An investigation into the Style and Asset class Adjusted Performance of South African Multi-Asset funds

by

Luke AC Richardson (RCHLUK002)

Supervised by Professor Paul van Rensburg

presented to the Department of Finance and Tax, University of Cape Town, in partial fulfilment of the requirements for the degree of

Master of Commerce

(Specialising in Finance in the field of Investment Management)

Faculty of Commerce

UNIVERSITY OF CAPE TOWN

February 2019

Declaration

I, Luke Adam Charlton Richardson hereby declare that the work on which this dissertation/thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

I empower the university to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

Signature: Signed by candidate

Date: 4 February 2019

ABSTRACT

Purpose: *This study examines 26 large and established South African multi-asset unit trusts in order to determine their style and asset class exposure over time. The objective is to ascertain whether South African multi-asset fund managers can realise outperformance, that exceeds what can be realised through exposure to representative, investable, style and asset class indices. Such an analysis assists in identifying unit trust manager skill, but a further consideration is how to combine unit trusts in a suitable manner, to this end portfolio construction tools are utilised to meet illustrative client objectives in a multi-asset context.*

Methodology: *This study uses monthly total return time series for several investable style and asset class indices as well as South African multi-asset unit trust monthly total return time series. Where historical data permits, the period under investigation is from 1 January 2003 to 30 June 2018. Style and asset class exposure is determined using the Returns Based Style Analysis (RBSA) of Sharpe (1992) applying a 24-month rolling window approach.*

Findings: *The equity style exposures estimated using RBSA provide evidence that on average the value style was dominant across the multi-asset high equity unit trusts examined. For the multi-asset low equity unit trusts examined the low volatility style was dominant. Moreover, a large proportion of the variability in returns of many multi asset unit trusts, can be explained by exposure to style and asset class indices. Consequently only 3 out of the 15 multi-asset high equity unit trusts analysed, could realise performance in excess of their custom style and asset class benchmark. As only a limited number of these unit trusts could demonstrate superior security selection ability the implication is that many asset managers stand to be disrupted by lower cost products that provide similar style and asset class index exposure.*

Originality/Value: *Much research has been conducted into the style exposures of SA general equity funds. However, to the author's own knowledge this is the first study to apply RBSA in a performance context to multi-asset unit trusts, under the new ASISA classification standards. The benefits of portfolio construction tools such as portfolio simulation and the 'Risk Budgeting' approach are also discussed and applied in a multi-asset context.*

Keywords: Multi-asset unit trust, RBSA, Regulation 28, Style effects, Risk Budgeting.

TABLE OF CONTENTS

ABSTRACT ..... **ii**

LIST OF TABLES ..... **iv**

LIST OF FIGURES ..... **iv**

1. INTRODUCTION **1**

2. LITERATURE REVIEW **4**

2.1 Equity Styles 4

2.1.1 Momentum 4

2.1.2 Value 5

2.1.3 Size 6

2.1.4 Low Volatility 7

2.1.5 The case for Style effects in South Africa 8

2.2 Performance measurement 9

2.3 Portfolio optimisation and risk budgeting 11

2.4 Returns Based Style Analysis 13

2.4.1 RBSA in South Africa 15

3. DATA AND SAMPLING **17**

3.1. Style and Asset Class Returns 17

3.2 Unit Trust Sample Selection 19

3.3 Descriptive Statistics 20

4. METHODOLOGY **27**

5. RESULTS & DISCUSSION **30**

5.1 Multi Asset High Equity 33

5.2 Multi Asset Medium Equity 38

5.3 Multi Asset Low Equity 42

5.4 Summary of unit trust exposures 44

5.5 Combining managers 48

5.5.1 Multi Asset High Equity Active Blends 48

5.5.2 Multi Asset Style Index Blend 50

5.5.3 Combining Style Indices and Active Management 52

5.5.4 Risk Contributions 54

5.6 Summary 56

6. LIMITATIONS & CONSTRAINTS 58

7. CONCLUSION 60

8. REFERENCES 62

Appendix A - Summary of the main features of the rules applying to Regulation 28 71

Appendix B - ASISA standard on fund classification for South African regulated collective investment scheme portfolios 72

Appendix C – Multi asset unit trust style maps 74

LIST OF TABLES

Table 3.1 Style and Asset Class Descriptive Statistics 21

Table 3.2 Correlation Matrix 22

Table 3.3 Unit Trust Details 23

Table 3.4 Unit Trust Descriptive Statistics 25

Table 5.1 Multi Asset High Equity Results 31

Table 5.2 Multi Asset Medium Equity 36

Table 5.3 Multi Asset Low Equity 40

Table 5.4 Average RBSA Unit Trust Exposures 45

LIST OF FIGURES

Figure 5.1 Cumulative Returns and Drawdowns Coronation Balanced Plus 35

Figure 5.2 Coronation Capital Plus Style Map 39

Figure 5.3 Old Mutual Multi Managers Defensive FoF Style Map 39

Figure 5.4 Rezco Value Trend Style Map 47

Figure 5.5 Feasible set of potential Active Manager blends 49

Figure 5.6 Feasible set of potential style index blends 51

Figure 5.7 Feasible set of potential style and asset class indices combined with unit trusts 53

Figure 5.8 Portfolio after Risk Budgeting considerations 55

1. **INTRODUCTION**

The conventional wisdom and industry practice of the past taught us that unit trust fund returns are driven by exposure to a market-related benchmark and an asset manager's ability to add value through security selection. However, there are a number of empirical studies that indicate that active fund managers may be unable to provide economic benefits to investors, once fees are considered. These studies propose that most fund returns are determined by an investor's exposure to an underlying asset class. Yet this appears to be only part of the puzzle.

Of particular interest to both academics and investment practitioners is the term 'investment style' which can be thought of as a portfolio manager's guiding philosophy, in that it is a set of principles consistently applied to the investment process (Bradfield, Firer and Robertson, 2000). Although specific descriptions of different styles were not yet defined, the notion that styles existed across equity portfolios began when the investment community conducted research into the characteristic and returns-based groupings of stocks and portfolios. This can be traced to work by King (1966) and Farrell (1975). It is clear today that many of these 'consistently applied principles' have realised excess market returns over time but historically they were not separated when evaluating fund manager performance.

As a result, the last few years have been categorised by the rise of investable style index trackers known as 'factor investments' or 'smart beta'. These are rules-based indices that target securities with favourable style characteristics and provide a lower cost alternative to active fund management. Different styles provide returns that tend to have lower correlations or have different volatility profiles and for the purpose of analysis strongly resemble asset classes. In the same way, an investment style is exposed to unique risks that must be considered when evaluating performance.

In recent years the South African economy has suffered from corruption, mismanagement and the near failure of several state-owned enterprises (SOEs). As a result, a low growth environment has persisted over multiple years, this eventually impacts on company earnings and has ultimately resulted in lower local market returns (Sasfin Wealth, 2018). A number of South African investors have embraced offshore investing, as a means to achieve higher returns and international diversification, and to their benefit this largely coincided with the

longest U.S equity bull market in history (Wursthorn and Otani, 2018). Nevertheless, additional factors such as financial education, liquidity, the cost of foreign exchange and the risks of currency mismatch practically limit offshore investing for the vast majority of South Africans.

Therefore, the focus of this study is on multi asset portfolios which are the investments most accessible to individuals, multi asset portfolios invest across the equity, bond, money and property markets. Given this diversification, these investments have become increasingly popular. The latest set of statistics from the Association for Savings and Investment South Africa (ASISA) indicate that as much as 44% of SA Collective investment scheme (CIS) assets are invested in multi asset funds. In contrast, South African equity funds make up only 20% of SA CIS industry assets whereas 25% of SA industry assets are invested in the multi asset high equity classification alone (ASISA, 2018).

Moreover, many multi asset unit trusts also comply with the strict limits set out in Regulation 28[1] of the Pension Fund Act summarised in Appendix A. This enables them to be used within an appropriate wrapper such as a Retirement Annuity or Preservation fund. According to the South African Retirement Reality Report prepared by 10X Investments 41% of South Africans sampled had no retirement plan and of those that did as much as 74% started planning for retirement late (10X Investments, 2018). As the average South African household tries their best to catch up, it is these investment vehicles that will have the most significant impact on their financial well-being.

Problem Statement

South African investors need to save toward their retirement, investment performance is fundamental to the achievement of this goal.

Active managers who can add value relative to alternatives within the constraints of Regulation 28 will improve the financial well-being of retirement savers through superior investment performance.

[1] Regulation 28 is issued under the Pension Fund Act. This regulation places asset type and asset class limits on retirement funds. The main objective is to prevent retirement assets from being invested in poorly diversified portfolios.

Aims and Objective

Over the last ten years several studies have made use of style index trackers and exchange traded funds [2] (ETFs) to replicate and gauge the style and asset class adjusted performance of fund managers in a South African context, (see Yu, 2008; Moore, 2013, and Eddy, 2014), but these studies are limited in that they only examine general equity funds. The aim of this study is to fill this gap in the literature by performing Returns Based Style Analysis on a number of regulation 28 compliant multi asset unit trusts, to determine their style and asset class exposure over time. Using this information, our objective is to determine whether South African multi asset fund managers possess skill and can realise outperformance, that exceeds what can be realised through exposure to representative, investable, style and asset class indices. If unit trusts with favourable characteristics are identified a related consideration faced by multi-managers, financial advisors and investors is what blend of exposures has the greatest likelihood of fulfilling a specific client objective or mandate to further enhance their financial well-being. Using the A-DEX prism quantitative toolkit an example is presented to illustrate how unit trusts with favourable risk/return characteristics can be combined to achieve investor objectives. This is followed by the evaluation of a custom multi asset portfolio with style index exposure and the same illustrative objectives. Historical data indicates that this multi asset style index blend can be enhanced by combining it with a specific allocation to the best performing unit trusts. Finally, this combined portfolio is evaluated using a 'Risk Budgeting' approach and modified to obtain a portfolio with more diversified risk allocations.

This thesis is organised as follows: Section 2 provides a review of key literature on different equity styles, performance measurement, portfolio optimisation and risk budgeting and Returns Based Style Analysis. Sections 3 and 4 discuss the data and methodology to be used in this study. Section 5 presents the results and discussion, Section 6 discusses the limitations and constraints of this work and Section 7 provides a conclusion as well as recommendations for future research.

[2] Exchange Traded Funds are listed investment products that typically track the performance of asset class indices. An ETF can be bought or sold in the same way as an Ordinary Share throughout the trading day.

2. LITERATURE REVIEW

This literature review begins with a brief overview of the Capital Asset Pricing model and evidence establishing the existence of style effects within global markets. We then focus specifically on style in the South African context. Furthermore, we discuss performance measurement of fund managers, portfolio optimisation, risk budgeting and a technique known as Returns Based Style Analysis (RBSA).

The Capital Asset Pricing Model (CAPM) of Sharpe (1964), Lintner (1965), and Black (1972) revolutionised the way in which both academics and financial practitioners thought about expected returns and risk. Despite a host of assumptions, the CAPM's chief prediction is that the market portfolio is mean-variance efficient (see Markowitz, 1959). The implication of this is that the expected return of a security has a positive linear relationship with its market beta or systematic risk (the slope coefficient in a regression of a security's return on the returns of the market), and further suggests that market betas are the only factor that can sufficiently describe the cross-section of expected returns. We discuss many empirical contradictions to the CAPM in this review that began as capital market anomalies but are now recognised as distinct style effects or factors.

2.1 Equity Styles

2.1.1 Momentum

Jegadeesh and Titman (1993) documented that relative strength strategies which buy stocks that have recently delivered good returns and sell stocks that have delivered poor returns offer abnormal positive returns over 3-12 month holding periods. Their study was completed using data from the 1965 to 1989 period on the New York Stock Exchange (NYSE) and the American Exchange (AMEX). They find that the abnormal returns are not a result of increased systematic risk but more importantly they discovered that part of the abnormal returns earned in the first year, subsequent to portfolio formation, erode in the following two years. As a result this style came to be known as the momentum effect. In a follow-up review on

momentum; Jegadeesh and Titman (2011) show that the returns of a zero-cost portfolio that comprised of long positions in past winners and short positions in past losers was profitable in every 5-year period from 1965 to 2004.

Rouwenhorst (1998) replicated Jegadeesh and Titman (1993) for 12 European countries identifying profits that were similar to those that could be realised in the United States.
A study by Chui, Titman and Wei (2010) examined momentum profits over 55 countries and found that momentum strategies generated profits in many global markets, with notable exceptions in some parts of East Asia.

The source of the momentum effect is likely rooted in behavioural finance where evidence suggests that momentum strategies are profitable because of an investor's delayed reaction to firm specific information (Jegadeesh and Titman 2011: 7). A broader investigation by Zhang (2006) found that higher information uncertainty, which is measured by the dispersion of analyst forecasts, the volatility of a firm's cash flow and return volatility lead to greater momentum profits. There are a number of possible theoretical explanations for the momentum effect but financial economists and researchers have not yet reached a consensus on the exact cause of momentum's profitability (Jegadeesh and Titman 2011: 21).

2.1.2 Value

The value effect refers to the positive relationship between security returns and ratios of accounting measures of value and cash flow relative to the market price of a security. Examples include: price to earnings ratio, book value to market value ratio and cash flow to price ratio (Keim, 2008: 2). A number of investment approaches based on the value effect have had a comparatively long history in the academic literature originating from Graham and Dodd (1934).

Basu (1977) was the first to document whether variables related to value could account for violations of the CAPM. The study was conducted on the NYSE from April 1957 to March 1971 and found that over that time, lower PE portfolios tended to outperform the higher PE portfolios in an absolute sense and after adjusting for risk. Reinganum (1981) confirmed and

extended Basu's findings. De Bondt and Thaler (1987), among others, also recorded a significant positive relationship between returns and book to market value.

Dividend yield and the ratio of cash dividend to price, also appears to be able to predict cross-sectional returns (see Litzenberger and Ramaswamy (1979), Miller and Scholes (1982)). Although they are similar to the value ratios, the explanatory power of a security's dividend yield is often accredited to tax differences between capital gains and regular income (Keim, 2008:3).

2.1.3 Size

Banz (1981) examined the relationship between the market capitalisation of a firm and its return. The study was conducted using stocks from the NYSE over the 1936 to 1975 period. Banz found that the common stock of small firms had, on average, higher risk-adjusted returns than the common stock of large firms. This finding came to be known as the size effect. Banz also found that the size effect was not linear as market capitalisation increased but was most prominent for smaller firms in his sample. The effect was also quite unstable over time. It is unclear whether the factor is size itself or whether it is a substitute for unknown factors that could have a correlation with size (Banz, 1981).

Using a cross-sectional regression approach Fama and French (1992) also support the value and size effects, over the period 1963 to 1990 on the AMEX, NYSE and the National Association of Securities Dealers Automated Quotations (NASDAQ). It was found that a firm's book to market value ratio and market capitalization can explain a substantial amount of the variation in cross-sectional equity returns over the period. A study by Fama and French (1993) utilised a 3-factor model with market, value and size as factors. This model was able to explain the returns of all style portfolios except for portfolios designed to exhibit Jegadeesh and Titman's (1993) short term momentum effect (Fama and French, 1996: 56).

2.1.4 Low Volatility

In addition to the widely recognised styles we have discussed thus far, another style anomaly has emerged more recently that has garnered support by both practitioners and academics. Blitz and van Vliet (2007) provide evidence that supports a low volatility effect. In summary low volatility stocks display significantly higher risk-adjusted returns than what could be obtained by holding the market portfolio, whereas high volatility stocks significantly underperform on a risk-adjusted basis. While this result may seem counterintuitive to the traditional risk/return trade-off the authors provide several compelling explanations for the style's success. Principal of these is that leverage is required to take advantage of attractive absolute returns provided by lower risk stocks. While theoretically it is simple to obtain leverage, in practice many investors are either unable or reluctant to use leverage. To make this clearer, if a portfolio has 2/3 of the volatility of the market portfolio as much as 50% leverage must be applied to obtain the market level of volatility. This creates barriers to arbitrage and can be traced to Black (1972) as a reason for the outperformance of low-beta stocks contrary to the central prediction of the CAPM. By definition, the beta estimate of a stock:

$$\beta_i = \rho \frac{\sigma_{Stock}}{\sigma_{Market}} \quad (1)$$

where β_i is the specified beta, ρ is the Pearson correlation coefficient of the stock and market, σ_{Stock} is the volatility of the stock, and σ_{Market} is the volatility of the market portfolio. Therefore, if portfolios contain stocks with low volatility it is also observed empirically that they exhibit lower CAPM betas (Blitz & van Vliet, 2007:103).

Their study was conducted on portfolios formed from the 1000 largest U.S. stocks over the 1968-2005 period and were obtained for both global and regional stocks over the same period. The volatility effect is compared to the established size, value and momentum styles using a Fama and French regression approach as well as a double-sorting methodology, and it is found that the low volatility anomaly is separate and of similar magnitude. Further studies have been conducted that support this anomaly. Baker et al. (2014) provide further depth by decomposing the low volatility anomaly into micro and macro components. Frazzini and

Pedersen (2014) further examined the effects of leverage constraints in the context of a portfolio which is long leveraged low-beta assets and short high-beta assets.

2.1.5 The case for Style effects in South Africa

In this section, we examine the South African literature on style effects to determine whether international findings can be applied to the Johannesburg Securities Exchange (JSE).

A study by Van Rensburg (2001) used a cluster analysis approach to decompose style-based effects for Industrial shares listed on the JSE. The period covered by this study was February 1983 to March 1999. He found that eleven of the twenty-three factors tested had effects that persisted even after adjusting for risk. Consistent with the international literature the returns to these eleven factors suggested that there were three types of effect: value, size and momentum. Van Rensburg and Robertson (2003a) extended this work on share returns and style effects, by adopting the cross-sectional regression methodology of Fama and Macbeth (1973). Over the period 1990 to 2000 they found evidence of a Size and Value effect but unlike the past literature no evidence of a Momentum effect was found.

Van Rensburg and Robertson (2003b) divided equal-weighted portfolios of stocks into quintiles using data for the period July 1990 to June 2000. They found that the average monthly returns of portfolios sorted by CAPM betas suggested that beta in fact had an inverse relationship with return and this is among the first South African evidence to support the prevalence of a low beta and related low volatility style effect as documented by Blitz and van Vliet (2007).

Hodnett, Hsieh and Van Rensburg (2012) examined the ability of five categories of firm-specific attributes to explain variation in cross-sectional equity returns. The period examined was from 1 January 1997 to 31 December 2007. The categories were: 1) fundamental value relative to share price, 2) solvency and liquidity, 3) fundamental growth, 4) size and return momentum, 5) consensus analyst forecasts. The solvency and liquidity category was the only one that was not significant further supporting the existence of the value and size effects as well as the short-term momentum effect on the JSE.

However, it should be noted that evidence of style effects and return predictability can be specific to certain sample periods (see Malkiel, 2003). To further the discussion on the choice of sample period, Kruger and Toerien (2014) conducted an investigation over the 2002 to 2009 period. They provide evidence that the style effects previously identified on the JSE are significant during the stable pre-crisis period of the sample, up to October 2007. This included evidence supporting both the 6-month and 12-month Momentum effects. Their findings suggest that style effects can be detected consistently over a sustained period. However, during the aftermath of the 2008 Sub-prime Mortgage crisis they find that cash flow to price is the only significant predictor of share returns suggesting that cash flow availability is the major source of outperformance during a period of market crisis. It is important to note that the findings of their study indicate that fundamental factors that are associated with style effects can be sensitive to significant changes in the market.

2.2 Performance measurement

In order to determine whether a manager has outperformed after adjusting for style it is necessary to examine how manager skill is measured. Kidd (2011) provides an explanation of the traditional performance measure, Jensen's alpha. Jensen's alpha, also referred to as ex post alpha, is a performance measure that is adjusted for risk and separates the portion of a portfolio's return explained by exposure to systematic risk. It was developed by Jensen (1968) in order to identify skilled mutual fund managers. Jensen wanted to determine if a manager could earn returns that were consistently higher than what was expected, given the level of systematic risk taken. Jensen's alpha is derived from the CAPM and is calculated as the difference between a portfolio's return and the expected return that theoretically corresponds to the portfolio's exposure to systematic risk (Kidd, 2011).

A positive value of alpha is indicative of greater skill; larger values of alpha suggest that a manager has better risk adjusted performance. A negative alpha suggests that the manager failed to generate a return that would be expected under the CAPM for the amount of systematic risk taken (Kidd, 2011). The disadvantages of Jensen's alpha are that it does not account for stock-specific risk, and it is sensitive to the market index chosen (Kidd, 2011).

The Sharpe ratio is another performance measurement tool and is the industry standard for measuring risk-adjusted return. The ratio is dependent on accurate measurement of expected

return and non-systematic risk and is used to evaluate investment decisions based on historical data (Kidd, 2011). The Sharpe Ratio is calculated as follows:

$$SR = \frac{R_p - r_f}{\sigma_p}, \quad (2)$$

where $\mathrm{R_p}$ represents the return of the portfolio $\mathrm{r_f}$ is the return of the risk-free rate for the time period that is being considered, and the standard deviation of the portfolio is represented by σ_p. The Sharpe ratio indicates how much of a portfolio's return is associated with risk taking, the added value relative to its total risk. A portfolio formed from risk free assets or one that offers no excess return above the return of the risk-free rate will have a Sharpe ratio of zero (Kidd, 2011).

Similar to the Sharpe Ratio the information ratio (IR) tells an investor how much excess return is generated from the amount of active risk taken relative to the benchmark. The information ratio is calculated as follows:

$$IR = \frac{R_p - R_B}{\sigma_{p-B}}, \quad (3)$$

where $\mathrm{R_p}$ represents the return of the portfolio $\mathrm{R_B}$ is the return of the relevant benchmark for the time period that is being considered and $\sigma_{\mathrm{p-B}}$ is the standard deviation of the difference in returns between the portfolio and its benchmark (Kidd, 2011). The portfolio's excess return $R_p - R_B$ is also called active return, and the variability of the excess return $\sigma_{\mathrm{p-B}}$ is termed active risk, tracking risk, or tracking error. A positive information ratio indicates that a manager has outperformed his or her benchmark on a risk-adjusted basis, but it cannot necessarily indicate whether this performance was due to skill or luck. Given its construction the information ratio is highly dependent on the time period under measurement and the chosen benchmark index (Kidd, 2011).

Market timing ability is also potentially a source of manager skill and refers to the dynamic allocation of capital among classes of investments (Bollen and Busse, 2001: 1077). An effective market timer increases equity weights and specifically high beta stocks before an increase in the market and decreases the weight before a decrease in the market. There have been studies providing some evidence on the market timing ability of managers but what is

clear is that it is a difficult endeavour where security selection is the source of most manager outperformance (see Merton and Henriksson, 1981, Grinold and Kahn, 2000).

2.3 Portfolio optimisation and risk budgeting

Constructing optimal portfolios by allocating funds more efficiently has a long history in the literature. Markowitz (1952) formalized the problem in a mean variance context that assumes that a rational investor wants to maximize expected portfolio return for a given level of risk. According to Maillard, Roncalli & Teiletche (2010) while the solution is elegant and appealing it has two major disadvantages. The first being that mean-variance efficient portfolios tend to be concentrated in a subset of all the assets being considered. The second is that changes in input parameters particularly expected returns, can lead to significant changes in the final portfolio's composition. With this in mind although the importance of risk in the asset allocation process is acknowledged, the concept tends to be simplified to refer to volatility minimisation as described in modern portfolio theory. Misconceptions also exist that optimising volatility (often called risk) is the same as optimising the diversification of risk which depending on your definition refers to the different sources of risk (Bruder and Roncalli, 2012).

Given these challenges an idea that has gained popularity is to additively decompose measures of portfolio risk into each individual asset's contribution to the total risk. Euler's theorem provides a general method to achieve this if we have a continuous homogenous function of degree one (van Rensburg, 2018a). A function f is homogenous of degree one if for any constant c:

$$f(c.w_1, \ldots, c.w_N) = c.f(w_1, \ldots, w_N), \qquad (4)$$

where w is a constituent weight with N constituents (van Rensburg, 2018a).
So, in the case of portfolio volatility σ_p, if every asset's weight is multiplied by a constant c then the portfolio's volatility σ_p is also increased by c. For example, a portfolio that is levered by a factor c.

Given such a function the Euler theorem posits that

$$f(\boldsymbol{w}) = \sum_{i=1}^{N} w_i \frac{\partial f(\boldsymbol{w})}{\partial w_i} \tag{5}$$

the total portfolio risk $f(\boldsymbol{w})$ is the sum of the asset weights w_i multiplied by the first partial derivative of total portfolio risk with respect to each asset weight w_i in a portfolio of N assets (van Rensburg, 2018a). In the case where portfolio variance as a measure of total risk is considered, it is defined as follows:

$$\sigma_\rho^2 = \sum_{i=1}^{N} \sum_{j=1}^{N} w_i w_j \sigma_{ij}, \tag{6}$$

where σ_{ij} is the covariance between asset i and asset j. As the number of assets N increases more covariance terms (N^2-N) form part of the equation (van Rensburg, 2018b). The variance contribution of asset 1 to the portfolio, σ_1^2, p would then be defined as below:

$$\sigma_1^2, p = \sum_{j=1}^{N} w_1 w_j \sigma_{1j} \, . \tag{7}$$

It follows that the risk contribution RC of an asset is the variance contribution of the asset as a proportion of total portfolio variance σ_p^2:

$$RC = \frac{\sigma_1^2, p}{\sigma_p^2} . \tag{8}$$

Examining risk contributions has become a standard practice for institutional investors, where the term 'Risk Budgeting' is used to describe the analysis of a portfolio in terms of risk contributions as opposed to portfolio weights (Maillard et al, 2010:3). A popular portfolio construction method is to equalise risk contributions from the different components of a portfolio, referred to as risk-parity or equal contribution to risk (ECR) portfolios (Maillard et al, 2010:3). An ECR portfolio benefits from not requiring expected return inputs that can be subject to error and as a result is quite robust with volatility lying somewhere between that of a naïve equally-weighted portfolio and the global minimum variance portfolio as described

by Markowitz (1952) (Maillard et al, 2010:1). Work by Qian (2006) concludes that risk contributions using a standard deviation approach are a good predictor of ex-post loss contribution with little error as long as the loss is between one and two standard deviations from the mean. This is likely because within such a range the effects of higher kurtosis are not yet prevalent. However, a Value-at-Risk (Var) approach to risk contribution analysis, while more difficult to compute, can also be used and offers a better estimation of the expected contribution to loss for losses of greater magnitude (Qian, 2006).

2.4 Returns Based Style Analysis

Sharpe (1992) developed a statistical method called Returns Based Style Analysis (RBSA) to establish an investor's exposure to different asset classes and styles that can be performed relatively easily as it does not require access to detailed holdings information. The results of this analysis can be used to determine overall portfolio exposures and if they are found to be undesirable, corrective action can be taken. RBSA's fundamental contribution is that it is used to determine the extent to which fund managers have added value through active management.

RBSA is an asset class factor model of the following form:

$$\tilde{\mathrm{R}}_{\rho} = \mathrm{b}_{\rho_1}\tilde{\mathrm{F}}_1 + \mathrm{b}_{\rho_2}\tilde{\mathrm{F}}_2 + \ldots + \mathrm{b}_{\rho \mathrm{n}}\tilde{\mathrm{F}}_{\mathrm{n}} + \tilde{\mathrm{e}}_{\rho}, \qquad (9)$$

where the $b_{\rho j}$ values are the portfolio's exposures to the asset classes. Each $b_{\rho j}$ is a weighted average of the exposures of a component fund to the relevant asset class, with the amounts invested in the funds used as weights. R_{ρ} denotes the return on the portfolio, $\tilde{\mathrm{F}}_I$ denotes the value of the I'th factor, for I {1,2,…,n} with n factors. $\tilde{\mathrm{e}}_{\rho}$ is the residual component of the portfolio returns. In order to obtain practical results quadratic programming is employed to find the optimal set of $b_{\rho j}$ values that sum to 100 percent and are positive to conform to fund policies such as long position only constraints. We assume that the residual term $\tilde{\mathrm{e}}_{\rho}$ is uncorrelated with the other asset class returns and we seek to minimise this unexplained variation.

Sharpe (1992) used the RBSA technique on 395 mutual funds from January 1985 to December 1989. Categories examined included: growth funds, income funds, utility funds, small stock

funds, high quality bond funds, convertible bond funds and balanced funds. Sharpe used 12 factors: the 90-day U.S. Treasury bill, the intermediate term government bond index, the long-term government bond index, the corporate bond index, the mortgage-backed security index, the large-cap value stock index, the large-cap growth stock index, the medium-cap stock index, the small-cap stock index, the non-U.S. government bond index, the European stock index and the Japanese stock index. The composition of each index was explained sufficiently by the provider representing a strategy that at the time could be accessed at low cost using an index fund. Otten and Bams (2000) state that simpler models, with fewer factors often provide more practical results. When selecting style and asset class benchmarks multicollinearity can pose a problem as it may result in imprecise estimates of slope coefficients, thus removing highly correlated factors may be desirable. In the presence of multicollinearity, Buetow, Johnson and Runkle (2000) show that RBSA outputs can be valuable provided that custom style benchmarks are used with the purpose of properly capturing the investment objectives of the portfolio being considered. However, Sharpe (1992) states "while not necessary it is desirable that the asset classes are 1) mutually exclusive, 2) exhaustive and 3) have returns that have low correlations and if not, different standard deviations."

Factor models of this type are usually assessed on their ability to explain the returns of the portfolio of assets being considered. The coefficient of determination or R-Squared is the proportion of variance in returns that is explained by the returns of the asset classes specified. R-squared can be defined, for portfolio ρ as follows:

$$\mathrm{R}^2 = 1 - \frac{Var(\tilde{\mathrm{e}}_{\rho})}{Var(\tilde{\mathrm{R}}_{\rho})}, \qquad (10)$$

where Var($\tilde{\mathrm{e}}_{\rho}$) is the variance of the residual component of the portfolio returns and $Var(\tilde{\mathrm{R}}_{\rho})$ denotes the total variance of returns on the portfolio. While this measure is useful, it only measures the degree to which a single specific model fits given data, in an in-sample sense. Given this, it is essential to evaluate a model's ability to explain a specific set of data but also its ability to explain data out-of-sample (Sharpe, 1992).

Sharpe (1992) found that on average more than 80 percent of the variation in a fund's return could be explained by a combination of asset class and style indices. Overall balanced funds provided similar results. Style and asset class accounted for approximately 90% of the

monthly variation in the returns of these funds. Utility funds were the exception to these findings. Sharpe offers the explanation that utility funds have concentrated holdings in a single industry and as result style accounts for a uniquely small amount of the variance in return albeit explaining about 59.3 percent. Given the frequent dividends often associated with utility firms, their returns give the impression of a portfolio invested in bonds and stocks, this example highlights that RBSA reflects how returns act, rather than a precise examination of what a portfolio includes.

According to Swinkels and Van Der Sluis (2006) a major shortcoming of the original RBSA is that, if one estimates a static point estimate of style exposures over a specific sample period one makes an implicit assumption that style is constant over that time. Rolling Regressions attempt to address this concern as the estimation window is shifted 1 month at a time across the sample period to establish how style coefficients change over time. Naturally this requires larger sample periods of at least 24 months.

2.4.1 RBSA in South Africa

Yu (2008) adopted RBSA using a passive mix of selected style and sector indices to replicate the performance of a sample of South African general equity unit trusts and hedge funds over the period January 1998 to December 2006. Yu's out-of-sample regression showed that none of the security selection returns of the 14 indices and funds analysed was different from zero at a 10 percent significance level. His observations suggest that SA unit trusts do not provide excess returns after adjustment for investment style.

Hsieh (2013) conducted a Review of Performance Evaluation Measures for Actively-Managed Portfolios and found that RBSA explains the return attributions of most long-only mutual funds across regions and time periods but there is empirical evidence that suggests that additional factors must be included to capture the unique risks of hedge funds that make use of short-selling, leverage and derivatives.

More recently, Eddy (2014) conducted a study for the 2003 to 2012 period using three methods: unconstrained style regressions, RBSA and RBSA return decomposition which all reached a similar conclusion. He found that most South African general equity managers

could not outperform after adjusting for style but there were exceptions that outperformed on a consistent basis.

2.5 Conclusion drawn from literature

This literature review has discussed the established research on the characteristics of style effects and their ability to generate abnormal returns over prolonged periods both in international markets and South Africa. Historically style effects were not separated when evaluating fund manager performance, but style index trackers known as 'factor investments' or 'smart beta' can now deliver a lower cost alternative to active fund management. Given that this study is closely related to performance measurement, a number of established metrics used to evaluate a unit trust's performance were discussed. The statistical technique known as Returns Based Style Analysis (RBSA) is one method of estimating a unit trust's style and asset class exposures in order to identify potential outperformance. The requirements and constraints of RBSA were discussed in addition to the use of the method in both the International and South African context. In the South African context, the use of this method for performance measurement is limited to general equity funds and hedge funds. This leads us to the subject of the present study which is to evaluate whether South African multi asset unit trusts can outperform representative, investable, style and asset class indices. Once superior unit trusts are identified a further consideration is how to combine unit trusts in a suitable manner, to address this need the literature on portfolio optimisation and a portfolio construction approach known as "Risk Budgeting" were discussed.

3. DATA AND SAMPLING

This section explores the data used in this study. The time period under investigation is the 15-and-a-half-year period from 1 January 2003 to 30 June 2018. This study makes use of two datasets the first being monthly total return time series data for a number of investable style and asset class indices. The second dataset required is South African unit trust monthly total return time series. An evaluation of the style and asset class index data is presented as well as the filter criteria used to obtain the unit trust universe under consideration. Descriptive statistics are prepared as well as the relevant ASISA Classifications.

3.1. Style and Asset Class Returns

Three style indices constructed by A-DEX/Salient Investment Management are used namely: Momentum, Value and Low Volatility. Each index typically consists of a set of 25-30 stocks chosen from the 60 largest and most liquid stocks listed on the JSE. Portfolio holdings comply with the Collective Investment Schemes Control Act (CISCA) rules. Each Style index includes a fee of 30 bps per annum. The specific methodology employed in the construction of these style indices is proprietary information belonging to A-DEX. However, a description of the primary goal of each index is provided:

> "The Momentum Index Fund tracks the proprietary Salient Momentum Index. It is constructed through a pre-defined rules-based strategy to select and weight stocks on their recent performance as measured by a composite of price and earnings acceleration metrics. Liquidity constraints are applied.
>
> The Value Index Fund tracks the proprietary Salient Value Index. It is constructed through a pre-defined rules-based strategy to select and weight stocks on their degree of cheapness as measured by price relative to a composite of headline earnings, book value and dividends.
>
> The Low Volatility Fund tracks the proprietary Salient Low Volatility Index. It is constructed through a pre-defined rules-based strategy to select and weight stocks so as to achieve the lowest risk possible for the overall equity-based fund. In this manner,

the Equity Market Premium in asset class returns is offered to investors both at low risk and low cost."

The Size effect cannot be used in this study as there is no suitable small capitalisation index available for investment in South Africa. All returns information for an index before its launch date would be back-tested. When performance is back-tested, it is not realised performance and is subject to certain limitations because it represents the application of an Index methodology and choice of constituents after the fact. However, given the relatively recent promulgation of smart beta products in South Africa there is not enough historical data available to dismiss back-tested results. These style returns can provide meaningful insight into the historical performance of SA unit trusts.

The asset class indices used are as follows: the Short Term Fixed Interest Composite Index known as the STEFI which is the primary benchmark for cash and money market funds in South Africa. The all bond index (ALBI) to capture the return profile of the bond market. The FTSE/JSE SA Listed Property Index (SAPY) to capture the return profile of the listed property market. The FTSE/JSE Top 40 index (ALSI40) to capture the return profile of the broad SA equity market and finally the MSCI World Index to capture the return profile of offshore equity exposure. Asset class index total return data is obtained from Salient Investment management and is adjusted as follows to account for the fee that an ETF/index fund investor would have to pay for the exposure:

- Stefi returns are adjusted by 25bps p.a this was motivated by the 19 bps Total Investment Charge for the ABSA TRACI 3 Month Exchange Traded Fund, the closest investable alternative, as well as the Satrix Money Market fund, which has a Total Investment Charge of 30 bps. p.a. ALBI returns are adjusted by 50 bps p.a This is in accordance with the Total Investment Charge of Sygnia All Bond Index Fund, and a similar TIC for the Satrix Bond Index Fund." SAPY returns adjusted by 35 bps p.a based on the fees charged by the Satrix Property ETF.
- ALSI40 returns adjusted by 15 bps p.a based on the Satrix 40 ETF
- MSCI World ZAR returns adjusted by 35 bps p.a based on the fees charged by the Satrix MSCI World Equity Feeder ETF

These asset class indices are all easily accessible and investable by South Africans, except for the STEFI, which has several viable substitutes. (Coronation Money Market Fund, ABSA TRACI 3M ETF). As a whole they provide a cross section of major assets available to SA long only unit trusts.

3.2 Unit Trust Sample Selection

When presented with various unit trust classes the Retail A class is used: this is to enhance comparability and obtain the longest possible returns history. The following screens are applied to identify the universe of unit trusts under consideration:

1. All unit trusts in the following classifications as defined by ASISA are included in the initial screen - South African Multi Asset High Equity, South African Multi Asset Medium Equity, South African Multi Asset Low Equity.
2. Only unit trusts with at least 10 years of history are examined
   I.e. unit trust launch must be before 30 June 2008
3. Regulation 28 compliant
4. Fund Size in South African Rand > R5 billion

These are practical considerations to limit the scope of the investigation to funds that are of sufficient size and thus easily accessible in South Africa, have investable passive alternatives and that are compliant with prudential guidelines as set out it in regulation 28 of the Pension Funds Act. While our sample is likely to exhibit survivorship bias because it does not include closed funds and smaller funds that existed over the period under review, our interest is in only the most accessible funds and their associated asset allocation and style exposure - providing an empirical analysis of the largest and most prominent within the multi asset universe rather than the entire unit trust population. The definition of each ASISA multi asset unit trust classification is included in Appendix B.

Total Return data for 26 multi asset unit trusts was sourced from Thomson Reuters' Datastream and additional unit trust information was obtained from Profile data fund analytics. Profile data provides information such as unit trust size, international security identification numbers and unit trust classifications and Datastream provides comprehensive total return data for SA unit trusts.

There are two distinct sources of return for an investor. Income is the first and includes dividends, interest and other distributions that are realised over time. Capital appreciation or loss is the second and it results from changes in the market price of an asset. Total return data captures both of these sources.

A monthly rate of return can be calculated as follows:

$$R_{ft} = \frac{\rho_{ft} - \rho_{ft-1}}{\rho_{ft-1}} \quad (11)$$

Where R_{ft} is the return of a unit trust or index fund *f* at time *t*, ρ_{ft} is the unit price of a unit trust or index fund at time *t* and ρ_{ft-1} is the unit price of a unit trust or index fund at time *t-1*.

3.3 Descriptive Statistics

To better facilitate an understanding of the data involved the relevant descriptive statistics for the unadjusted Style and Asset class Index return time series are outlined in Table 3.1 and the correlation matrix in Table 3.2. This is followed by the list of unit trusts examined in Table 3.3 as well as relevant descriptive statistics in Table 3.4.

Table 3.1 Style and Asset Class Descriptive Statistics

Below are the statistics calculated using monthly returns over the period 1 January 2003 to 30 June 2018.

Style Indices	**Mean**	**Median**	**Std dev**	**Kurtosis**	**Skewness**	**Min**	**Max**	**Count**
Low Volatility	1.69%	1.97%	3.46%	0.76	-0.33	-11.56%	11.02%	186
Momentum	1.88%	1.94%	4.28%	0.57	0.10	-10.56%	16.24%	186
Value	1.80%	1.72%	4.38%	0.08	-0.13	-11.58%	12.76%	186
Asset Class Indices	**Mean**	**Median**	**Std dev**	**Kurtosis**	**Skewness**	**Min**	**Max**	**Count**
ALSI 40	1.31%	1.23%	4.73%	0.53	0.01	-14.27%	14.67%	186
ALBI	0.76%	0.82%	1.99%	2.06	0.16	-6.67%	8.51%	186
MSCI World	0.96%	0.84%	4.20%	0.66	0.15	-12.52%	14.38%	186
SAPY	1.55%	1.83%	4.69%	1.29	-0.14	-13.93%	18.19%	186
Stefi	0.61%	0.58%	0.19%	10.78	-0.84	-0.68	1.13%	186

Table 3.2 Correlation Matrix

	Momentum	*Value*	*Low Volatility*	*ALSI 40*	*ALBI*	*SAPY*	*MSCI World*	*STEFI*
Momentum	1.00							
Value	0.82	1.00						
Low Volatility	0.87	0.84	1.00					
ALSI 40	0.74	0.73	0.65	1.00				
ALBI	0.17	0.39	0.31	0.02	1.00			
SAPY	0.47	0.58	0.67	0.24	0.56	1.00		
MSCI World	0.25	0.20	0.22	0.54	-0.35	-0.07	1.00	
STEFI	-0.02	-0.05	-0.04	-0.09	0.04	0.09	-0.19	1.00

Table 3.3 Unit Trust Details

The below table includes the names, ASISA classifications and International Securities Identification Numbers (ISIN) for the unit trusts under consideration as well as the period over which data is obtained.

Fund Name	ASISA Classification	ISIN	Fund Size (M)	Time Period
Allan Gray Balanced A	Multi-Asset High Equity	ZAE000025029	152,574.64	1 January 2003 – 30 June 2018
Coronation Balanced Plus A	Multi-Asset High Equity	ZAE000019808	91,179.73	1 January 2003 – 30 June 2018
Foord Balanced A	Multi-Asset High Equity	ZAE000042172	37,636.29	1 January 2003 – 30 June 2018
Investec Managed A	Multi-Asset High Equity	ZAE000024170	14,034.41	1 January 2003 – 30 June 2018
Investec Opportunity A	Multi-Asset High Equity	ZAE000024162	44,346.19	1 January 2003 – 30 June 2018
Old Mutual Multi-Managers Balanced FoF A	Multi-Asset High Equity	ZAE000036489	14,788.17	1 January 2003 – 30 June 2018
Prudential Balanced A	Multi-Asset High Equity	ZAE000020863	20,429.23	1 January 2003 – 30 June 2018
PSG Balanced A	Multi-Asset High Equity	ZAE000019485	11,727.03	1 January 2003 – 30 June 2018
Stanlib Balanced A	Multi-Asset High Equity	ZAE000025193	5,539.56	1 January 2003 – 30 June 2018
Stanlib Multi-Manager Balanced A	Multi-Asset High Equity	ZAE000035382	5,214.45	1 January 2003 – 30 June 2018
Sanlam Investment Management Balanced A	Multi-Asset High Equity	ZAE000056610	17,358.10	1 September 2004 – 30 June 2018
Rezco Value Trend A	Multi-Asset High Equity	ZAE000058459	5,727.28	1 December 2004 – 30 June 2018
PSG Wealth Moderate FoF	Multi-Asset High Equity	ZAE000065603	19,322.29	1 July 2007 – 30 June 2018

Table 3.3 Unit Trust Details (continued)

Name	ASISA Classification	ISIN	Fund Size (M)	Time Period
Old Mutual Balanced A	Multi-Asset High Equity	ZAE000097424	18,285.42	1 December 2007 – 30 June 2018
Discovery Balanced	Multi-Asset High Equity	ZAE000107504	24,023.39	1 December 2007 – 30 June 2018
Coronation Capital Plus A	Multi-Asset Medium Equity	ZAE000031514	16,816.33	1 January 2003 – 30 June 2018
Nedgroup Investments Opportunity A	Multi-Asset Medium Equity	ZAE000023024	8,759.02	1 May 2003 – 30 June 2018
Old Mutual Multi-Managers Defensive FoF A	Multi-Asset Medium Equity	ZAE000036463	6,072.82	1 January 2003 – 30 June 2018
Allan Gray Stable A	Multi-Asset Low Equity	ZAE000025896	49,264.73	1 January 2003 – 30 June 2018
Prudential Inflation Plus A	Multi-Asset Low Equity	ZAE000030284	35,625.59	1 January 2003 – 30 June 2018
Old Mutual Real Income A	Multi-Asset Low Equity	ZAE000076493	5,204.66	1 May 2006 – 30 June 2018
Investec Cautious Managed A	Multi-Asset Low Equity	ZAE000078929	10,240.34	1 August 2006 – 30 June 2018
PSG Wealth Preserver FoF	Multi-Asset Low Equity	ZAE000065660	10,663.89	1 July 2007 – 30 June 2018
Nedgroup investment Stable A	Multi-Asset Low Equity	ZAE000108197	23,325.21	1 December 2007 – 30 June 2018
Old Mutual Stable Growth A	Multi-Asset Low Equity	ZAE000097770	6,055.87	1 December 2007 – 30 June 2018
Coronation Balanced Defensive A	Multi-Asset Low Equity	ZAE000090627	35,314.21	1 December 2007 – 30 June 2018

Table 3.4 Unit Trust Descriptive Statistics

Below are the descriptive statistics calculated using monthly returns over the time period indicated in Table 3.3 for each unit trust.

Unit Trust	Mean	Median	Std dev	Kurtosis	Skewness	Min	Max	Count
Allan Gray Balanced A	1.14%	0.95%	2.54%	1.05	0.16	-6.85%	9.59%	186
Coronation Balanced Plus A	1.20%	1.04%	2.83%	0.59	0.02	-8.25%	9.42%	186
Foord Balanced A	1.15%	0.97%	2.85%	1.14	0.39	-7.92%	10.51%	186
Investec Managed A	1.13%	1.05%	2.81%	0.87	-0.02	-9.06%	9.11%	186
Investec Opportunity A	1.11%	0.94%	2.59%	1.83	0.25	-6.89%	11.44%	186
Old Mutual Multi-Managers Balanced FoF A	1.01%	0.92%	2.26%	0.26	-0.04	-6.10%	6.47%	186
Prudential Balanced A	1.09%	1.12%	2.75%	0.98	-0.01	-8.44%	10.27%	186
PSG Balanced A	1.10%	1.00%	2.53%	1.41	-0.13	-7.72%	7.93%	186
Stanlib Balanced A	0.97%	0.88%	3.04%	1.71	-0.31	-9.30%	11.63%	186
Stanlib Multi-Manager Balanced A	0.98%	1.08%	2.80%	0.61	-0.10	-7.86%	9.08%	186
Sanlam Investment Management Balanced A	1.01%	1.06%	2.77%	1.79	-0.69	-9.62%	7.99%	166
Rezco Value Trend A	1.21%	1.14%	2.61%	1.59	0.37	-7.42%	10.52%	163
PSG Wealth Moderate FoF	0.66%	0.79%	2.25%	0.86	-0.40	-6.32%	5.89%	132
Old Mutual Balanced A	0.63%	0.94%	2.63%	1.05	-0.47	-7.45%	7.13%	127
Discovery Balanced	0.78%	0.98%	2.72%	0.81	-0.29	-8.05%	7.59%	127
Coronation Capital Plus A	0.95%	0.93%	1.97%	0.53	0.07	-4.76%	7.79%	186
Nedgroup Investments Opportunity A	1.04%	1.04%	2.77%	1.70	-0.59	-8.00%	10.00%	182
Old Mutual Multi-Managers Defensive FoF A	0.89%	0.80%	1.83%	1.08	-0.20	-5.91%	5.68%	186
Allan Gray Stable A	0.86%	0.82%	1.48%	0.03	0.15	-3.31%	4.66%	186

Table 3.4 Unit Trust Descriptive Statistics (continued)

Unit Trust	Mean	Median	Std dev	Kurtosis	Skewness	Min	Max	Count
Prudential Inflation Plus A	0.91%	1.03%	1.88%	0.70	-0.30	-4.97%	5.84%	186
Old Mutual Real Income A	0.65%	0.55%	1.23%	2.22	-0.08	-3.74%	4.74%	146
Investec Cautious Managed A	0.69%	0.61%	1.65%	6.27	0.01	-6.36%	8.66%	143
PSG Wealth Preserver FoF	0.60%	0.63%	1.23%	1.43	-0.39	-3.47%	3.95%	132
Coronation Balanced Defensive A	0.77%	0.82%	1.32%	0.63	-0.27	-3.88%	4.55%	127
Nedgroup investment Stable A	0.75%	0.82%	1.59%	2.85	-0.08	-5.61%	6.98%	127
Old Mutual Stable Growth A	0.63%	0.71%	1.50%	2.67	-0.82	-5.17%	5.17%	127

4. METHODOLOGY

This section discusses the methodology to be used in this study. The Returns Based Style Analysis (RBSA) of Sharpe (1992) is the key method used in this study and is thus quantitative in nature. The model is examined, and the process used to obtain results is documented.

RBSA is fundamentally an Ordinary Least Squares (OLS) factor model approach of the following form:

$$\widetilde{\mathrm{R}}_{\rho} = [\mathrm{b}_{\rho_1}\tilde{\mathrm{F}}_1 + \mathrm{b}_{\rho_2}\tilde{\mathrm{F}}_2 + \ldots + \mathrm{b}_{\rho \mathrm{n}}\tilde{\mathrm{F}}_{\mathrm{n}}] + \tilde{\mathrm{e}}_{\rho}, \qquad (9)$$

where the $b_{\rho j}$ values are the portfolio's exposures to style and asset class factors. Each $b_{\rho j}$ is a weighted average of the exposures of a component fund to the relevant asset class/style, with invested amounts used as weights. R_{ρ} denotes the return on the portfolio, $\tilde{\mathrm{F}}_I$ denotes the value of the I'th factor, for I {1,2,…,n} with *n* factors. We assume that the residual term $\tilde{\mathrm{e}}_{\rho}$ is uncorrelated with the other asset class returns and we seek to minimise this unexplained variation.

Put differently, each style and asset class index return series are factors used together that seek to explain the returns of a particular unit trust - the portfolio in question. The residual component of the portfolio returns $\tilde{\mathrm{e}}_{\rho}$ can be interpreted as the excess return of the portfolio that is not explained by the portfolio exposures to style and asset class index returns. This excess return represents the difference between unit trust returns and those of a passive portfolio with the same style and asset class exposures.

A traditional multifactor model estimates exposure weights that can take on negative and positive values. However, most of the multi asset unit trusts examined in this study are long-only in nature and therefore a negative exposure to an asset class (short position) is not permissible. In order to address this issue Sharpe applies the following constraint to Equation 9:

$$b_{\rho j} \geq 0. \qquad (12)$$

A further necessary constraint is that all of the exposures must sum to 1 (Equation 13), this ensures that the specified model provides exposures that can be thought of as feasible portfolio weights and effectively transforms the model from a multi factor model to an asset class model where an investable portfolio ρ with *n* asset classes is specified.

$$\sum_{j=1}^{n} b_{\rho j} = 1 \qquad (13)$$

for each portfolio ρ.

Given these inequality constraints a quadratic programming algorithm is applied to determine the appropriate style and asset class weights.

In this study the change in SA multi asset unit trust exposures are evaluated over time. Rolling window RBSA is used to capture this information. The length of the rolling estimation period is to some degree arbitrary but seeks to balance between two conflicting considerations. A longer estimation period is more statistically robust with less noise in the data providing a more accurate description of the average style and asset class exposure. However, for an active manager who rotates between several asset classes, in addition to providing security selection ability, a shorter estimation…" period may be more appropriate to capture these dynamic changes (Dor et al. 2003:20). Given that multi asset fund managers are likely to fall into this group 24 months is chosen as the rolling window period used in this study. However, it is noted that alternative rolling window periods can produce differing results. For each unit trust an initial regression is performed on 24 months of returns data where the style and asset class exposures are estimated using returns from month t-24 to t-1. The return of the passive portfolio that attempts to replicate this exposure can then be calculated in month t. This process is repeated by adding one more month of returns data and removing the oldest monthly data point until exposures have been estimated over the total period available. In this manner replicating portfolio weights are always estimated using 2 years of past data.

While this method is useful for establishing a unit trust's style and asset class exposure over time; a more practical contribution is that fund-specific custom benchmarks that closely match the investment objectives of the portfolio in question can be generated. The return earned by a unit trust each month can be compared with the return on a passive portfolio

with the same estimated exposures prior to the current month. This provides a simple way to evaluate the statistical robustness of the method out-of-sample. These benchmarks can then be used to isolate asset selection ability and can be evaluated using a number of quantitative risk/return metrics.

5. RESULTS & DISCUSSION

In this section the results of the application of the Sharpe (1992) RBSA approach as applied to the sample of SA multi asset unit trusts are presented. Using the specified rolling window methodology, the returns of each unit trust relative to the constructed replicating benchmark or shadow portfolio are examined. The overall R squared is presented to evaluate the model's ability to explain the variation in returns of the unit trust in question. Asset selection ability is also evaluated along with several risk/return metrics relative to the shadow portfolio and a simple benchmark. Each ASISA classification is discussed separately followed by a broad summary of unit trust exposures to each style and asset class.

The multi asset high equity unit trusts that display the best style and asset class adjusted performance and risk characteristics are used to simulate a feasible set of 2000 potential portfolios using historical risk and return metrics for each combination. The best blends based on specific criteria are then obtained. This process is repeated using style and asset class indices to obtain a custom multi asset high equity portfolio with substantial style index exposure. Finally, the active unit trusts identified are combined with the custom style and asset class indices to illustrate a blend with superior performance outcomes.

Table 5.1 Multi Asset High Equity Results

	Unit Trust Returns			Shadow Portfolio Returns			Benchmark Returns: 60% Swix, 30% ALBI, 10% STEFI		
Multi Asset High Equity Unit Trust	**Annualised Return %**	**Annualised Standard Deviation %**	**Max Drawdown %**	**Annualised Return %**	**Annualised Standard Deviation %**	**Max Drawdown %**	**Annualised Return %**	**Annualised Standard Deviation %**	**Max Drawdown %**
Allan Gray Balanced A	12.77%	8.17%	16.26%	12.98%	7.06%	10.64%	12.55%	9.09%	19.99%
Coronation Balanced Plus A	13.46%	9.67%	20.30%	13.19%	9.16%	23.43%	12.55%	9.09%	19.99%
Foord Balanced A	13.31%	9.34%	15.91%	13.14%	8.47%	22.16%	12.55%	9.09%	19.99%
Investec Managed A	11.89%	9.52%	23.58%	13.60%	9.16%	23.27%	12.55%	9.09%	19.99%
Investec Opportunity A	11.47%	8.52%	18.20%	13.21%	7.66%	16.92%	12.55%	9.09%	19.99%
Old Mutual Multi-Managers Balanced FoF A	11.20%	7.72%	15.21%	12.71%	7.32%	13.22%	12.55%	9.09%	19.99%
Prudential Balanced A	12.38%	8.94%	23.23%	14.29%	8.89%	20.05%	12.55%	9.09%	19.99%
PSG Balanced A	12.32%	8.16%	25.05%	13.64%	7.31%	9.56%	12.55%	9.09%	19.99%
Stanlib Balanced A	10.44%	9.96%	34.09%	13.25%	9.70%	28.63%	12.55%	9.09%	19.99%
Stanlib Multi-Manager Balanced A	10.39%	9.09%	27.63%	14.30%	8.66%	15.59%	12.55%	9.09%	19.99%
Sanlam Investment Management Balanced A	8.89%	9.19%	27.04%	11.61%	8.24%	18.03%	10.94%	8.94%	19.99%
Rezco Value Trend A	11.62%	8.00%	10.19%	10.75%	7.45%	21.81%	10.39%	8.97%	19.99%
PSG Wealth Moderate FoF	10.83%	6.48%	4.42%	13.03%	5.86%	5.37%	12.31%	7.61%	5.62%
Old Mutual Balanced A	9.33%	7.08%	5.16%	12.97%	6.80%	4.71%	11.37%	7.55%	5.62%
Discovery Balanced	10.92%	7.00%	4.52%	12.79%	6.74%	5.90%	11.37%	7.55%	5.62%

	Fund Relative to Shadow								Fund Relative to Benchmark							
Multi-Asset High Equity Unit Trust	**Alpha**	**Beta**	**Correlation**	**R-Squared**	**Tracking Error**	**t-statistic (alpha)**	**p-value (alpha)**	**IR**	**Alpha**	**Beta**	**Correlation**	**R-Squared**	**Tracking Error**	**t-statistic (alpha)**	**p-value (alpha)**	**IR**
Allan Gray Balanced A	-0.22	0.93	0.80	0.64	4.92	-0.07	0.94	-0.04	0.12	0.72	0.76	0.57	6.33	0.20	0.84	0.06
Coronation Balanced Plus A	0.31	0.95	0.90	0.81	4.28	0.34	0.73	0.09	0.93	0.90	0.85	0.71	5.33	0.79	0.43	0.22
Foord Balanced A	0.11	0.96	0.87	0.75	4.65	0.17	0.86	0.04	0.14	0.82	0.77	0.59	6.54	0.21	0.83	0.05
Investec Managed A	-1.60	0.90	0.87	0.75	4.81	-1.13	0.26	-0.35	-0.08	0.82	0.78	0.61	6.28	0.08	0.94	0.01
Investec Opportunity A	-1.61	0.90	0.81	0.66	5.02	-1.09	0.28	-0.35	-0.24	0.75	0.78	0.60	6.09	-0.04	0.97	-0.01
Old Mutual Multi-Managers Balanced FoF A	-1.38	0.96	0.91	0.83	3.21	-1.52	0.13	-0.47	-1.34	0.72	0.86	0.73	4.80	-1.01	0.31	-0.26
Prudential Balanced A	-1.75	0.93	0.92	0.85	3.53	-1.76	0.08	-0.54	-0.35	0.92	0.89	0.79	4.39	-0.23	0.82	-0.07
PSG Balanced A	-1.20	0.95	0.85	0.73	4.25	-0.96	0.34	-0.31	-0.11	0.74	0.79	0.63	5.75	0.04	0.97	0.02
Stanlib Balanced A	-2.58	0.92	0.89	0.80	4.56	-2.01	0.05	-0.62	-1.94	0.96	0.85	0.71	5.63	-1.26	0.21	-0.38
Stanlib Multi-Manager Balanced A	-3.49	0.96	0.92	0.84	3.64	-3.50	0.00	-1.08	-1.74	0.92	0.88	0.77	4.72	-1.37	0.17	-0.40
Sanlam Investment Management Balanced A	-2.61	0.89	0.80	0.64	5.56	-1.53	0.13	-0.51	-1.05	0.86	0.82	0.67	5.64	-0.59	0.55	-0.19
Rezco Value Trend A	0.63	0.72	0.67	0.45	6.32	0.44	0.66	0.14	1.70	0.55	0.55	0.30	8.60	0.88	0.38	0.27
PSG Wealth Moderate FoF	-1.99	0.95	0.86	0.74	3.33	-1.75	0.08	-0.66	-2.09	0.65	0.76	0.57	5.98	-1.07	0.29	-0.33
Old Mutual Balanced A	-3.28	0.93	0.90	0.80	3.17	-3.02	0.00	-1.15	-2.22	0.86	0.85	0.72	4.97	-1.39	0.17	-0.46
Discovery Balanced	-1.73	0.89	0.86	0.74	3.65	-1.34	0.18	-0.51	-0.39	0.86	0.82	0.67	5.54	-0.14	0.89	-0.05

5.1 Multi Asset High Equity

Each of the unit trusts under examination are compared to their custom benchmark/shadow portfolio over the period indicated in Table 3.3 where the first 24 months of available data are used to ascertain existing unit trust exposures and the remaining data used to perform rolling window regressions that capture asset allocation and style changes over time. Of the 15 multi asset high equity unit trusts examined, 3 displayed positive alpha/security selection ability that exceeded the estimated custom benchmark, 12 displayed negative alpha/security selection. None of the unit trusts that displayed positive alpha relative to their custom benchmark did so at a statistical level of significance. However, the economic significance of incremental gains over long term horizons cannot be underestimated. Of the 12 unit trusts displaying negative alpha, 5 exhibited negative alpha that was statistically different from zero at the 10% level.

It should be noted that a manager with good asset class allocation ability will likely experience more difficulty in outperforming the custom benchmark because if their overall asset allocation and style bias was favourable then the custom benchmark will reflect the passive returns to those assets. Therefore, the manager must display positive security selection ability within asset classes to outperform. It is for this reason that unit trust returns are also examined relative to a simple balanced benchmark broadly representative of a typical multi asset high equity asset allocation with similar risk, namely: 60% SWIX for the broad equity market, 30% All Bond Index and a 10% cash allocation represented by the STEFI. The annualised standard deviation of the returns of this benchmark (9.09%) is equal to the median standard deviation of the 10 Multi Asset High Equity unit trusts with return history available from 1 January 2003 – 30 June 2018.

Relative to the simple benchmark the results remain fairly similar with one additional unit trust, Allan Gray Balanced Fund, exhibiting positive alpha. Of the 11 unit trusts that displayed negative alpha there is no evidence of underperformance at a statistical level of significance relative to the simple asset class benchmark. Once again, the compounding of underperformance for several years can have economic significance on future return outcomes.

Another important consideration is the level of risk taken by a unit trust, the annualised standard deviation or volatility as a measure of return dispersion, and therefore risk is examined, as well as the maximum drawdown of the unit trust over the applicable period. The maximum drawdown is the

maximum loss that occurred from the peak to the trough before a new peak is reached over the period under consideration. This metric provides us with a measure of the historical capital losses within a unit trust and as a result some indication of relative losses across investments.

All high equity unit trusts examined exhibited greater volatility than their custom benchmark/shadow portfolios. To better understand the risk, maximum drawdowns are examined. The maximum drawdown is highly sensitive to the historical period under examination. Therefore, it is necessary to separate the first 10 unit trusts which cover the same 1 January 2003 – 30 June 2018 period and the remaining 5 which cover slightly shorter periods when evaluating drawdowns. Particular attention is drawn to the Foord Balanced Fund that displayed a meaningfully lower maximum drawdown 15.91% vs 22.16% for its custom style benchmark and to a lesser extent Coronation Balanced Plus Fund. The remaining 8 funds exhibited higher drawdowns than their shadow portfolios.

Relative to the simple benchmark the results differ - 4 of the 10 unit trusts covering the 1 January 2003 – 30 June 2018 period achieved lower maximum drawdowns. Of The remaining 5 high equity unit trusts where less data was available: Rezco Value Trend Fund is the most notable from a risk perspective with a maximum drawdown of only 10.19% roughly half that of the shadow portfolio and simple benchmark at 21.81% and 19.99% respectively. Discovery Balanced Fund also had a slightly lower drawdown than the shadow portfolio and simple benchmark. In order to better visualise the three portfolios being considered an example of the cumulative returns and drawdowns using Coronation Balanced Plus Fund is shown in Figure 5.1.

The shadow portfolio estimated for each unit trust explains a large proportion of the variation in return as evidenced by the R-squared figures in Table 5.2. The only exception is Rezco Value Trend Fund where the model could only explain 45% of the variation in return. This is likely due to the higher active risk taken by the manager relative to peers and the simple benchmark as evidenced by the tracking error of 8.60%.

What is clear is that there are several high equity unit trusts that can outperform style and asset class benchmarks estimated using RBSA. However, more than half of the funds examined cannot. As the availability, sophistication and track-record of smart beta products in the South African market increases, investors will be faced with more passive investment options that will continue to place pressure on active managers that are unable to deliver robust alpha after adjusting for style effects.

Figure 5.1 Cumulative Returns and Drawdowns Coronation Balanced Plus Fund

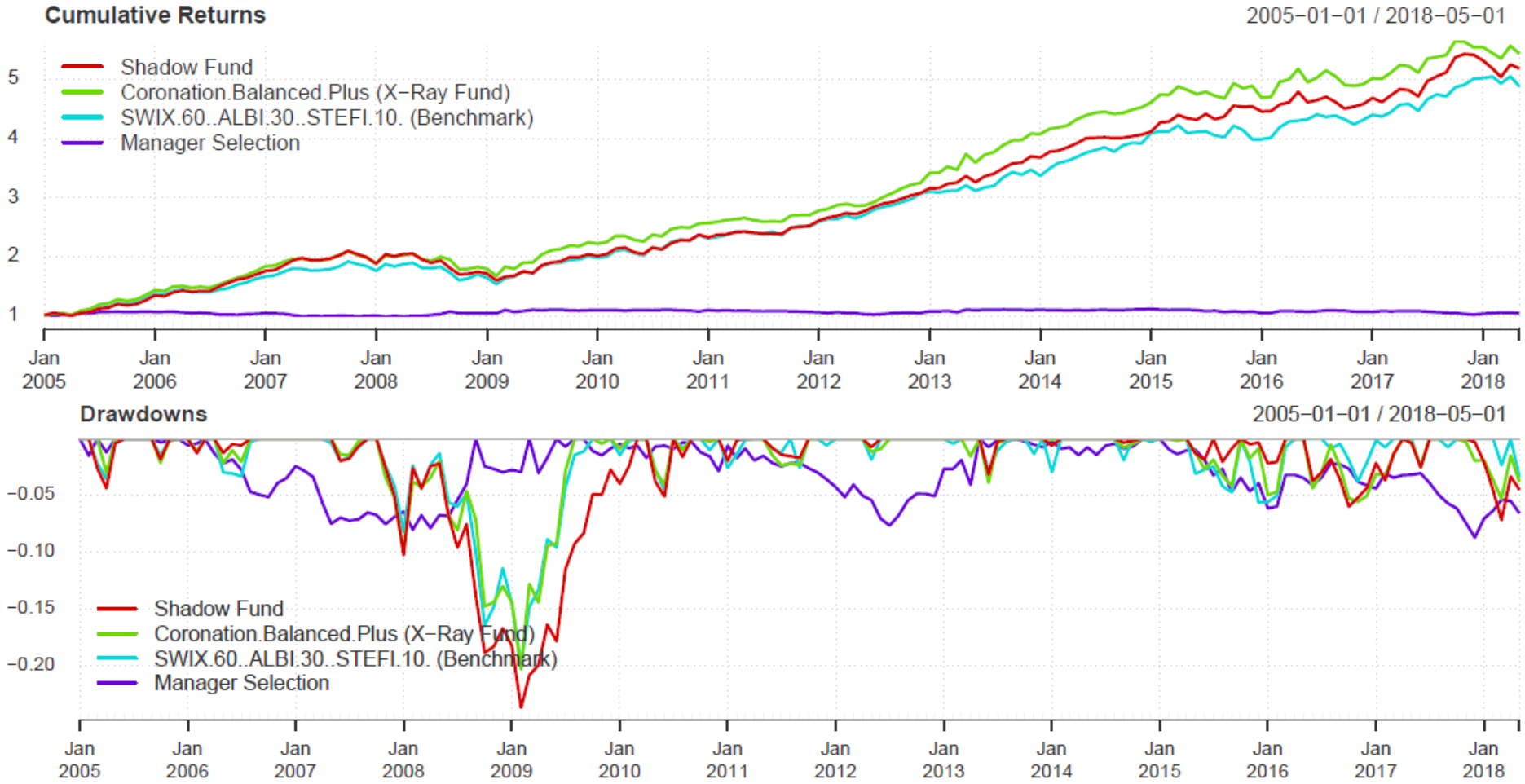


Table 5.2 Multi Asset Medium Equity

	Unit Trust Returns			Shadow Portfolio Returns			Benchmark Returns: 40% Swix, 60% STEFI		
Multi-Asset Medium Equity Unit Trust	**Annualised Return %**	**Annualised Standard Deviation %**	**Max Drawdown %**	**Annualised Return %**	**Annualised Standard Deviation %**	**Max Drawdown %**	**Annualised Return %**	**Annualised Standard Deviation %**	**Max Drawdown %**
Coronation Capital Plus A	10.63%	6.42%	7.57%	11.24%	5.79%	11.23%	10.64%	5.59%	11.67%
Nedgroup Investments Opportunity A	10.11%	9.33%	31.98%	12.66%	8.34%	20.47%	10.47%	5.62%	11.67%
Old Mutual Multi-Managers Defensive FoF A	9.41%	6.19%	9.60%	11.80%	5.59%	6.07%	10.64%	5.59%	11.67%

	Fund Relative to Shadow								Fund Relative to Benchmark							
Multi Asset Medium Equity Unit Trust	**Alpha**	**Beta**	**Correlation**	**R-Squared**	**Tracking Error**	**t-statistic (alpha)**	**p-value (alpha)**	**IR**	**Alpha**	**Beta**	**Correlation**	**R-Squared**	**Tracking Error**	**t-statistic (alpha)**	**p-value (alpha)**	**IR**
Coronation Capital Plus A	-0.58	0.92	0.83	0.68	3.65	-0.51	0.60	-0.17	0.29	0.93	0.78	0.61	4.30	0.35	0.73	0.08
Nedgroup Investments Opportunity A	-2.36	0.88	0.78	0.62	5.87	-1.37	0.17	-0.43	0.73	1.41	0.84	0.70	5.76	0.60	0.55	0.11
Old Mutual Multi-Managers Defensive FoF A	-2.19	0.87	0.79	0.62	3.88	-2.02	0.04	-0.62	-0.51	0.86	0.78	0.60	4.08	-0.41	0.68	-0.12

5.2 Multi Asset Medium Equity

Due to the small number of funds that met the filter criteria for fund size and return history the analysis of funds in this category is limited and could be an interesting area for future research. The medium equity classification is difficult to evaluate using simple benchmarks for several reasons. The first being that the objectives, mandate and exposure of each fund can differ markedly. A further complication is the prevalence of Consumer Price Index (CPI) based benchmarks. While these may be useful for outcome-based planning and as a gauge of the relative aggressiveness in which a unit trust seeks returns. The level of inflation is not linked to the performance that could be generated by major asset classes over time and more importantly is not linked to the risk taken. As a result, these benchmarks are largely unhelpful when evaluating whether a fund manager is skilled.

To illustrate the difference in effective exposures the RBSA style map for Coronation Capital Plus Fund and Old Mutual Multi Managers Defensive Fund of Funds is presented in Figure 5.2 and Figure 5.3 below. The style map is a visual representation of how the estimated exposure to the specified style and asset class indices, changes over time. The estimated style map for each unit trust examined in this study can be found in Appendix C.

Up until 2011 the Coronation Capital Plus Fund style map indicates that the fund had an average exposure of approximately 26% to the All Bond Index. However, Old Mutual Multi Managers Defensive Fund of Funds had an average exposure of only 11% over the same period with a bias toward larger cash holdings. Another notable difference is the average exposure to offshore equity at 16% for Coronation and under 5% for Old Mutual. These differences can have significant effects on the range of risk and return outcomes. The jumps that can be seen on the style maps occur when the model has difficulty determining the appropriate index weight and is more frequent as a result of short-term asset allocation changes.

None of the unit trusts in this category were able to outperform their RBSA custom benchmarks/shadow portfolios. However, Coronation Capital Plus Fund performed roughly the same as the simple benchmark of 40% SWIX 60% STEFI but did so with a lower maximum drawdown 7.57% compared to 11.67% for the simple benchmark.

Figure 5.2 Coronation Capital Plus Style Map

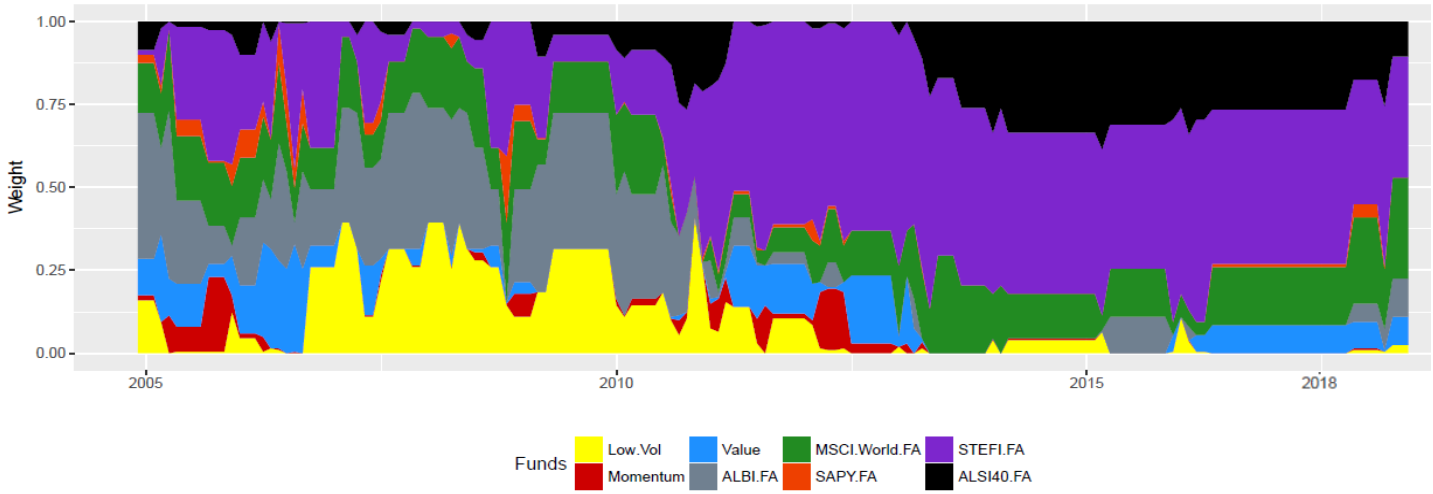


Figure 5.3 Old Mutual Multi Managers Defensive FoF Style Map

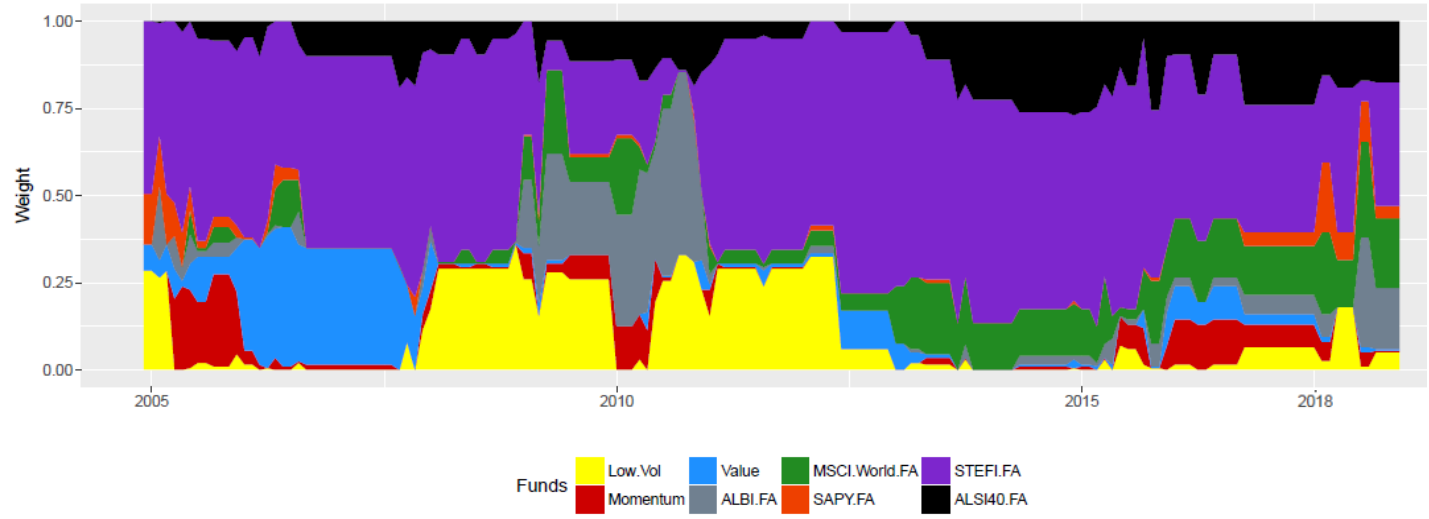


Table 5.3 Multi Asset Low Equity

	Unit Trust Returns			Shadow Portfolio Returns			Benchmark Returns: 30% SWIX, 70% STEFI		
Multi Asset High Equity Unit Trust	**Annualised Return %**	**Annualised Standard Deviation %**	**Max Drawdown %**	**Annualised Return %**	**Annualised Standard Deviation %**	**Max Drawdown %**	**Annualised Return %**	**Annualised Standard Deviation %**	**Max Drawdown %**
Allan Gray Stable A	10.02%	4.94%	6.20%	9.06%	3.21%	3.23%	9.83%	4.19%	6.86%
Prudential Inflation Plus A	10.73%	6.34%	9.26%	11.63%	5.56%	8.16%	9.83%	4.19%	6.86%
Old Mutual Real Income A	8.37%	4.04%	3.87%	8.92%	3.48%	6.35%	8.18%	4.01%	6.86%
Investec Cautious Managed A	8.06%	5.74%	11.70%	8.40%	4.43%	6.35%	8.48%	3.97%	5.80%
PSG Wealth Preserver FoF	8.53%	3.81%	3.47%	10.02%	3.40%	2.26%	8.99%	3.40%	1.58%
Nedgroup investment Stable A	9.25%	4.27%	4.12%	10.42%	3.65%	2.45%	8.47%	3.34%	1.58%
Old Mutual Stable Growth A	8.26%	3.76%	2.62%	10.22%	3.21%	1.36%	8.47%	3.34%	1.58%
Coronation Balanced Defensive A	9.41%	3.90%	2.91%	9.56%	3.44%	3.22%	8.47%	3.34%	1.58%

	Fund Relative to Shadow								Fund Relative to Benchmark							
Multi-Asset Low Equity Unit Trust	**Alpha**	**Beta**	**Correlation**	**R-Squared**	**Tracking Error**	**t-statistic (alpha)**	**p-value (alpha)**	**IR**	**Alpha**	**Beta**	**Correlation**	**R-Squared**	**Tracking Error**	**t-statistic (alpha)**	**p-value (alpha)**	**IR**
Allan Gray Stable A	0.87	0.78	0.51	0.26	4.32%	0.81	0.42	0.22	0.08	0.36	0.31	0.09	5.59%	0.16	0.87	0.04
Prudential Inflation Plus A	-0.86	0.85	0.74	0.55	4.27%	-0.63	0.53	-0.21	0.70	1.14	0.75	0.57	4.34%	0.72	0.47	0.17
Old Mutual Real Income A	-0.57	0.58	0.50	0.25	3.81%	-0.41	0.68	-0.15	-1.01	0.45	0.43	0.18	4.46%	-0.72	0.48	-0.22
Investec Cautious Managed A	-0.38	0.71	0.55	0.31	4.99%	-0.21	0.83	-0.09	-0.77	0.65	0.46	0.21	5.28%	-0.41	0.68	-0.15
PSG Wealth Preserver FoF	-1.37	0.91	0.81	0.66	2.25%	-1.82	0.07	-0.67	-1.00	0.74	0.71	0.50	3.20%	-0.99	0.32	-0.32
Nedgroup investment Stable A	-1.10	0.79	0.67	0.46	3.24%	-0.95	0.35	-0.36	0.91	0.70	0.52	0.27	4.87%	0.68	0.49	0.21
Old Mutual Stable Growth A	-1.81	0.84	0.72	0.52	2.65%	-1.97	0.05	-0.74	-0.59	0.83	0.66	0.44	3.95%	-0.42	0.67	-0.15
Coronation Balanced Defensive A	-0.15	0.90	0.79	0.62	2.42%	-0.14	0.89	-0.06	1.14	0.75	0.68	0.46	3.49%	1.11	0.27	0.36

5.3 Multi Asset Low Equity

In this classification 8 unit trusts were examined but only the Allan Gray Stable Fund could outperform its shadow portfolio. It should be noted that the Allan Gray Stable Fund Shadow portfolio was unable to explain much of the variation in the fund's returns using the asset classes specified with an R-squared of only 0.26 and as a result may be inappropriate. After additional analysis of the Allan Gray Stable Fund it is clear that a large portion of the fund is invested in hedged equities, an exposure that by its nature is not available to retail investors in a passive form.

According to Allan Gray (2018) "We use hedging when we are concerned about asset valuations as it provides downside protection for your investments. Hedged equities can be thought of as cash-equivalents where we effectively exchange market returns for more stable cash-like returns. At the same time, we retain exposure to the potential outperformance from our selection of shares relative to the market, which should further enhance returns over the long term"

This exposure is achieved through short positions in futures contracts to reduce effective equity market exposure. As discussed previously, Hsieh (2013) indicated that additional factors are necessary to capture the unique risks of hedge fund strategies that make use of derivative instruments. Nevertheless, hedge strategies such as this, if executed sensibly, will continue to differentiate active managers with risk cognizant mandates and may continue to provide barriers to replication for managers that are able to outperform equity markets.

The remaining 7 funds all underperformed their shadow portfolios with Coronation Balanced Defensive Fund only marginally underperforming with an alpha of -0.15. Two of the 7 funds displayed negative alpha that was statistically significant at the 10% level. All low equity unit trusts examined exhibited greater volatility than their custom benchmark/shadow portfolios. From a maximum drawdown perspective Old Mutual Real Income Fund and Coronation Balanced Defensive Fund achieved lower drawdowns than their custom benchmarks with all other funds demonstrating higher drawdowns.

Relative to a simple benchmark of 30% SWIX and 70% STEFI motivated by the maximum equity allocation of 40% for this classification, 5 of the 8 funds evaluated outperformed as indicated by their positive alpha. However, all funds displayed higher maximum drawdowns than the simple benchmark (given its significant cash exposure) except once again for the Old

Mutual Real Income Fund which achieved a drawdown of 3.87% vs 6.86% for the simple benchmark. The higher risk as indicated by the volatility and drawdowns of most funds in this classification and the underperformance of most funds relative to the custom benchmark suggests that risk is being taken that is not adequately compensated. As a result of a lack of homogeneity within the classification these risks are largely not captured by arbitrary simple benchmarks because they are unrepresentative of the universe of assets in which each unit trust invests, emphasising the need for improved benchmarking.

Overall the RBSA model could explain more than 50% of the variation in returns for 4 of the 8 unit trusts examined in this classification. This reduced explanatory power is likely a result of asset classes not specified in our model that are more income focused and become more prevalent in the low-equity classification such as commodities, preference shares, foreign bonds and foreign property. As ETFs become available in South Africa for these asset classes, with a suitable performance history, future research could include further analysis of this classification as well as the Multi Asset Income classification.

5.4 Summary of unit trust exposures

In this section the average exposure of unit trusts to particular styles and asset classes are discussed. The average style and asset class exposure estimated for each unit trust using the specified RBSA model is presented in Table 5.4.

The unit trust with the greatest average exposure to the JSE top 40 in the multi asset high equity classification was Coronation Balanced Plus Fund. Interestingly this was consistent with Coronation Balanced Defensive Fund which had the greatest average exposure to the top 40 in the Multi Asset low equity classification. Prudential was also highly consistent across classifications as it had the greatest average exposure to the value style and the bond asset class in the Prudential Balanced Fund and The Prudential Inflation Plus Fund.

As indicated by Table 5.4 Value has been the most significant style bias among the unit trusts examined in the SA Multi Asset high equity and Multi Asset medium equity classifications. However, In the low equity classification Table 5.4 indicates that there is a style bias toward low volatility, consistent with the classifications tendency to display reduced short-term volatility (ASISA, 2017:5).

Rezco Value Trend Fund displayed the highest average exposure to both cash and the momentum style in the high equity classification. The Rezco Value Trend Fund style map is presented in Figure 5.4. Upon inspection from 2008 to 2010 when the exposure to the momentum style was significant, it was balanced by greater cash holdings. This trend repeated itself during the 2015 to 2017 period. The style map also indicates that there was less exposure to cash when property and low volatility equities had greater exposure. This suggests that the managers have taken care to continually moderate volatility in the fund.

Table 5.4 Average RBSA Unit Trust Exposures

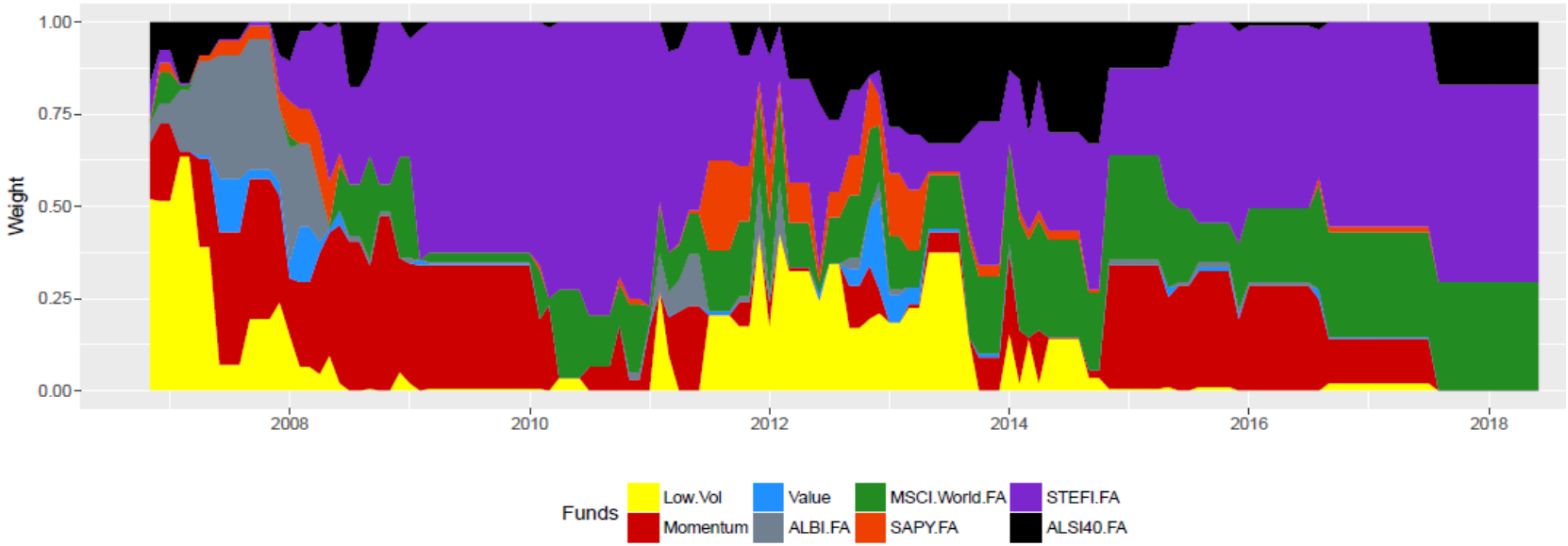
	Average Exposure								
Multi Asset High Equity Unit Trust	**Low.Vol**	**Momentum**	**Value**	**ALBI**	**MSCI.World**	**SAPY**	**STEFI**	**ALSI40**	Time Period
Allan Gray Balanced A	7.1%	3.7%	5.2%	9.5%	16.4%	0.4%	34.1%	23.7%	1 January 2003 – 1 June 2018
Coronation Balanced Plus A	7.1%	4.9%	13.3%	6.1%	18.0%	2.1%	19.9%	28.7%	1 January 2003 – 1 June 2018
Foord Balanced A	4.9%	10.6%	6.0%	7.1%	17.8%	5.9%	23.9%	23.8%	1 January 2003 – 1 June 2018
Investec Managed A	2.5%	11.7%	7.8%	7.8%	12.3%	0.7%	29.3%	28.0%	1 January 2003 – 1 June 2018
Investec Opportunity A	10.7%	3.4%	8.9%	6.4%	17.0%	1.7%	33.2%	18.6%	1 January 2003 – 1 June 2018
Old Mutual Multi-Managers Balanced FoF A	9.1%	3.6%	9.2%	8.4%	12.3%	2.6%	33.4%	21.4%	1 January 2003 – 1 June 2018
Prudential Balanced A	7.4%	6.4%	14.9%	10.4%	14.3%	2.3%	20.1%	24.3%	1 January 2003 – 1 June 2018
PSG Balanced A	5.4%	7.6%	12.7%	3.9%	18.2%	2.3%	36.8%	13.3%	1 January 2003 – 1 June 2018
Stanlib Balanced A	11.4%	7.6%	8.6%	8.8%	12.0%	2.1%	22.5%	27.1%	1 January 2003 – 1 June 2018
Stanlib Multi-Manager Balanced A	9.5%	7.2%	13.9%	8.9%	9.4%	3.1%	24.2%	24.1%	1 January 2003 – 1 June 2018
Sanlam Investment Management Balanced A	9.0%	3.6%	13.3%	6.4%	9.8%	0.9%	32.5%	24.7%	1 September 2004 – 1 June 2018
Rezco Value Trend A*	10.0%	16.8%	1.5%	4.0%	16.3%	3.2%	38.8%	9.4%	1 December 2004 – 1 June 2018
PSG Wealth Moderate FoF	10.4%	4.7%	7.3%	2.4%	21.2%	1.1%	34.5%	18.3%	1 July 2007 – 1 June 2018
Old Mutual Balanced A	2.3%	10.4%	14.4%	7.3%	16.8%	1.8%	26.1%	20.8%	1 December 2007 – 1 June 2018
Discovery Balanced	6.3%	7.6%	13.0%	4.6%	17.9%	0.9%	28.8%	21.0%	1 December 2007 – 1 June 2018
Average across unit trusts	**7.5%**	**7.3%**	**10.0%**	**6.8%**	**15.3%**	**2.1%**	**29.2%**	**21.8%**	

	Average Exposure								
Multi Asset Medium Equity Unit Trust	Low.Vol	Momentum	Value	ALBI	MSCI.World	SAPY	STEFI	ALSI40	Time Period
Coronation Capital Plus A	9.7%	2.1%	6.1%	14.7%	15.5%	1.4%	37.4%	13.0%	1 January 2003 – 1 June 2018
Old Mutual Multi-Managers Defensive FoF A	10.5%	4.1%	7.1%	6.9%	8.9%	1.8%	48.9%	11.7%	1 January 2003 – 1 June 2018
Nedgroup Investments Opportunity A	11.0%	1.8%	19.8%	18.1%	6.6%	1.0%	26.3%	15.5%	1 May 2003 – 1 June 2018
Average across unit trusts	**10.4%**	**2.7%**	**11.0%**	**13.2%**	**10.4%**	**1.4%**	**37.6%**	**13.4%**	

Multi Asset Low Equity Unit Trust	Low.Vol	Momentum	Value	ALBI	MSCI.World	SAPY	STEFI	ALSI40	Time Period
Allan Gray Stable A*	1.5%	0.9%	0.9%	5.2%	14.8%	0.5%	71.3%	4.9%	1 January 2003 – 1 June 2018
Prudential Inflation Plus A	4.4%	4.5%	3.9%	20.3%	10.0%	6.3%	41.0%	9.7%	1 January 2003 – 1 June 2018
Old Mutual Real Income A*	11.0%	3.3%	0.4%	15.0%	3.7%	2.6%	62.9%	1.2%	1 May 2006 – 1 June 2018
Investec Cautious Managed A*	1.8%	1.5%	1.2%	17.7%	17.5%	0.7%	52.0%	7.7%	1 August 2006 – 1 June 2018
PSG Wealth Preserver FoF	3.8%	1.5%	3.1%	4.1%	16.7%	1.5%	61.6%	7.7%	1 July 2007 – 1 June 2018
Nedgroup investment Stable A*	8.3%	3.2%	1.5%	7.5%	15.6%	0.4%	59.0%	4.5%	1 December 2007 – 1 June 2018
Old Mutual Stable Growth A	5.9%	6.0%	3.8%	12.5%	9.9%	2.0%	56.1%	3.8%	1 December 2007 – 1 June 2018
Coronation Balanced Defensive A	6.3%	3.4%	1.6%	6.2%	12.3%	0.9%	59.5%	9.8%	1 December 2007 – 1 June 2018
Average across unit trusts	**5.4%**	**3.0%**	**2.0%**	**11.1%**	**12.6%**	**1.8%**	**57.9%**	**6.2%**	

Unit trusts marked with an asterisk * had a model R-Squared below 50% and as a result the model may be incompletely specified.

Figure 5.4 Rezco Value Trend Style Map



5.5 Combining managers

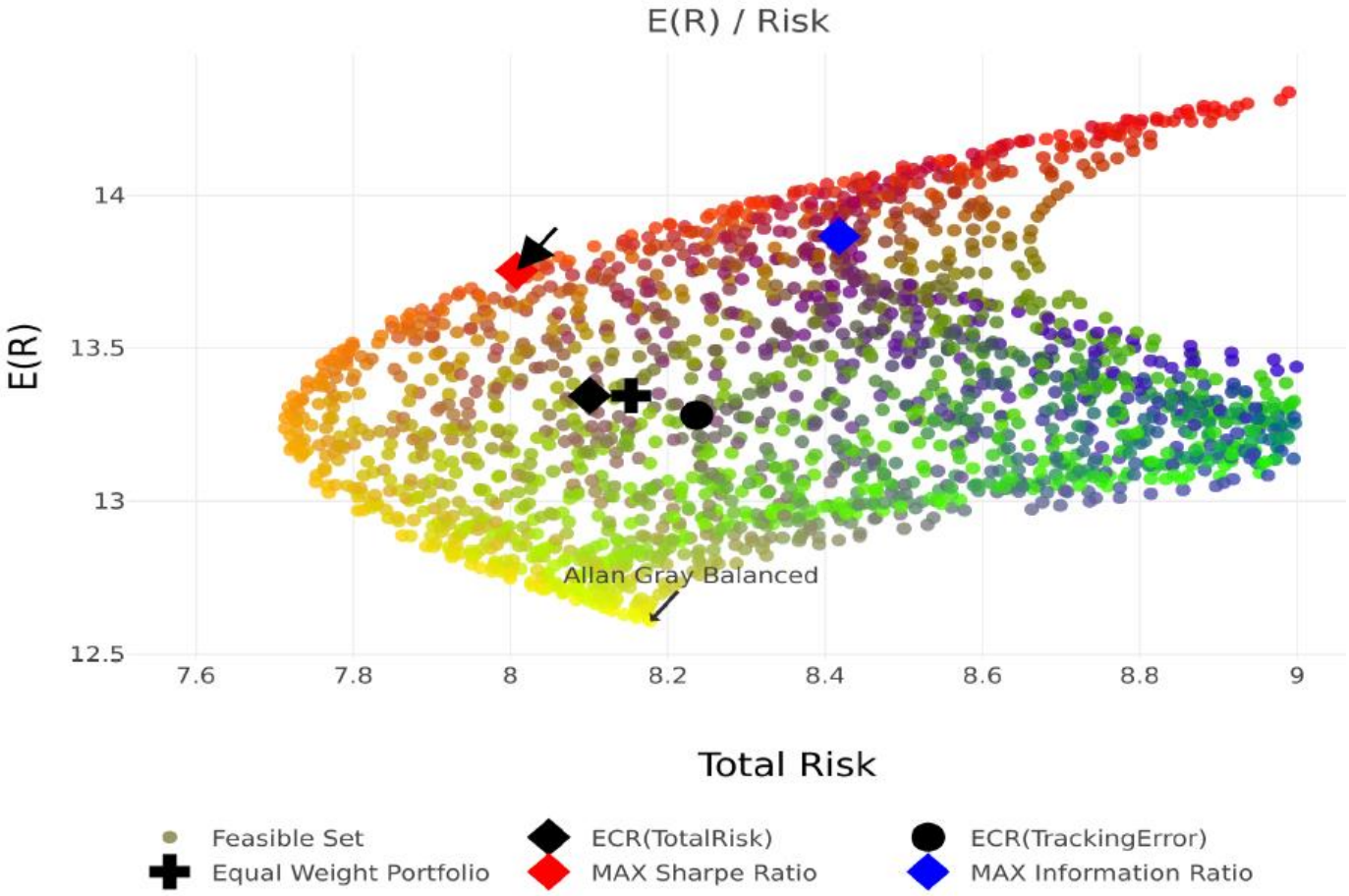
5.5.1 Multi Asset High Equity Active Blends

Once unit trusts with favourable characteristics are identified an important consideration faced by multi-managers, financial advisors and investors is what blend of exposures has the greatest likelihood of fulfilling a specific client objective or mandate. In this section the A-DEX prism quantitative toolkit is used to simulate a feasible set of 2000 potential portfolio blends using historical risk and return information. Such an analysis can be used to filter out blends that are inefficiently constructed, for example those that did not provide the maximum return for a specific level of risk. Further portfolio construction considerations available in the A-DEX prism are restrictions on tracking error i.e. the active risk managers take relative to a specified benchmark; a requirement in some institutional investment mandates as well as the 'Risk Budgeting' approach discussed in section 2.3 where an asset's risk contribution is found to be a good predictor of the contribution to ex-post loss.

Four unit trusts from the multi asset high equity category are selected for inclusion in the unit trust analysis namely Allan Gray Balanced Fund, Coronation Balanced Plus Fund, Foord Balanced Fund and Rezco Value Trend Fund. These funds outperformed their custom style and asset class benchmarks except for Allan Gray Balanced Fund whose underperformance was marginal (annualised alpha of -0.22).

The particular objective used in this example and those that follow is to target an annualised risk level of 8% while maximising annualised return. Using a common starting point of 1 January 2005 to 30 June 2018, it is found that the blend that most closely matches this objective was 32% Allan Gray Balanced Fund, 64% Rezco Value Trend Fund and 4% Coronation Balanced Plus Fund. In this particular scenario this point also represents the blend with the highest risk-adjusted return or Sharpe ratio. A visual representation of the information is presented in Figure 5.5 below where annualised expected return is plotted on the y-axis and annualised total risk or standard deviation is plotted on the x-axis. The proportional contribution of each unit trust to total risk and tracking error is also presented. The simple benchmark of 60% SWIX, 30% ALBI and 10% STEFI is used as the multi asset high equity benchmark in this example. The blend being discussed in the figure is indicated by a large black arrow. For assets with similar risk such as those considered in this example, the combination that contributes equally to total risk (ECR) is similar to an equally weighted portfolio and the point of equal contribution to tracking error as indicated in Figure 5.5.

Figure 5.5 Feasible set of potential Active Manager blends



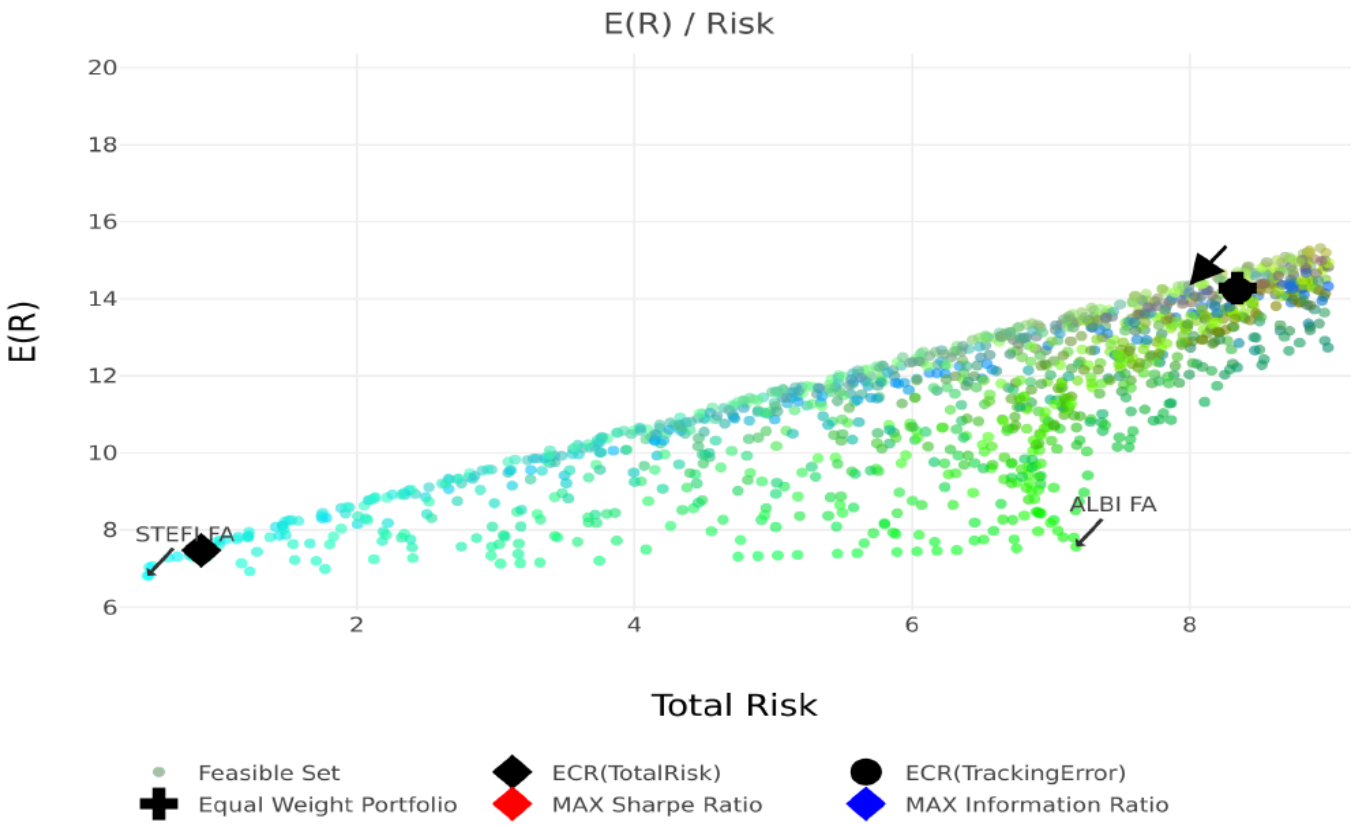
Name	Weight(%)	Risk Contribution(%)	TE Contribution(%)
Rezco Value Trend	64	69.37	76.08
Allan Gray Balanced	32	26.88	22.25
Coronation Balanced Plus	4	3.74	1.67

Total Return	Total Risk	Tracking Error
13.753	8.008	6.998

5.5.2 Multi Asset Style Index Blend

In this section a custom multi asset high equity blend with substantial exposure to style indices is presented. Such a portfolio is liquid, diversified and given its rules-based nature is not susceptible to style drift. The same example of maximising annualised return while targeting annualised risk of 8% as in Section 5.5.1 is used and covers the same period - 1 January 2005 to 30 June 2018. The style indices used are Low volatility, Value and Momentum for equities with the ALBI and STEFI used to gain exposure to the bond and cash asset classes respectively. The blend being discussed in Figure 5.6 is indicated by a large black arrow.

Figure 5.6 Feasible set of potential style index blends



Name	Weight(%)	Risk Contribution(%)	TE Contribution(%)
Momentum	22	38.19	25.49
Low Vol	24	33.87	29.23
Value	16	27.68	6.95
ALBI FA	2	0.55	1.02
STEFI FA	36	−0.29	37.31

Total Return	Total Risk	Tracking Error
14.343	7.996	4.12

In this blend each style index contributes roughly 1/3 toward the overall risk in a risk budgeting sense. Most notably this portfolio achieved an annualised return of 14.343% approximately 0.59% greater than the active unit trust high equity blend for approximately the same amount of risk.

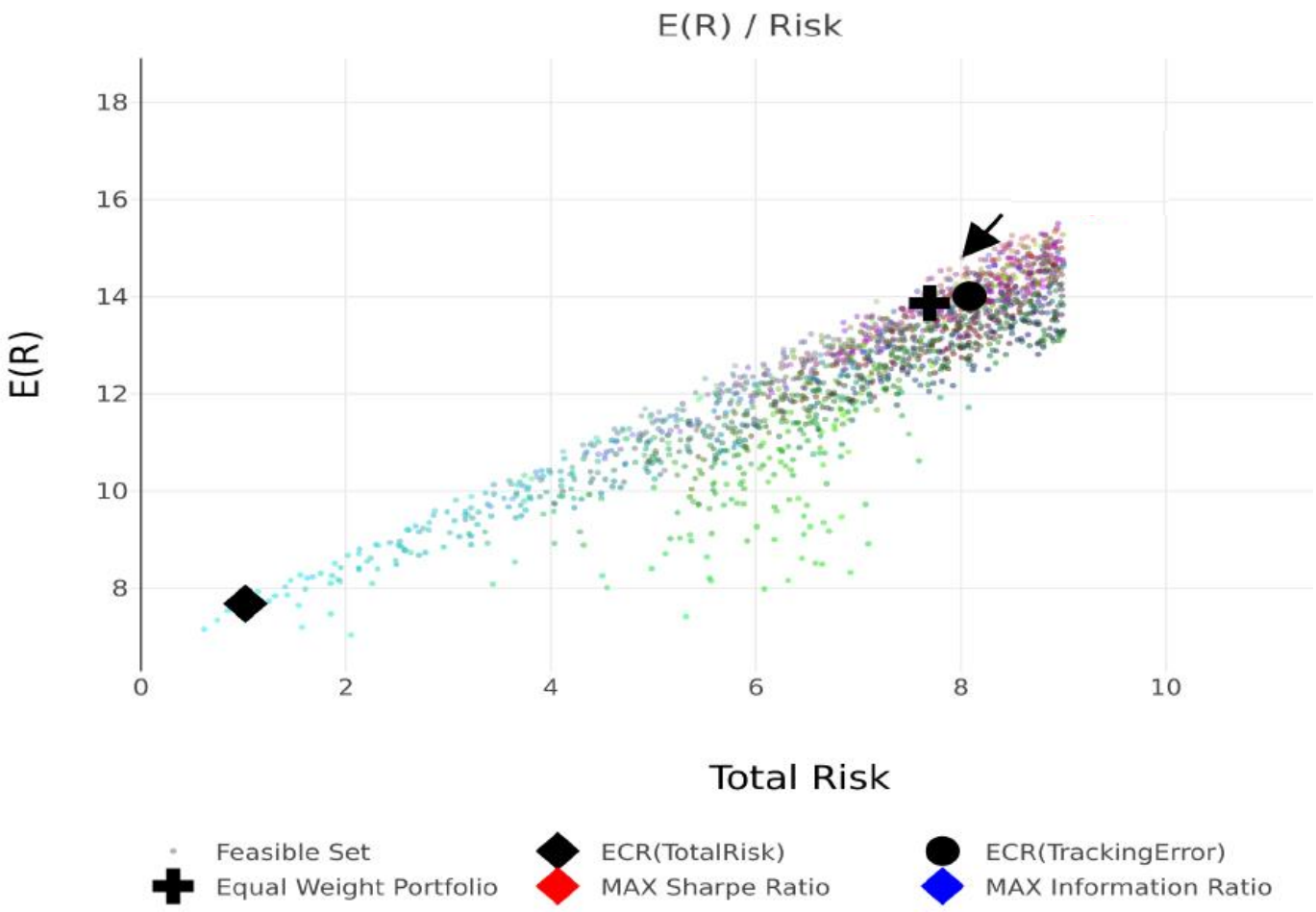
5.5.3 Combining Style Indices and Active Management

The results of the returns-based style analysis and subsequent performance measurement for the multi asset high equity unit trusts examined in this study provide evidence to support the notion that certain active managers do outperform their custom style and asset class benchmarks over a period of at least ten years. This indicates that there may be benefits to the inclusion of active unit trusts alongside a multi asset style index blend. Using the A-DEX prism quantitative toolkit a feasible set of 2000 potential portfolio blends is simulated using the risk and return of the following assets: Allan Gray Balanced Fund, Coronation Balanced Plus Fund, Foord Balanced Fund, Rezco Value Trend Fund, in addition to the Low Volatility, Value, Momentum, ALBI and STEFI style and asset class indices. The blend that provides the best return with a target annualised risk level of 8% is indicated in Figure 5.7.

Such a blend has an annualised total return of 14.798% an enhancement of 0.455% over the style and asset class index blend stated in Figure 5.6. Unlike the blend in Figure 5.6 this blend does not include an allocation to the Momentum style index but has a 32% Rezco Value Trend Fund weighting and a significantly lower STEFI cash index weighting. Recall from Table 5.4 that Rezco Value Trend Fund displayed the highest average exposure to both cash and the momentum style in the high equity classification, given the long-term excess return provided by this unit trust this substitution makes intuitive sense.

Overall this combination of assets provides the greatest return for the specified level of risk and emphasises that a combination of active and passive exposures could provide a favourable outcome to investors.

Figure 5.7 Feasible set of potential style and asset class indices combined with unit trusts



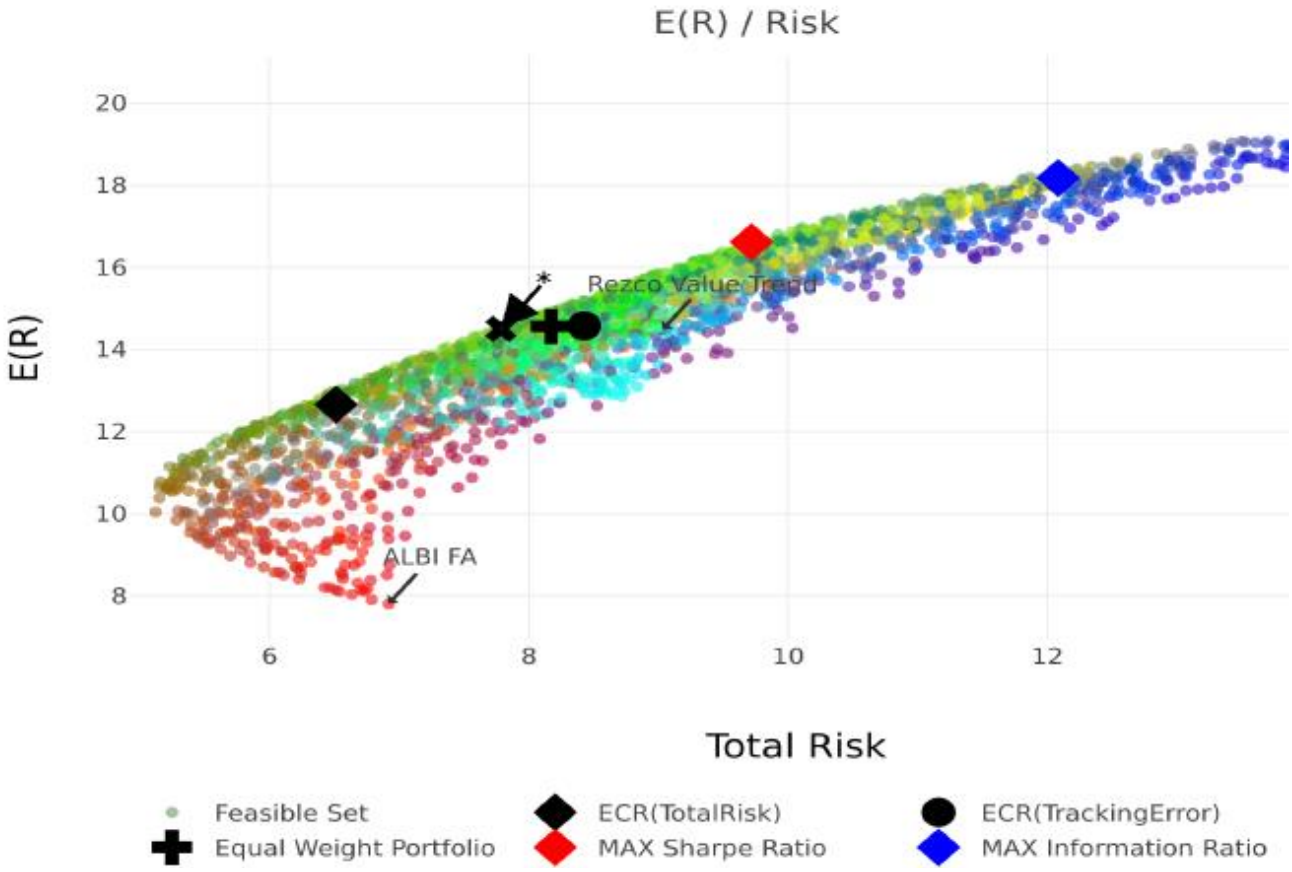
Name	Weight(%)	Risk Contribution(%)	TE Contribution(%)
Low Vol	38	53.43	37.51
Value	8	12.47	0.13
ALBI FA	2	0.37	0.54
STEFI FA	14	−0.13	12.08
Rezco Value Trend	32	29.40	45.93
Allan Gray Balanced	6	4.46	3.82

Total Return	Total Risk	Tracking Error
14.798	8.011	4.98

5.5.4 Risk Contributions

The previous examples attempted to maximise the expected return for a targeted level of risk. The implicit assumption was to use the annualised historical return as the expected return for the assets under consideration, but of course past performance may not be the best indicator of future results. Reliance on expected return inputs - historical or otherwise and a re-emphasis on diversification following the 2008 financial crisis prompted the mainstream emergence of 'Risk Budgeting' approaches (Bruder and Roncalli, 2012). To illustrate the utilisation of such an approach, it is clear from Figure 5.7 that more than half of the portfolio's risk is attributable to the 38% allocation to the Low Volatility active index. With the majority of the remaining risk arising from the 29.4% allocation to Rezco Value Trend Fund. As indicated by Malkiel (2003) and Kruger and Toerien (2014) factors associated with style effects can be sensitive to certain sample periods. It is also well established that different asset classes benefit under different macroeconomic conditions (see Bridgewater 2011). Therefore, where possible and without specific consideration for the quantum of expected return we attempt to increase the diversification in the portfolio with respect to style and asset class risk contributions with the goal of enhancing long-term robustness. The result is a less concentrated portfolio indicated by the large black arrow in Figure 5.8. The Low Volatility active index now represents 40% of the risk budget with a greater proportion of the remaining risk budget spread across the other assets. The risk and expected return of a such a portfolio is similar to the previous examples (maintaining an equity bias) but emphasis is placed on increased diversification with regard to asset class, manager and style.

Figure 5.8 Portfolio after Risk Budgeting considerations



Name	Weight(%)	Risk Contribution(%)	TE Contribution(%)
ALBI FA	18	16.93	13.15
Low Vol	28	40.01	32.32
Value	10	14.44	17.32
Rezco Value Trend	26	22.87	25.27
Allan Gray Balanced	18	5.76	11.95

Total Return	Total Risk	Tracking Error
14.502	7.783	4.184

5.6 Summary

This section presented the results of the Sharpe (1992) RBSA approach as applied to the sample of SA multi asset unit trusts with each ASISA classification discussed separately. The multi asset high equity unit trusts that displayed the best style and asset class adjusted performance and risk characteristics were then allocated to a portfolio using portfolio construction tools in the context of an illustrative client objective. Alternative portfolios were examined that included only style and asset class index exposure as well as a combination of active unit trusts and style and asset class indices. To further enhance portfolio robustness the 'Risk Budgeting' approach was applied in the last example.

Of the 15 multi asset high equity unit trusts examined, 12 displayed negative alpha relative to their custom benchmark and 5 exhibited negative alpha that was statistically different from zero at the 10% level. Of the 11 unit trusts that displayed negative alpha there was no evidence of underperformance at a statistical level of significance relative to a simple asset class benchmark. The custom benchmark/shadow portfolios estimated for each unit trust were able to explain a large proportion of the variation in return particularly in the multi asset high equity classification. There were 3 multi asset high equity unit trusts that could outperform the style and asset class benchmarks estimated using RBSA but more than half of the funds examined could not outperform. Due to the small number of multi asset medium equity funds that met the filter criteria for fund size and return history the analysis of funds in this category was limited. In the multi asset low equity classification 8 unit trusts were examined but only the Allan Gray Stable Fund could outperform its shadow portfolio. However, the shadow portfolio was mis specified and could not explain much variation in this fund's returns as a large portion of Allan Gray Stable Fund was invested in derivative hedged equities, an exposure that by its nature is not available to retail investors in a passive form.

The A-DEX prism quantitative toolkit was used to simulate a feasible set of 2000 potential portfolio blends of the selected multi asset high equity unit trusts using their historical risk and return information. This analysis was used to filter out blends that were inefficiently constructed such as those combinations that did not maximise return for a certain level of risk ex post with the ultimate goal of obtaining a better performing portfolio. The results of the returns-based style analysis and subsequent performance measurement for the multi asset high equity unit trusts examined in this

study provided evidence to support the notion that certain active managers do outperform their custom style and asset class benchmarks over a period of at least ten years. This indicates that there may be benefits to the inclusion of active unit trusts alongside a multi asset style index blend. A portfolio that combined the identified unit trusts and style and asset class indices provided the greatest return for the specified level of risk ex post and emphasises that a combination of active and passive exposures could provide a favourable outcome to investors.

The 'Risk Budgeting' approach ignores expected return inputs and is focused on an asset's risk contribution which is found to be a good predictor of the contribution to ex-post loss. This represents an alternative to constructing portfolios that seek to maximise risk adjusted returns based on past performance and there is evidence to suggest that the implementation of this approach can enhance portfolio robustness.

This study has applied RBSA as a method of identifying multi asset unit trusts that can outperform style and asset class indices with the ultimate goal of creating portfolios that can improve the financial well-being of retirement savers through superior investment performance. Portfolio construction tools such as portfolio simulation and the 'Risk Budgeting' approach may also be able to assist in the improvement of a portfolio's risk and return characteristics. The limited number of unit trusts that could demonstrate superior security selection ability, among those examined, suggests that many asset managers stand to be disrupted by lower cost products that can provide similar style and asset class index exposure.

6. LIMITATIONS & CONSTRAINTS

In this section the limitations and constraints that underlie this investigation are discussed. It is necessary that the reader understands these limitations so that future research may provide further insight into the style adjusted performance of multi asset unit trusts in South Africa.

In order to make the specified model practical and more importantly represent asset combinations that are both liquid and investible in South Africa, the style indices used in this investigation do not meet all the requirements as set out by Sharpe (1992). The first limitation is that they are not mutually exclusive. Such a problem is difficult to overcome in a South African context given the considerably smaller share universe, liquidity constraints and the significant levels of concentration amongst just a few companies relative to developed markets. As a result, the Value, Momentum and Low Volatility indices exhibit reasonably high correlations but do exhibit different volatility profiles. All returns information for an index before its launch date is back-tested. When performance is back-tested, it is not actual performance and is subject to inherent limitations because it represents the application of an Index methodology to select index constituents after the fact. Return and risk for the Value index is live from December 2009. Return and risk for the Low Volatility Index is live from April 2016 and return and risk is live for the Momentum index from May 2017.

Moreover, in a regulation 28 multi asset context the asset classes specified in the RBSA model are by no means exhaustive. As indicated in Appendix A unlisted equities, fund of hedge funds and fund of private equity funds can be held by regulation 28 compliant unit trusts. It is unlikely that passive replication will ever be available for these types of exposures in South Africa and as a result an RBSA model cannot sufficiently explain the returns of unit trusts that hold these assets. Care has been taken to ensure that allocations in this work are Regulation 28 compliant. Where breaches due to historical market movements occurred, funds generally have 12 months to correct the position, but no new investments may be made into assets in breach (10X Investments, 2017).

The sample of unit trusts was limited to those in the multi asset high equity, multi asset medium equity and multi asset low equity classifications that are regulation 28 compliant with sizeable assets under management and sufficient performance history. In general, the multi asset high equity classification provided the most meaningful results. Due to the small number of multi asset medium equity funds that met the filter criteria for fund size and return history the analysis of this classification was limited. The multi asset low equity classification provided mixed results as a consequence of low R-squared figures for 3 of the 8 unit trusts examined in the classification. The multi asset flexible classification was excluded from this investigation as unit trusts in this classification are generally not regulation 28 compliant due to the flexibility of their mandate (Cameron, 2014).

7. CONCLUSION

This study set out to provide a returns-based style analysis of multi asset unit trusts in South Africa to determine their style and asset class exposures over time. Using this information, the objective was to determine whether large South African multi asset fund managers can realise outperformance that exceeds what can be obtained through exposure to representative, investable, style and asset class indices. The equity style exposures estimated using RBSA revealed that on average the value style was dominant across the multi asset high equity unit trusts examined, whereas for the multi asset low equity unit trusts examined the low volatility style was dominant. The results of the performance evaluation show that only 3 out of the 15 multi asset high equity unit trusts analysed could provide returns greater than those of a custom style and asset class benchmark estimated using RBSA with one additional unit trust displaying only marginal underperformance. Of the 12 unit trusts displaying negative alpha, 5 exhibited negative alpha that was statistically different from zero at the 10% level. Only 1 of the 8 unit trusts examined in the multi asset low equity classification could outperform its custom style and asset class benchmark but this result is not conclusive as the model could not accurately capture the return profile of this unit trust. However, a large proportion of the variability in returns of many of the multi asset unit trusts studied, can be explained by exposure to style and asset class indices.

As the availability, sophistication and track-record of smart beta products in the South African market increases, investors will be faced with more compelling investment options. These results raise further questions surrounding the justification of fees for many multi-asset managers while others have demonstrated an ability to outperform. The findings emphasise the need for more advanced models that are able to adequately capture the risks associated with unit trust exposures to enhance multi asset benchmarking. Despite its limitations RBSA remains a powerful supplementary technique to better understand unit trust exposures particularly when detailed holdings information cannot be obtained. After qualitative research has identified assets to be included in a portfolio and some intuition has been applied, quantitative techniques such as risk budgeting and portfolio construction methods that filter out blends that are inefficiently constructed - though not without weakness have the potential to achieve lower risk and greater returns.

The sample of unit trusts examined in this study is by no means comprehensive but does include some of the largest by fund size and oldest by performance history. Several avenues for future research are recommended: much enquiry has been conducted on general equity funds but to better grasp the performance potential of multi asset unit trust managers, comprehensive research could be conducted into the asset class adjusted returns of South African fixed income managers. Active fixed income managers have a variety of tools and strategies at their disposal such as positions on credit quality, duration and sector and as a result may be able to add considerable value. Finally as passive alternatives with sufficient performance history become available for diversified exposure to commodities, preference shares, and foreign bonds among other assets. RBSA could be used to conduct further research into the style and asset class adjusted return of unit trusts in the multi asset income, multi asset low equity and multi asset medium equity classifications.

8. REFERENCES

1. 10X Investments. 2017. *The Final Version of Revised Regulation 28 in a Nutshell.* Available: https://www.10x.co.za/blog/the-final-version-of-revised-regulation-28-in-a-nutshell [2018, December 18]
2. 10X Investments. 2018. *10X South African Retirement Reality Report.* Available: https://cdn2.hubspot.net/hubfs/3390004/10X%20Document/10X%20SA%20Retirement%20Reality%20Report%202018.pdf [2019, January 1]
3. Absa. 2018. Minimum Disclosure Document NewFunds TRACI 3 Month ETF, June 2018. Available: http://etfcib.absa.co.za/Fund%20Documents/NewFunds%20TRACI%203%20Month-30%20June%202018.pdf [2018, September 12].
4. Allan Gray. 2018. *Stable Fund: Safeguarding our clients' capital is our core focus.* Available: https://www.allangray.co.za/latest-insights/local-investing/stable-fund-safeguarding-our-clients-capital-is-our-core-focus/ [2018, November 27]
5. ASISA. 2017. *ASISA standard on fund classification for south african regulated collective investment scheme portfolios.* Available: https://www.asisa.org.za/wp-content/uploads/2018/06/ASISA-Fund-Classification-Standard-effective-2017-06-07.pdf [2018, October 7]
6. ASISA. 2018. *LOCAL FUND STATISTICS.* Available: https://www.asisa.org.za/statistics/collective-investment-schemes/local-fund-statistics/ [2018, December 27]
7. Baker, M., Bradley, B. & Taliaferro, R. 2014. The Low-Risk Anomaly: A Decomposition into Micro and Macro Effects. *Financial Analysts Journal.* 70(2):43-58. DOI: 10.2469/faj.v70.n2.2.
8. Banz, R.W. 1981. The relationship between return and market value of common stocks. *Journal of Financial Economics.* 9(1):3-18. DOI: https://doi.org/10.1016/0304-405X(81)90018-0

9. Basu, S. 1977. *The Investment Performance of Common Stocks in Relation to Their Price/Earnings Ratio: A Test of the Efficient Market Hypothesis.* DOI:10.1111/j.1540-6261.1977.tb01979.x.

10. Black, F. 1972. Capital market equilibrium with restricted borrowing. *The Journal of Business.* 45(3):444-455. DOI: http://dx.doi.org/10.1086/295472

11. Blitz, D.C. & van Vliet, P. 2007. The Volatility Effect. *Journal of Portfolio Management.* 34(1):102-113. DOI: https://doi.org/10.3905/jpm.2007.698039

12. Bollen, N.P.B. & Busse, J.A. 2001. On the Timing Ability of Mutual Fund Managers. *Journal of Finance.* 56(3):1075-1094. DOI: https://doi.org/10.1111/0022-1082.00356

13. Bridgewater. 2011. *Risk Parity is about Balance.* Available: https://www.bridgewater.com/resources/risk-parity-is-about-balance.pdf [2019, January 24]

14. Bruder, Benjamin & Roncalli, Thierry, 2012. Managing risk exposures using the risk budgeting approach. *MPRA Paper 37246*, University Library of Munich. Available: https://mpra.ub.uni-muenchen.de/37246/1/MPRA_paper_37246.pdf [2019, January 20]

15. Buetow, G.W., Jr., Johnson, R.R. & Runkle, D.E. 2000. The Inconsistency of Return-Based Style Analysis. *Journal of Portfolio Management.* 26(3):61-77. DOI: http://www.iijournals.com/loi/jpm.

16. Cameron, J. 2014. *Multi Asset Class Flexible funds: why they beat balanced and equity funds.* Available: https://www.biznews.com/wealth-building/2014/02/04/multi-asset-class-flexible-funds-theyre-stars-unit-trust-show [2019, January 1]

17. Chui, A.C., Titman, S. & Wei, K.J. 2010. Individualism and momentum around the world. *The Journal of Finance.* 65(1):361-392. DOI: https://doi.org/10.1111/j.1540-6261.2009.01532.x

18. Henriksson, R.D. and Merton, R.C., 1981. On Market Timing and Investment Performance. II. Statistical Procedures for Evaluating Forecasting Skills. *The Journal of Business.* 54:513-33. DOI: 10.1086/296144.

19. De Bondt, W.F.M. & Taler, R.H. 1987. Further Evidence On Investor Overreaction and Stock Market Seasonality. *The Journal of Finance.* 42(3):557-581. DOI:10.1111/j.1540-6261.1987.tb04569.x.

20. Dor, A.B., Jagannathan, R. & Meier, I. 2003. Understanding Mutual Fund and Hedge Fund Styles Using Return-Based Style Analysis. *Journal of Investment Management.* 1(1):94-134. DOI: https://www.joim.com/article-archives/.

21. Eddy, C. 2014. Style adjusted performance of South African general equity unit trusts. Mcom Thesis. University of Cape Town. Available: http://hdl.handle.net/11427/8558 [2018, December 29].

22. Fama, E.,F. & French, K. 1993. Common Risk Factors in Returns on Stocks and Bonds. *Journal of Financial Economics.* 33:3-56. DOI: 10.1016/0304-405X(93)90023-5.

23. Fama, E.F. & French, K.R. 1992. The Cross-Section of Expected Stock Returns. *The Journal of Finance.* 47(2):427-465. DOI: 10.1111/j.1540-6261.1992.tb04398.x.

24. Fama, E.F. & French, K.R. 1996. Multifactor Explanations of Asset Pricing Anomalies. *The Journal of Finance.* 51(1):55-84. DOI: 10.1111/j.1540-6261.1996.tb05202.x.

25. Fama, E.F. & MacBeth, J.D. 1973. Risk, Return, and Equilibrium: Empirical Tests. *Journal of Political Economy.* 81(3):607-636. DOI: 10.1086/260061.

26. Farrell Jr, J.L. 1975. Homogeneous stock groupings: Implications for portfolio management. *Financial Analysts Journal.* 31(3):50-62. Available: https://www.jstor.org/stable/4477825 [2018, December 29].

27. Fisher, K.L. & Statman, M. 1997. The Mean-Variance-Optimization Puzzle: Security Portfolios and Food Portfolios. *Financial Analysts Journal.* 53(4):41-50. DOI: https://doi.org/10.2469/faj.v53.n4.2098

28. Frazzini, A. & Pedersen, L.H. 2014. Betting against beta. *Journal of Financial Economics.* 111(1):1-25. DOI: https://doi.org/10.1016/j.jfineco.2013.10.005

29. Fung, W. & Hsieh, D.A. 1996. Performance Attribution and Style Analysis: From Mutual Funds to Hedge Funds. *Working Paper Duke Fuqua School of Business.* :1-41. Available: https://faculty.fuqua.duke.edu/~dah7/style.pdf [2018, December 29].

30. Graham, B. & Dodd, D.L. 1934. *Security analysis: Principles and technique.* McGraw-Hill.

31. Grinold, R.C. & Kahn, R.N. 2000. *Active portfolio management.* McGraw Hill New York, NY.

32. Hodnett, K., Hsieh, H. & van Rensburg, P. 2012. Payoffs To Equity Investment Styles On The JSE Securities Exchange: The Case Of South African Equity Market. *International Business & Economics Research Journal (IBER).* 11:19. DOI: 10.19030/iber.v11i1.7153.

33. Hsieh, H. 2013. A Review of Performance Evaluation Measures for Actively-Managed Portfolios. *Journal of Economics and Behavioral Studies.* 5 number 12. Available: http://hdl.handle.net/10566/2582 [2018, December 29].

34. Jegadeesh, N. & Titman, S. 1993. Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency. *Journal of Finance.* 48(1):65-91. DOI: http://onlinelibrary.wiley.com/journal/10.1111/%28ISSN%291540-6261/issues.

35. Jensen, M.C. 1968. The performance of mutual funds in the period 1945–1964. *The Journal of Finance.* 23(2):389-416. DOI: https://doi.org/10.1111/j.1540-6261.1968.tb00815.x

36. Keim, D.B. 2016. Financial Market Anomalies. In *The New Palgrave Dictionary of Economics.* London: Palgrave Macmillan UK. DOI: https://doi.org/10.1057/978-1-349-95121-5_1958-1

37. Kidd, D. 2011. Measures of risk-adjusted return: let's not forget Treynor and Jensen. *Investment Performance Measurement Feature Articles.* 2011(1). Available: https://static1.squarespace.com/static/571a590286db43237523fc11/t/585168a1b3db2bd1b028b722/1481730218485/Measures+of+Risk-Adjusted+Return.pdf [2018, December 29].

38. Kidd, D. 2011. The Sharpe Ratio and the Information Ratio. *Investment Performance Measurement Feature Articles.* 2011(1):1-4. DOI:10.2469/ipmn.v2011.n1.7.

39. King, B.F. 1966. Market and industry factors in stock price behavior. *The Journal of Business.* 39(1):139-190. Available: https://www.jstor.org/stable/2351742 [2018, December 29].

40. Kruger, R. & Toerien, F. 2014. The consistency of equity style anomalies on the JSE during a period of market crisis. *African Finance Journal,.* 16(1):1-18. Available: https://hdl.handle.net/10520/EJC156039 [2018, December 29].

41. Lintner, J. 1965. The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. *The Review of Economics and Statistics.* :13-37. DOI: https://doi.org/10.1016/B978-0-12-780850-5.50018-6

42. Litzenberger, R.H. & Ramaswamy, K. 1979. The Effect of Personal Taxes and Dividends on Capital Asset Prices: Theory and Empirical Evidence. *Journal of Financial Economics.* 7(2):163-195. DOI: https://doi.org/10.1016/0304-405X(79)90012-6

43. Maillard, S., Roncalli, T. & Teiletche, J. 2010. The Properties of Equally Weighted Risk Contribution Portfolios. *Journal of Portfolio Management.* 36(4):60-70. DOI: https://doi.org/10.3905/jpm.2010.36.4.060

44. Malkiel, B.G. 2003. The efficient market hypothesis and its critics. *The Journal of Economic Perspectives.* 17(1):59-82. DOI: https://doi.org/10.2469/dig.v33.n4.1367

45. Markowitz, H. 1952. PORTFOLIO SELECTION*. *The Journal of Finance.* 7(1):77-91. DOI: 10.1111/j.1540-6261.1952.tb01525.x.

46. Markowitz, H. 1959. *Portfolio Selection; Efficient Diversification of Investments.* Yale University Press.

47. Miller, M.,H. & Scholes, M. 1982. Dividends and Taxes: Some Empirical Evidence. *Journal of Political Economy.* 90:1118-41. DOI:10.1086/261114.

48. Moore, D. 2013. An assessment of the style and performance of South African institutional fund managers. Mcom Thesis. University of Cape Town. Available: http://hdl.handle.net/11427/12362 [2018, December 29].

49. Muller, C. & Ward, M. 2013. Style-based effects on the Johannesburg Stock Exchange: A graphical time-series approach. *Investment Analysts Journal.* 42(77):1-16. DOI: https://doi.org/10.1080/10293523.2013.11082552

50. Otten, R. & Bams, D. 2001. Statistical tests for return-based style analysis. Maastricht University Working Paper. DOI: http://dx.doi.org/10.2139/ssrn.277688

51. Qian, E. 2006. On the Financial Interpretation of Risk Contribution: Risk Budgets Do Add Up. *Journal of Investment Management.* 4(4):41-51. Available: https://www.joim.com/article-archives/. [2018, December 29].

52. Reinganum, M.R. 1981. Misspecification of capital asset pricing. *Journal of Financial Economics.* 9(1):19-46. DOI: http://dx.doi.org/10.1016/0304-405X(81)90019-2

53. Robertson, M., Firer, C. & Bradfield, D. 2000. Identifying and correcting misclassified South African equity unit trusts using style analysis. *Investment Analysts Journal.* 29(52):11-24. DOI: https://doi.org/10.1080/10293523.2000.11082409

54. Rouwenhorst, K.G. 1998. International momentum strategies. *The Journal of Finance.* 53(1):267-284. DOI: https://doi.org/10.1111/0022-1082.95722

55. Sasfin Wealth. 2018. *How to navigate a low-return environment.* Available: https://www.moneyweb.co.za/mymoney/moneyweb-financial-planning/how-to-navigate-a-low-return-environment/ [2018, September 10]

56. Satrix. 2018. Minimum Disclosure Document Satrix Bond Index Fund, July 2018. Available: https://satrix.co.za/media/25509?inline=true [2018, September 12].

57. Satrix. 2018. Minimum Disclosure Document Satrix 40, July 2018. Available: https://satrix.co.za/media/25616?inline=true [2018, September 12]

58. Satrix. 2018. Minimum Disclosure Document Satrix MSCI World Feeder ETF, July 2018. Available: https://satrix.co.za/media/25629?inline=true [2018, September 12]

59. Satrix. 2018. Minimum Disclosure Document Satrix Property ETF, July 2018. Available: https://satrix.co.za/media/25624?inline=true [2018, September 12]

60. Satrix. 2018. Minimum Dosclosure Document Satrix Money Market Fund, August 2018. Available: https://satrix.co.za/media/26198?inline=true [2018, October 7]

61. Sharpe, W.F. 1964. Capital asset prices: A theory of market equilibrium under conditions of risk. *The Journal of Finance.* 19(3):425-442. DOI: https://doi.org/10.1111/j.1540-6261.1964.tb02865.x

62. Sharpe, W.F. 1992. Asset allocation: Management style and performance measurement. *Journal of Portfolio Management.* 18(2):7-19. DOI: https://doi.org/10.3905/jpm.1992.409394

63. Strugnell, D., Gilbert, E. & Kruger, R. 2011. Beta, size and value effects on the JSE, 1994–2007. *Investment Analysts Journal.* 40(74):1-17. DOI: 10.1080/10293523.2011.11082537.

64. Swinkels, L. & Van Der Sluis, Pieter J 2006. Return-based style analysis with time-varying exposures. *The European Journal of Finance.* 12(6-7):529-552. DOI: 10.1080/13518470500248508

65. Sygnia. 2018. Sygnia All Bond Index Fund Factsheet, August 2018. Available: https://www.sygnia.co.za/docs/default-source/individuals---fund-fact-sheets/unit-trusts/2018-aug-(syaba)-sygnia-all-bond-index-fund---class-a---ffs_2016_skel.pdf?sfvrsn=74 [2018, September 12]

66. Van Rensburg, P. 2001. A decomposition of style-based risk on the JSE. *Investment Analysts Journal.* 30(54):45-60. DOI: https://doi.org/10.1080/10293523.2001.11082431

67. Van Rensburg, P. & Robertson, M. 2003a. Style characteristics and the cross-section of JSE returns. *Investment Analysts Journal.* 7(57):7. DOI: https://doi.org/10.1080/10293523.2003.11082444

68. Van Rensburg, P. & Robertson, M. 2003b. Size, price-to-earnings and beta on the JSE Securities Exchange. *Investment Analysts Journal.* 7(58):7-16. DOI: https://doi.org/10.1080/10293523.2003.11082449

69. Van Rensburg, P. 2018a. Risk Budgeting [FTX5044H Lecture notes]. Department of Finance and Tax, University of Cape Town.

70. Van Rensburg, P. 2018b. Calculating the Risk of a Multi-Asset Portfolio [FTX5044H Lecture notes]. Department of Finance and Tax, University of Cape Town.

71. Wursthorn , M., & Otani, A. 2018. *U.S. Stocks Poised to Enter Longest-Ever Bull Market.* Available: https://www.wsj.com/articles/u-s-stocks-poised-to-enter-longest-ever-bull-market-1534843800 [2018, September 10]

72. Yu, X. 2008. Style Indices and Active Portfolio Construction on the JSE. Mcom Thesis. University of Cape Town. Available: http://hdl.handle.net/11427/14038 [2018, December 29].

73. Zhang, X.F. 2006. Information Uncertainty and Stock Returns. *Journal of Finance.* 61(1):105-136. DOI:10.1111/j.1540-6261.2006.00831.x.

Appendix A - Summary of the main features of the rules applying to Regulation 28[3]

Category	Limit	Sub Limit
EQUITIES	75%	
No more than 15% in an equity where the market cap is in excess of R20bn		15%
No more than 10% in an equity where the market cap is between R2bn and R20bn		10%
No more than 5% in an equity with a market cap of less than R2bn		5%
Limit for unlisted equities Subject to strict valuation requirements		15%
Foreign exposure including inward listed shares		25%
Investment in a suitably regulated vehicle in Africa		5%
CASH No more than 25% in a single Money Market instrument issued by a South African bank	100%	
DEBT The limit for (on-balance sheet) bank issued corporate and public debt is raised to 75%	100%	
PROPERTY A fund may have up to 25% in listed property similar to equities listed property is divided in to 3sub-categories	25%	
A market cap greater than R10bn		15%
A market cap between R3bn – R10bn		10%
A market cap less than R3bn		5%
COMMODITIESA fund can invest in listed commodities up to 10% in gold or up to 5% in any other commodities	10%	
HEDGE FUNDS AND PRIVATE EQUITY Fund of hedge funds and fund of private equity funds, 5% per fund or 2.5% per hedge fund or private equity fund.	15%	
Other assets not referred to in the amendment	2.5%	
HOUSING LOANS Loans granted to members directly by the fund Loans granted to members where the fund stands as surety can take place normally as per the regulations	95%	

[3] Source: 10X Investments https://www.10x.co.za/blog/the-final-version-of-revised-regulation-28-in-a-nutshell

Appendix B - ASISA standard on fund classification for South African regulated collective investment scheme portfolios[4]

5.2. Multi Asset Portfolios:

Multi Asset portfolios are portfolios that invest in a wide spread of investments in the equity, bond, money and property markets to maximise total returns (comprising capital and income growth) over the long term.

5.2.1. Multi Asset – Flexible portfolios - These portfolios invest in a flexible combination of investments in the equity, bond, money and property markets. The underlying risk and return objectives of individual portfolios may vary as dictated by each portfolio's mandate and stated investment objective and strategy. These portfolios may be aggressively managed with assets being shifted between the various markets and asset classes to reflect changing economic and market conditions and the manager is accorded a significant degree of discretion over asset allocation to maximise total returns over the long term.

5.2.2. Multi Asset - High Equity portfolios - These portfolios invest in a spectrum of investments in the equity, bond, money, or property markets. These portfolios tend to have an increased probability of short term volatility, aim to maximise long term capital growth and can have a maximum effective equity exposure (including international equity) of up to 75% and a maximum effective property exposure (including international property) of up to 25% of the market value of the portfolio. The underlying risk and return objectives of individual portfolios may vary as dictated by each portfolios mandate and stated investment objective and strategy.

5.2.3. Multi Asset - Medium Equity portfolios - These portfolios invest in a spectrum of investments in the equity, bond, money, or property markets. These portfolios tend to display average volatility, aim for medium to long term capital growth and can have a maximum effective equity exposure (including international equity) of up to 60% and a maximum effective property exposure (including international property) of up to 25% of the market

[4] Source: ASISA https://www.asisa.org.za/wp-content/uploads/2018/06/ASISA-Fund-Classification-Standard-effective-2017-06-07.pdf

value of the portfolio. The underlying risk and return objectives of individual portfolios may vary as dictated by each portfolios mandate and stated investment objective and strategy.

5.2.4. Multi Asset - Low Equity portfolios - These portfolios invest in a spectrum of investments in the equity, bond, money, or property markets. These portfolios tend to display reduced short term volatility, aim for long term capital growth and can have a maximum effective equity exposure (including international equity) of up to 40% and a maximum effective property exposure (including international property) of up to 25% of the market value of the portfolio. The underlying risk and return objectives of individual portfolios may vary as dictated by each portfolios mandate and stated investment objective and strategy.

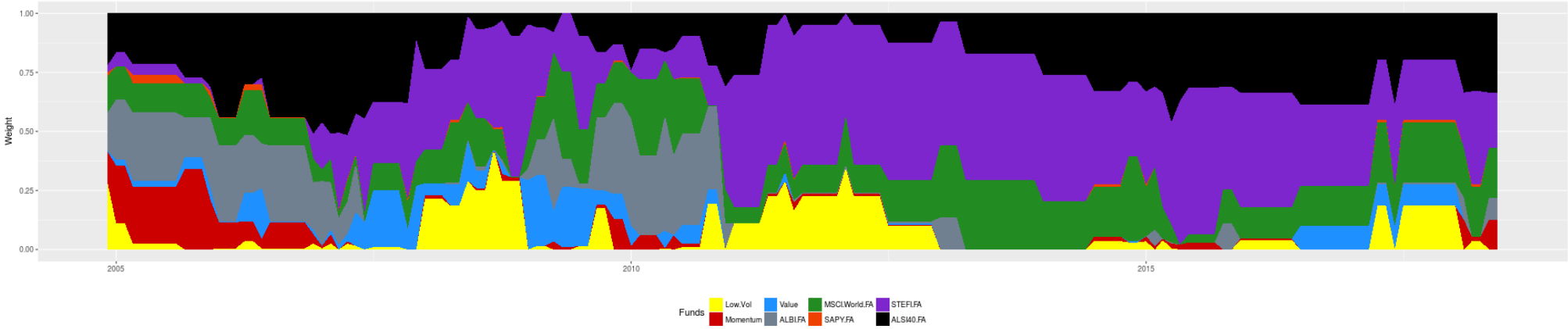
5.2.5. Multi Asset – Income portfolios – These portfolios invest in a spectrum of equity, bond, money market, or real estate markets with the primary objective of maximising income. The underlying risk and return objectives of individual portfolios may vary as dictated by each portfolios mandate and stated investment objective and strategy. These portfolios can have a maximum effective equity exposure (including international equity) of up to 10% and a maximum effective property exposure (including international property) of up to 25% of the market value of the portfolio.

5.2.6. Multi Asset – Target Date portfolios – These portfolios invest in a spectrum of equity, bond, money market, or real estate markets where the asset mix changes over time in a predetermined manner as the target date approaches. Due to the change in asset mix over time, portfolios in this category cannot be compared and consequently cannot be ranked.

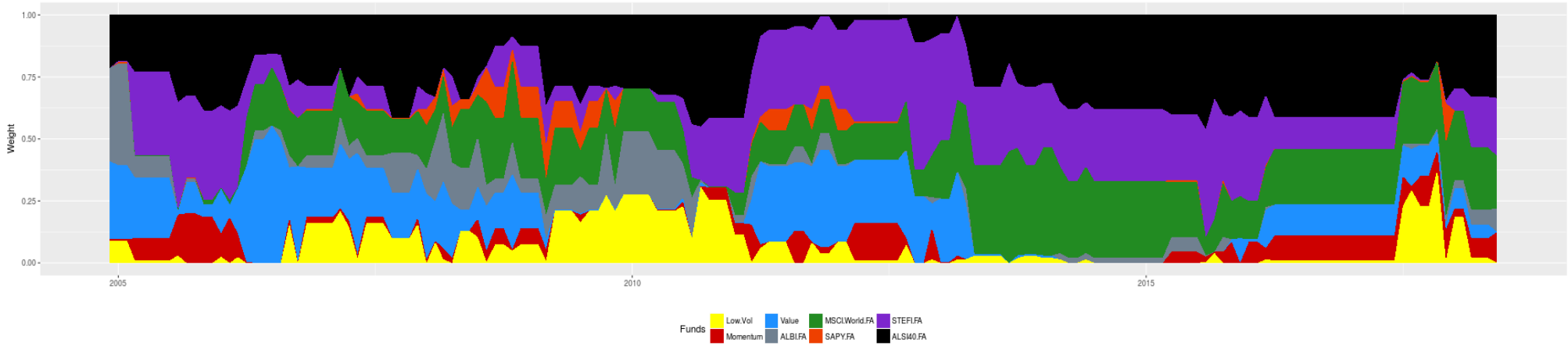
Appendix C – Multi asset unit trust style maps

Multi Asset High Equity

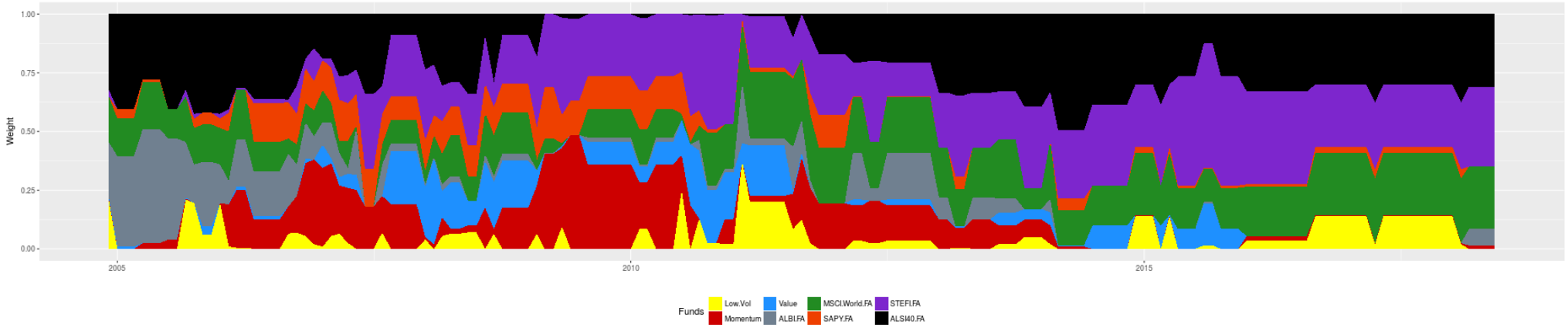
Allan Gray Balanced 2004/12/01 to 2018/06/01



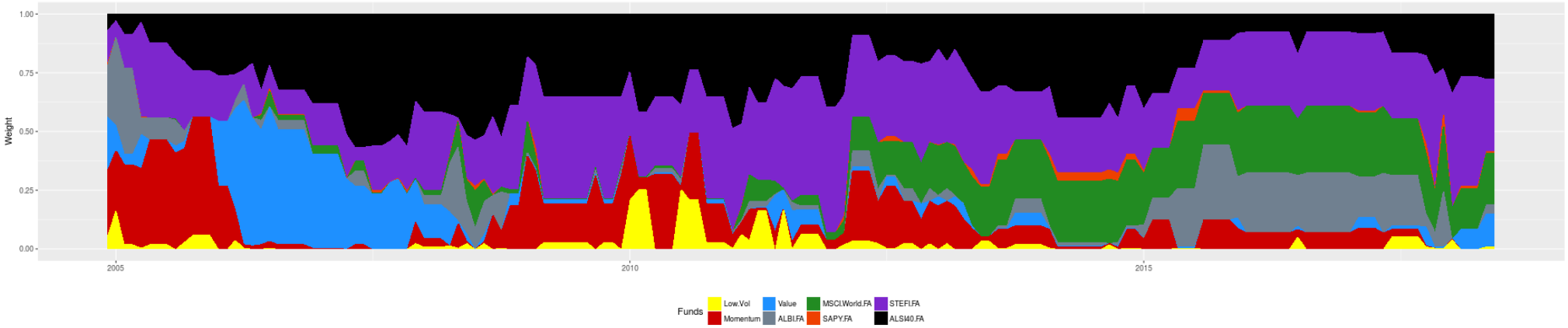
Coronation Balanced Plus 2004/12/01 to



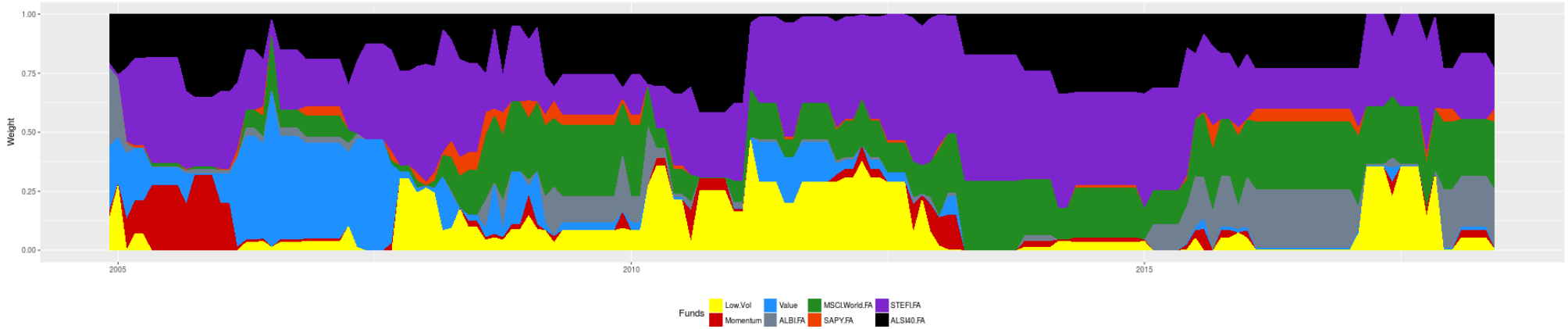
Foord Balanced 2004/12/01 to 2018/06/01



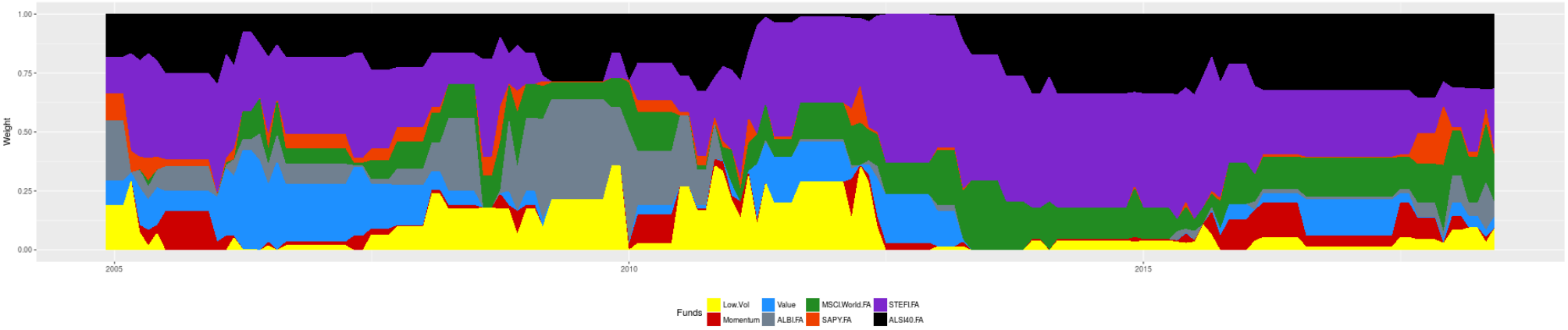
Investec Managed 2004/12/01 to 2018/06/01



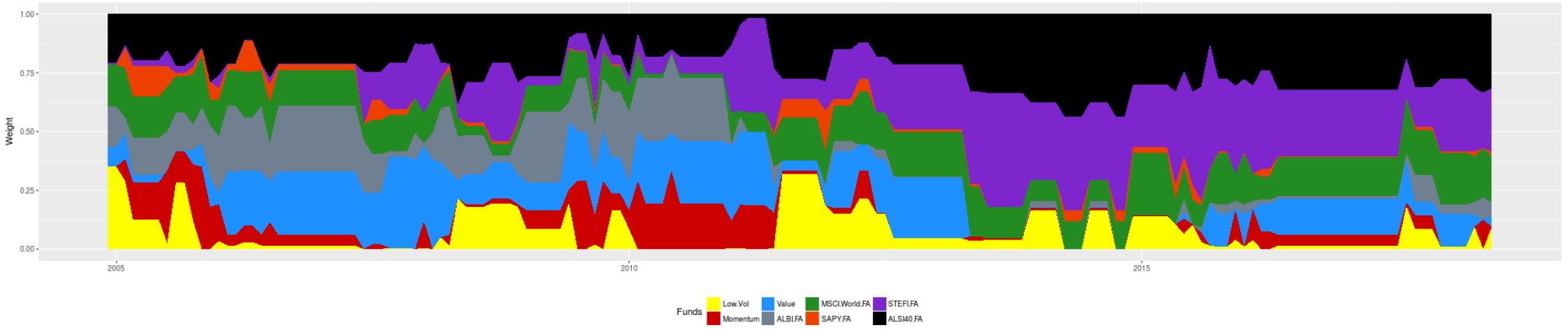
Investec Opportunity 2004/12/01 to 2018/06/01



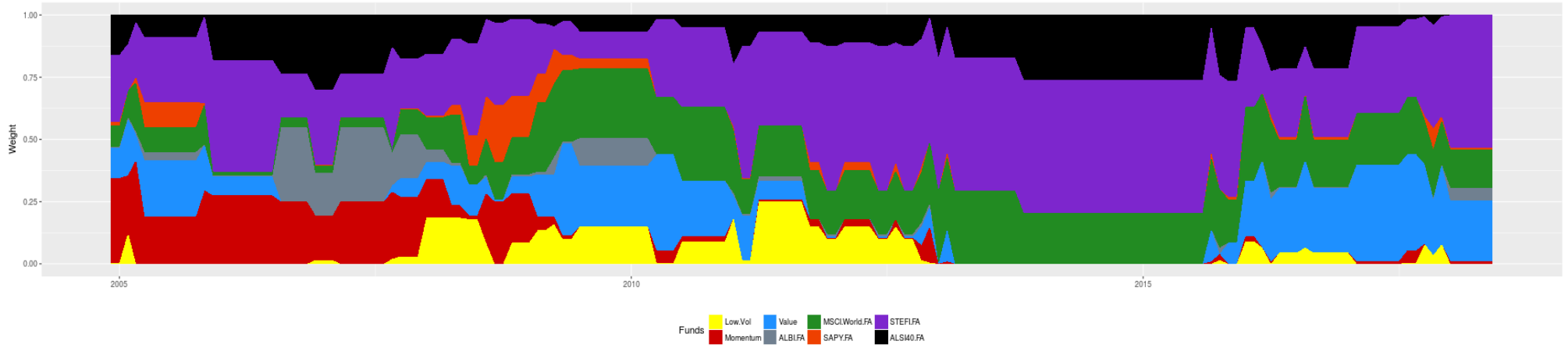
Old Mutual Multi-Managers Balanced FoF 2004/12/01 to 2018/06/01



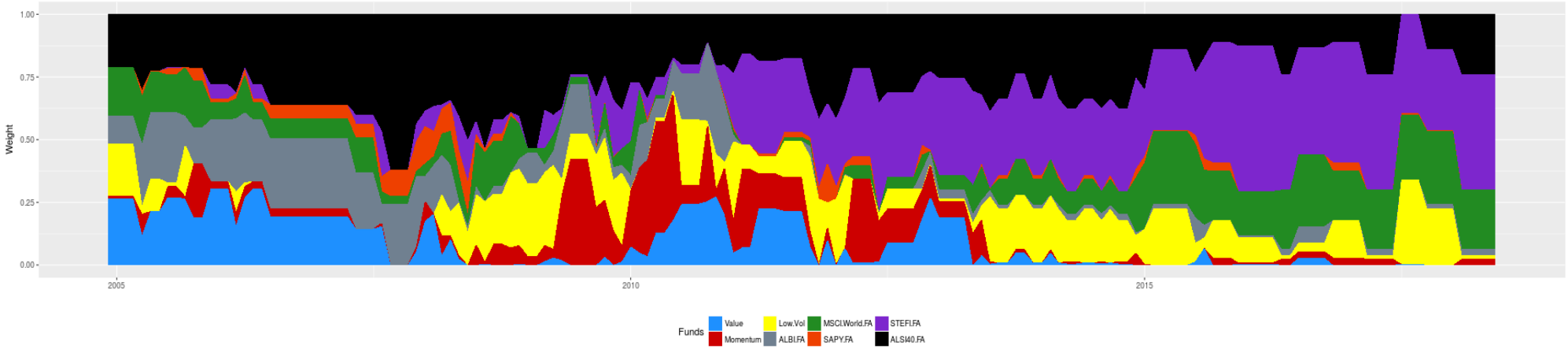
Prudential Balanced 2004/12/01 to 2018/06/01



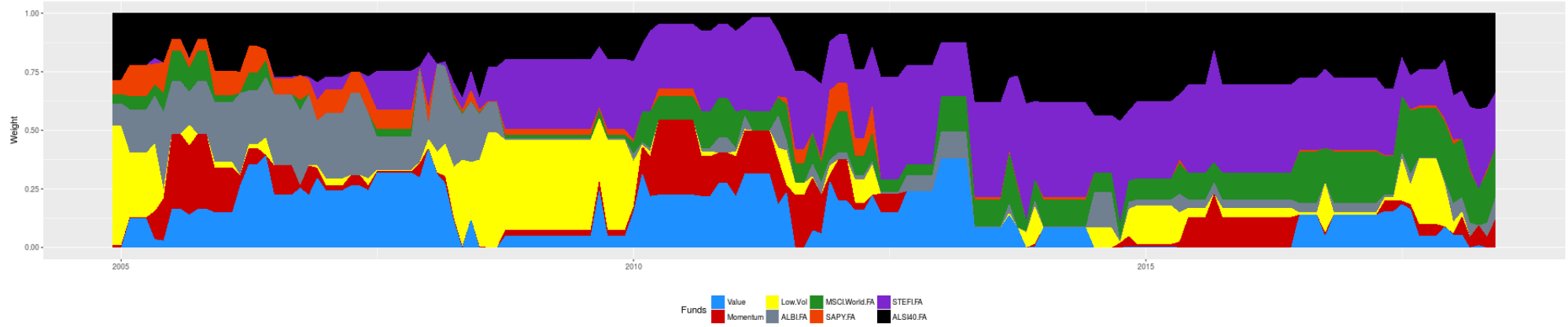
PSG Balanced 2004/12/01 to 2018/06/01



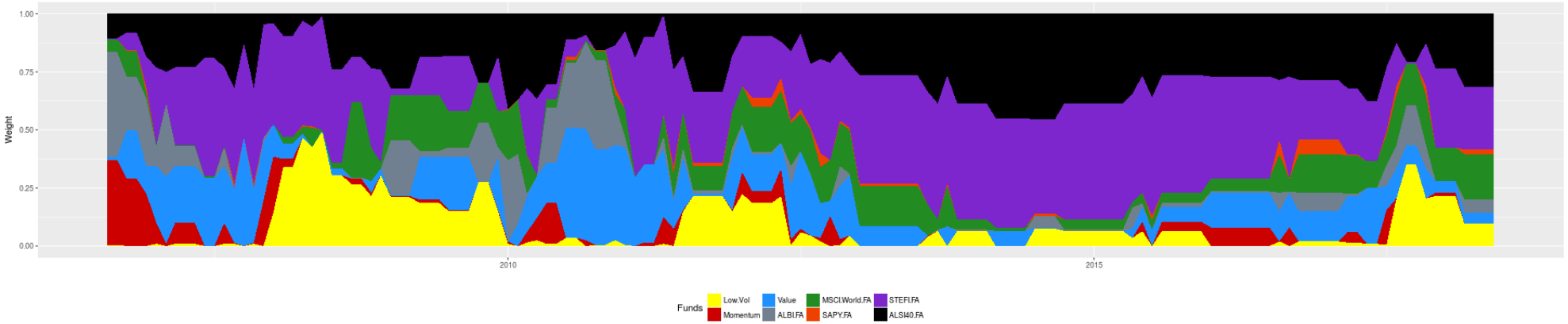
Stanlib Balanced 2004/12/01 to 2018/06/01



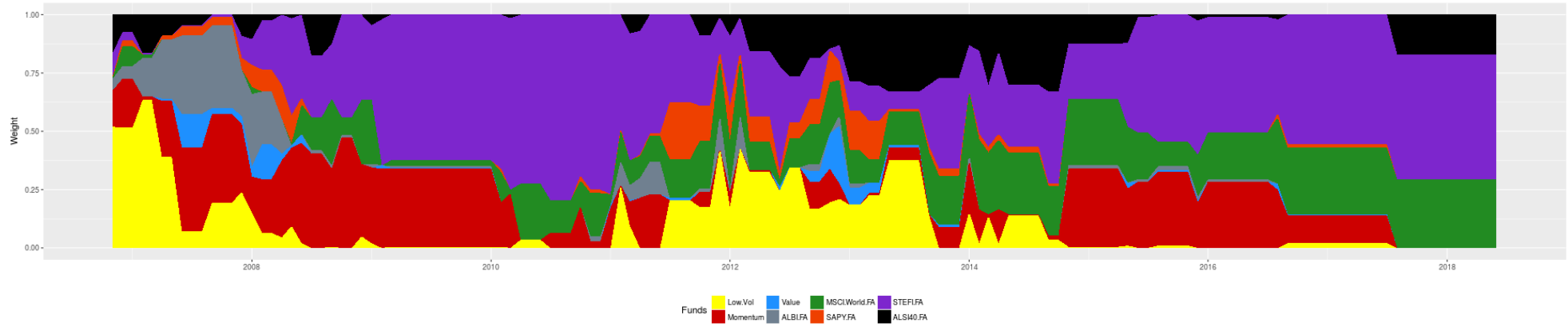
Stanlib Multi-Managers Balanced FoF 2004/12/01 to 2018/06/01



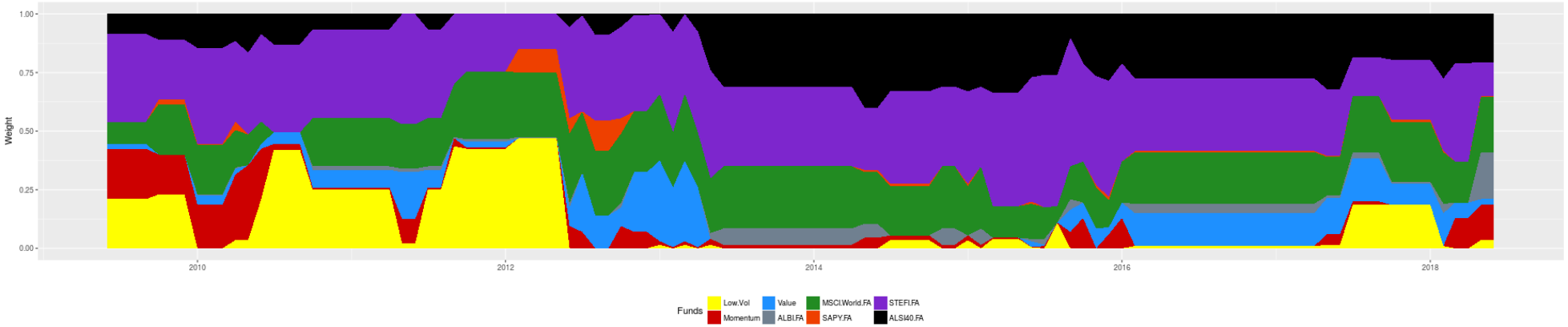
Sanlam Balanced 2006/08/01 to 2018/06/01



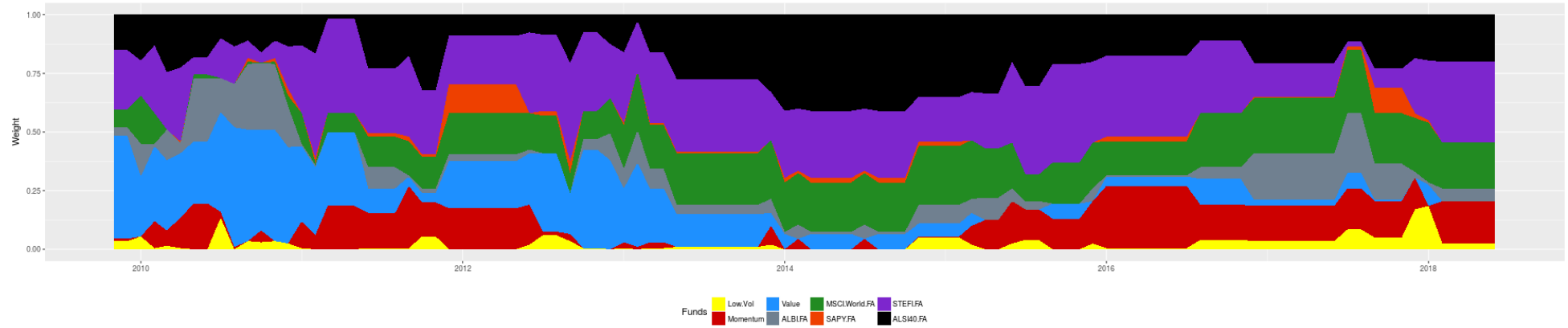
Rezco Value Trend 2006/11/01 to 2018/06/01



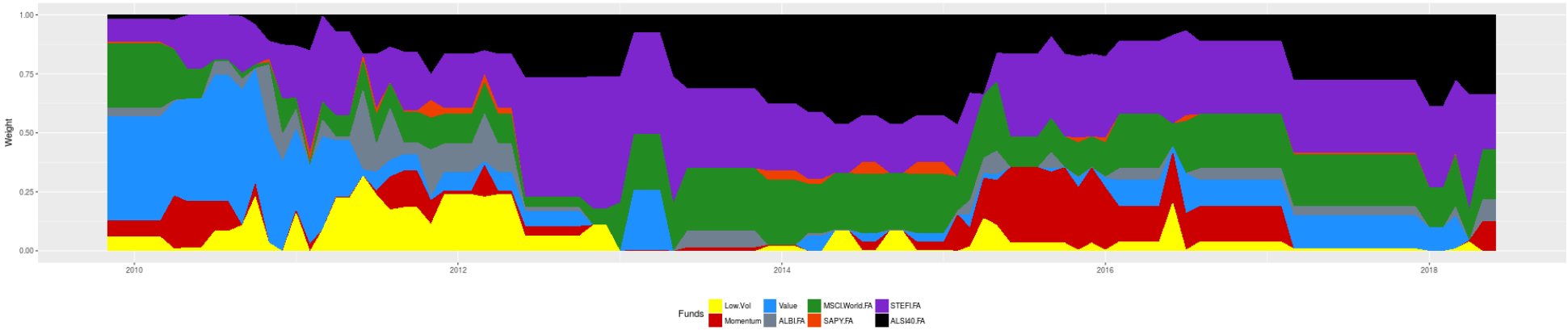
PSG Wealth Moderate FoF 2009/06/01 to 2018/06/01



Old Mutual Balanced 2009/11/01 to 2018/06/01

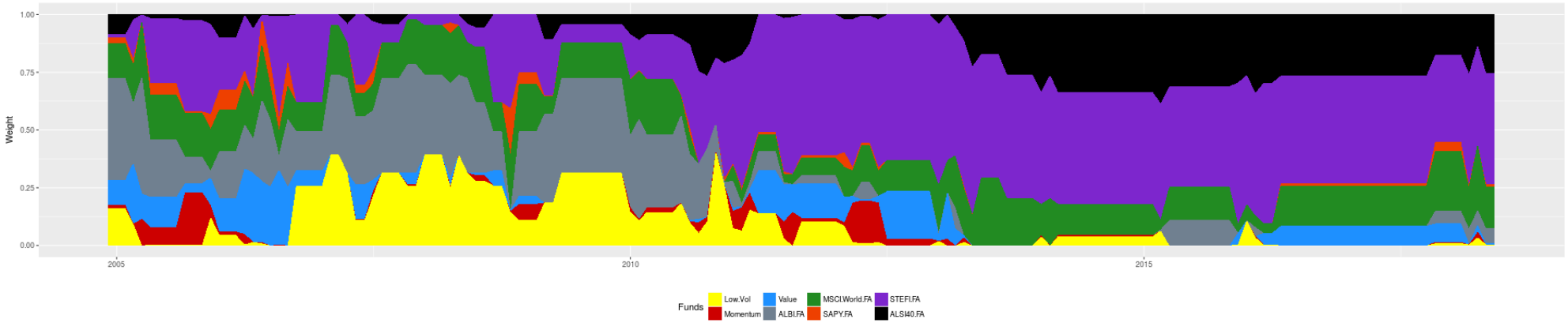


Discovery Balanced 2009/11/01 to 2018/06/01

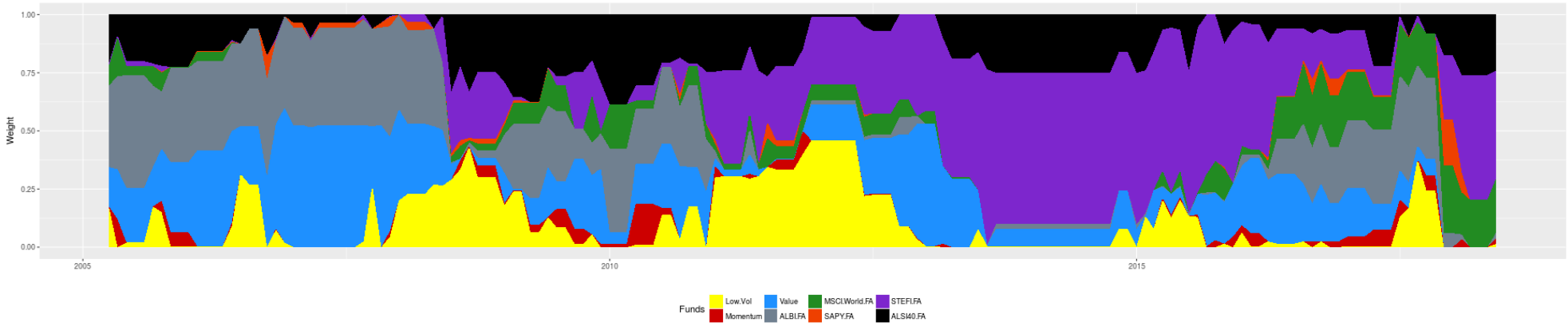


Multi Asset Medium Equity

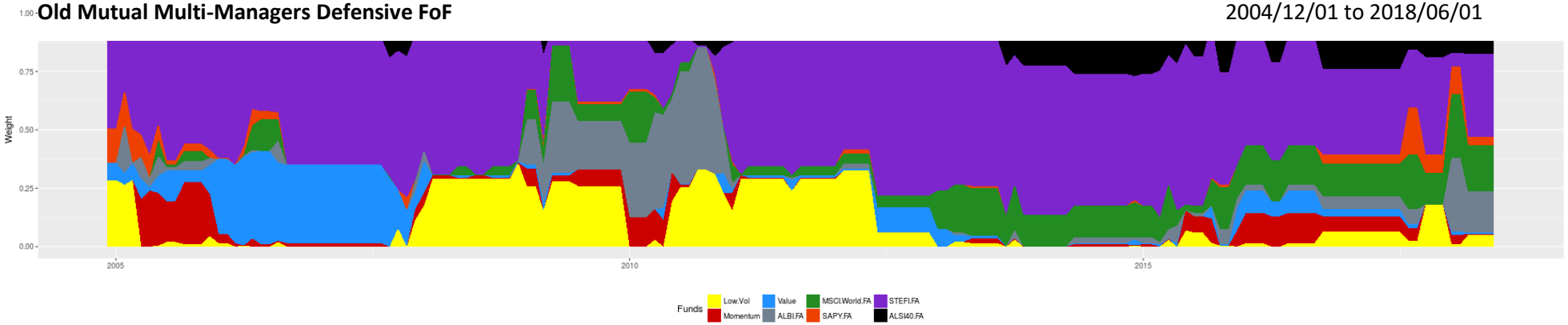
Coronation Capital Plus 2004/12/01 to 2018/06/01



Nedgroup Opportunity 2005/04/01 to 2018/06/01

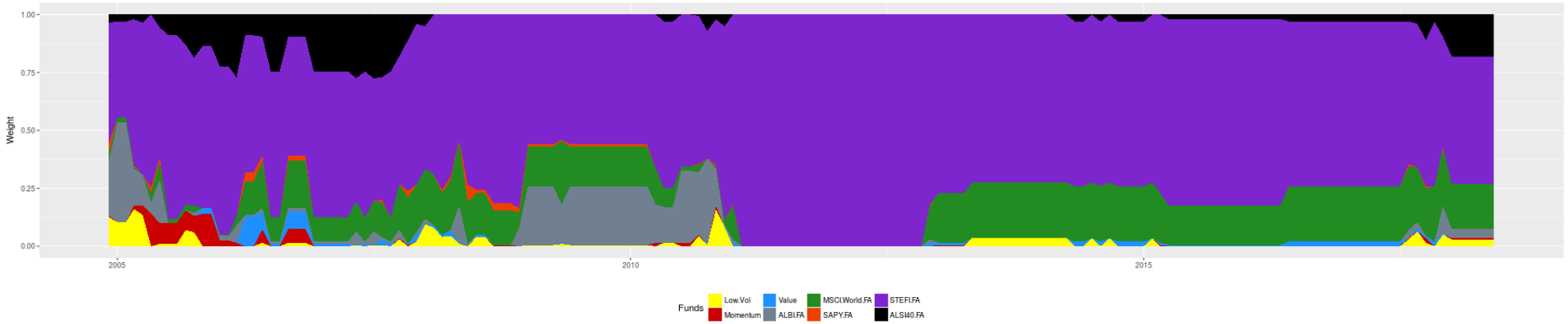


Old Mutual Multi-Managers Defensive FoF 2004/12/01 to 2018/06/01

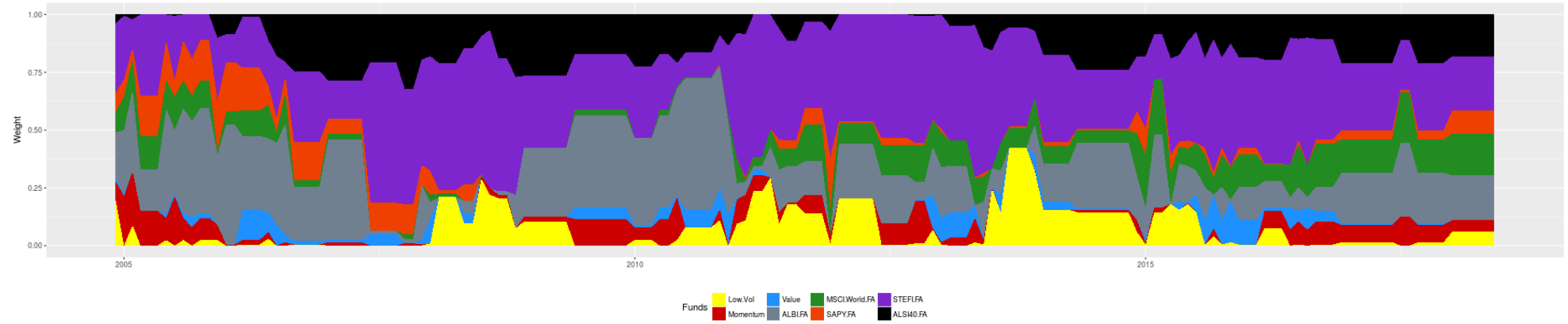


Multi Asset Low Equity

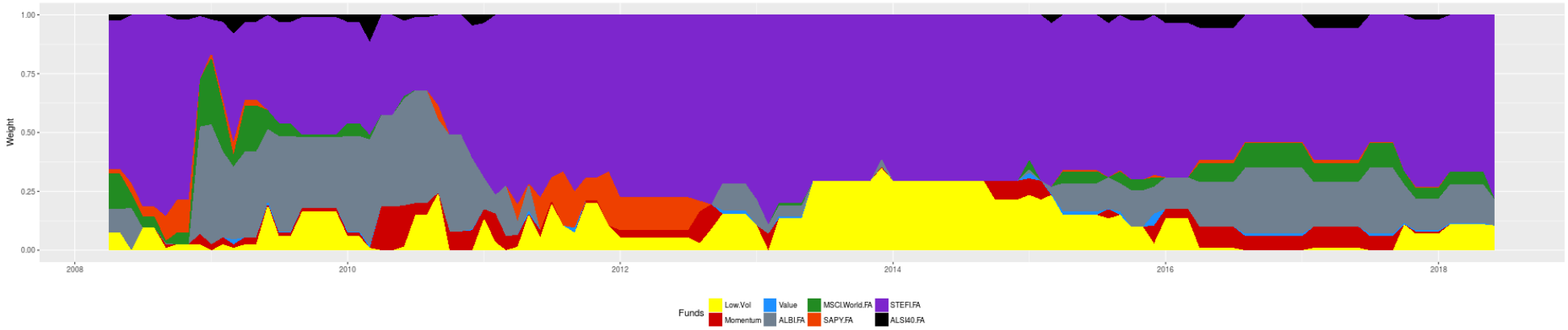
Allan Gray Stable 2004/12/01 to 2018/06/01



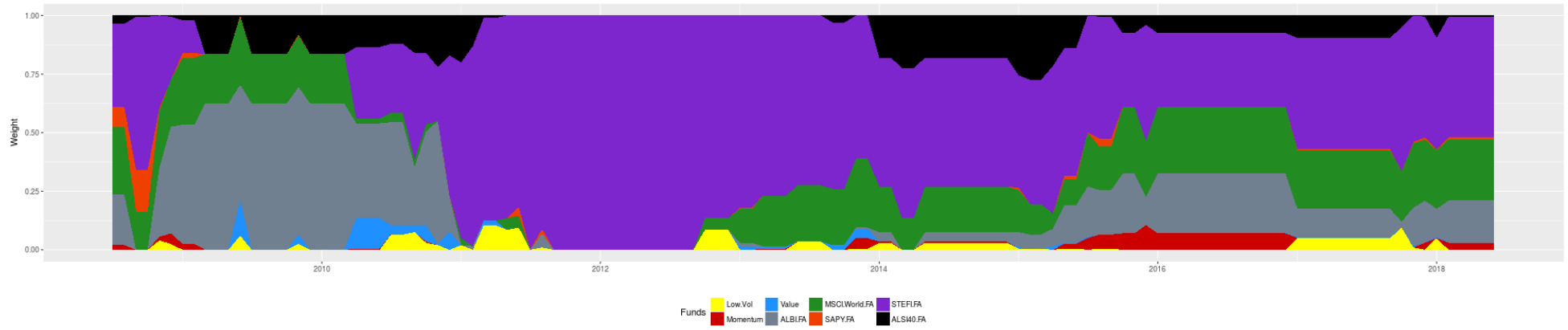
Prudential Inflation Plus 2004/12/01 to 2018/06/01



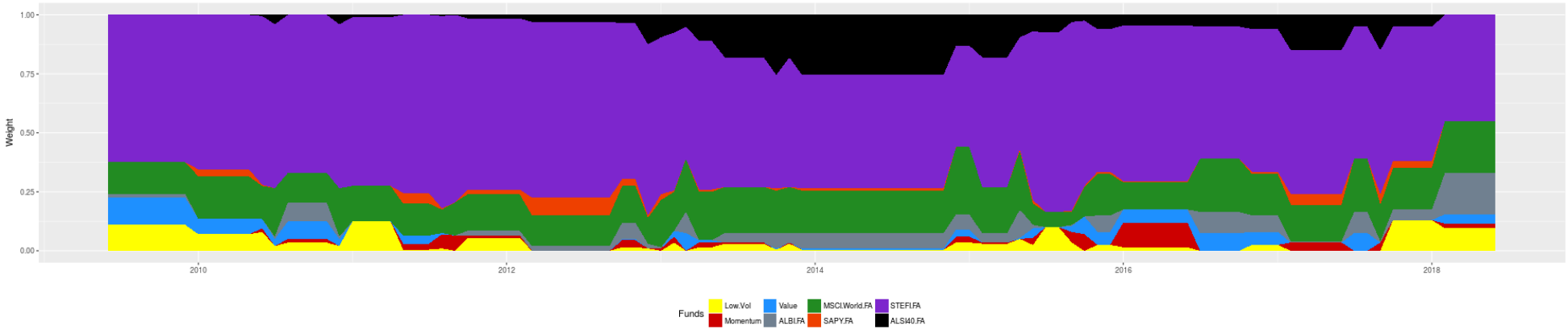
Old Mutual Real Income 2004/04/01 to 2018/06/01



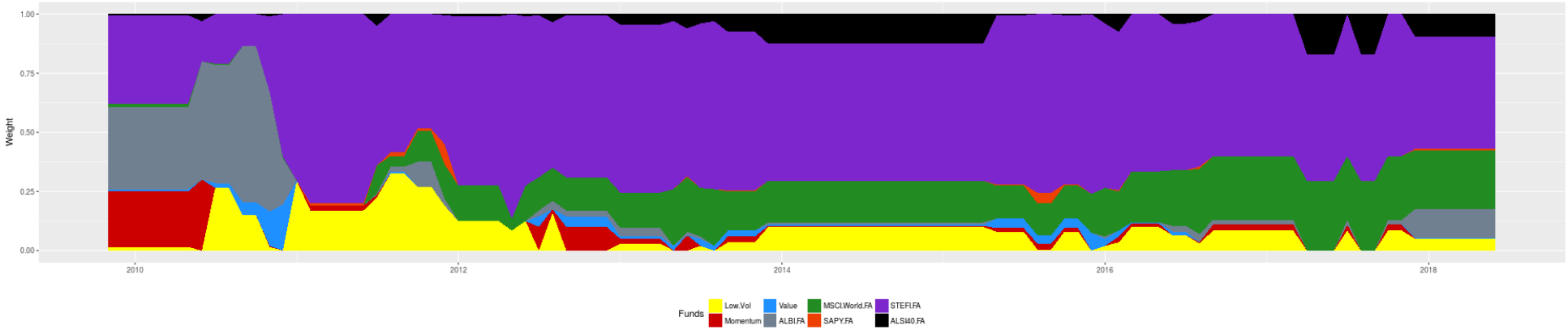
Investec Cautious Managed 2008/07/01 to 2018/06/01



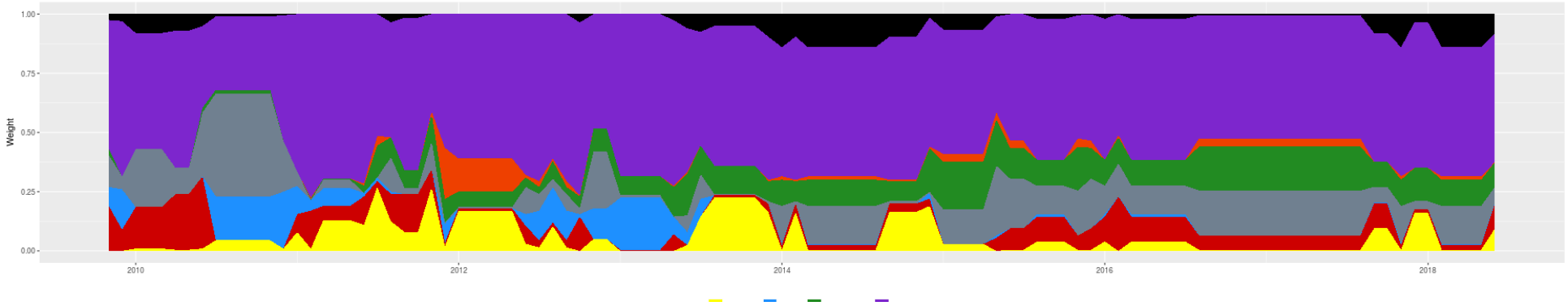
PSG Wealth Preserver FoF 2009/06/01 to 2018/06/01



Nedgroup Stable 2009/11/01 to 2018/06/01



Old Mutual Stable Growth 2009/11/01 to 2018/06/01



Coronation Balanced Defensive 2009/11/01 to 2018/06/01