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GORDON INSTITUTE
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Active fund management and cross-sectional variance of returns

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Abstract

In active portfolio management, fund managers seek to follow an investment strategy with the objective of outperforming an investment benchmark index. Opportunities to outperform a benchmark in active fund management is made possible through cross-sectional dispersion of returns in the market. It is cross-sectional volatility of returns that allows fund managers to identify changing trends in market relationships and to take advantage of market opportunities.

Quarterly active share and active return data of Domestic General Equity funds was used to determine whether the level of active share and active return has a correlation with volatility measures such as cross-sectional variance of returns or the South African Volatility Index (SAVI). The actively-managed funds' outperformance of the benchmark index during periods of differing cross-sectional variance was also looked at. Lastly, the possibility of whether market volatility can be used to inform fund investment decisions was also examined.

The findings in this study are that there is no significant relationship between the cross-sectional variance of returns, active share and active returns. In measuring fund performance in times of differing cross-sectional dispersion and breaking the analysis period into such intervals rather than as a continuous time series, active funds outperform the benchmark index during periods of low and moderate cross-sectional variance. The SAVI can be used as a fairly accurate and readily available approximation of cross-sectional variance.

Keywords: Unit trust, cross-sectional variance, active management, active share, active return, fund performance

Declaration

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other university. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

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List of Acronyms and Abbreviations

ALSI	FTSE/JSE All Share Index
ASISA	Association for Savings and Investment SA
CBOE	Chicago Board Options Exchange
CSV	Cross-sectional variance
DGE	Domestic General Equity
JSE	Johannesburg Stock Exchange
MPT	Modern portfolio theory
OLS	Ordinary least squares
SAVI	South African Volatility Index
VIX	CBOE Volatility Index

Chapter 1 Introduction

1.1. Outperforming the Benchmark Index

In active portfolio management, fund managers seek to follow an investment strategy with the objective of outperforming an investment benchmark index (Raubenheimer, 2012), with the manager's performance being judged relative to the benchmark performance rather than the risk-free rate (Grinold and Khan, 1999). As a reward for achieving this higher standard of performance, active managers are able to charge higher fees.

The activities required for managing a portfolio of assets is a part of the justification for the management fee that fund managers are paid (Muller and Ward, 2011). These activities carried out by managers “include some level of due diligence in the selection of investments, day-to-day accounting, statutory and fiduciary duties and other administrative activities” (Muller and Ward, 2011, p. 19). Over and above this management fee, investors are also willing to reward the skill of fund managers as measured by consistent outperformance of the benchmark and growth of the fund’s asset base even after deducting performance-related fees.

Passive portfolio managers, on the other hand, manage index tracker or passive funds that simply invest in the index. The motivation behind this type of investment seems sound considering that in an efficient market (Fama, 1970), investors cannot consistently outperform the market, which means that if the index is used as a proxy for the market, performance will tend towards the index in the long term.

The debate as to whether active fund performance trumps passive funds, and in effect the benchmark index, is on-going in academia, and amongst financial practitioners and investors. Supporters of active portfolio management, with these most likely to be the fund management companies drumming up demand for and offering active funds because of the higher fees that active management justifies (Byron and Verhoeven, 2008), point to the potential that investors can be earning better returns than if they had put their money in passive funds.. If there is not, passively managed funds would appear to be an alternative that makes more sense to investors. The debate continues

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with mainstream business publications publishing a number of articles in recent times regarding the advantages of passive investment (Collinson, 2010; Davis, 2010; Cameron, 2011). These articles argue that with the efficiency that is prevalent in the current market, fund managers cannot really outperform the market over the long run, particularly after the deduction of fees, and that passive funds are an attractive investment alternative considering their low costs and being able to avoid taking on more than the average market risk.

While it is desired that active funds achieve excess of benchmark returns to justify their additional fees and risk, there is conflicting evidence as to whether this is the case in reality (Moskowitz, 2000; Bogle, 2002; Kosowski, Timmermann, Wermers and White, 2006; Cremers and Petajisto, 2009; Muller and Ward, 2011).

In order for fund managers to outperform benchmark performance, it is necessary that they choose one or a combination of leveraging the fund, engaging in scrip lending, short-selling or stock-picking (Muller and Ward, 2011). Active share (Cremers and Petajisto, 2009), which is a term used to describe the proportion of a fund's holdings which does not overlap the benchmark index, is achieved through stock picking. This means that fund managers take a position in the market which differs from that of the benchmark to achieve active share. Fund managers need to track changes in the macro- and microeconomic environment, capture these actual and expected trends in the market, and express these sentiments and knowledge in the investment decisions that they make.

1.2. Market Volatility as an Indication of Opportunity

Modern portfolio theory (MPT) is traditionally based on an examination of time series or longitudinal volatility of investment returns (De Silva, Sapra and Thorley, 2001; Ankrim and Ding, 2002; Gorman, Sapra and Weigand, 2008). However, it is cross-sectional volatility of returns, as an instantaneous and dynamic measure, that allows fund managers to identify changing trends in market relationships (Solnik and Roulet, 2000). The cross-sectional dispersion of expected returns provides managers of active funds with a realistic opportunity for expressing "relative preferences" when they decide on how to distribute the limited pool of assets under their management among various investments (Raubenheimer, 2011b; Raubenheimer, 2012).

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Raubenheimer (2011b; 2012) found that when there is low cross-sectional volatility in the market, there is relatively less movement in the market and thus there are fewer opportunities to outperform peers, so active risk taking should be reduced to maintain efficiency. Conversely, she concludes that the higher the cross-sectional dispersion, the opportunity for taking active risk is greater, *ceteris paribus*. Drawing on her findings, her recommendation to fund sponsors is that they should remember that "changes in the active risk forecast of a portfolio could be a reaction to changes in market conditions and not the result of changes in the active positions of the fund" (Raubenheimer, 2011b, p.24). As a result, both fund sponsors and managers should be cautious when reacting to variations in active risk forecasts (Raubenheimer, 2011b; Raubenheimer, 2012). To evaluate the merit of her caution, it is necessary to measure the extent of active portfolio management.

Active share is a measure of active portfolio management formulated by Cremers and Petajisto (2009) which describes the proportion of a portfolio's holdings that differs from the benchmark index. Cremers and Petajisto (2009) proposes that active share can be used to predict fund performance, and they found that, both before and after expenses, funds with the highest active share perform considerably better than their benchmarks and they demonstrate solid performance that is enduring.

1.3. Research Problem and Purpose

The purpose of this research is to explore the relationship between varying cross-sectional volatility on the one hand, and the behaviour of active fund managers and the performance of actively-managed funds on the other hand. If it can be shown that the returns or active returns made by managed funds during periods of high cross-sectional dispersion, it proves the caution from Raubenheimer (2012) to fund sponsors and managers in acting on changes in active risk estimates to be unfounded. This study also seeks to determine if there is a relationship between market volatility and active fund performance, whether it is possible to inform fund decisions using volatility forecasts.

A question that arises is whether there are high active returns (i.e. returns resulting from active share) when there is a high level of cross-sectional variance. This will be a measure of the quality of the active positions taken by fund managers and hence is a measure of their performance.

There appears to be no prior research done on the dispersion of returns on JSE and active returns over periods with different levels of cross-sectional volatility. It would be useful to see how well active funds perform during these different market conditions and whether they outperform the benchmark as a reward for taking on risk above the average of investing in the index.

1.4. Research Objectives

The research objectives of this study are to investigate:

1. Whether there is a relationship between the cross-sectional variance of the market and the defining characteristics of actively-managed funds;
2. Whether actively-managed funds outperform compared to the benchmark index during periods of differing market cross-sectional variance; and
3. Whether market volatility can be used to inform fund investment decisions.

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Chapter 2 Literature Review

The focus of the literature survey is on reviewing relevant and significant research on the unit trust industry in South Africa, active management, cross-sectional variance of returns, and forecasting market volatility.

2.1. Unit Trust Industry in South Africa

The history of unit trusts in South Africa began with the establishment of the first fund in 1965 (ASISA, 2012b). The fund was launched to offer investors an investment product which has its assets professionally managed, is convenient, has low investing costs, is liquid, is tax efficient, spreads risk, and allows for low initial investment amounts (Oldert, 2005). Over the years, the unit trust industry grew from two funds with total assets of R3 million at the end of 1965, to 951 funds with assets totalling R1.06 trillion as of June 2012 (ASISA, 2012b).

Out of the R1.06 trillion of assets that was managed by South African unit trusts in June 2012, only R397 billion were held in listed equities which makes up a relatively small 5% of the R7.35 trillion JSE market capitalisation (ASISA, 2012b; JSE, 2012). In comparison, the total value of the mutual fund industry in the United States was $12.18 trillion in the same period (ICI, 2012b), with its holding in 29% of the total US market capitalisation amounting to approximately $5.1 trillion in equities (ICI, 2012a; WFE, 2012).

In South Africa, the Association for Savings and Investment SA (ASISA) is a non-profit association that represents the majority of the domestic collective scheme management companies (ASISA, 2012c). ASISA has developed a classification system to categorise funds according to investment styles and objectives, which allows investors to make investment decisions based on desired asset class and risk exposure and also to compare funds with similar mandates (Anderson, 2009).

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ASISA classifies the first tier of collective investment portfolios as (ASISA, 2012a):

- Domestic funds which are required to invest a minimum of 70% of the assets under their management in South African investment markets at all times;
- Worldwide funds which are required to invest in both South African and foreign markets, but there are no minimum requirements for either domestic or foreign assets; and
- Foreign funds which are required to invest at least 85% of their assets outside South Africa at all times.

Each of these categories is broken down further into a second tier of sub-categories, each with their specific third tier classifications as follows (ASISA, 2012a):

- Equity portfolios which include General, Growth, Value, Large Cap, Smaller Companies, Resources and Basic Industries Sector, Financial Sector, and Industrial Sector portfolios;
- Asset Allocation portfolios which include Prudential Low Equity, Prudential Medium Equity, Prudential High Equity, Prudential Variable Equity, Flexible, and Targeted Absolute and Real Return portfolios;
- Fixed Interest portfolios which include Bond, Income, Money Market, and Varied Specialist Portfolios; and
- Real Estate portfolios which include General portfolios.

Applying the above ASISA classification system, unit trusts fall into the category of Domestic General Equity (DGE) funds. There were 951 funds at the end of June 2012, of which 125 were DGE funds (ASISA, 2012b). In contrast there were 7,697 mutual funds in the US in the same period, with 4,614 being stock funds (ICI, 2012b).

Domestic portfolios are required to have at least 70% of their assets invested in the South African investment markets at any time (ASISA, 2012a). Equity portfolios invest predominantly in shares listed on the JSE and are required to invest a minimum of 75% of their portfolios in equities. General Equity portfolios invest in selected shares across all economic groups and industry sectors of the JSE, without subscribing to a particular theme or investment style, as well as across the range of large, mid and smaller cap shares. DGE funds are benchmarked against the FTSE/JSE All Share Index (also known as the ALSI or J203).

The objective and end results of mutual funds in the United States are largely comparable to unit trust funds in South Africa. Both of these bring together money from many investors, and invest these collective assets in a way that bring the benefits of having assets professionally managed, spreading risk by diversifying investments and investing at a relatively low cost (Oldert, 2005). But the industries in the two countries have significant structural differences such as industry size, maturity and compound growth rate; value of assets held; and the number of funds entering and exiting (Meyer-Pretorius and Wolmarans, 2006).

A survey of the amount of academic research carried out on the performance of unit trusts in South Africa reveals that it is sparse compared to the body of literature available on equivalent mutual funds, mainly regarding the US industry (see for example Fant, 1999; Edelen and Warner, 2001; Cremers and Petajisto, 2009). The main reason for this is the large number of US mutual funds in existence (ICI, 2012b) and also the availability of mutual fund holding data as a consequence of US legislation which requires detailed quarterly reporting (Anderson, 2009). In South Africa, unit trust holding information at individual stock level is safely guarded by fund managers and funds are not required by law to publish this data, and as a result, the only information that is readily available is the quarterly holding of unit trust funds at sector level as published by ASISA (2012a).

While relatively little research has been done on domestic unit trust funds per se, there is a large body of knowledge on US mutual funds that can be drawn on to understand unit trusts. However, the comparison and application of US findings to the domestic industry should be done with circumspect because work by Rudman (2008) has indicated that there are reasons to believe that the results for US studies would not be applicable to South African unit trusts in general as the two industries operate under different market conditions. These conditions are evident from the differences highlighted by Meyer-Pretorius and Wolmarans (2006).

2.2. Active Management

Active managers pursue active returns, which are returns in excess of the benchmark, rather than returns in excess of the risk-free rate (Grinold and Khan, 1999), and seek to implement different fund management strategies to achieve it. Active managers

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usually act on perceptions of mispricing, and active managers tend to trade somewhat frequently as these misperceptions change relatively frequently (Sharpe, 1991). The extent of active management can be determined using active share, active weight, tracking error volatility, or R-squared.

Cremers and Petajisto (2009) introduced the active share metric, which measures the share of portfolio holdings that differ from the benchmark holdings and is thus a measure of the magnitude of the active position. It is defined by the authors in terms of the holdings of individual shares that make up a fund. These active share positions allow fund managers to outperform or underperform compared to their competitors or the benchmark (Muller and Ward, 2011). While this early work by Cremers and Petajisto (2009) examined fund at the level of individual equity holdings, Muller and Ward (2011) found that calculating active share using a sector level approach to fund holdings is an acceptable approximation. The adapted active share equation defined in terms of holding at sector level is given in Equation 2.1 (Muller and Ward, 2011).

Equation 2.1 Active share calculated at sector level

$$Active\ share\ = \frac{1}{2}\sum_{i=1}^{N}\left|w_{fund\ i} - w_{index\ i}\right|$$

where

$w_{fund\ i}$ is the weighting of each sector in the fund

$w_{index\ i}$ is the weighting of each sector in the index

Muller and Ward (2011) found that the level of active share on the JSE has fallen from around 50% in 1998 to 15% in 2001 and it has remained at that level through to the end of 2010. Their interpretation of this result is that fund managers are unable or unwilling to take active positions. The authors also provide convincing evidence that challenges the high fees that many fund managers charge investors. They observed that firstly, there is “no relationship between the level of active share and a fund’s return, raising doubts about the stock picking ability of fund managers” (Muller and Ward, 2011, p. 26), in fact the spread of returns increases as active share increases. Secondly, some funds that track an index have low active share but they consistently outperform approximately 80% of domestic general equity funds on the JSE over holding periods of five years.

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Recent research by Evensky and Pfeiffer (2010) suggests that, contrary to prior work that indicates that active management adds value in recessions of economic cycles (Moskowitz, 2000; Kosowski, Timmermann, Wermers and White, 2006), on average active portfolio management subtracts value from the investor in either bull or bear markets. Furthermore, any gains in performance dwindle over subsequent business cycles and that prior outperformance is not a significant predictor of future performance in either expansionary or recessionary environments. Hence the authors conclude that active portfolio managers “show no meaningful persistence in performance across business cycles” (Evensky and Pfeiffer, 2010, p. 11). In line with this finding, Muller and Ward (2011) found that although active share positions are a necessary condition for outperformance, there is no evidence to support the view that fund managers take good active positions and thereby justify fees that are higher than those of passive funds. The authors have shown that over the period from 2002 to 2010, a low active share index fund consistently outperforms around 70% of unit trusts on the basis of a five-year holding period.

The manager's active return is the difference between the return on the manager's portfolio and the return on the benchmark portfolio (Grinold and Khan, 1999).

Equation 2.2 Realised active return

$$R_{a,i} = R_i - R_b$$

where

$R_{a,i}$ is the active return of asset *i*

R_i is the realised return of the asset *i*

R_b is the realised return of the benchmark

In MPT, the aim is to find the investment weights that describe a portfolio that satisfies the investor’s risk and return requirements (Raubenheimer, 2012). In an active management framework, the portfolio selection problem is solved in terms of active weights i.e. the weights that describe the chosen portfolio’s departure from the benchmark portfolio.

Equation 2.3 Active weight

$$w_{a,i} = w_{p,i} - w_{b,i}$$

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where

$w_{p,i}$ is the relative size (weight) of the portfolio's investment in asset *i*

$w_{b,i}$ is the weight of the benchmark in the same asset

$w_{a,i}$ is the active weight of the portfolio in asset *i*

Grinold and Kahn (1999) describe tracking error volatility as a commonly used measure of the performance of actively-managed funds and is defined as the standard deviation of the difference between the fund return and its benchmark return index. The tracking error is a metric that active fund managers seek to maximise.

Equation 2.4 Tracking error volatility

$$Tracking\ error = Stddev\left[R_{fund} - R_{index}\right]$$

While tracking error is a widely-used metric and much research has been done on determining its relationship with performance in active management, Cremers and Petajisto (2009) found that using tracking error on its own is inadequate.

The conclusions drawn from academic research on the performance of mutual funds is varied but on the balance points to mutual funds not being able to consistently beat the market (Sharpe, 1966; Chen, Jegadeesh and Wermers, 2000). Looking at unit trusts in the domestic market, Wessels and Krige (2005) found evidence of short term fund performance but this did not persist over the long term. Over the period of Oldham and Kroeger's (2005) study from 1998 to 2002, it was found that there is no evidence of above average performance that is consistent.

2.3. Cross-sectional Variance of Returns

The work of authors like De Silva, Sapra and Thorley (2001), Ankrim and Ding (2002), and Gorman, Sapra and Weigand (2008) indicates that modern portfolio theory is based on studies of time series or longitudinal volatility, but it is fund managers' understanding of cross-sectional dispersion of investment returns that will distinguish successful managers from those that are not. There are also problems with techniques such as using time series data to estimate correlation between the performance of various global markets on a rolling 60 month window of simultaneous returns across world markets (Solnik and Roulet, 2000).

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The formula for calculating the weighted cross-sectional volatility as proposed by Ankrim and Ding (2002) is given in Equation 2.5.

Equation 2.5 Realised cross-sectional variance

$$s_{cs,t}^2 = \sum_i^N w_{i,t-1}(R_{i,t} - R_{b,t})^2$$

where

$s_{cs,t}^2$	is the weighted realized cross-sectional variation of a particular benchmark or index over a particular investment period
$W_{i,t-1}$	is the weight of each stock *i* at time *t-1* in the benchmark
$R_{i,t}$	is the total returns for each stock *i* from time *t-1* to time *t*
$R_{b,t}$	is the corresponding benchmark/index return which is the weighted average return across stocks over the same period

Raubenheimer (2011a) states that the varying cross-sectional volatility in the South African equity market provides varying opportunity sets for active managers, with a higher cross-sectional volatility allowing greater opportunity for active risk taking. She observes that in recent years, there has been a sharp decline in cross-sectional dispersion, and hence opportunities, on the ALSI following the high levels seen during the financial crisis in 2008 (Raubenheimer, 2012).

In measuring the performance of funds over time, the degree of dispersion among competing funds' performances fluctuates significantly over time, resulting in the time series of fund performance displaying heteroscedasticity (Raubenheimer, 2012). This makes the use of standard parametric methods such as t-statistics, Sharpe or Information Ratios, for detecting significant above average performance irrelevant and OLS regression unsuitable.

Equation 2.6 OLS performance analysis

$$R_{p,t} = \hat{\alpha}_p + \hat{\beta}_p R_{b,t} + \varepsilon_{p,t}$$

where

$R_{p,t}$	is the fund return
$R_{b,t}$	is the return of the benchmark index

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$\hat{\alpha}_p$ and $\hat{\beta}_p$	are fitted regression coefficients for the intercept (alpha) and slope (leverage) respectively
$\varepsilon_{p,t}$	are the residuals which are assumed to be distributed randomly with a constant variance and zero mean

The Breusch-Pagan test was used to determine the presence of heteroscedasticity in the OLS regressions applied to each fund by investigating the significance of the squared residuals with the cross-sectional variance of the benchmark (Raubenheimer, 2012). She had used an F-test for a second regression of the squared residuals against the cross-sectional variance. Equation 2.7 gives the hypothesis that was tested.

Equation 2.7 Breusch-Pagan regression to test for heteroscedasticity in benchmark dispersion

$$\frac{{\varepsilon_{p,t}}^2}{\overline{\overline{{\varepsilon_p}^2}}} = \hat{a} + \hat{b}{s_{cs,t}}^2 + \gamma_t$$

where

$\overline{\overline{{\varepsilon_p}^2}}$	is the average squared residual
$\hat{a}$ and $\hat{b}$	are the fitted regression coefficients
γ	is the residual term

Raubenheimer (2012) investigated correcting the performance of competing portfolio managers for the varying cross-sectional risk of their investment environment in order to more accurately and fairly assess the extent of their success and skill. This was achieved by dividing all the terms in the conventional OLS regression by the cross-sectional variance of the fund performance. This has the effect of giving greater importance to data with lower variance, seen as more reliable data, and less important to data points taken from distributions with greater variance (Raubenheimer, 2012).

The performance measurement represented by the regression in Equation 4.6 was then corrected for heteroscedasticity by dividing each term of this equation by $s_{cs,t}$ to obtain Equation 2.8.

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Equation 2.8 Weighted OLS regression

$$\frac{R_{p,t}}{s_{cs,t}} = \hat{\alpha}_p \frac{1}{s_{cs,t}} + \hat{\beta}_p \frac{R_{b,t}}{s_{cs,t}} + \frac{\varepsilon_{p,t}}{s_{cs,t}}$$

What Raubenheimer (2012) found was that with the OLS regression, 86% of her sample showed that her time series of OLS residuals has a significant linear relationship with the dispersion of benchmark returns and hence exhibited heteroscedasticity. However, when the weighting was applied per Equation 2.8, the number of funds that were not homogeneous dropped down to 17%. Hence her results show that the weighting corrected for heteroscedasticity but also, it is proof that returns achieved in high times of dispersion should be discounted when measuring performance because funds generally do well due to luck and all round favourable market conditions, and to overweigh CSV in low times because that is a true indication of the quality of investment decisions and skill of fund managers (2011b, 2012).

2.4. Forecasting Market Volatility

Financial models developed for forecasting volatility, such as the Autoregressive Conditional Heteroscedasticity (ARCH) (Blair, Poon and Taylor, 2001), generalised ARCH (GARCH) (Bollerslev, 1986) and threshold ARCH (TARCH) models (Glosten, Jaganathan and Runkle, 1993), have varying abilities to forecast volatility. Samouilhan and Shannon (2008) confirm the varying success of forecasting volatility on the JSE using these models (2008). In addition, these models require statistical analysis to be performed on historical return data to produce volatility forecasts.

An alternative approach to volatility forecasting is the South African Volatility Index (SAVI), which is an implied index developed by the JSE in collaboration with Cadiz Securities as a market forecast of volatility based on the FTSE/JSE Top 40 Index level (Kotzé, Joseph and Oosthuizen, 2009). The SAVI relies on implied volatility data obtained from option prices and so is a measure of future asset price return uncertainty priced in by the market over a specific time period (Samouilhan and Shannon, 2008). The original index was launched in 2007 as a measure of the market's expectation of the 3-month volatility and is hence an indicator of market sentiment. It was updated in 2009 to become a calculation of "at-the-money volatility adjusted for the volatility skew as determined by the actively traded options in the market" (Kotzé, Joseph and

Oosthuizen, 2009, p.1). It is comparable to the Chicago Board Options Exchange Volatility Index (VIX) as a measure of “market fear”, except that the VIX is a forecast over a 30 day period while the SAVI is calculated for 90 days.

The study by Samouilhan and Shannon (2008) looked at using different financial models as well as the SAVI to forecast the volatility of equity returns. However, the forecast period that was examined is short at one day ahead and one week ahead. It was found that the SAVI forecast over predict both one day ahead and one week ahead domestic volatility. Other than this study, a search for academic literature on the SAVI reveals that little else has been done on the subject.

Chapter 3 Hypotheses

The three hypotheses and their associated sub-hypotheses detailed in this chapter directly address the research objectives as stated in Section 1.4. and also constitute the themes on which the analysis in this study are based. The three themes are firstly the relationship between cross-sectional variance and active management, secondly the characteristics of fund performance, and lastly the possibility of making investment decisions based on volatility forecasts. These hypotheses were tested using sector holdings and total returns of DGE unit trust funds on the JSE, ALSI sector market capitalisation data, individual share returns and market capitalisation data, and SAVI data.

3.1. Hypothesis 1

H0: There is no correlation between cross-sectional variance in the benchmark index and the level of active share and active return of unit trust funds.
HA: There is a correlation between cross-sectional variance in the benchmark index and the level of active share and active return of unit trust funds.

3.1.1. Sub-hypothesis 1A

H0: There is no relationship between the level of active share in unit trust funds and the level of cross-sectional variance of returns.
HA: There is a relationship between the level of active share in unit trust funds and the level of cross-sectional variance of returns.

3.1.2. Sub-hypothesis 1B

H0: There is no relationship between the level of active return in unit trust funds and the level of cross-sectional variance of returns.
HA: There is a relationship between the level of active return in unit trust funds and the level of cross-sectional variance of returns.

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3.1.3. Sub-hypothesis 1C

H0: There is no relationship between the level of active share in unit trust funds and the level of active return.
HA: There is a relationship between the level of active share in unit trust funds and the level of active return.

3.2. Hypothesis 2

H0: Actively-managed funds do not outperform the benchmark index during periods of differing cross-sectional variance.
HA: Actively-managed funds outperform the benchmark index during periods of differing cross-sectional variance.

3.2.1. Sub-hypothesis 2A

H0: Actively-managed funds do not outperform the benchmark index during periods of high cross-sectional variance.
HA: Actively-managed funds outperform the benchmark index during periods of high cross-sectional variance.

3.2.2. Sub-hypothesis 2B

H0: Actively-managed funds do not outperform the benchmark index during periods of moderate cross-sectional variance.
HA: Actively-managed funds outperform the benchmark index during periods of moderate cross-sectional variance.

3.2.3. Sub-hypothesis 2C

H0: Actively-managed funds do not outperform the benchmark index during periods of low cross-sectional variance.
HA: Actively-managed funds outperform the benchmark index during periods of low cross-sectional variance.

3.2.4. Sub-hypothesis 2D

H0: Returns delivered in periods of high dispersion in the benchmark assets should not be weighted less than returns earned in periods of low benchmark dispersion.
HA: Returns delivered in periods of high dispersion in the benchmark assets should be weighted less than returns earned in periods of low benchmark dispersion.

3.3. Hypothesis 3

H0: The outlook on market volatility cannot be used to inform fund investment decisions.
HA: The outlook on market volatility can be used to inform fund investment decisions.

3.3.1. Sub-hypothesis 3A

H0: There is no relationship between the SAVI and cross-sectional variance of returns.
HA: There is a relationship between the SAVI and cross-sectional variance of returns.

3.3.2. Sub-hypothesis 3B

H0: There is no correlation between the SAVI and fund performance as measured by the active return.
HA: There is a correlation between the SAVI and fund performance as measured by the active return.

3.3.3. Sub-hypothesis 3C

H0: The SAVI cannot be used to inform fund investment decisions in periods of varying cross-sectional variance.
HA: The SAVI can be used to inform fund investment decisions in periods of varying cross-sectional variance.

Chapter 4 Research Methodology

4.1. Research Design

The research design chosen for this quantitative causal study was an experimental design using longitudinal secondary data (Saunders and Lewis, 2012). The following historical time series data in their raw form were analysed to obtain processed data: DGE unit trust sector holdings of individual funds; total returns of individual DGE funds; total returns of individual shares that make up the ALSI; ALSI market capitalisation at sector level; ALSI market capitalisation at individual stock level; J203 index levels; and SAVI levels.

These sets of secondary data were all readily available in the public domain from data vendors and free-access websites.

4.2. Population and Sampling

The population of the study consisted of all the DGE funds registered with ASISA that existed at any time during the period between September 2006 and June 2012. The total number of DGE funds at the beginning of this period was 82 and increasing to 125 funds in June 2012 (ASISA, 2012b). The category of DGE funds was chosen for analysis because this enabled the dispersion across a relatively large sample of peer funds to be examined and these funds use the ALSI as their investment benchmark (Raubenheimer, 2012). In addition, because DGE funds have a similar investment mandate and the same asset class restrictions (Rudman, 2008), the choice of DGE unit trusts ensured that most of the funds' investments are in equity and hence fund performance can be compared on a level playing field.

This particular time frame was chosen because quarterly DGE total fund returns data was available for this period, hence it was the maximum number of quarters that was feasible. As will be illustrated in Section 5.3. of the results, the interval from September 2006 to September 2007 is a period of moderate cross-sectional variance, from December 2007 to September 2009 the cross-sectional volatility is relatively high, while during the period from December 2009 to June 2012 relatively low dispersion was experienced in the market. This time frame was thus sufficient to include one each of the possible periods of different cross-sectional dispersion for analysis.

The funds that existed, as well as those that were created, terminated, reclassified or renamed during this period, were all included in the study as the events took place. This was necessary to ensure that survivorship bias, which can have a significant effect in time series studies in the financial context (Gilbert and Strugnell, 2010), was mitigated.

The sampling method used for the analysis is purposive sampling, which is a technique not based on probability but rather on the researcher's judgement of what is appropriate to include and exclude in the sample for a range of possible reasons and premises (Saunders and Lewis, 2012). In this study, the funds which were excluded from analysis are Islamic Sharia funds, funds of funds and index tracking funds. The funds that were excluded from this analysis are listed in Appendix 1. The Islamic Sharia funds were identified by consolidating two lists from ASISA (2012b) and Bloomberg (2012), the funds of funds were identified as such by ASISA (2012b), and the index tracking funds were identified through a list published by Profile Media (2012).

Islamic funds were not considered in the sample because these are a type of specialist fund which exclude certain stocks from their investment universe, and as a result, display significantly different performance history to the rest of the DGE funds (Raubenheimer, 2012). Funds of funds did not form part of the sample because including these funds in the analysis would have resulted in double counting of sector holdings as these funds' holdings were maintained indirectly through other DGE funds (Anderson, 2009). Index tracking funds were also excluded from this analysis because their purpose is to avoid incurring active risk or return, and as a result, their performance objectives differ to those of the remaining funds in the DGE category (Raubenheimer, 2012).

The sample of DGE funds taken was further narrowed down for practical purposes as a result of the data that was available for analysis. Missing data points from the fund databases in some instances made it necessary to remove funds for which no information was available and to also exclude funds if the calculated times series of active returns and active shares did not contain at least one pair of observations. Out of the population of 82 DGE funds in September 2006 and 125 in June 2012 (ASISA, 2012b), 15 and 57 funds was the size of the eventual sample that was analysed at the beginning and end of the time frame, respectively. The detail of the number of funds evaluated in each year of the investigation period is presented in Table 5.1.

The sample data consisted of various time series made up of 24 quarters:

- ASISA holdings reports, which contains the monetary value of each DGE fund's holdings stated per JSE sector;
- ALSI market capitalisation at sector level, which is the monetary value of each JSE sector's market capitalisation on the last day of each quarter;
- Total returns of individual DGE funds, which is the percentage of total return achieved over the quarter (total return includes capital gain as a result of the growth in the share price and dividend yield); and
- J203 index levels, which was the closing level of the index on the last day of each quarter.

Characteristics of the sample of funds were tested against quarterly measures related to the JSE, these being the total returns and market capitalisation of individual shares that make up the ALSI as well as the SAVI. When these measures were compared to the fund data themselves, quarterly data was used and it covered the time frame already discussed. But when these measures were compared to each other, data was sampled monthly so that as much information as possible was analysed but not at any greater frequency. Monthly performance statistics is typically used as a high frequency performance monitoring tool in portfolio management and it is unconventional for the industry to report at a higher frequency (Raubenheimer, 2012). The time frame in the case of the monthly measurements began in January 2005 and ended in June 2012. This was limited by the period covered in the database used for the market capitalisation and total returns of the individual stocks on the JSE. The SAVI index was launched in February 2007 (Kotzé, Joseph and Oosthuizen, 2009) and hence data was only available from that date.

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4.3. Data Collection

The raw data used in the study was collected through electronic downloads from the ASISA and McGregor BFA online databases, as well as consulting printed copies of the JSE Monthly Bulletin. Data from Profile Media and other additional datasets based on the JSE Monthly Bulletin were obtained with the assistance of Mike Ward and Chris Muller. The sources of the raw data used as well as their description and how they were applied are detailed in Table 4.1.

Table 4.1 Sources and description of raw data

Raw Data	Source	Description	Where Used
Sector holdings of each DGE unit trust fund	ASISA	Monetary value of holdings on the last day of a quarter	Calculation of active share
ALSI market capitalisation at sector level	JSE Monthly Bulletin	Monetary value of market capitalisation on the last day of a quarter	Calculation of active share
Total returns of individual DGE funds	Profile Media	Percentage of total returns over a quarter	Calculation of active return
J203 index levels	McGregor BFA	Index levels on the last day of a quarter	Calculation of active return
Total returns of individual shares that make up the ALSI	JSE Monthly Bulletin	Monetary value of total returns over a month	Calculation of CSV
ALSI market capitalisation at individual stock level	JSE Monthly Bulletin	Monetary value of market capitalisation on the last day of the month	Calculation of CSV
SAVI levels	McGregor BFA	Monthly and quarterly index levels	Comparison with CSV and active return

Difficulty with the availability of detailed fund holdings data was experienced because there are no statutory or regulatory requirements in South Africa that funds publish information on the stocks that it holds in its portfolio. However, funds that are registered with ASISA are required to provide detailed quarterly holdings information. Despite this requirement, many of these funds have requested that detailed holdings information at the individual stocks level be withheld from third parties (Anderson, 2009). A possible reason for withholding individual shareholding information would be to protect intellectual property and hence competitive advantage. ASISA provides free access to the quarterly sector holding information through its website (ASISA, 2012b).

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4.4. Data Analysis

4.4.1. Data Processing

The raw data collected was processed to form the variables that were used to test the research hypotheses. The sets of processed data obtained from the analysis consisted of the cross-sectional standard deviation of the returns of the stocks that make up the ALSI, and the levels of active share and active return of the DGE unit trust funds. The SAVI levels were downloaded from an online database and were ready for use as they stood.

The active share of each individual fund was calculated using Equation 4.1 according to Muller and Ward (2011). The overall active share was determined by calculating the median of the individual active share data. The median was chosen so that any risk of overweighting and underweighting in the active shares cancelling out, as is the case with calculating average or mean, can be avoided.

Equation 4.1 Active share

$$Active\ share = \frac{1}{2}\sum_{i=0}^{n}\left|w_{fund\ i} - w_{index\ i}\right|$$

where

Active share is the active share of

$W_{fund\ i}$ is the weighting of each sector in the fund

$W_{index\ i}$ is the weighting of each sector in the index

The weightings for the fund and index were calculated using the sector level fund holdings from ASISA and the JSE market capitalisation for each sector respectively.

Equation 4.2 was used to calculate the active returns of each individual fund. The median of the active return for all the funds was also calculated to obtain an overall active return time series.

Equation 4.2 Realised active return

$$R_{a,i} = R_i - R_b$$

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where

$R_{a,i}$	is the active return of asset *i*
R_i	is the realised return of the asset *i*
R_b	is the realised return of the benchmark

The tracking error, which is in effect the standard deviation of the active return, was determined using Equation 4.3.

Equation 4.3 Tracking error

$$Tracking\ error = Stddev[R_i - R_b]$$

The cross-sectional variance of the market return was calculated using Equation 4.4 in the same way as Raubenheimer's study (2012).

Equation 4.4 Weighted realised cross-sectional variance

$$s_{cs,t}^2 = \sum_i^N w_{i,t-1}(R_{i,t} - R_{b,t})^2$$

where

$s_{cs,t}^2$	is the weighted realised cross-sectional variance of a particular benchmark or index over a particular investment period
$W_{i,t-1}$	is the weight of each stock *i* at time *t-1* in the benchmark
$R_{i,t}$	is the total returns for each stock *i* from time *t-1* to time *t*
$R_{b,t}$	is the corresponding benchmark/index return which is the weighted average return across stocks over the same period

The variable $W_{i,t-1}$ is typically the market capitalisation of each stock. The cross-sectional standard deviation was calculated by taking the square root of the cross-sectional variance.

The database for fund returns did not contain any data for the quarter of December 2007 and a few data points within the fund returns time series were also missing. This meant that correlations and regressions involving returns at fund level had one data pair less for both of these cases. For the purposes of completing the time series at overall fund return level, the average of the adjacent data points before and after December 2007 was used.

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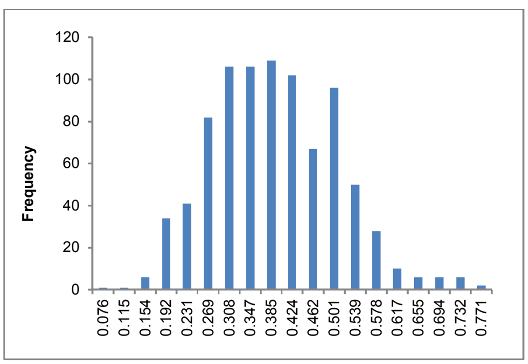
4.4.2. Statistical Analysis

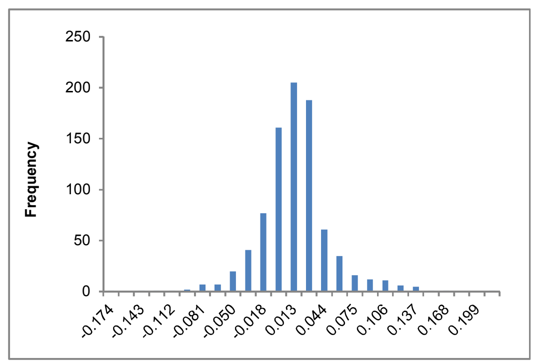
IBM SPSS Statistics was the software used to carry out the statistical data analysis. The statistical analyses performed were correlation analysis, regression analysis, forecasting and testing for homogeneity of variance. The issue of homogeneity of variance will be discussed in detail in the next section.

A necessary step before deciding on which statistical tests to carry out was to determine whether parametric or non-parametric tests were to be used (Pallant, 2011). Active share, active return and cross-sectional standard deviation are continuous variables, and they are shown in Figure 4.1 (a), (b) and (c) to be normally distributed. Figure 4.1 (d) shows that the SAVI data is slightly skewed but since the parametric tests are fairly robust, it can accommodate slight skewness (Pallant, 2011). Therefore, parametric tests were used for analysing these variables.

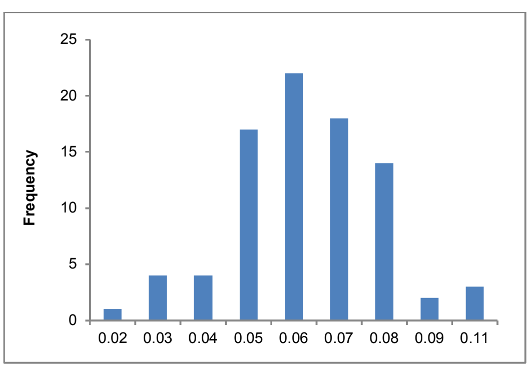
Figure 4.1 Histograms of data to be analysed



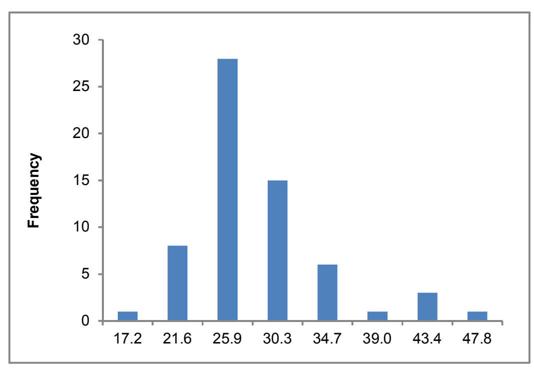
(a) Active share data



(b) Active return data



(c) Cross-sectional std dev data



(d) SAVI data

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The Pearson product-moment correlation coefficient (also known as Pearson's *r*) was used to analyse the strength of the relationship between two variables and the probability of this happening by chance (Saunders and Lewis, 2012). A correlation can have a Pearson's *r* of any value between 0 and +1 or -1, with 0 indicating that the two variables are independent and +1 or -1 indicating that they are perfectly correlated (Albright, Winston and Zappe, 2006). A positive value for Pearson's *r* is interpreted to mean a positive correlation where one variable increases as the other one increases. A negative value means a negative correlation where one variable increases as the other decreases and vice versa. The statistical significance of the correlation below a chosen level of typically 0.05 or 0.01 indicates that the relationship is unlikely to have happened by chance.

Ordinary least squares (OLS) regressions were carried out to determine the relationship between two variables by fitting a line in the form of Equation 4.5.

Equation 4.5 General OLS regression

$$y = mx + c + \varepsilon$$

where

y is the dependent variable

x is the independent variable

m is the slope of the fitted line

c is the intercept of the fitted line

ε is the residual term

The SAVI was forecasted using the forecasting add-on tool in *IBM SPSS Statistics*. It is recommended that when modelling time series data, the historical data to be forecasted should be divided into a portion that is used to build the model and another, called the holdout cases, that is used to validate the model (IBM, 2011). However, since the SAVI was only launched in 2007, there was insufficient data to both build and validate the model, hence the data was used to develop the model only.

The forecasting tool produces forecasts by estimating exponential smoothing, univariate Autoregressive Integrated Moving Average (ARIMA) and multivariate ARIMA models for time series (IBM, 2011). The Expert Modeller function in the tool automatically identifies the most appropriate model and estimates the best-fitting

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ARIMA or exponential smoothing model for the dependent variable series inputted. Alternatively, it is also possible to specify an ARIMA or exponential smoothing model for the procedure. Since no prior research on forecasting the SAVI in particular can be found (Samouilhan and Shannon, 2008), the judgement of the Expert Modeller function for the choice of appropriate model was relied upon.

4.4.3. Testing and Correcting for Heteroscedasticity

The test for and correction of heteroscedasticity in the benchmark dispersion was carried out following the procedure outlined in Raubenheimer's (2012) research.

An OLS regression for the fund performance for each fund was determined according to Equation 4.6. This regression assumes homoscedasticity.

Equation 4.6 OLS for fund performance

$$R_{p,t} = \hat{\alpha}_p + \hat{\beta}_p R_{b,t} + \varepsilon_{p,t}$$

where

$R_{p,t}$	is the fund return
$R_{b,t}$	is the return of the benchmark index
$\hat{\alpha}_p$ and $\hat{\beta}_p$	are fitted regression coefficients for the intercept (alpha) and slope (leverage) respectively
$\varepsilon_{p,t}$	are the residuals which are assumed to be distributed randomly with a constant variance and zero mean

The Breusch-Pagan test was used to determine the presence of heteroscedasticity in the OLS regressions applied to each fund by investigating the significance of the squared residuals with the cross-sectional variance of the benchmark (Raubenheimer, 2012). Equation 4.7 gives the hypothesis that was tested.

Equation 4.7 Breusch-Pagan regression to test for heteroscedasticity in benchmark dispersion

$$\frac{{\varepsilon_{p,t}}^2}{\overline{{\varepsilon_p}^2}} = \hat{a} + \hat{b}{s_{cs,t}}^2 + \gamma_t$$

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where

$\overline{\overline{\varepsilon_p{}^2}}$	is the average squared residual
$\hat{a}$ and $\hat{b}$	are the fitted regression coefficients
γ	is the residual term

Raubenheimer (2012) used the F-test on the second regression of the squared residuals against the cross-sectional variance. The Levene's test was used to test for homogeneity of variance. The null hypothesis in the Levene's test in *IBM SPSS Statistics* is that there is no difference between the variances of the two or more sample groups being tested (Pallant, 2011; Beins and McCarthy, 2012). Finding that the *p* value is larger than 0.05 indicates a non-significant result and so the null hypothesis cannot be rejected, which means that the difference between the variances of the samples are equal and hence homogeneous.

To summarise the test for heteroscedasticity, the residual in Equation 4.6 ($\varepsilon_{p,t}$) was first determined, $\varepsilon_{p,t}{}^2/\overline{\overline{\varepsilon_p{}^2}}$ was then regressed against $s_{cs,t}{}^2$ to obtain a second residual γ_t. The Levene's test was applied to the residual γ_t and $s_{cs,t}{}^2$.

The performance measurement represented by the regression in Equation 4.6 was then corrected for heteroscedasticity by dividing each term of this equation by $s_{cs,t}$ to obtain Equation 4.8.

Equation 4.8 Weighted OLS regression

$$\frac{R_{p,t}}{s_{cs,t}} = \hat{\alpha}_p \frac{1}{s_{cs,t}} + \hat{\beta}_p \frac{R_{b,t}}{s_{cs,t}} + \frac{\varepsilon_{p,t}}{s_{cs,t}}$$

4.5. Research Limitations

The decisions made regarding this study as a consequence of the data that was available has resulted in a number of limitations. The three most significant limitations concern the sampling frequency and time frame of the study, sector level fund holdings, and the missing data in the fund returns dataset.

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This study was restricted to six years of quarterly unit trust fund holding data so there was a limitation on both the sampling frequency and the duration of the study. Increasing the sampling frequency to monthly would greatly improve the level of detail analysed and also monthly is the typical high frequency measure in the fund management industry (Raubenheimer, 2012). Using quarterly data means that three months of successive data are represented by two data points on either end of the period so that anything that any events that occur in between were not taken into account. In comparison, other studies of a similar nature covered monthly sampling frequency at least (Raubenheimer, 2012).

Related to the duration of the study is the forecasting of the SAVI, there was not enough historical data to estimate the forecast as well as to validate the model.

Sector level fund holding information was used to calculate active share so it is only an approximation (Muller and Ward, 2011). As a result, it was not possible to measure changes in holdings at stock level and this inherently incorporated inaccuracies in the estimation. It could be possible that a fund manager has changed share holdings within the same sector, these shares having different performance as represented by returns even though they are in the same sector, but this difference will not reflect in the data in the form that is currently available from ASISA.

The missing data points in the fund returns for December 2007 and in some other places in the time series of fund data had introduced inaccuracies into the analysis. This casts doubt as to the reliability of the results from the analysis performed because it provides an incomplete picture of the reality of fund performance.

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Chapter 5 Results

5.1. Sample Description

The information shown in Table 5.1 puts DGE unit trust funds and the analysis thereof in context with the overall size of the market for the time period studied.

Table 5.1 Summary of DGE unit trusts and JSE market capitalisation (June of each year) (Anderson, 2009; ASISA, 2012b; JSE, 2012)

Year	Number of DGE Funds in Analysis	Total Number of DGE Funds	Domestic Equities Held by All DGE Funds (Rm)	Total Assets Held by All DGE Funds (Rm)	JSE Market Capitalisation (Rbn)
2006	15	82	77,498	81,851	4,299.9
2007	18	94	105,292	112,032	5,641.3
2008	29	107	90,867	102,604	5,950.3
2009	39	117	80,727	88,608	4,732.9
2010	46	117	95,096	104,524	5,634.9
2011	53	120	115,250	123,946	6,687.1
2012	57	125	136,600	146,275	7,354.1

A total of 60 funds was analysed but not all of them existed in all the years of the study or all the quarters of those years. The overview of the active return and active share data for the DGE unit trusts in the sample are given in Table 5.2 and 5.3 respectively.

Table 5.2 DGE funds active return data

Year	Number of Quarters	Number of Data Points	Active Return (%)			
			Median	Mean	Min	Max
2006	2	33	12.8	11.7	4.0	21.0
2007	3	55	4.8	5.7	0.0	13.2
2008	4	118	-5.1	-6.1	-25.5	10.4
2009	4	160	8.8	6.8	-14.3	19.4
2010	4	189	6.4	4.7	-9.7	17.7
2011	4	219	0.3	1.2	-9.0	11.2
2012	2	114	2.5	3.3	-5.3	11.5

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Table 5.3 DGE funds active share data

Year	Number of Quarters	Number of Data Points	Active Share (%)			
			Median	**Mean**	**Min**	**Max**
2006	2	46	44.0	43.9	24.1	71.3
2007	4	108	43.4	42.7	10.3	83.3
2008	4	134	39.8	41.2	7.6	84.3
2009	4	168	38.6	40.9	15.0	119.5
2010	4	188	35.9	36.9	14.8	71.2
2011	4	215	32.7	34.4	15.0	69.9
2012	2	113	33.4	34.2	14.5	62.2

5.2. Variable Descriptions

The variables listed in Table 5.4 are the time series that have been derived from the processing the raw data and used in testing the hypotheses of the research.

Table 5.4 Variables used to test hypotheses

Variable Name	Description
Active share	Share holdings that represent what is different from the benchmark of individual funds (quarterly)
Active return	Total fund returns that is different from the benchmark returns (quarterly)
CSstddev	Cross-sectional standard deviation of the market returns (quarterly and monthly)
TrErr	Tracking error which is defined as the standard deviation of the difference between the fund returns and the benchmark returns (quarterly)
SAVI	Volatility index levels of JSE Top 40 (quarterly and monthly)

5.3. Hypothesis 1: Cross-sectional Variance and Active Management

H0: There is no correlation between cross-sectional variance in the benchmark index and the level of active share and active return of unit trust funds.

HA: There is a correlation between cross-sectional variance in the benchmark index and the level of active share and active return of unit trust funds.

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5.3.1. Sub-hypothesis 1A

H0: There is no relationship between the level of active share in unit trust funds and the level of cross-sectional variance of returns.

HA: There is a relationship between the level of active share in unit trust funds and the level of cross-sectional variance of returns.

Table 5.5 Summary of correlations between active share of individual funds and cross-sectional deviation of returns

	Relationship	No Relationship	Total
Count	11	49	60
%	18	82	100

Table 5.6 Correlation between median active share and cross-sectional standard deviation of returns

Pearson Correlation	
Value	0.416
Correlation strength	Moderate
Correlation direction	Positive
Significance level	0.05

Decision: Cannot reject the null hypothesis

5.3.2. Sub-hypothesis 1B

H0: There is no relationship between the level of active return in unit trust funds and the level of cross-sectional variance of returns.

HA: There is a relationship between the level of active return in unit trust funds and the level of cross-sectional variance of returns.

Table 5.7 Summary of correlations between active return of individual funds and cross-sectional deviation of returns

	Relationship	No Relationship	Total
Count	1	59	60
%	2	98	100

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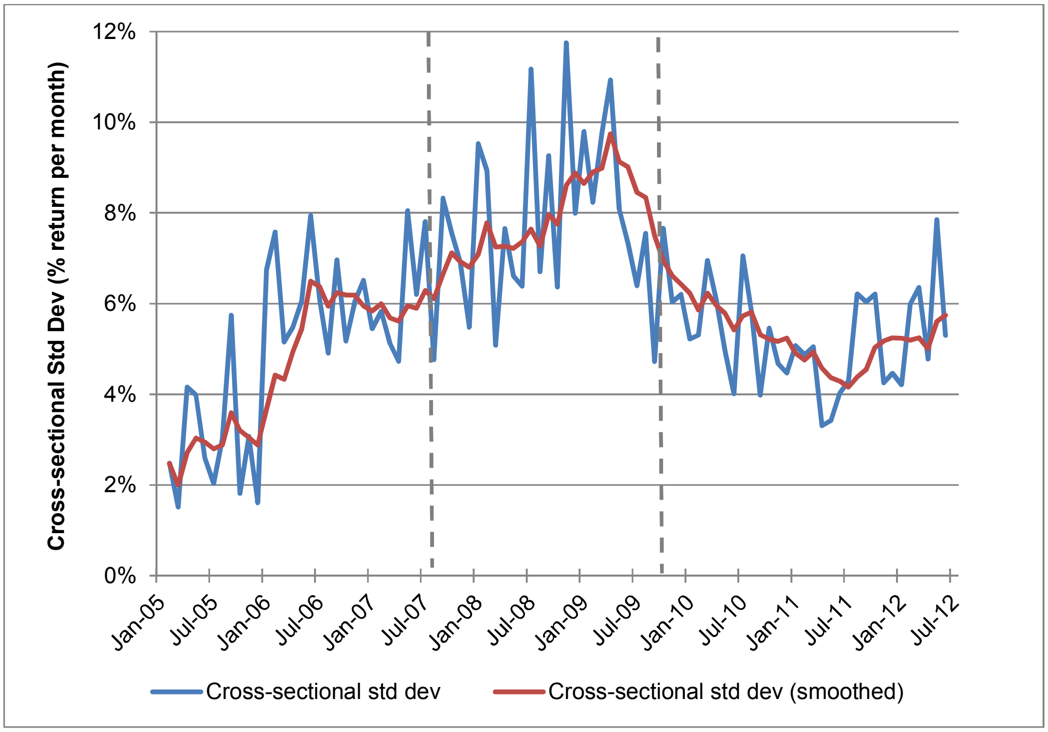
Figure 5.1 Cross-sectional standard deviation of returns on FTSE/JSE ALSI



From Figure 5.1 the periods of differing cross-sectional volatility are distinguished as follows:

- Moderate: September 2006 to September 2007
- High: December 2007 to September 2009
- Low: December 2009 to June 2012

Table 5.8 Summary of correlations between active return of individual funds and cross-sectional standard deviation of returns during differing CSV

		Relation-ship	No Relation-ship	Total	Not in Period	Grand Total
High	**Count**	2	32	34	26	60
	%	6	94	100	-	100
Moderate	**Count**	0	17	17	43	60
	%	0	100	100	-	100
Low	**Count**	2	57	59	1	60
	%	3	97	100	-	100

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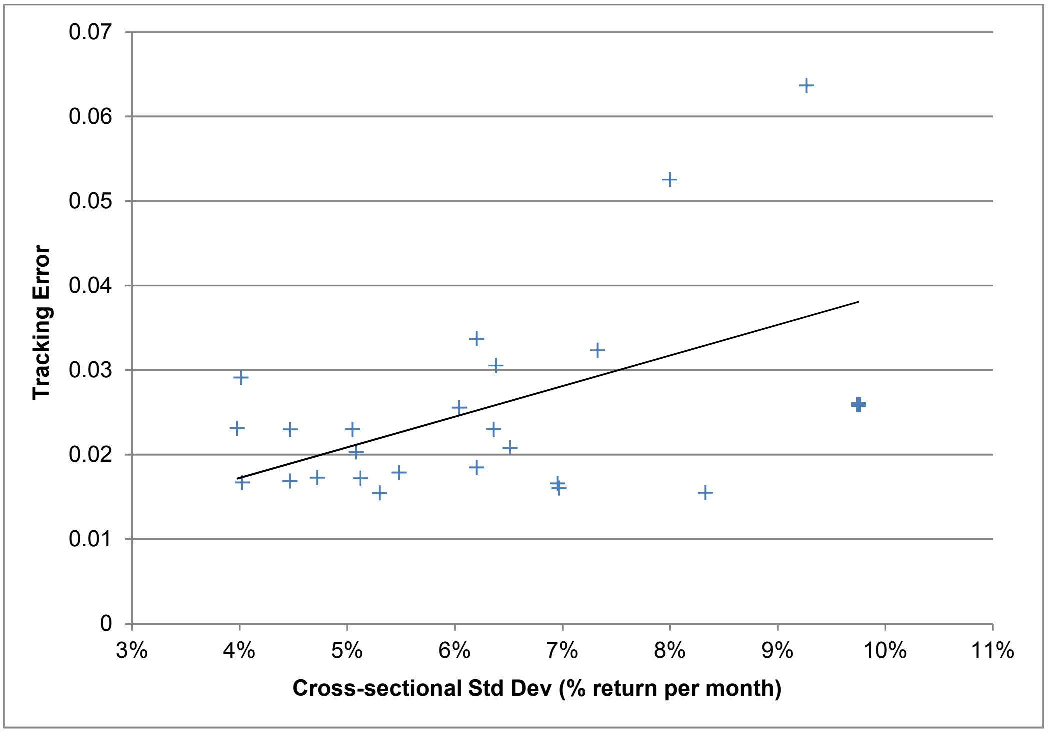
Table 5.9 Correlation between median active return and cross-sectional standard deviation of returns

Pearson Correlation	
Value	-0.360
Correlation strength	Moderate
Correlation direction	Negative
Significance level	0.091

Figure 5.2 Regression of cross-sectional standard deviation and tracking error



Equation 5.1 OLS regression of cross-sectional standard deviation and tracking error

$Tracking\ error = 0.3626 CSstddev + 0.0027$

$R^2 = 0.2481$

Decision: Cannot reject the null hypothesis

5.3.3. Sub-hypothesis 1C

H0: There is no relationship between the level of active share in unit trust funds and the level of active return.

HA: There is a relationship between the level of active share in unit trust funds and the level of active return.

Table 5.10 Summary of correlations between active share and active return of individual funds

	Relationship	No Relationship	Total
Count	2	58	60
%	3	97	100

Figure 5.3 Scatterplot of active share and active returns for all funds analysed over entire period

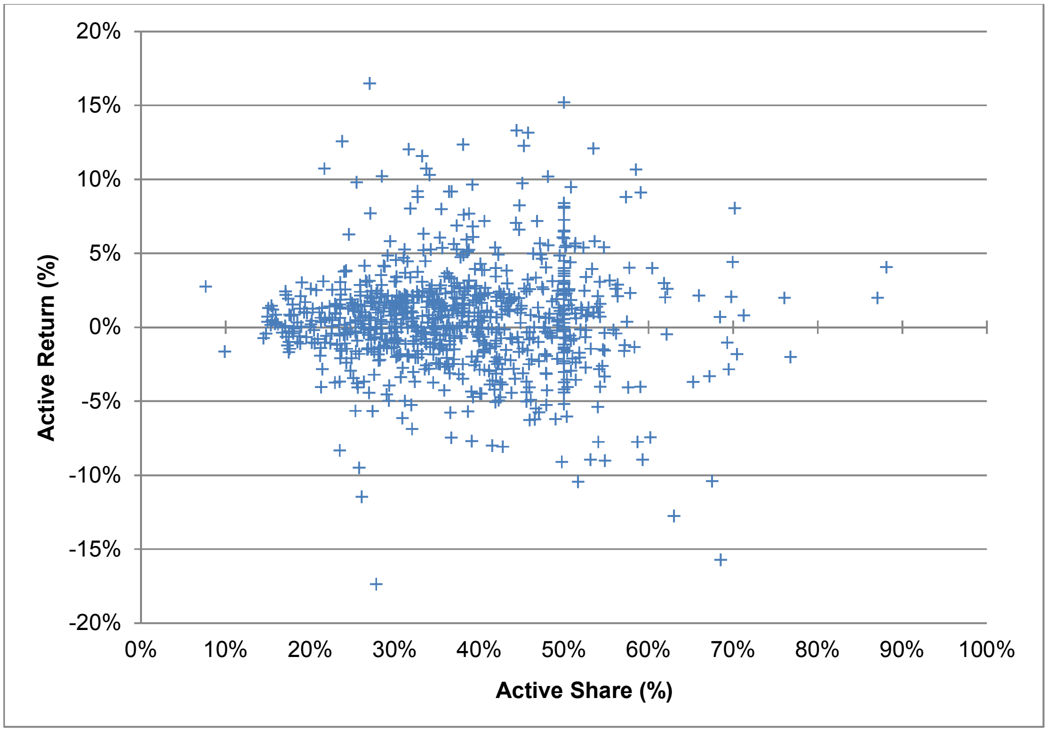


Table 5.11 Correlation between median active return and active share of funds

Pearson Correlation	
Value	0.162
Correlation strength	None
Correlation direction	Positive
Significance level	0.461

<u>Decision</u>: Cannot reject the null hypothesis

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5.4. Hypothesis 2: Fund Performance

H0: Actively-managed funds do not outperform the benchmark index during periods of differing cross-sectional variance.

HA: Actively-managed funds outperform the benchmark index during periods of differing cross-sectional variance.

5.4.1. Sub-hypothesis 2A

H0: Actively-managed funds do not outperform the benchmark index during periods of high cross-sectional variance.

HA: Actively-managed funds outperform the benchmark index during periods of high cross-sectional variance.

Table 5.12 Number of funds that outperform or underperform compared to benchmark index during high CSV

	Above	Below	Total
Count	113	146	259
%	44	56	100

Decision: Inconclusive

5.4.2. Sub-hypothesis 2B

H0: Actively-managed funds do not outperform the benchmark index during periods of moderate cross-sectional variance.

HA: Actively-managed funds outperform the benchmark index during periods of moderate cross-sectional variance.

Table 5.13 Number of funds that outperform or underperform compared to benchmark index during moderate CSV

	Above	Below	Total
Count	88	0	88
%	88	0	100

Decision: Reject the null hypothesis and accept the alternative hypothesis

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5.4.3. Sub-hypothesis 2C

H0: Actively-managed funds do not outperform the benchmark index during periods of low cross-sectional variance.

HA: Actively-managed funds outperform the benchmark index during periods of low cross-sectional variance.

Table 5.14 Number of funds that outperform or underperform compared to benchmark index during low CSV

	Above	Below	Total
Count	386	179	565
%	68	32	100

Decision: Reject the null hypothesis and accept the alternative hypothesis

5.4.4. Sub-hypothesis 2D

H0: Returns delivered in periods of high dispersion in the benchmark assets should not be weighted less than returns earned in periods of low benchmark dispersion.

HA: Returns delivered in periods of high dispersion in the benchmark assets should be weighted less than returns earned in periods of low benchmark dispersion.

The OLS regression and the weighted OLS regression as described by Equations 4.6 and 4.8 were tested for heteroscedasticity.

Table 5.15 Comparison of correction for heteroscedasticity of return dispersion

	OLS			**Weighted OLS**		
	Homoscedasticity	**Heteroscedasticity**	**Total**	**Homoscedasticity**	**Heteroscedasticity**	**Total**
Count	17	43	60	23	37	60
%	28	72	100	38	62	100

Decision: Cannot reject the null hypothesis

5.5. Hypothesis 3: Investment Decisions Based on Volatility

H0: The outlook on market volatility cannot be used to inform fund investment decisions.

HA: The outlook on market volatility can be used to inform fund investment decisions.

5.5.1. Sub-hypothesis 3A

H0: There is no relationship between the SAVI and cross-sectional variance of returns.

HA: There is a relationship between the SAVI and cross-sectional variance of returns.

Figure 5.4 FTSE/JSE All Share Index level and implied volatility

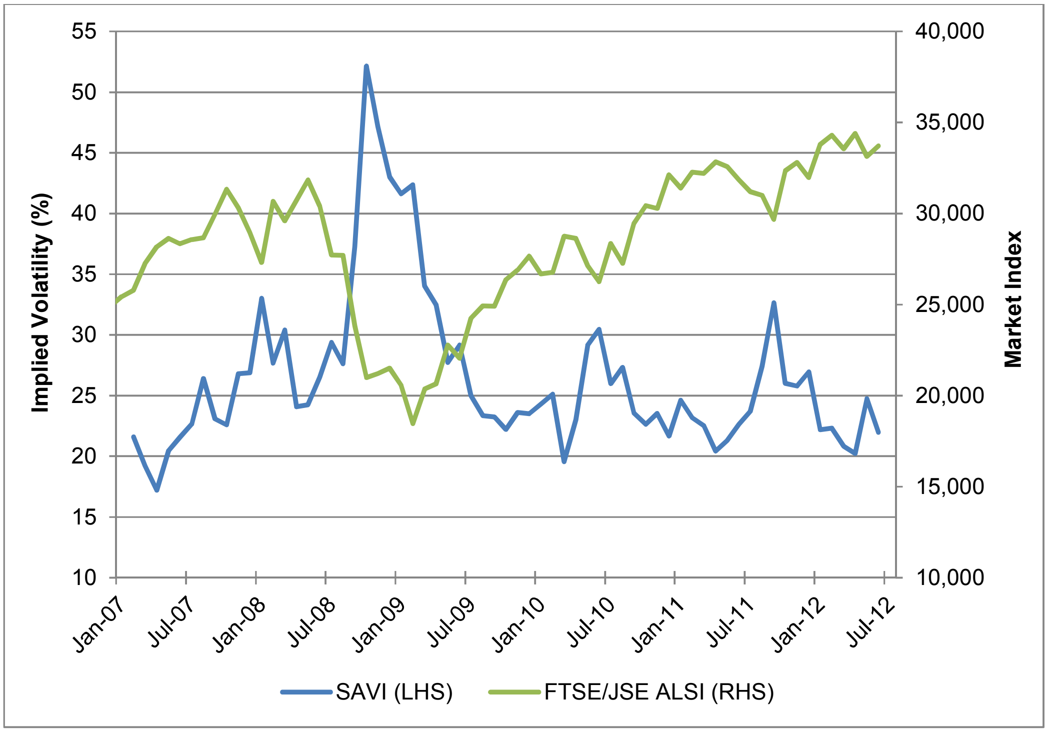

Table 5.16 Correlation between the SAVI and ALSI levels

Pearson Correlation	
Value	-0.684
Correlation strength	Strong
Correlation direction	Negative
Significance level	0.01

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Figure 5.5 Comparison of the SAVI with the cross-sectional std dev of returns

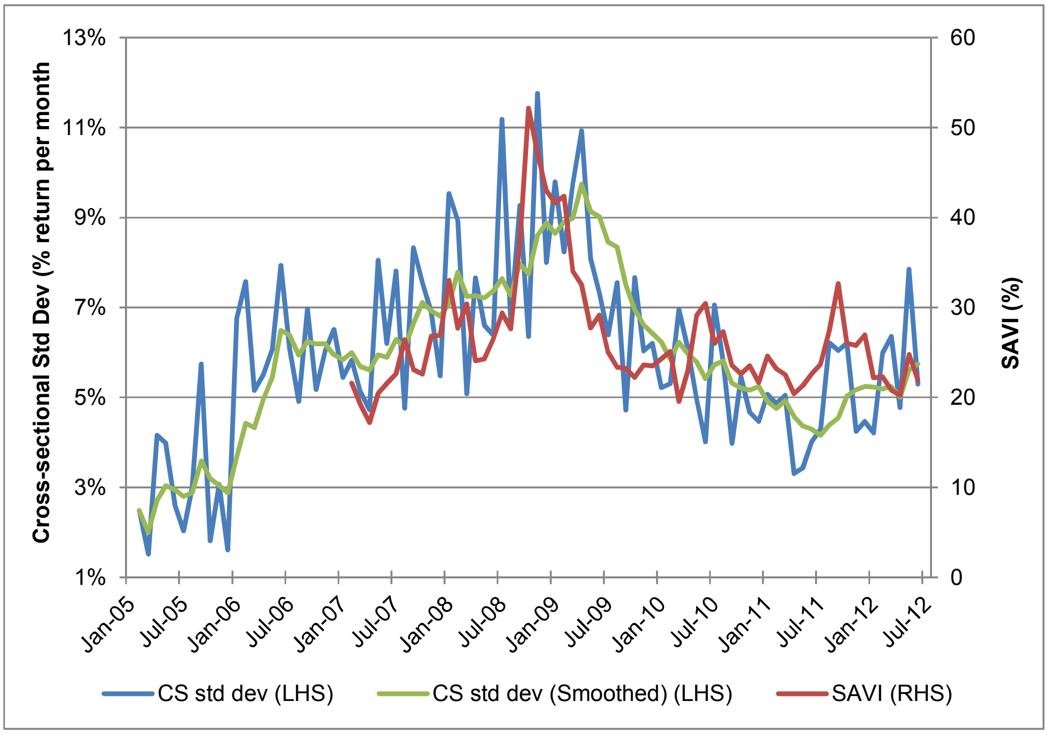

Table 5.17 Correlation between the SAVI and cross-sectional standard deviation

Pearson Correlation	
Value	0.498
Correlation strength	Moderate
Correlation direction	Positive
Significance level	0.01

Decision: Reject the null hypothesis

5.5.2. Sub-hypothesis 3B

H0: There is no correlation between the SAVI and fund performance as measured by the active return.

HA: There is a correlation between the SAVI and fund performance as measured by the active return.

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Table 5.18 Summary of correlations between active return of individual funds and the SAVI

	Relationship	No Relationship	Total
Count	10	50	60
%	17	83	100

Table 5.19 Correlation between the SAVI and median active return

Pearson Correlation	
Value	-0.711
Correlation strength	Strong
Correlation direction	Negative
Significance level	0.00

Decision: Inconclusive

5.5.3. Sub-hypothesis 3C

H0: The SAVI cannot be used to inform fund investment decisions in periods of varying cross-sectional variance.

HA: The SAVI can be used to inform fund investment decisions in periods of varying cross-sectional variance.

Table 5.20 Correlation between the SAVI offset by 3 months and cross-sectional standard deviation

Pearson Correlation	
Value	0.452
Correlation strength	Moderate
Correlation direction	Positive
Significance level	0.05

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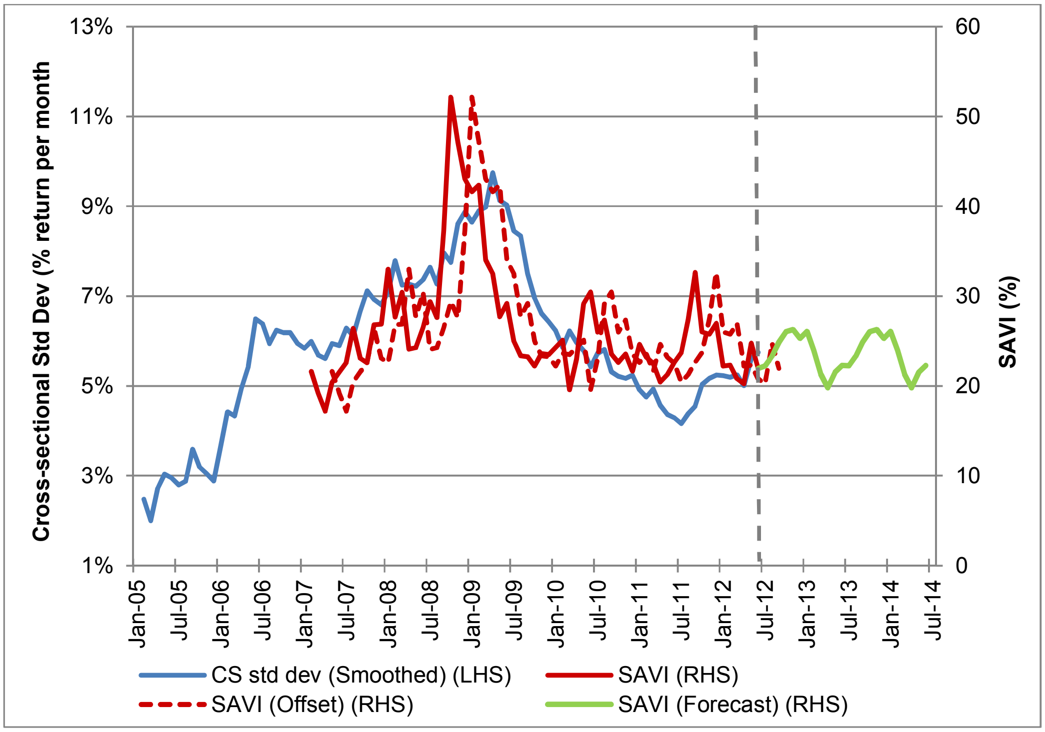
Figure 5.6 Plot of the SAVI with its forecast and cross-sectional standard deviation



<u>Decision</u>: Inconclusive

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Chapter 6 Discussion of Results

6.1. Hypothesis 1: Cross-sectional Variance and Active Management

The first hypothesis that this study seeks to test is whether there is a relationship between the cross-sectional variance in the return of assets in the benchmark index and the level of active share and active return of unit trust funds. This was achieved through considering the relationship between each pair of these variables.

6.1.1. Sub-hypothesis 1A: Relationship between Active Share and CSV

Expanding on the summary in Table 5.5, the Pearson correlations carried out on each of the DGE funds' active share with the cross-sectional standard deviation gives the results that 11 funds have a level of significance below 0.05 for a two-tailed test. The details of the individual correlations are given in Appendix 2.

Eight of these funds exhibit a positive correlation while three funds show a negative correlation. The funds with a positive correlation are Sasfin Equity Fund, Clade Cash Flow Weighted Equity Fund, Maestro Equity Fund, Oasis General Equity Fund, Lion of Africa General Equity Fund, ABSA Select Equity Fund, Harvard House General Equity Fund, and ABSA General Fund. The funds that show a negative correlation are Stanlib SA Equity Fund, Stanlib Equity Fund, and Allan Gray Equity Fund.

The median active share was correlated against the cross-sectional standard deviation and the result in Table 5.6 shows that it is statistically significant. The table also shows that the active share should increase as the dispersion increases. At 18% of the sample showing a statistically significant correlation but only 13% having a positive correlation, there is a possibility that there is a relationship between the active share of funds and the CSV of market returns but it is marginal. Hence, the test at the detailed fund level, which is more appropriate, indicates that the null hypothesis should not be rejected. It can be concluded that there is no correlation between cross-sectional variance in the benchmark index and the level of active share and active return of unit trust funds.

The generalisation of these findings is limited considering the eventual sample data used is only a fraction of the sample that was identified i.e. that of DGE funds but excluding Sharia funds, funds of funds and index trackers.

6.1.2. Sub-hypothesis 1B: Relationship between Active Return and CSV

The cross-sectional standard deviation of all the individual shares that make up the FTSE/JSE ALSI for the period January 2005 to June 2012 is given in Figure 5.1. The smoothed data using the 6-month moving average is also plotted on the same graph. This plot is used to divide the time frame of the study period into intervals of high, moderate and low volatility.

Figure 1 confirms Raubenheimer's (2012) observation that in recent years, cross-sectional dispersion on the ALSI is at a low level following the high levels of dispersion seen during the financial crisis in 2008.

The Pearson correlation carried out on each of the DGE funds' active return with the cross-sectional standard deviation are summarised in Table 5.7 and its details are given in Appendix 3. It can be seen that there is only one fund with a statistical significance at the 0.05 level for a two-tailed test and exhibiting a positive correlation. The very low number of significant correlations in Table 5.7 illustrates that there is largely no relationship between the active return of individual funds and the cross-sectional standard deviation of returns. The result from the correlation between the median active return and the dispersion, as shown in Table 5.9 confirms this result.

Table 5.8 presents the results of correlations between active return of individual funds and cross-sectional standard deviation. It shows that of the 17 funds that fall within the moderate cross-sectional dispersion period, none of them have a statistically significant correlation. From the same table, 34 out of the 60 funds fall within the high cross-sectional volatility interval but only 6% of the 34 funds show a statistically significant relationship between the individual funds' active returns and the dispersion. Similarly, with 3% of funds showing a correlation, the same results are obtained as for

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high and moderate CSV. These levels of correlation are too low for the null hypothesis to be rejected.

The independent variable active return, as represented by the tracking error, is plotted against the dependent variable cross-sectional standard deviation of the market returns in Figure 5.2. The OLS regression equation that results is given in Equation 5.1. The relatively small magnitude of the coefficient of determination at 0.2481 shows that linear regression is not appropriate regression for this set of data.

Muller and Ward (2011) conclude from their work that there is no relationship between the level of active share and a fund's return. The finding in the current research confirms this result.

The proof from the correlation tests and the regression means that the null hypothesis cannot be rejected. The conclusion is that there is no relationship between the level of active return in unit trust funds and the level of cross-sectional variance of returns.

The results regarding the high, moderate and low periods of dispersion cannot be generalised as only one interval of each of interval was analysed.

6.1.3. Sub-hypothesis 1C: Relationship between Active Return and Active Share

Table 5.10 shows that the number of individual funds with statistically significant correlations between its active return and active share are very low. It is expected that as active share increases, the associated investment risk increases as well, which would only be justified if there is additional return for taking this above average risk. However, the finding that there is no relationship between the active share and active return means that this expectation is not met in reality.

Table 5.11 shows that with a significance level of 0.461, the correlation of the median active return with the active share is not statistically significant.

Figure 5.3 is a scatterplot of all the active share and active return data for all of the funds analysed over the period from September 2006 to June 2012. It illustrates that there is no general trend between the two variables even though the pattern appears to

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be fan shaped, mirrored about the horizontal axis. This plot thus confirms the finding from the two sets of correlations that there is no relationship between the two variables.

It can be concluded that the null hypothesis cannot be rejected and hence there is no relationship between the level of active share in unit trust funds and the level of active return.

6.2. Hypothesis 2: Fund Performance

6.2.1. Sub-hypothesis 2A: Active Fund Performance in High CSV

The active return of each fund was measured against the returns of the ALSI and the results are presented in Table 5.12. The interval of high cross-sectional variance is defined as between December 2007 and September 2009, containing a total of 259 data points during that period. Of this total, 44% of these instances demonstrated that the active fund outperformed the benchmark, while 56% achieved returns less than the benchmark.

The conclusion is that based on the analysis carried out and the results obtained, it cannot be determined whether active funds significantly outperform the benchmark index during periods of high cross-sectional variance.

6.2.2. Sub-hypothesis 2B: Active Fund Performance in Moderate CSV

The period of moderate cross-sectional variance in the time frame of the study is defined as that between September 2006 and September 2007, where there is a level of dispersion but not as high as the period around 2008 and not as low as the CSV in recent times. Table 5.13 shows that all of the 88 instances of active share during the period of moderate CSV outperformed the benchmark.

It can be concluded that the null hypothesis should be rejected and the alternative hypothesis accepted. Thus, actively-managed funds outperform the benchmark index during periods of moderate cross-sectional variance.

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6.2.3. Sub-hypothesis 2C: Active Fund Performance in Low CSV

During the period of low cross-sectional variance, defined as December 2009 to June 2012, the instances of fund return being higher than the benchmark return is 68% and 32% of data points below it. A considerable number of data points confirm that the funds are able to outperform the benchmark index in times of low cross-sectional variance.

Hence, it can be concluded that the null hypothesis can be rejected and the alternative hypothesis accepted, proving that active funds outperform the benchmark index during periods of low cross-sectional variance.

6.2.4. Sub-hypothesis 2D: Correcting for Heteroscedasticity

Raubenheimer (2012) postulates that returns delivered in periods of high dispersion in the benchmark assets should be weighted less than returns earned in periods of low benchmark dispersion. She found that due to the heteroscedasticity of the benchmark dispersion, it was necessary to correct for it through weighting the OLS regression by dividing the regression expression by the cross-sectional standard deviation of the market, which in effect discounted the returns achieved during periods of high volatility and added more weight to returns achieved in low dispersion. What she found was that using the conventional OLS regression, 51 of the 60 funds showed heteroscedasticity. When the OLS regression was weighted by the CSV factor, she found that only 10 out of the 60 funds displayed the phenomenon.

The results obtained in this study for the OLS and weighted OLS regressions are shown in Table 5.15. It can be seen that the number of heteroscedastic cases only decreases from 43 to 37 out of the same sample size as Raubenheimer's study. The initial level was not as high as what she observed and the improvement is also not as drastic or significant.

The conclusion is that the null hypothesis cannot be reject the null hypothesis that returns delivered in periods of high dispersion in the benchmark assets should not be weighted less than returns earned in periods of low benchmark dispersion. This is proof that perhaps an alternative method to correcting for heteroscedasticity needs to

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be found, one where it does not result in the effect of fund managers' performance being reduced in high times and enhanced in low times.

6.3. Hypothesis 3: Investment Decisions Based on Volatility

6.3.1. Sub-hypothesis 3A: Relationship between SAVI and CSV

The SAVI is a volatility measure that is based on the FTSE/JSE Top 40 Index. As a result, there is a clear negative correlation between the underlying index level and its volatility. Figure 5.4 is a plot of the SAVI against the ALSI which clearly shows this negative relationship, and even though the SAVI is based on the Top 40 Index, it is a close approximation to the forecasting the volatility behaviour of the ALSI. The physical interpretation of this is that the SAVI is a measure of market fear so that fear rises as markets fall and conversely, fear decreases with market optimism and activity. This result is confirmed by the strong negative correlation between the two variables, as shown in Table 5.16.

From Figure 5.5, it can seen that the SAVI closely approximates the cross-sectional standard deviation as a measure of volatility. The difference in the two variables is in the way that it is derived: the SAVI is an implied index that can be obtained from a database, while the cross-sectional deviation requires more effort as it needs to be calculated from fund and benchmark returns. Table 5.17 shows that there is a moderate positive correlation between the SAVI and cross-sectional standard deviation that is statistically significant. Hence, the SAVI can be said to be an acceptable proxy for CSV to be used in analysing active fund performance.

The conclusion is to reject the null hypothesis that there is no relationship between the SAVI and cross-sectional variance of returns, and to accept the alternative hypothesis that there is a relationship between the SAVI and cross-sectional variance.

6.3.2. Sub-hypothesis 3B: Relationship between SAVI and Active Return

As can be seen in the summary presented as Table 5.18, out of the 60 correlations between the SAVI and the individual fund's active return, only 10 showed a statistical significance. All of these instances exhibit a positive correlation between the SAVI and

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the active return, implying that as volatility increases, so does the quantum of the returns earned in excess of the benchmark. The details of the correlations are given in Appendix 4.

An analysis of the relationship between the SAVI and the median active return shows that there is a strong negative correlation between the SAVI and the mean active return (refer to Table 5.19). The interpretation of this finding is that as the volatility increases, the active return decreases.

In light of the conflicting outcomes that resulted from analysing the relationship between the SAVI and active return, the finding is that this test is inconclusive.

6.3.3. Sub-hypothesis 3C: Forecasting CSV from SAVI

The SAVI is a 3-month forecast of market volatility. As a result, any point in the SAVI time series should be predicting a point in the cross-sectional volatility of the assets underlying the ALSI three months in advance. The "offset SAVI" that is shown in Figure 5.6 is a plot of the SAVI offset three months into the future to reflect the fact that what it is forecasting at a point in time is a possible reality three months in the future.

A comparison of the correlation between the SAVI (Table 5.17) and the offset SAVI (Table 5.20) reveals that the correlation of the cross-sectional standard deviation with the former is stronger. This result shows that it is preferable to forecast the SAVI rather than the offset SAVI.

Sub-hypothesis 3A shows that there is a relationship between the SAVI and the cross-sectional standard deviation of returns. So based on this finding, the possibility of determining a relationship for the SAVI to be used to forecast the cross-sectional deviation is explored.

The forecasting tool in *IBM SPSS Statistics* is used to generate a forecast of the SAVI two years into the future. The model that was chosen by the Expert Modeller function is exponential smoothing of the simple seasonal type.

Various regression models were investigated in an attempt to find a relationship between the cross-sectional variance and the SAVI in the form of a formula. If this is found, then the SAVI forecasts can be applied to this formula to forecast cross-sectional variance, with the objective to forecast three months in advance of when fund managers should increase or decrease their active share to take advantage of prevailing market conditions and opportunities. The linear, logarithmic, inverse, quadratic and cubic regression models were all run but meaningful results were not found.

It can be concluded that because the relationship between the SAVI and the cross-sectional variance could not be found, the remainder of the hypothesis could not be taken to conclusion.

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Chapter 7 Conclusions and Recommendations

7.1. Cross-sectional Variance and Active Management

The findings in this study show that there is no significant relationship between the cross-sectional variance, active share and active returns. This means that even though cross-sectional dispersion can be an opportunity for fund managers to deviate from the benchmark, there is no clear evidence that active share increases with cross-sectional variance.

Also, it is expected that as active share increases, the associated investment risk increases as well, which would only be justified if there is additional return for taking this above average risk. However, the finding that there is no relationship between the active share and active return means that this expectation is not met in reality.

7.2. Fund Performance

It was shown in this study that in measuring fund performance in times of differing cross-sectional dispersion and breaking the analysis period into such intervals rather than as a continuous time series, active funds outperform the benchmark index during periods of low and moderate cross-sectional variance.

The implication of this finding is that perhaps active fund managers should concentrate on taking on more active share in times of moderate and low cross-sectional volatility.

Heteroscedasticity exists in measuring fund performance but it is uncertain what is the best method to correct for it because the results obtained in the study are inconclusive

7.3. Investment Decisions Based on Volatility

The SAVI can be used as a fairly accurate approximation of cross-sectional variance as a ready-to-use measurement of volatility rather than having to calculate cross-sectional variance from fund and index returns.

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In this study, various regression models were investigated in an attempt to find a formula with the cross-sectional variance as the dependent variable and the SAVI as the independent variable. If this is found, then the SAVI forecasts can be applied to this formula to forecast cross-sectional variance, with the objective to forecast three months in advance of when fund managers should increase or decrease their active share to take advantage of prevailing market conditions and opportunities. However, no meaningful relationships were not found.

7.4. Significance of Findings

The significance of the findings for investors is that this study adds to the mass of prior research that concludes that investing in active funds does not necessarily have benefits over passive funds. Active management does result in return above the benchmark for the additional risk that is taken on as a result of investing in anything other than the benchmark index. This is true especially after fees are taken into account and in particular when long term investing is considered.

Hence, investors should not dismiss passive funds as inferior investment vehicles in favour of active funds.

7.5. Recommendations for Future Research

The recommendations for future research detailed in this section result from the pertinent limitations selected for discussion in Section 4.5. These are focused around the missing data points in the total fund return database, the forecasting model using the SAVI

The decisions made regarding this study as a consequence of the data that was available has resulted in a number of limitations. The three most significant limitations concern the sampling frequency and time frame of the study, sector level fund holdings, and the missing data in the fund returns dataset.

The limitation of the ASISA unit trust fund holding data used in this study is that it is quarterly data and also given at sector level. A recommendation for future research would be to obtain monthly holding data at individual stock level and to repeat the study. Obtaining access could be achieved through negotiating confidential access to detailed historical monthly investment holding information with a few companies, undertaking that the information sourced in this way will be purely for academic purposes, that any information that can identify the source with it is removed and results to be shared with companies that provided input data. If relatively old historical data is made available, it will not compromise the investment companies' competitive position that results from its intellectual property and at the same time would contribute to the quest for a better understanding of the domestic unit trust industry.

The part of this research related to relationships with and forecasting of the SAVI should be repeated once there is enough historical data to do meaningful statistical tests as well as to estimate the forecast and to validate the model. Also, while the in-depth study of the forecasting ability of the SAVI and other volatility models by Samouilhan and Shannon (2008) examined their forecasting ability one day and one week into the future, it would be useful to investigate forecasting longer periods using the SAVI. This index is constructed from data that defines it as looking three months into the future, and as such, this could be the upper limit of this recommendation for future work

The missing data points in the fund returns for December 2007 and in some other places in the time series of fund data had caused the results of this research to be unreliable and incomplete. A recommendation would be to calculate the data from first principles through basic data published regularly by companies, and to compare and confirm this data through various databases such as McGregor BFA, INET Bridge and Bloomberg before it is used.

A further research recommendation is to investigate the use of alternative methods to correct the fund performance data for heteroscedasticity. This is a well-studied area of statistics and alternative methods are available. Perhaps one could be found that better reflects the realities of rewarding fund managers highly in times of high cross-sectional variance because they were able to take advantage of the opportunities presented to them.

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Appendix 1 List of Excluded Unit Trust Funds

Islamic Sharia Funds (ASISA, 2012b; Bloomberg, 2012)	
1	27Four Active Equity Fund
2	Elements Islamic Equity Fund
3	Fraters Islamic Equity
4	Futuregrowth Albaraka
5	Kagiso Islamic Equity Fund
6	Oasis Crescent Equity Fund
7	Old Mutual Albaraka Equity Fund
8	Stanlib Shariah Equity Fund

Funds of Funds (ASISA, 2012b)	
1	ABSA Growth Fund of Funds
2	Advantage Aggressive Equity Fund of Funds
3	Advantage Equity Fund of Funds
4	APS Equity Fund of Funds
5	Ayanda Conservative Equity Fund of Funds
6	Capstone Active Equity Fund of Funds
7	Dynasty Wealth Accumulator Fund of Funds
8	FG Mercury Equity Fund of Funds
9	Glenrand Equity Fund of Funds
10	Intervest Equity Fund of Funds
11	Investment Solutions Multi-manager Equity Fund of Funds
12	Lynx Opportunities Fund of Funds
13	Matador Equity Fund of Funds
14	Momentum Aggressive Equity Fund of Funds
15	Momentum Moderate Equity Fund of Funds
16	Momentum Multifocus Fund of Funds
17	Pioneer Equity Fund of Funds
18	PSG Advance Wealth Creator Fund of Funds
19	PSG Alphen Equity Fund of Funds
20	PSG Konsult Creator Fund of Funds
21	RWM Opportunities Fund of Funds
22	Sanlam Multi Manager Equity Fund of Funds
23	Sasfin Capital Growth Fund of Funds
24	SMMI Equity Fund of Funds
25	Stanlib Multi Manager All Stars Equity Fund of Funds
26	Stanlib Multi Manager Equity Feeder
27	Stanlib Multi Manager Inst Aggressive Fund of Funds
28	Stewart Macro Equity Fund of Funds
29	Symmetry Equity Fund of Funds
30	Verso Multi Manager Equity

Index Tracking Funds (Profile Media, 2012)	
1	Grindrod RAFI Enhanced SA Strategy Fund
2	Gryphon All Share Tracker Fund
3	Kagiso Top 40 Tracker Fund
4	Momentum Top 40 Index Fund
5	Old Mutual RAFI 40 Tracker Fund
6	Old Mutual Top 40 Fund
7	Prudential Enhanced SA Property Tracker Fund
8	Sanlam All Share Index Fund
9	Satrix Rafi 40 Total Return EFT
10	SIM Index Fund
11	SIM Dividend Plus Index Fund
12	SIM Equally Weighted Top 40 Index Fund
13	SIM RAFI 40 Index Fund
14	Stanlib ALSI 40 Fund
15	Stanlib Index Fund

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Appendix 2 Correlation Between Active Share and Cross-sectional Standard Deviation

Fund Name	Pearson Correlation	Significance (2-tailed)	Sum of Squares and Cross-products	Covariance
Stanlib SA Equity Fund	-0.741*	0.022	-0.003	0.000
Sasfin Equity Fund	0.660**	0.004	0.027	0.002
Stanlib Equity Fund	-0.643*	0.018	-0.005	0.000
Clade Cash Flow Weighted Equity Fund	0.621*	0.013	0.035	0.002
Maestro Equity Fund	0.575*	0.012	0.017	0.001
Oasis General Equity Fund	0.572**	0.004	0.032	0.001
Lion of Africa General Equity Fund	0.563*	0.019	0.030	0.002
ABSA Select Equity Fund	0.551**	0.006	0.019	0.001
Harvard House General Equity Fund	0.534*	0.011	0.022	0.001
ABSA General Fund	0.522*	0.038	0.008	0.001
Allan Gray Equity Fund	-0.458*	0.028	-0.009	0.000
Truffle General Equity Fund	0.633	0.563	0.001	0.001
BJM Multi Manager Equity Fund	0.615	0.142	0.003	0.000
Melville Douglas High Alpha Fund	0.556	0.330	0.001	0.000
Dynamic Wealth Optimal Fund	0.524	0.365	0.001	0.000
Prescient Equity Active Quants Fund	0.520	0.652	0.001	0.000
Marriott Dividend Growth Fund	0.498	0.070	0.009	0.001
Imara Equity Fund	0.484	0.079	0.013	0.001
NEFG Equity Fund	0.424	0.131	0.013	0.001
Kagiso Equity Alpha Fund	0.393	0.165	0.007	0.001
Huysamer Equity Fund	0.392	0.064	0.010	0.000
Coronation Equity Fund	0.364	0.088	0.015	0.001
Stanlib Nationbuilder Fund	0.356	0.161	0.013	0.001
Foord Equity Fund	0.345	0.107	0.016	0.001
Discovery Equity Fund	0.345	0.161	0.018	0.001
Aylett Equity Fund	0.340	0.121	0.030	0.001
Old Mutual High Yield Opportunity Fund	0.326	0.327	0.003	0.000
Old Mutual Top Companies Fund	0.300	0.164	0.009	0.000
Momentum Equity Fund	0.294	0.706	0.000	0.000
SIM Top Choice Equity Fund	0.278	0.279	0.005	0.000
Stanlib Multi Manager Equity Fund	0.266	0.489	0.001	0.000
SIM General Equity Fund	0.264	0.324	0.002	0.000
Prudential Equity Fund	0.226	0.325	0.008	0.000
Old Mutual Active Quant Equity Fund	0.203	0.550	0.002	0.000
Efficient Active Quant Fund	0.201	0.703	0.001	0.000
Community Growth Fund	0.180	0.410	0.006	0.000
Old Mutual Investors Fund	0.176	0.433	0.004	0.000
Old Mutual Growth Fund	0.139	0.528	0.005	0.000
Investec Equity Fund	0.121	0.657	0.002	0.000
RMB Private Bank Equity Fund	0.119	0.712	0.001	0.000
SPI Equity Fund	0.045	0.955	0.000	0.000
Coris Capital General Equity Fund	0.021	0.930	0.002	0.000
Analytics Managed Equity Fund	0.010	0.976	0.000	0.000
Cannon Equity Fund	-0.005	0.981	0.000	0.000
Prescient Equity Quant Fund	-0.020	0.938	0.000	0.000
Aeon Enhanced Equity Fund	-0.035	0.965	0.000	0.000
NFB Equity Fund	-0.103	0.826	-0.001	0.000
Element Earth Equity Fund	-0.193	0.549	-0.002	0.000
Capstone Equity Fund	-0.223	0.857	0.000	0.000
Newfunds Newsa Index Portfolio	-0.238	0.700	0.000	0.000
Mazi Capital Equity Fund	-0.303	0.508	0.000	0.000
Miplan IP Beta Equity Fund	-0.309	0.385	-0.001	0.000
FNB Growth Fund	-0.397	0.060	-0.010	0.000

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Fund Name	Pearson Correlation	Significance (2-tailed)	Sum of Squares and Cross-products	Covariance
Investec Active Quants Fund	-0.458	0.074	-0.010	-0.001
Personal Trust SA Equity Fund	-0.469	0.145	-0.005	0.000
Verso Long Term SA Equity Fund	-0.484	0.516	-0.001	0.000
Afena Equity Fund	-0.491	0.217	-0.003	0.000
Efficient General Equity Fund	-0.522	0.185	-0.003	0.000
Momentum Best Blend Specialist Equity	-0.792	0.418	0.000	0.000
Flagship IP Equity Fund	-0.963	0.174	0.000	0.000

* Correlation is significant at 0.05 level (2-tailed)

** Correlation is significant at 0.01 level (2-tailed)

Appendix 3 Correlation Between Active Return and Cross-sectional Standard Deviation

Fund Name	Pearson Correlation	Significance (2-tailed)	Sum of Squares and Cross-products	Covariance
Lion of Africa General Equity Fund	0.526*	0.030	0.007	0.000
SPI Equity Fund	0.898	0.102	0.001	0.000
Momentum Best Blend Specialist Equity	0.889	0.302	0.001	0.000
Stanlib SA Equity Fund	0.654	0.056	0.001	0.000
Prescient Equity Active Quants Fund	0.653	0.547	0.000	0.000
Truffle General Equity Fund	0.568	0.615	0.001	0.000
BJM Multi Manager Equity Fund	0.529	0.222	0.001	0.000
Momentum Equity Fund	0.488	0.512	0.000	0.000
SIM General Equity Fund	0.461	0.073	0.007	0.000
Discovery Equity Fund	0.438	0.069	0.019	0.001
Imara Equity Fund	0.434	0.121	0.004	0.000
Melville Douglas High Alpha Fund	0.433	0.466	0.000	0.000
Capstone Equity Fund	0.431	0.717	0.000	0.000
Efficient General Equity Fund	0.403	0.322	0.002	0.000
Aeon Enhanced Equity Fund	0.399	0.601	0.000	0.000
Prudential Equity Fund	0.387	0.083	0.010	0.000
Coris Capital General Equity Fund	0.385	0.093	0.008	0.000
Sasfin Equity Fund	0.381	0.131	0.003	0.000
Miplan IP Beta Equity Fund	0.375	0.286	0.001	0.000
Aylett Equity Fund	0.363	0.097	0.012	0.001
Investec Equity Fund	0.355	0.177	0.003	0.000
SIM Top Choice Equity Fund	0.351	0.168	0.009	0.001
Analytics Managed Equity Fund	0.338	0.282	0.004	0.000
Community Growth Fund	0.338	0.115	0.004	0.000
Oasis General Equity Fund	0.328	0.127	0.007	0.000
Coronation Equity Fund	0.314	0.145	0.008	0.000
Old Mutual Top Companies Fund	0.260	0.231	0.006	0.000
Efficient Active Quant Fund	0.258	0.621	0.001	0.000
Allan Gray Equity Fund	0.241	0.269	0.007	0.000
Old Mutual Growth Fund	0.238	0.274	0.006	0.000
Mazi Capital Equity Fund	0.236	0.610	0.000	0.000
Huysamer Equity Fund	0.220	0.314	0.004	0.000
Maestro Equity Fund	0.209	0.406	0.005	0.000
ABSA Select Equity Fund	0.202	0.355	0.005	0.000
Foord Equity Fund	0.169	0.441	0.004	0.000
Old Mutual Investors Fund	0.150	0.505	0.003	0.000
Harvard House General Equity Fund	0.141	0.532	0.003	0.000
Kagiso Equity Alpha Fund	0.139	0.637	0.001	0.000
Cannon Equity Fund	0.101	0.647	0.003	0.000
Dynamic Wealth Optimal Fund	0.079	0.900	0.000	0.000
FNB Growth Fund	0.065	0.768	0.001	0.000
ABSA General Fund	0.061	0.822	0.001	0.000
Newfunds Newsa Index Portfolio	0.024	0.969	0.000	0.000
Clade Cash Flow Weighted Equity Fund	0.011	0.970	0.000	0.000
Investec Active Quants Fund	0.008	0.977	0.000	0.000
NFB Equity Fund	0.002	0.997	0.000	0.000
Stanlib Equity Fund	-0.019	0.951	0.000	0.000
RMB Private Bank Equity Fund	-0.023	0.943	0.000	0.000
Stanlib Multi Manager Equity Fund	-0.067	0.865	-0.001	0.000
Afena Equity Fund	-0.111	0.793	0.000	0.000
Personal Trust SA Equity Fund	-0.160	0.638	-0.001	0.000
Old Mutual Active Quant Equity Fund	-0.161	0.636	-0.001	0.000
Prescient Equity Quant Fund	-0.187	0.471	-0.001	0.000

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Fund Name	Pearson Correlation	Significance (2-tailed)	Sum of Squares and Cross-products	Covariance
Old Mutual High Yield Opportunity Fund	-0.210	0.534	-0.001	0.000
NEFG Equity Fund	-0.217	0.456	-0.001	0.000
Marriott Dividend Growth Fund	-0.257	0.376	-0.003	0.000
Stanlib Nationbuilder Fund	-0.400	0.111	-0.013	-0.001
Element Earth Equity Fund	-0.422	0.172	-0.003	0.000
Flagship IP Equity Fund	-0.535	0.641	0.000	0.000
Verso Long Term SA Equity Fund	-0.643	0.357	-0.003	-0.001

* Correlation is significant at 0.05 level (2-tailed)

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Appendix 4 Correlation Between Active Return and SAVI

Fund Name	Pearson Correlation	Significance (2-tailed)	Sum of Squares and Cross-products	Covariance
Personal Trust SA Equity Fund	0.716*	0.013	0.955	0.096
Lion of Africa General Equity Fund	0.657**	0.004	1.987	0.124
Allan Gray Equity Fund	0.652**	0.001	3.764	0.188
SIM General Equity Fund	0.627**	0.009	1.987	0.132
Element Earth Equity Fund	0.593*	0.042	0.882	0.080
SIM Top Choice Equity Fund	0.560*	0.019	2.937	0.184
Aylett Equity Fund	0.556**	0.009	4.077	0.204
Coris Capital General Equity Fund	0.491*	0.038	2.195	0.129
Discovery Equity Fund	0.479*	0.044	4.338	0.255
ABSA Select Equity Fund	0.469*	0.032	2.413	0.121
Flagship IP Equity Fund	0.893	0.298	0.020	0.010
NFB Equity Fund	0.651	0.113	0.334	0.056
Newfunds Newsa Index Portfolio	0.610	0.275	0.280	0.070
BJM Multi Manager Equity Fund	0.587	0.166	0.443	0.074
Old Mutual High Yield Opportunity Fund	0.534	0.091	0.577	0.058
Afena Equity Fund	0.514	0.192	0.130	0.019
ABSA General Fund	0.479	0.061	1.614	0.108
Miplan IP Beta Equity Fund	0.461	0.180	0.209	0.023
Stanlib Multi Manager Equity Fund	0.454	0.220	1.921	0.240
Imara Equity Fund	0.447	0.109	1.100	0.085
Prudential Equity Fund	0.438	0.053	2.156	0.113
Momentum Equity Fund	0.435	0.565	0.123	0.041
Kagiso Equity Alpha Fund	0.418	0.137	0.714	0.055
Efficient General Equity Fund	0.417	0.304	0.482	0.069
Huysamer Equity Fund	0.384	0.086	1.358	0.068
Investec Equity Fund	0.365	0.164	0.759	0.051
Efficient Active Quant Fund	0.364	0.478	0.224	0.045
RMB Private Bank Equity Fund	0.357	0.254	0.262	0.024
Analytics Managed Equity Fund	0.352	0.319	0.976	0.108
Verso Long Term SA Equity Fund	0.349	0.651	0.278	0.093
Community Growth Fund	0.344	0.127	0.861	0.043
Marriott Dividend Growth Fund	0.339	0.236	0.710	0.055
Sasfin Equity Fund	0.324	0.204	0.573	0.036
Coronation Equity Fund	0.318	0.160	1.607	0.080
Old Mutual Top Companies Fund	0.296	0.192	1.223	0.061
Oasis General Equity Fund	0.285	0.210	1.274	0.064
Foord Equity Fund	0.282	0.215	1.381	0.069
FNB Growth Fund	0.275	0.228	1.034	0.052
Old Mutual Investors Fund	0.251	0.286	0.926	0.049
Old Mutual Growth Fund	0.226	0.325	1.056	0.053
NEFG Equity Fund	0.196	0.502	0.293	0.023
Stanlib Equity Fund	0.172	0.573	0.202	0.017
Maestro Equity Fund	0.116	0.645	0.576	0.034
Dynamic Wealth Optimal Fund	0.104	0.868	0.034	0.009
SPI Equity Fund	0.096	0.904	0.024	0.008
Capstone Equity Fund	0.093	0.941	0.010	0.005
Clade Cash Flow Weighted Equity Fund	0.043	0.879	0.063	0.004
Harvard House General Equity Fund	-0.001	0.997	-0.004	0.000
Old Mutual Active Quant Equity Fund	-0.041	0.904	-0.033	-0.003
Truffle General Equity Fund	-0.066	0.958	-0.020	-0.010
Cannon Equity Fund	-0.088	0.705	-0.476	-0.024
Mazi Capital Equity Fund	-0.093	0.842	-0.032	-0.005
Stanlib SA Equity Fund	-0.096	0.806	-0.047	-0.006

Fund Name	Pearson Correlation	Significance (2-tailed)	Sum of Squares and Cross-products	Covariance
Investec Active Quants Fund	-0.172	0.525	-0.333	-0.022
Prescient Equity Active Quants Fund	-0.172	0.890	-0.018	-0.009
Melville Douglas High Alpha Fund	-0.181	0.770	-0.044	-0.011
Prescient Equity Quant Fund	-0.189	0.468	-0.198	-0.012
Stanlib Nationbuilder Fund	-0.424	0.090	-2.916	-0.182
Aeon Enhanced Equity Fund	-0.508	0.492	-0.088	-0.029

* Correlation is significant at 0.05 level (2-tailed)
** Correlation is significant at 0.01 level (2-tailed)