	-0.14%
	Fixed Income	-1.53%	-5.33%	0.37%	-6.50%
Client K	**All investments**	**1.27%**	**-11.66%**	**0.72%**	**-9.68%**
	Equities	0.21%	-8.04%	-0.33%	-8.17%
	Fixed Income	1.06%	-3.62%	1.05%	-1.51%
Client L	**All investments**	**0.59%**	**3.52%**	**-0.75%**	**3.35%**
	Equities	0.18%	7.14%	-0.67%	6.65%
	Fixed Income	0.41%	-3.63%	-0.08%	-3.30%
Client N	**All investments**	**-1.57%**	**-3.75%**	**0.10%**	**-5.23%**
	Equities	-0.65%	-0.48%	0.02%	-1.11%
	Fixed Income	-0.92%	-3.27%	0.07%	-4.12%
Client O	**All investments**	**7.98%**	**17.34%**	**-4.08%**	**21.23%**
	Equities	2.66%	4.28%	0.53%	7.47%
	Fixed Income	5.32%	13.06%	-4.61%	13.77%

		Allocation (BF)	Selection	Interaction	Sum of Performance attribution (BF)
Client P	**All investments**	**3.27%**	**-6.22%**	**-0.03%**	**-2.97%**
	Equities	1.31%	-2.09%	-0.39%	-1.18%
	Fixed Income	1.96%	-4.12%	0.36%	-1.80%
Client Q	**All investments**	**-3.54%**	**-3.97%**	**0.05%**	**-7.46%**
	Equities	-2.10%	-2.06%	1.29%	-2.88%
	Fixed Income	-1.44%	-1.91%	-1.24%	-4.59%
Client R	**All investments**	**-0.69%**	**-12.97%**	**-1.88%**	**-15.53%**
	Equities	-0.44%	5.03%	-0.63%	3.95%
	Fixed Income	-0.24%	-18.00%	-1.24%	-19.48%
Client S	**All investments**	**-1.25%**	**-2.63%**	**-3.66%**	**-7.54%**
	Equities	-1.05%	4.92%	-2.84%	1.02%
	Fixed Income	-0.19%	-7.55%	-0.81%	-8.56%
Client T	**All investments**	**3.37%**	**-7.75%**	**-1.13%**	**-5.51%**
	Equities	2.73%	-3.53%	-2.06%	-2.86%
	Fixed Income	0.64%	-4.21%	0.93%	-2.65%
Client W	**All investments**	**0.04%**	**3.48%**	**0.37%**	**3.89%**
	Equities	0.01%	0.37%	0.21%	0.60%
	Fixed Income	0.03%	3.10%	0.16%	3.29%
Client Y	**All investments**	**2.52%**	**28.03%**	**0.19%**	**30.75%**
	Equities	1.63%	-1.20%	2.88%	3.31%
	Fixed Income	0.89%	29.23%	-2.68%	27.44%
Client Z	**All investments**	**1.77%**	**-6.61%**	**0.14%**	**-4.69%**
	Equities	1.60%	-0.98%	0.05%	0.67%
	Fixed Income	0.18%	-5.63%	0.09%	-5.37%
Client AB	**All investments**	**3.14%**	**-4.03%**	**-0.89%**	**-1.77%**
	Equities	2.64%	-2.23%	-0.84%	-0.42%
	Fixed Income	0.50%	-1.80%	-0.05%	-1.35%
Client AC	**All investments**	**1.85%**	**-6.28%**	**-0.08%**	**-4.52%**
	Equities	1.66%	-1.42%	-0.48%	-0.25%
	Fixed Income	0.18%	-4.86%	0.41%	-4.27%
Client AD	**All investments**	**-0.39%**	**-10.00%**	**0.28%**	**-10.11%**
	Equities	-0.35%	-0.81%	0.30%	-0.86%
	Fixed Income	-0.04%	-9.19%	-0.03%	-9.25%
Client AF	**All investments**	**-4.68%**	**-1.00%**	**-3.65%**	**-9.33%**
	Equities	-3.12%	3.28%	-2.78%	-2.61%
	Fixed Income	-1.56%	-4.28%	-0.87%	-6.71%

APPENDIX 2

		Allocation (BF)	Selection	Interaction	Sum of performance attribution (BF)
Client A	**Equities**	**-4.92%**	**-3.84%**	**3.31%**	**-5.45%**
	Emerging markets	-3.33%	0.46%	-1.09%	-3.96%
	Europe	-0.99%	3.96%	1.42%	4.39%
	Finland	0.90%	-1.98%	-0.25%	-1.33%
	Global	-0.11%	-4.89%	4.32%	-0.68%
	North America	-1.38%	-1.39%	-1.09%	-3.86%
Client B	**Equities**	**5.61%**	**-3.39%**	**3.24%**	**5.46%**
	Emerging markets	3.85%	-7.01%	2.87%	-0.29%
	Europe	-0.15%	4.54%	0.81%	5.21%
	Finland	0.53%	-1.41%	0.03%	-0.86%
	Global	1.02%	0.03%	-0.32%	0.74%
	Japan and Asia	-0.03%	0.24%	-0.03%	0.18%
	North America	0.39%	0.22%	-0.13%	0.48%
Client C	**Equities**	**-5.15%**	**-2.97%**	**-2.02%**	**-10.14%**
	Emerging markets	-0.18%	-3.81%	-0.67%	-4.67%
	Europe	-0.65%	-1.10%	-0.53%	-2.28%
	Finland	-3.59%	0.79%	-0.71%	-3.52%
	North America	-0.73%	1.16%	-0.11%	0.32%
Client D	**Equities**	**-2.26%**	**52.22%**	**2.74%**	**52.70%**
	Emerging markets	-5.01%	1.39%	0.86%	-2.76%
	Europe	2.37%	1.06%	-0.99%	2.44%
	Finland	1.56%	49.89%	6.04%	57.49%
	Global	-0.05%	-2.61%	-1.26%	-3.93%
	North America	-1.12%	2.49%	-1.92%	-0.55%
Client E	**Equities**	**3.64%**	**-10.01%**	**3.62%**	**-2.74%**
	Emerging markets	3.91%	-1.06%	1.82%	4.67%
	Finland	-0.22%	-6.65%	1.87%	-4.99%
	World, Other	-0.04%	-2.30%	-0.07%	-2.42%
Client F	**Equities**	**-1.58%**	**22.97%**	**0.22%**	**21.61%**
	Emerging markets	0.21%	1.92%	0.40%	2.53%
	Europe	-0.75%	8.46%	1.53%	9.25%
	Finland	-0.59%	12.36%	-1.55%	10.22%
	World, Other	-0.46%	0.21%	-0.16%	-0.40%
Client I	**Equities**	**0.50%**	**2.45%**	**-2.20%**	**0.75%**
	Emerging markets	0.38%	0.22%	0.09%	0.70%
	Finland	-0.30%	7.22%	-0.52%	6.40%
	World, Other	0.42%	-4.99%	-1.78%	-6.34%
Client J	**Equities**	**1.98%**	**0.35%**	**-0.88%**	**1.45%**
	Europe	0.46%	6.96%	-0.60%	6.82%
	North America	2.02%	-0.98%	3.15%	4.18%
	World, Other	-0.50%	-5.62%	-3.43%	-9.55%
Client K	**Equities**	**-3.64%**	**-8.43%**	**1.68%**	**-10.40%**
	Emerging markets	-0.78%	0.58%	0.16%	-0.04%
	Europe	-0.31%	-0.02%	-0.02%	-0.36%
	Finland	-1.45%	-6.66%	0.33%	-7.78%
	Japan and Asia	-0.05%	-0.39%	0.37%	-0.06%
	North America	-1.06%	-1.95%	0.84%	-2.16%

		Allocation (BF)	Selection	Interaction	Sum of Performance attribution (BF)
Client L	**Equities**	**0.96%**	**11.74%**	**-1.32%**	**11.38%**
	Emerging markets	1.75%	7.44%	-1.08%	8.11%
	Europe	0.01%	4.98%	0.20%	5.19%
	Finland	0.67%	0.06%	-0.34%	0.39%
	North America	-1.46%	-0.75%	-0.10%	-2.31%
Client N	**Equities**	**-2.77%**	**-3.66%**	**3.81%**	**-2.61%**
	Emerging markets	-6.70%	1.61%	1.21%	-3.88%
	Europe	1.73%	-1.84%	1.20%	1.09%
	Finland	0.69%	-1.39%	-0.09%	-0.78%
	World, Other	1.51%	-2.04%	1.48%	0.96%
Client O	**Equities**	**0.39%**	**4.47%**	**1.33%**	**6.18%**
	Emerging markets	0.26%	-1.99%	-0.02%	-1.74%
	Europe	0.09%	3.07%	1.18%	4.35%
	Finland	0.99%	2.40%	-0.22%	3.17%
	World, Other	-0.95%	0.98%	0.38%	0.41%
Client P	**Equities**	**7.56%**	**-15.62%**	**3.78%**	**-4.27%**
	Europe	4.39%	-4.59%	5.26%	5.05%
	Finland	3.14%	-1.93%	-1.44%	-0.23%
	World, Other	0.03%	-9.09%	-0.04%	-9.10%
Client Q	**Equities**	**-3.46%**	**-1.98%**	**0.94%**	**-4.50%**
	Emerging Markets	-2.10%	0.17%	0.13%	-1.79%
	Europe	-0.03%	3.02%	-0.09%	2.91%
	Finland	-0.78%	-5.51%	0.68%	-5.61%
	North America	-0.55%	0.33%	0.22%	0.01%
Client R	**Equities**	**5.35%**	**-2.13%**	**13.43%**	**16.65%**
	Emerging markets	3.01%	0.67%	1.63%	5.31%
	Europe	-0.01%	-2.99%	4.08%	1.09%
	Finland	2.62%	1.09%	1.59%	5.30%
	Global	0.05%	5.20%	-0.37%	4.89%
	Japan and Asia	0.19%	-1.30%	1.46%	0.35%
	North America	-0.52%	-4.81%	5.04%	-0.29%
Client S	**Equities**	**-6.51%**	**26.81%**	**12.12%**	**32.42%**
	Emerging markets	-3.11%	10.92%	-0.95%	6.86%
	Europe	0.43%	23.13%	6.65%	30.22%
	Global (exl. North A	-3.83%	-7.25%	6.41%	-4.66%
Client T	**Equities**	**3.49%**	**-18.76%**	**-8.16%**	**-23.43%**
	Europe	1.46%	-8.03%	-1.13%	-7.70%
	Finland	-1.46%	-2.79%	1.63%	-2.61%
	World, Other	3.48%	-7.94%	-8.67%	-13.12%
Client W	**Equities**	**2.43%**	**-1.18%**	**1.36%**	**2.61%**
	Europe	0.86%	4.70%	-0.54%	5.01%
	Finland	-0.44%	-6.89%	1.78%	-5.55%
	Global	2.01%	1.01%	0.12%	3.15%

		Allocation (BF)	Selection	Interaction	Sum of Performance attribution (BF)
Client Y	**Equities**	**-1.79%**	**-19.48%**	**11.81%**	**-9.46%**
	Europe	-2.27%	0.13%	7.41%	5.27%
	Finland	3.78%	-6.41%	-5.81%	-8.43%
	North America	-2.99%	-10.10%	9.59%	-3.50%
	World, Other	-0.31%	-3.11%	0.62%	-2.80%
Client Z	**Equities**	**4.03%**	**-58.23%**	**28.38%**	**-25.82%**
	Europe	2.74%	-22.06%	19.02%	-0.30%
	Finland	2.16%	-14.73%	-10.63%	-23.20%
	World, Other	-0.87%	-21.44%	19.99%	-2.32%
Client AB	**Equities**	**-4.77%**	**-12.08%**	**-2.76%**	**-19.62%**
	Europe	-1.64%	4.01%	1.48%	3.86%
	Finland	-2.97%	-7.76%	0.34%	-10.38%
	World, Other	-0.17%	-8.34%	-4.59%	-13.10%
Client AC	**Equities**	**-7.90%**	**-5.51%**	**0.86%**	**-12.55%**
	Emerging markets	-1.98%	-1.15%	-0.43%	-3.56%
	Europe	-3.36%	-0.51%	2.07%	-1.80%
	Finland	-3.32%	-0.14%	0.41%	-3.05%
	World, Other	0.77%	-3.71%	-1.19%	-4.13%
Client AF	**Equities**	**4.36%**	**-1.63%**	**4.42%**	**7.15%**
	Emerging markets	6.47%	0.96%	-0.25%	7.18%
	Europe	-1.93%	2.41%	4.10%	4.58%
	Finland	0.33%	-4.40%	0.90%	-3.17%
	World, Other	-0.50%	-0.60%	-0.33%	-1.43%

APPENDIX 3

		Allocation (BF)	Selection	Interaction	Sum of Performance attribution (BF)
Client A	**Fixed income**	**0.37%**	**-16.18%**	**0.13%**	**-15.68%**
	Bonds, Emerging markets	0.31%	-6.69%	1.01%	-5.38%
	Bonds, Government	-0.44%	-1.03%	-0.50%	-1.97%
	Bonds, High Yield	-0.08%	-11.12%	-0.39%	-11.60%
	Bonds, Investment Grade	0.21%	1.41%	0.01%	1.63%
	Money Market	0.38%	1.26%	0.00%	1.64%
Client B	**Fixed income**	**6.12%**	**2.00%**	**-20.72%**	**-12.60%**
	Bonds, Emerging markets	2.87%	-11.19%	-8.65%	-16.96%
	Bonds, High Yield	1.77%	0.04%	0.45%	2.26%
	Bonds, Investment Grade	0.23%	13.41%	-12.71%	0.94%
	Money Market	1.25%	-0.26%	0.18%	1.17%
Client C	**Fixed income**	**-3.99%**	**-7.96%**	**1.43%**	**-10.53%**
	Bonds, Emerging markets	-0.19%	-2.16%	-0.64%	-2.99%
	Bonds, Government	-1.84%	-3.07%	2.44%	-2.46%
	Bonds, High Yield	-1.77%	-1.90%	0.73%	-2.93%
	Bonds, Investment Grade	0.29%	-1.45%	-1.13%	-2.28%
	Money Market	-0.49%	0.61%	0.02%	0.14%
Client D	**Fixed income**	**3.49%**	**-22.23%**	**4.78%**	**-13.96%**
	Bonds, Emerging markets	1.22%	-5.12%	-1.47%	-5.37%
	Bonds, Government	-1.12%	-13.40%	12.18%	-2.34%
	Bonds, High Yield	3.79%	-3.16%	-4.59%	-3.96%
	Bonds, Investment Grade	-0.38%	-1.00%	-1.35%	-2.73%
	Money Market	-0.02%	0.45%	0.01%	0.44%
Client E	**Fixed income**	**-6.33%**	**-8.83%**	**8.19%**	**-6.97%**
	Bonds, Emerging markets	-2.59%	-5.64%	3.61%	-4.62%
	Bonds, Government	-1.03%	-1.48%	1.23%	-1.27%
	Bonds, High Yield	-2.09%	-3.77%	3.37%	-2.48%
	Bonds, Investment Grade	0.74%	-0.32%	-0.28%	0.15%
	Money Market	-1.37%	2.38%	0.24%	1.25%
Client F	**Fixed income**	**9.00%**	**1.94%**	**1.22%**	**12.16%**
	Bonds, Emerging markets	1.16%	-3.94%	0.70%	-2.08%
	Bonds, Government	1.04%	-0.44%	-1.21%	-0.60%
	Bonds, High Yield	4.18%	4.50%	1.60%	10.27%
	Bonds, Investment Grade	2.78%	0.59%	0.17%	3.53%
	Money Market	-0.15%	1.23%	-0.04%	1.04%
Client I	**Fixed income**	**-5.49%**	**-11.36%**	**-0.70%**	**-17.56%**
	Bonds, Emerging markets	-3.21%	-6.31%	1.19%	-8.33%
	Bonds, High Yield	-3.18%	-1.25%	-2.55%	-6.98%
	Bonds, Investment Grade	0.90%	-3.80%	0.66%	-2.24%
Client J	**Fixed income**	**-9.32%**	**-14.43%**	**14.09%**	**-9.66%**
	Bonds, Government	-1.54%	-12.27%	12.27%	-1.54%
	Bonds, High Yield	-0.14%	-2.08%	2.24%	0.01%
	Bonds, Investment Grade	-0.24%	-0.49%	-0.99%	-1.72%
	Money Market	-7.39%	0.41%	0.57%	-6.41%

		Allocation (BF)	Selection	Interaction	Sum of Performance attribution (BF)
Client K	**Fixed income**	**-0.93%**	**-20.41%**	**5.74%**	**-15.60%**
	Bonds, Emerging markets	-1.48%	-8.10%	3.45%	-6.14%
	Bonds, Government	0.19%	-4.59%	4.59%	0.19%
	Bonds, High Yield	1.30%	-6.48%	-1.47%	-6.66%
	Bonds, Investment Grade	-1.48%	-1.28%	-0.87%	-3.63%
	Money Market	0.55%	0.04%	0.05%	0.63%
Client L	**Fixed income**	**-4.22%**	**-14.84%**	**9.78%**	**-9.28%**
	Bonds, Emerging markets	-0.83%	-1.67%	-0.55%	-3.05%
	Bonds, Government	-2.39%	-12.26%	10.59%	-4.05%
	Bonds, High Yield	0.31%	-0.86%	-0.39%	-0.94%
	Bonds, Investment Grade	0.42%	-0.19%	-0.16%	0.07%
	Money Market	-1.73%	0.13%	0.29%	-1.30%
Client N	**Fixed income**	**0.29%**	**-4.23%**	**-0.69%**	**-4.64%**
	Bonds, Emerging markets	-0.42%	-0.26%	-0.01%	-0.68%
	Bonds, Government	0.55%	-1.30%	-0.21%	-0.96%
	Bonds, High Yield	-0.53%	-3.25%	0.00%	-3.78%
	Bonds, Investment Grade	0.04%	-0.41%	-0.33%	-0.69%
	Money Market	0.63%	0.98%	-0.14%	1.47%
Client O	**-**	-	-	-	
Client P	**Fixed income**	**-7.00%**	**-14.48%**	**11.23%**	**-10.25%**
	Bonds, Emerging markets	0.56%	-3.39%	3.25%	0.42%
	Bonds, Government	-3.79%	-11.29%	11.02%	-4.07%
	Bonds, High Yield	1.59%	-1.66%	-3.91%	-3.99%
	Money Market	-5.35%	1.87%	0.87%	-2.61%
Client Q	**Fixed income**	**6.86%**	**-8.79%**	**1.91%**	**-0.02%**
	Bonds, Government	-0.94%	-7.61%	7.61%	-0.94%
	Bonds, High Yield	6.40%	-2.83%	-4.36%	-0.80%
	Bonds, Investment Grade	0.33%	4.06%	-2.13%	2.25%
	Money Market	1.09%	-2.41%	0.79%	-0.53%
Client R	**Fixed income**	**2.87%**	**-26.76%**	**-0.61%**	**-24.50%**
	Bonds, Emerging markets	1.09%	-10.78%	2.68%	-7.01%
	Bonds, Government	0.15%	-1.82%	-0.20%	-1.88%
	Bonds, High Yield	2.20%	-12.34%	-3.02%	-13.15%
	Bonds, Investment Grade	-0.56%	-1.82%	-0.08%	-2.46%
Client S	**Fixed income**	**-5.97%**	**-7.59%**	**4.59%**	**-8.97%**
	Bonds, Emerging markets	0.47%	-1.54%	-1.34%	-2.40%
	Bonds, Government	-3.31%	-6.96%	5.62%	-4.65%
	Bonds, High Yield	1.27%	-0.54%	-0.34%	0.39%
	Bonds, Investment Grade	-0.33%	0.21%	-0.01%	-0.13%
	Money Market	-4.07%	1.24%	0.65%	-2.18%
Client T	**Fixed income**	**2.26%**	**-6.47%**	**1.80%**	**-2.40%**
	Bonds, Government	-3.74%	-7.77%	7.47%	-4.04%
	Bonds, High Yield	6.46%	-0.81%	-7.72%	-2.08%
	Bonds, Investment Grade	-0.18%	1.85%	2.01%	3.68%
	Money Market	-0.28%	0.27%	0.06%	0.04%

		Allocation (BF)	Selection	Interaction	Sum of Performance attribution (BF)
Client W	**Fixed income**	**-2.63%**	**-11.30%**	**17.95%**	**4.02%**
	Bonds, Government	-3.30%	-14.92%	14.92%	-3.30%
	Corporate Bonds (HY & IG)	0.42%	3.09%	3.21%	6.71%
	Money Market	0.25%	0.54%	-0.18%	0.60%
Client Y	**Fixed income**	**4.93%**	**23.83%**	**13.34%**	**42.10%**
	Bonds, Government	-0.94%	-2.32%	2.32%	-0.94%
	Bonds, High Yield	3.61%	3.91%	16.91%	24.44%
	Bonds, Investment Grade	-0.22%	13.89%	-2.34%	11.33%
	Money Market	2.47%	8.34%	-3.55%	7.27%
Client Z	**Fixed income**	**-2.27%**	**-10.90%**	**7.40%**	**-5.77%**
	Bonds, Government	-3.11%	-9.19%	9.19%	-3.11%
	Bonds, High Yield	1.32%	-1.54%	-1.19%	-1.41%
	Bonds, Investment Grade	0.75%	-1.62%	-0.76%	-1.63%
	Money Market	-1.23%	1.44%	0.16%	0.37%
Client AB	**Fixed income**	**4.71%**	**-3.52%**	**-2.48%**	**-1.29%**
	Bonds, Government	-1.57%	-2.71%	1.53%	-2.75%
	Bonds, High Yield	2.59%	-1.21%	-3.13%	-1.75%
	Bonds, Investment Grade	0.95%	-0.89%	-0.27%	-0.21%
	Money Market	2.74%	1.30%	-0.61%	3.43%
Client AC	**Fixed income**	**2.09%**	**-4.02%**	**-3.18%**	**-5.11%**
	Bonds, Emerging markets	1.75%	-2.25%	-2.67%	-3.17%
	Bonds, Government	0.10%	-0.46%	-0.10%	-0.46%
	Bonds, High Yield	1.20%	-1.08%	-1.05%	-0.93%
	Bonds, Investment Grade	-1.31%	-1.74%	0.58%	-2.47%
	Money Market	0.35%	1.51%	0.06%	1.92%
Client AD	**Fixed income**	**2.78%**	**-10.13%**	**-2.28%**	**-9.63%**
	Bonds, Emerging markets	0.08%	-0.54%	-0.13%	-0.60%
	Bonds, Government	0.88%	-0.53%	-1.29%	-0.94%
	Bonds, High Yield	0.48%	-1.46%	-0.48%	-1.46%
	Bonds, Investment Grade	0.08%	-8.27%	-0.24%	-8.44%
	Money Market	1.28%	0.67%	-0.14%	1.81%
Client AF	**Fixed income**	**-1.61%**	**-5.85%**	**1.56%**	**-5.89%**
	Bonds, Emerging markets	-0.36%	-0.38%	0.04%	-0.69%
	Bonds, Government	-0.44%	-2.19%	0.85%	-1.78%
	Bonds, High Yield	-0.48%	-5.08%	-0.22%	-5.78%
	Bonds, Investment Grade	0.02%	1.49%	1.01%	2.53%
	Money Market	-0.35%	0.31%	-0.12%	-0.16%