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**An Investigation into Performance Persistence amongst South African  
General Equity Unit Trusts Funds: For the Period 2000 to 2011**

Presented to

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For the degree of

Master of Commerce (Financial Management)

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## Declaration

I hereby declare that this is my own original work and that all the sources have been accurately reported and acknowledge. It is submitted for the degree of Masters of Commerce to the University of Cape Town. This thesis has not been submitted for any degree or examination at this or any other university.

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## Abstract

This research paper investigates performance persistence amongst South African general equity unit trust funds over the period 2000 to 2011. This paper updates aspects of the original study done by Collinet in his 2001 UCT Masters Thesis "*Characterising Persistence of Performance amongst South African General Equity Unit Trusts*", in which he tested performance persistence over the period 1980 to 1999. This updated study focuses on testing whether the performance of a unit trust fund in one period can be used to predict the performance of that unit trust fund in a subsequent period.

The overall results of the updated study were comparable to the Collinet (2001) study, although in the Collinet study evidence of short-term performance persistence was found when holding periods of 6 months were tested. The results for the 1, 2 and 3 year holding periods tested were inconclusive and no evidence was found that performance persists over any of those holding periods. It was found that results for performance persistence studies over longer time periods are highly sensitive to the beginning and ending dates selected in the test being performed.

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## Chapter 1 – Introduction

### The South African Unit Trust Industry: 1965 to 2011

The South African unit trust industry has come a long way from 1965, when South Africa's first unit trust fund was launched. The Sage Fund was started with assets under management of just R600 000. By the end of 1969 the industry had grown to assets under management of over R1 billion and a total of 9 funds. The industry experienced slow growth over the next decade and by the end of 1979 the number of funds had increased to just 12 funds. The South African unit trust industry experienced its first real period of growth in the 1980s with the total assets under management growing to R4.8 billion and the number of funds increasing to 31 funds.

By the mid-1990s the unit trust industry had grown to over 60 funds with more than R20 billion under management. By the end of December 1999, this had grown to 33 management companies and almost 300 unit trust funds with approximately R130 billion under management. The industry continued its rapid growth and reached the R1 trillion mark by the end of December 2011 (FAnews, 2012) with 947 unit trust funds available to the general public. The number of management companies also increased to 42 (Association for Savings and Investment South Africa (ASISA), 2010).

The South African unit trust industry has come about owing to demand for a financial product that would act as a diversified long-term investment vehicle through which investors could curb the effects of inflation, effectively diversify their capital and gain access to the domestic capital market. Unit trust funds in South Africa have remained popular for some of the following reasons:

- Unit trusts funds are fairly liquid and easily accessible; it is easy to deposit and withdraw funds.
- The funds are transparent – unit prices are published daily allowing investors to monitor the value of their portfolio. The administration of the investment is minimal on the part of the investor.
- Investors do not need to be market experts; this is provided by portfolio managers in return for a management fee. No time is required on the part of the investor to research, select and monitor securities held in the portfolio.
- The industry is regulated and the investment is regarded as fairly safe.
- The funds give the small investor exposure to equities at a reasonable cost.
- Diversification is achievable even when small amounts are invested.

## 1.2 Overview of the original study

The study by Lance Collinet in his 2001 dissertation, "Characterising Persistence of Performance amongst South African General Equity Unit Trusts", examined the performance persistence of unit trust funds relative to each other. This study covered a 20 year period starting 1 January 1980 and ending 31 December 1999 and tested for evidence on whether some unit trust funds can consistently beat others on a risk adjusted basis. The out-performance or underperformance of the unit trust funds either individually or as a group relative to a market benchmark was not the focus of the Collinet (2001) study.

Evidence of performance persistence will indicate that some unit trust funds do beat the market. However, if performance persistence can be sustained over a long time period by making investment based only on a fund's past performance, it would suggest that either the stock market is not efficient or that the results uncovered are a product of the date set used. The probability of it being the latter was mitigated by testing the data sets for correctness and varying the time periods under review, to ensure that these results are not unique to a specific time period. No evidence of performance persistence will cast doubt on the ability of fund managers and investment advisors to select a superior unit trust fund.

The Collinet study further explored the question that several past performance persistence studies had tried to answer: is it possible to use a fund's past performance to make a prediction about that fund's future performance? If it is possible that some unit trust funds outperform the market consistently and others are persistent underperformers over a long time period, then it should be possible that persistent performance could prevail long enough to take advantage of a fund's past performance information (for example by switching from one consistently under-performing fund to another fund that consistently outperforms).

The conduct of investment advisors, who often refer to a fund's past performance rankings either to make investment decisions themselves or to advise their clients on which unit trust fund to invest in, and the advertising by Asset Management companies of their unit trust funds' past performance to attract new investors would suggest that a fund's past performance information is being used as an indicator of possible future performance.

The Collinet (2001) study made use of a database of monthly returns over a 20 year period. A long time period reduces the changes of the results being a function of a specific time period selected. All 12 months of a year were used as starting points in the test for performance persistence. This added to the robustness of the output data by ensuring that the observations were not related to a specific market period.



The Collinet (2001) study tested 3 different hypotheses.

- (1) *Information content of past performance rankings*: This hypothesis aimed to answer the question. "Can the performance of a fund in one period be used to predict the performance of that fund in the next period?"
- (2) *Persistence in the performance of individual funds*: This hypothesis aimed to determine whether or not an investor can select a fund that will outperform the average funds consistently over time, ignoring transaction costs.
- (3) *Economic viability of investment strategies*: This hypothesis aimed to determine whether past return patterns can be used to devise future investment strategies to earn returns in excess of the cost incurred in carrying out such strategies.

The Collinet (2001) study was confined by a few limitations; these being the small number of funds and the relatively short time period for which some of the funds had been in existence given that the bulk of the funds used in the study only appear in the last few years covered by the study period.

Highlights of the Collinet (2001) study were as follows:

- Performance persistence studies are highly sensitive to the holding period lengths, the time period of the study and the ending date of the analysis.
- There was evidence of funds showing performance persistence over a 6 month period. Hence, funds that outperform in the one 6 month period continue to outperform in a subsequent 6 month period. Similarly, funds that underperform in the one 6 month period continue to underperform in a subsequent 6 month period.
- Individual unit trust funds do not perform consistently for any length of time. This suggested that the observed persistence arises from short-term persistence amongst different unit trust funds.
- Results obtained from previous studies on the performance persistence of unit trusts in South Africa could be explained partly by the application of different methodologies and different time periods. Because the degree of observed persistence was weak and the results of the persistence studies were highly dependent on the sample period and the holding period selected, the results obtained from different periods and studies were not consistent.

### 1.3 Motivation for updated study

For the relatively unsophisticated individual investor, selecting a unit trust fund today can be a challenging undertaking. Most investment advice provided by investment professionals in the South African unit trust industry is centred on diversification, asset allocation and matching a portfolio's mandate to an investor's risk profile. Little guidance is given by investment professionals on how to select objectively a specific unit trust fund, from a larger fund category, that will maximise the investor's chances of achieving positive performance persistence over the investment period.

Since the introduction of the first unit trust fund in 1965, there has been extensive investigation into the performance of South African unit trust funds. Similar studies on fund performance have been done internationally for a much longer time. An ongoing trend in the findings of these studies both in South Africa and internationally is that the different techniques, methodologies and time periods used in the studies have resulted in very contradictory results, with some studies finding evidence of performance persistence while others have found no evidence.

Contradictory findings were evident in the research on performance persistence between funds by Friend, Brown, Herman and Vickers (1962), Sharpe (1966) and Jensen (1968), whose studies revealed that funds do not consistently beat the market. Studies by Grinblatt and Titman (1993) and Hendricks, Patel and Zeckhauser (1993), reported short-run market beating performance, but a Malkiel (1995) study disputed these findings, suggesting that once the results were adjusted for survivorship bias, all evidence of performance persistence vanished.

Some of the earlier studies focused on making use of the Sharpe, Treynor and Jensen performance measurement methods. These studies developed techniques to measure a unit trust fund's performance for persistence over a time period. These tests would also help in revealing whether the portfolio manager of the fund had skill in managing the fund. From an investor's perspective, "skill" is a manager's talent in selecting investment opportunities for the fund, sufficient to generate a positive alpha, net of trading costs and fund expenses.

These assessments of the performance of unit trust funds are at best problematic. In the standard test of fund performance, the rate of return to the holder of a particular fund is compared to the performance of a "buy and hold portfolio" that has the same priced risk characteristics as the fund under consideration. If the unit trust manager of a particular fund had access to superior information, it would be reasonable for an investor to expect superior fund performance compared to a fund manager who did not have access to this information.

Oldham and Kroeger's (2005) study of South African funds found that there was no evidence of consistent above average performance over the period 1998 to 2002. Wessels and Krige (2005) found some instances of short term fund performance persistence, but again this did not translate into long term persistence in fund performance. The worst performing funds produced below average performance more consistently than winner funds were able to replicate superior performance.

Conclusive evidence of above average fund performance is not available from prior studies done on South African unit trusts. The information that is available on the performance of South African unit trust funds provides investors with an analysis of the overall returns provided by the funds over varying investment horizons. However, it gives no indication of whether the returns achieved are associated with each manager's ability or merely accidental predictions on future market conditions.

The Collinet (2001) study was done up to December 1999. Since then there have been many changes in the South African unit trust industry. Statistics provided by ASISA indicate that the total number of funds and assets under management alone had grown from 60 funds and R20 billion in 1999 to 947 funds and over R1 trillion by the end of December 2011. The industry also experienced one of its biggest challenges in the financial crisis of 2007 to 2009, which impacted the South African economy and might have impacted the South African unit trust industry.

Since the Collinet (2001) study over a decade has past and the South African unit trust industry, at the end of December 2011, had hundreds more unit trust funds available than in December 1999. This time lapse provides an opportunity to update the Collinet (2001) study to December 2011 and to compare the findings to those of the Collinet (2001) study. The updated study will use the same techniques and methodology as the Collinet (2001) study and will focus on the performance of South African general equity unit trust funds.

For the average investor, identifying a good performing general equity unit trust fund can be a challenging undertaking. An updated assessment of performance persistence amongst South African general equity unit trust funds available today could prove to be extremely useful to investors attempting to maximise their wealth using this type of investment medium.

## 1.5 Objective of the Study

This research paper investigates performance persistence amongst South African general equity unit trust funds over the period 2000 to 2011. This paper updates the original study done by Collinet (2001) entitled “Characterising Persistence of Performance amongst South African General Equity Unit Trusts”, in which performance persistence over the period 1980 to 1999 was tested. This updated study will focus on testing whether the performance of a unit trust fund in one period can be used to predict the performance of that unit trust fund in a subsequent period.

The results of the updated study will be compared to that of the Collinet (2001) study to determine whether there have been any changes over the years since.

## 1.6 Hypothesis

The study tests the following hypothesis regarding the information content of past performance rankings:

1.  $H_0$ : There is no relationship between the relative performance (ranking) of a fund in the formation period and the relative performance of that fund in the subsequent holding period.

$H_1$ : There is a relationship between the relative performance (ranking) of a fund in the formation period and the relative performance of that fund in the subsequent holding period.

The *formation period* is the period immediately prior to investment that is used to make an investment decision. The *holding period* is the period immediately following the formation period over which an investment is held and its performance evaluated. This hypothesis tries to answer the following key questions:

1. What historical formation period length has the most predictive power?
2. How significant is the relationship between past and future performance?
3. If future performance is related to past performance what is the optimal holding period length?
4. Is the relationship between past and future performance consistent over time?

## Chapter 2 – Literature Review

### 2.1 Introduction

In an effort to market their product and services, many unit trust managers and unit trust investment advisors claim to be able to provide investors with unit trust funds that are able to provide investment returns that are superior to those which investors can achieve by their own efforts. The question of whether “experts” who have specialised knowledge of the market can earn superior risk adjusted returns has led to a great deal of debate in the financial literature where these claims have been tested using a variety of empirical techniques.

In essence, some of these techniques have attempted to distinguish between the market timing skills of fund managers, their asset selection skills and ultimately whether they are persistent performers. Market timing refers to the fund manager’s macro forecasting ability – his or her ability to forecast and exploit anticipated movement in the market as a whole. An asset selection skill refers to a manager’s micro ability – his or her ability to select specific securities that are undervalued by the market.

It is very difficult to differentiate, in the performance of the portfolio manager, between the aggressiveness of the manager, the superior quality of the information he or she possesses or the lack thereof. It is apparent that superior performance of a unit trust fund can occur because of the portfolio manager’s ability to time the general movements of the market or because of his ability to forecast the movements of individual assets. Portfolio managers often characterise themselves as being skilled at either one of the two.

Some investors and researchers who allow for the possibility that a number of unit trust managers have skill, the ability to time the market and pick great stock, have been hard pressed to find evidence of this skill in the data. Beyond a year there is little evidence of performance persistence. Unit trust managers who do well in one year are no more likely to do well the following year. This fact is widely interpreted as evidence that the performance of the best unit trust managers is due entirely to luck rather than skill.

Studies on unit trust performance persistence and portfolio manager skill have generally yielded very different results. Following the ground breaking research by Jensen (1968), numerous authors have proposed alternative and enhanced statistical procedures in an effort to refine the analysis. However, most of them have concentrated on the aggregate market price of the funds as the means of measuring fund manager performance. See below a brief synopsis which sets out the results of the most important international studies on performance persistence.

Table1: International Performance persistence studies

Author	Research Method	Data Analysis	Results
Jensen (1968)	Capital Asset Pricing Model	115 United States mutual funds from 1995 to 1964	No Funds significantly outperformed a buy and hold strategy
McDonald (1974)	Sharpe, Treynor & Jensen measures	123 United States mutual funds from 1960 to 1969	Majority of funds did not perform as well NYSE
Kong & Jen (1979)	Varying market risk over time & CAPM	49 United States mutual funds from 1960 to 1971	Results indicated a large Number of funds engage in marketing timing activities due to multiple levels of beta risk
Kon (1983)	Extension of the 1979 analysis to examine selectivity & timing issues	37 United States mutual funds from 1960 to 1976	14 Funds had overall timing performance but none were statistically significant. 23 funds had selectivity performance but only five were significant
Henriksson (1984)	CAPM, selectivity & timing analysis	116 United States mutual funds from 1960 to 1980	11 Significantly positive and 8 significantly negative measures of selectivity ability. 3 significantly positive and 9 significantly negative measures of timing ability
Chang & Lewellen (1984)	CAPM, selectivity & timing analysis	Monthly returns of 67 United States funds from 1971 to 1979	4 funds exhibited statistically significant timing skills while 5 funds exhibited statistically significant selection skills and of these 3 were negative
Chen & Stockum	CAPM using generalised varying parameter regression procedure to examine selectivity, timing & beta instability	Quarterly returns of 43 United States Funds	Approximately 30% of the funds exhibited selectivity, 19% were found to have random betas, 14% had significantly negative timing performance
Grinblatt & Titman (1989)	CAPM, selectivity & timing using a Jensen type measures	Quarterly holding period returns on 274 US mutual funds using actual portfolio holding from 1974 to 1984	Evidence of superior performance especially among the aggressive growth portfolios
Lee & Rahman (1990)	CAPM, selectivity & timing analysis	Monthly returns of 93 United States mutual funds from 1977 to 1984	Some evidence of superior selection and timing ability
Black, Fraser & Power (1992)	CAPM, selectivity & timing using random walk betas	Monthly returns of 30 United Kingdom mutual funds from 1977 to 1984	Majority of funds offered investors significantly higher risk adjusted returns
Grinblatt & Titman (1993)	Portfolio change measure	Quarterly proportional holdings of 155 US funds from 1974 to 1984	Funds achieved abnormal returns on average
Black & Page (1994)	Extension of the methodology by Elton Gruber (1991)	Monthly proportional holdings of 16 Israel unit trust	No evidence of timing or selection ability found

Results of later performance persistence studies include that of Carhart (1997) who found that persistence in fund performance does not reflect superior stock-picking skills. Rather, common factors in stock returns and persistent differences in mutual fund expenses and transaction costs explain all of the predictability in mutual fund returns. Carhart's (1997) results did not support the existence of skilled or informed fund portfolio managers.

Studies have also focused attention on the relationship between fund flows and fund performance, and the lack of performance persistence. Berk and Green's (2002) study concluded that the vast majority of active managers have at least enough skill to make back their fees. This finding is consistent with a study by Barras, Scaillet and Wermers (2010) that found that portfolio managers may be able to pick stocks well enough to cover their trading costs/fees. Barras *et al.* discovered that there was a much higher incidence of funds with positive alphas, pre-expense than after fees.

Berk and Xu (2004) observed that performance persistence amongst the worst performing actively managed funds is credited to funds that have performed poorly both in the current and prior year. In their study they tried to ascertain whether it is possible to earn superior returns by taking advantage of persistence and selecting portfolio managers based on such persistence results. Berk and Xu (2004) concluded that funds with superior performance will attract capital inflows and funds with poor performance will experience capital outflows. This relationship between flows and fund performance reflects the portfolio manager's skill in managing the mutual fund.

The above studies are all useful in uncovering whether, on the margin, outperforming unit trust funds exist. These studies are not particularly informative regarding the prevalence of such funds in the entire fund population. The Collinet study developed some techniques that draw on several of these studies to try to identify unit trust funds that exhibit performance persistence over time. From an investment perspective, precisely locating skilled portfolio managers could maximize the chances of achieving performance persistence.

## **2.2 Performance Persistence: South African studies – pre 2000**

Since the initial introduction of South African Unit Trust funds in 1965 there has been extensive investigation into the performance of these funds and, similar to studies done internationally, the results in South Africa have been mixed. The early studies on unit trusts' performance were limited by the lack of data available from a small unit trust industry. Most of the early research done on unit trust funds concentrated on making use of the Sharpe, Treynor and Jensen performance measures. Below are summaries of key findings, on some of the early research done on unit trust performance.

Kerbel (1974) plotted the mean return and standard deviation of six unit trusts funds relative to a constructed security market line. This was done over 15 quarters up to December 1970. Kerbel (1974) found that all the unit trust funds lay below the security market line indicating that, in terms of mean-variance analysis, the unit trust funds were not well managed.

Gilbertson (1976) studied 11 funds for the period 1970-1976, and found that the unit trust funds under investigation, on average, earned 1.1% less per annum than the market when adjusted for risk. Gilbertson (1976) did, however, conclude that the funds outperformed at least three market indices which they had chosen as a "benchmark" portfolio and against which they measured performance.

Taylor (1977) found evidence similar to that of Gilbertson (1976) in his 1977 study of ten unit trust funds over a six-year period 1970 to 1976. The ten funds made, on average, about 2.4% less return per annum when compared to the market.

The Carter, Affleck-Graves and Money (1982) study concluded that large and sophisticated investors on the JSE are operationally inefficient. In their study they plotted the JSE All Share Index (ALSI) against the constructed Markowitz efficient frontier for three consecutive five-year periods. Gilbertson and Vermaak (1982) studied the performance of eleven South African unit trust funds over the eight-year period 1974 to 1981 and found that the returns achieved by the funds ranged from 15.9 % per annum to 22.5% per annum; these returns were less than those achieved by three stock market indexes. When risk adjusted measures of performance were used, it was found that the unit trust funds outperformed the three indexes.

Knight and Firer (1989) updated the study of Gilbertson and Vermaak (1982). Knight and Firer (1989) investigated the returns of 10 unit trusts over 10 years on a non-risk adjusted basis and a risk-adjusted basis using Treynor (1965), Sharpe (1966) and Jensen (1965) measures. Knight and Firer's (1989) findings indicate that some persistence did exist when using risk adjusted performance measures for the period 1977-1986. After adjusting for risk, they found that no unit trust fund performed significantly worse than the market in the first or second year period. The same winning fund identified by Gilbertson and Vermaak (1982) continued to be the best performer.

Trevor Garvin (1995) examined the performance of unit trust fund managers using a benchmark; his study investigated the performance of 32 general equity unit trust funds from inception to the end of 1992. The results of this study found that fund managers were not able to outperform the market consistently, or that any manager consistently performed worse than the market.

Garvin concluded that the performance obtained by portfolio managers is not inconsistent with that which could be obtained by an uninformed manager and/or investor and that there is minute performance persistence amongst fund managers.



A later study by Nicholson (1996) found no evidence, based on Jensen's Alpha, that unit trusts performed significantly better or worse than the market in the ten years ending in December 1994. Nicholson's results were consistent with Garvin's (1995) findings.

Studies by Theron (1996) and De Lange (1996) found that there is some evidence of performance persistence of unit trusts in South Africa. They advise that it is important to invest in one of the better performers, which in the long run can make a significant difference in return. Positive returns will be consistently obtained on investment in the top quartile of best performers.

Meyer (1998) studied the persistence of South African unit trusts for the period 1985-1995. This study used one, two and four-year intervals to determine whether the repeat winner or loser occurrence exists. Meyer (1998) concluded that "performance persistence seems to exist and it appears to be a guide to beat the pack in the long-run, the longer the evaluation period, the better the results". This study found that the repeat winner phenomenon exists over two-year periods and the repeat loser incidence is present over one, two and four-year periods and at a much higher frequency.

The results of all the above studies leading up to the year 2000, on either unit trust performance or unit trust performance persistence, have been mixed. Some of the earlier studies by Kerbel (1974), Taylor (1977), Gilbertson (1976), Carter, Affleck-Graves and Money (1982) and Gilbertson and Vermaak (1982) found the South African unit trust industry to be underperforming relative to the market and operationally inefficient. With Kerbel (1974) concluding that, according to the results of his study, South African unit trust funds were not well managed.

However, results from the late 1980s and early 1990s showed some indications of unit trust performance persistence and even unit trust outperformance. Knight and Firer (1989) indicated some performance persistence did exist when using a risk adjusted performance measures method. These results were however contradicted by Garvin (1995) and Nicholson (1996) who found no evidence of any unit trust fund consistently performing worse than the market or strong evidence for performance persistence amongst unit trust funds. Studies from the latter part of 1990s again found some evidence of unit trust performance persistence. These contradictory trends were evident in all the studies leading up to the year 2000. There was no sustained period of strong evidence either for or against unit trust performance persistence in South Africa.

## 2.3 Performance Persistence: South African studies – post 2000

By the year 2000 the South African unit trust industry was fairly well-established, having grown to 33 management companies and almost 300 unit trust funds with approximately R130 billion under management. The financial landscape of the 2000s was also very different to any point in recent history. South Africa was now truly part of the global world economy and, events impacting different parts of the world, could now potentially impact the South African unit trust industry. The largest of these events that impacted the South African financial markets was the financial crisis of 2008. Below are summaries of the key findings of some of the research done on unit trust performance from the year 2000 onwards.

Von Wielligh and Smit (2000) tested the performance persistence of general equity unit trusts and all unit trusts funds in South Africa for the periods January 1988 to December 1997 and January 1993 to December 1997. This study found evidence of both short-term and long-term performance persistence of the worst performing general equity funds. The portfolio with an average performance tends to become the top performer over time, while the top performer tends to become an average performer over time.

The Chen, Jegadeesh and Wermers (2000) study supported the persistence of fund performance, highlighting that isolated cases of performance persistence were attributed to the momentum effect; the tendency of past “winners” of stocks to outperform “loser” stocks, rather than to the stock selection skills of fund managers.

Collinet (2001) studied the relative performance of general equity unit trust funds from 1980 to 1999. The most significant results from this study were that persistence studies are highly sensitive to the holding period length, the time period studied and the ending date of the analysis. The formation period length also has an effect on the degree of persistence found, but is less significant. Regardless of the ending date selected, persistence of winning funds and losing funds is evident where holding periods and formation periods of six month are tested. Little to no evidence was found when longer periods were tested.

Edwards, Firer, Hendrie, and Scheppening (2001) studied the performance persistence of general equity and fixed income unit trust funds over the January 1989 to December 1999 period. Significant persistence was found for most combinations of formation and holding periods for risk-adjusted equity unit trusts. The strongest overall persistence was found when the six-month information periods were used. However, the best winner-winner persistence was for the two-year information-holding period. Scheppening *et al.* (2001) suggested choosing the winners from the previous two years and holding them for the next two years as the best long-term strategy to adopt.

Brink (2004) examined the performance of actively managed unit trusts in seven performance periods that ranged over twenty years. The study found that over a twenty-year period the average unit trust funds delivered a return of 16.87% and the index a return of 16.62%. This difference is not that significant; if it is assumed that an index fund delivered the same return as the index, and after taking expenses into consideration, then it is obvious that the average fund manager still has the ability to perform better than the index. This study found some evidence of performance persistence.

Oldham and Kroeger (2005) used 20 unit trust funds from different fund categories and concluded that there is some convincing evidence to support the view of fund persistence, but this was more related to anti-persistence (negative persistence) than positive persistence. Scher and Muller (2005) in their study followed a similar approach by using funds from different fund categories. Scher and Muller looked at the period January 1990 to December 2002. Using Sharpe's returns-based method for style analysis, Scher and Muller found that small and value funds have negative persistence over at least two years while there was some evidence of persistence among large cap funds. A study by Wessels and Krige's (2005) study found some instances of short-term fund performance, but again this did not translate into long-term persistence in fund performance; with the worst performing funds producing below average performance more consistently than winner funds were able to replicate superior performance.

Brown's (2008) study aimed to provide a new approach for assessing fund management and to establish whether there is empirical support for this approach. Funds were ranked each quarter using various performance measures and segmented into winners and losers; firstly according to the median of the ranks and, secondly, according to quintile rankings. The funds' rankings were examined for evidence of persistence. Some of the findings of the study were that winning managers provide higher returns to their funds through their trading activities, but that this may be due largely to the success in picking the securities that are bought and sold rather than due to market timing. The study concluded that the evidence is insufficient to deduce that fund managers possess security trading ability, regardless of trading horizon. This study found little evidence of performance persistence.

Overall, the contradictory trend in findings pre-2000 continued post the year 2000; these results should not be surprising or alarming as all of the differences in the results of the above studies may be attributed to the difference in the size and period of the data set used. Another reason for the differences may also be due to the different methodologies used in the testing and to the risk-adjustment measures used by the different researchers. For the foreseeable future the topic of performance persistence of South African unit trust funds will be relevant and will warrant a revisit on a regular basis. The answers such studies try to ascertain will remain relevant to all stakeholders interested in the South African units trust industry.

## 2.4 Performance Persistence: International studies

Studies done internationally were fairly split in their findings on fund performance and performance persistence. Significant studies done internationally that found evidence for performance persistence were done by Sharpe (1996), Carlson (1970), Lehman and Modest (1987), Grinblatt and Titman (1988, 1992), DiBartolomeo and Godfredsen (1990) and Goetzmann and Ibbotson (1994). Important international studies that found evidence against performance persistence were undertaken by Jensen (1968), Kritzman (1983), Dunn and Thiesen and Elton, Gruber and Rentzler (1990). Below are summaries of the findings of some of the research done on performance persistence internationally.

The majority of US studies concluded that actively managed portfolios, on average, underperform market indices. The results from the studies, listed below, found that, when considering the history of fund performance, there is little evidence of performance persistence beyond a year. Portfolio managers who do well in one year are no more likely to do well in the following year. Given these results, investors still chase good returns; a common factor highlighted in the studies reviewed was that a few good years of performance for a fund could induce an inflow of funds and a bad year induces an outflow of funds. Thus, the flow of funds into and out of actively managed funds is sensitive to the funds' past performance even though there is no strong evidence of persistence.

Sharpe (1966) compared the performance rank orders of funds based on the Sharpe ratio of two successive decades and found positive correlations, and thus, performance persistence. Jensen (1968), using the same lengths as Sharpe did, for both the holding period and formation period, examined fund performance as determined by the Jensen Alpha. Jensen (1968) found that some fund performance may be consistently inferior and others consistently superior. Jensen (1968) concluded that a fund manager who experienced superior performance in an earlier period would be far more likely to experience superior results in the latter period. That positive correlation between these two periods is mainly due to persistence of substandard performance.

Carlson (1970) studied a set of 57 equity funds for the period 1948-1967, and found evidence of performance persistence in some of his results and that some funds with above-median returns over the preceding year typically repeat their superior performance. Carlson (1970) concluded that there is no evidence of persistence when the study period is split into separate ten year periods, but that persistence is again detectable if the time horizon is further subdivided into intervals of five years.

Hendricks, Patel, and Zeckhauser (1993), Goetzmann and Ibbotson (1994), Brown and Goetzmann (1995), and Wermers (1996) found evidence of performance persistence over short-term horizons of one to three years, and attributed the persistence to "hot hands" or common investment strategies. The expression "hot hands" is used to define persistent winners over a shorter time period.

Grinblatt and Titman (1992) in their study, divided the time horizon into two five-year periods. They covered the period from 1974 to 1984 and found evidence of performance persistence, especially in aggressive growth funds. This finding is supported somewhat by Elton, Gruber, Das, and Hlavka (1993), and Elton, Gruber, Das and Blake (1996) who, in their respective studies, documented fund return predictability over longer horizons of five to ten years, and attributed this to manager differential information or stock-picking talent.

Brown and Goetzmann (1995) discovered, by desegregating the persistence tests on an annual basis, that performance persistence is strongly dependent upon the time period of the study. Preceding studies have aggregated the results from different time periods in order to increase the power of tests designated to identify performance persistence. Brown and Goetzmann (1995) concluded that most winners and losers repeat and, occasionally, this effect is reversed. The two most common factors in this reversal in fund performance are firstly, performance persistence is correlated across managers, likely due to a common strategy that is not captured by standard stylistic categories or risk adjusted procedures. Secondly, while losing funds have an increased probability of disappearance or merger, not all of them are eliminated. The market fails to fully discipline underperformers and their presence in a sample contributes to the pattern of relative persistence.

The Carhart (1997) study concluded that persistence in mutual fund performance does not reflect superior stock-picking skills. Rather, common factors in stock return and persistent differences in fund expenses and transaction costs explain almost all of the predictability in mutual fund returns. Only the strong, persistent underperformances by the worst-return mutual funds remain anomalous. Furthermore, funds that earn higher one-year returns do so not because fund managers successfully follow momentum strategies, but because some funds just happen by change to hold relatively larger positions in that year's winning stocks. "Hot-hands" funds infrequently repeat their abnormal performance. Carhart's results did not support the existence of skilled or informed fund managers.

A more recent study using different methods to test for evidence of performance persistence was done by Blake and Morey (2000). They used the Morningstar ratings as a predictor of fund performance based on two sample groups for time periods of different lengths. The comparison indicated that the Morningstar ratings were in the middle in terms of predicating future performance. Blake and Morey (2000) concluded that the Morningstar rating system is able to identify low-performing funds since funds with a low Morningstar rating generally have much worse future performance than any other group of funds.

Jain and Wu (2000) studied the advertised performance of 294 funds; they observed that performance was no better after advertising. That advertised funds have superior performance prior to advertisement year, but turn to underperformers in the year following advertising. Jain and Wu (2000) concluded that sponsors selected funds to attract savings on the basis of superior past performance rather than to publicise more efficient management.

A study that adopted an alternative methodology to try to detect trading skill and thus, skilled fund managers, was done by Baker, Litov, Wachter and Wurgler (2007). Baker *et al.* associated trading skill with the ability to buy stocks that are about to enjoy high return upon the upcoming quarterly earnings announcement and to sell stocks that are about to suffer low return around the next earnings announcement. This was applied on all actively managed US equity mutual funds between 1980 and 2005. Baker *et al.* discovered that the future earnings announcement returns on stocks that funds buy are, on average, higher than the future returns on stocks they sell. The stocks that funds buy perform significantly better at future earnings announcement than stocks with similar characteristics, while the stocks that funds sell perform significantly worse than such stocks. Their results confirm the existence of skilled trading among funds, and that skilled fund managers do exist.

The Kosowski, Timmermann, Wermers, and White (2004) study applied a new bootstrap statistical technique to examine the performance of the US open-end, domestic equity mutual fund industry over the 1975 to 2002 period. This bootstrap analysis attempted to establish whether a fund manager's performance ability is due to luck rather than skill, as defined by the authors. Kosowski *et al.* discovered that the performance of the best and worse managers is not solely due to luck, that is, it cannot be explained solely by sampling variability. They found strong evidence of superior performance and performance persistence among growth-oriented funds using a bootstrap test for significance; no evidence was found on the ability of managers of income-oriented funds.

The methodology used by Kosowski *et al.* (2004), has been applied to UK data by Cuthbertson, Nitzche and O' Sullivan (2005). Cuthbertson *et al.* used a comprehensive data set of UK mutual funds over the same time period 1975 to 2002 as Kosowski *et al.* (2004) and applied the same bootstrap methodology to try to distinguish between skill and luck for individual funds.

Prior studies on the UK mutual and pension fund industry had found that there is little evidence of persistence in superior performance but much stronger evidence that poor performers continue to underperform (for example, Blake and Timmermann 1998; Allen and Tan 1999; Fletcher and Forbes 2002, and Tonks 2004). This is consistent with US studies of mutual funds that suggest little or no superior performance but somewhat stronger evidence of underperformance. In comparison with the US, there have been comparatively fewer studies on performance of UK funds.

The above review of performance persistence reveals that plenty of international studies have been published both for and against the prediction power of past performance. The results of above studies also indicate that there is not only one truth on this issue. Several studies draw contrary conclusions, mainly due to the different time period and methodologies used in the study.

## Chapter 3 – Research Methodology

This paper updates aspects of the original study done by Collinet (2001). As far as possible all the techniques and methodologies used in Collinet (2001) will be implemented in this updated study. On conclusion of this updated study, the results will be compared to that of the original study for analysis.

### 3.1 Data Sample

The database used in this study contains the month-end closing net asset value (NAV) prices, as well as, information on all income distribution of all available actively managed Domestic General Equity funds from the year 2000 to 31 December 2011. This paper examines the performance of Domestic General Equity funds for a 12-year period starting 1 January 2000. Only unit trust funds with a performance history of more than 1 year as at the end of December 2011 have been included in the data sample. To measure performance persistence the minimum fund information required is 12 months; this would be enough data to compile a 6 month formation and a 6 month holding period. General equity funds with a performance history of less than 1 year as at the end of December 2011 have been excluded from this study, on the basis that these would have no impact on the results of this study. Furthermore, all index tracking funds have also been excluded from the study, as their performance will be highly correlated to market and may amplify the persistence results.

The Association for Savings and Investments of South Africa's (ASISA) list of all South African unit trust funds as at the end of December 2011 has been accepted as a complete and final list of all funds. A comparison of the ASISA fund listing at the end of December 2011 was made to the lists of several third party data vendors, namely: FinSwitch, Sharenet, Equinox and Profile Funds Data. The comparison revealed that the ASISA fund listing included all the funds listed in these sources. However, not all the third party data vendors included the same fund listings as ASISA and each other. A total of 83 actively managed general equity funds were included in this study. See Figure 1 below and Table 2 on the following page.

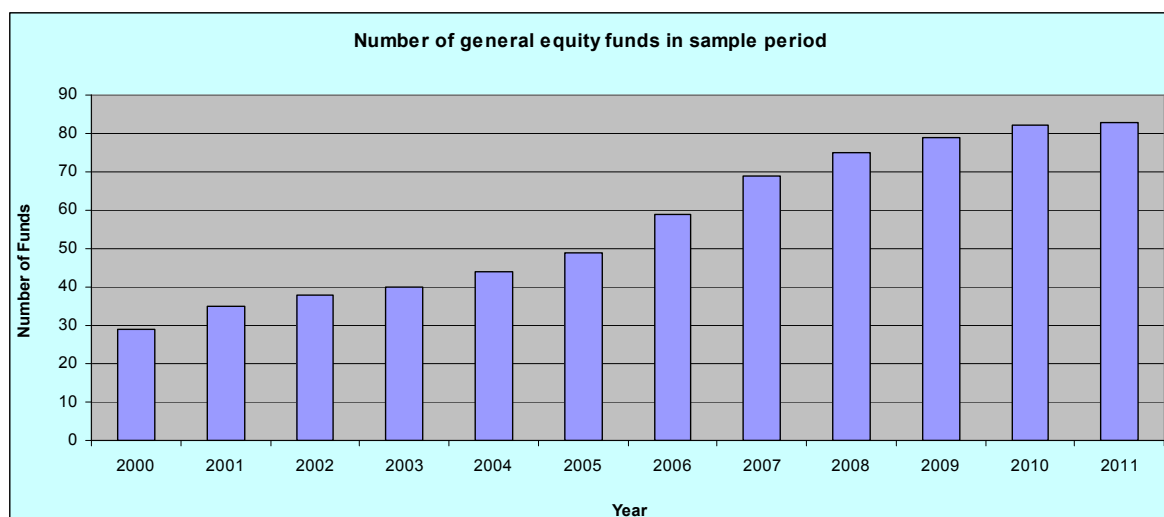


Table 2: Actively managed General Equity unit trust funds included in sample

Fund Name	Fund No:	Short name Security Code	First Month-End	Last Month End
Investec Active Quants Fund - R	1	INVI	Feb-00	Dec-11
Investec Equity Fund - R	2	METF	Feb-00	Dec-11
Old Mutual Investors Fund - R	3	OMTL	Feb-00	Dec-11
Old Mutual Top Companies Fund	4	OMTC	Feb-00	Dec-11
Absa General Fund - R	5	ABSA	Mar-00	Dec-11
Absa Growth FoF	6	ABSG	Mar-00	Dec-11
Allan Gray Equity Fund	7	AGEF	Mar-00	Dec-11
Community Growth Equity Fund	8	CGMG	Mar-00	Dec-11
Coris Capital General Equity Fund	9	GIGE	Mar-00	Dec-11
Coronation Equity Fund - R	10	CORG	Mar-00	Dec-11
FNB Growth Fund	11	FNBG	Mar-00	Dec-11
IP Equity Fund	12	TREF	Mar-00	Dec-11
Marriott Dividend Growth Fund - R	13	HLMK	Mar-00	Dec-11
Metropolitan General Equity Fund	14	MTLE	Mar-00	Dec-11
Momentum Equity Fund - R	15	RMEF	Mar-00	Dec-11
Nedgroup Investments Equity Fund - R	16	NDBG	Mar-00	Dec-11
Nedgroup Investments Rainmaker Fund - A	17	AHVE	Mar-00	Dec-11
Oasis Crescent Equity Fund	18	OCEF	Mar-00	Dec-11
Old Mutual Active Quant Equity Fund - A	19	OMAA	Mar-00	Dec-11
Old Mutual Futuregrowth Albaraka Equity Fund	20	STPF	Mar-00	Dec-11
Old Mutual Growth Fund - R	21	OMGR	Mar-00	Dec-11
Old Mutual High Yield Opportunity Fund	22	OMHY	Mar-00	Dec-11
Prudential Equity Fund	23	PRUO	Mar-00	Dec-11
PSG Equity Fund - A	24	PSGG	Mar-00	Dec-11
SIM General Equity Fund - R	25	SNTR	Mar-00	Dec-11
STANLIB Equity Fund - R	26	GDBK	Mar-00	Dec-11
STANLIB Multi-Manager Equity Fund - A1	27	GDSE	Mar-00	Dec-11
STANLIB SA Equity Fund - R	28	GDBT	Mar-00	Dec-11
Analytics Managed Equity Fund - A	29	FEWS	Aug-00	Dec-11
PSG Alphen Equity FoF - A	30	PSTF	Nov-00	Dec-11
Momentum Multi-Focus FoF	31	SAMC	Dec-00	Dec-11
SYmmENTRY Equity FoF - A	32	GAEU	Aug-01	Dec-11
Investment Solutions Multi-Manager Equity Fund	33	ISPE	Nov-01	Dec-11
RMB Private Bank Equity Fund	34	RMAE	Nov-01	Dec-11
Element Earth Equity Fund - A	35	FEFA	Dec-01	Dec-11
Oasis General Equity Fund	36	OGEN	Dec-01	Dec-11
METROPOLITAN INTERNEURON EQUITY	37	MABF	Oct-02	Dec-11
Foord Equity Fund	38	FEQF	Nov-02	Dec-11
Prescient Equity Quant Fund - A1	39	PEQF	Aug-03	Dec-11
SMMI Equity FoF	40	SAFF	Mar-04	Dec-11
Absa Select Equity Fund	41	ASEF	May-04	Dec-11
Kagiso Equity Alpha Fund	42	KEAF	Jun-04	Dec-11
Nedgroup Investments Quants Core Equity Fund - A	43	NQCE	Oct-04	Dec-11
Indequity Technical Fund	44	INDT	Feb-05	Dec-11
Efficient Equity Fund	45	VAGE	May-05	Dec-11
Matador Equity FoF	46	MAME	May-05	Dec-11
Cannon Equity Fund	47	MCEF	Sep-05	Dec-11
Maestro Equity Fund	48	MOEF	Sep-05	Dec-11
Sasfin Equity Fund	49	MSSR	Dec-05	Dec-11
Element Islamic Equity Fund - A	50	FIEU	Apr-06	Dec-11
MI-Plan IP Beta Equity Fund - B2	51	PBEB2	Apr-06	Dec-11
Dynamic Wealth Optimal Fund - A	52	MDWO	Jun-06	Dec-11
Aylett Equity Fund - A1	53	AYEF	Sep-06	Dec-11
SIM Top Choice Equity Fund - A1	54	STCA1	Oct-06	Dec-11
Harvard House General Equity Fund	55	MHGE	Nov-06	Dec-11
Huysamer Equity Fund - A1	56	HUEF	Dec-06	Dec-11
STANLIB Multi-Manager All Stars FoF - A	57	STMMAA	Dec-06	Dec-11
Prescient Equity Active Quant Fund - A1	58	PEAB4	Jan-07	Dec-11
STANLIB Nationbuilder Fund - A	59	STNA	Mar-07	Dec-11
PSG Konsult Creator FoF - A	60	PAWC	Sep-07	Dec-11
STANLIB Shariah Equity Fund - A	61	STSEA	Sep-07	Dec-11
Momentum Best Blend Specialist Equity Fund - A	62	MEME	Oct-07	Dec-11
Plexus RAFI Enhanced SA Strategy Fund - A1	63	PRES	Oct-07	Dec-11
BJM Multi-Manager Equity Fund - B1	64	BCEA2	Jan-08	Dec-11
Discovery Equity Fund	65	DIEF	Jan-08	Dec-11
Lion of Africa General Equity Fund	66	MLAG	Jan-08	Dec-11
Stewart Macro Equity FoF - A	67	SMEFA	Jan-08	Dec-11
Afena Equity Fund - A1	68	AFEA1	Jul-08	Dec-11
Imara Equity Fund	69	MIEF	Jul-08	Dec-11
Clade Cash Flow Weighted Equity Fund	70	MCCF	Aug-08	Dec-11
NeFG Equity Fund	71	MNEF	Oct-08	Dec-11
27Four Active Equity Fund - A1	72	27FA1	Nov-08	Dec-11
Efficient Active Quant Fund	73	VGEF	Nov-08	Dec-11
NFB Equity Fund - A2	74	NFEA2	Nov-08	Dec-11
Verso Long Term SA Equity Fund	75	MVLT	Nov-08	Dec-11
Lynx Opportunities FoF - A1	76	RWOCA	Apr-09	Dec-11
Kagiso Islamic Equity Fund	77	KAIE	Sep-09	Dec-11
Personal Trust SA Equity Fund	78	PTSAE	Sep-09	Dec-11
PPS EQUITY FUND	79	PPSE	Jan-10	Dec-11
Contego B6 Growth Plus Fund	80	MCGP	Aug-10	Dec-11
Mazi Capital Equity Fund - A1	81	MCEA1	Oct-10	Dec-11
Dynasty Wealth Accumulator FoF - A2	82	DWAA2	Dec-10	Dec-11
Mergence Equity Fund - Class A1	83	MEEA1	Jan-11	Dec-11



### 3.2 Data Collection

The database used in this study was built from price information collected from the following third party data vendors: I-Net, Profile Media, FinSwitch, Sharenet and PSG online. For each unit trust fund in the sample the following information was collected: daily NAV prices, month-end NAV prices, the distribution rate per unit for each distribution, the distribution declaration date, the payment (reinvestment) data and NAV price on the date of reinvestment. The data supplied online by I-Net, FinSwitch, Sharenet and PSG was supplied at no cost, while an 12-year historical daily price database was purchased from Profile Media.

The price data used in constructing the actual 12-year daily price database was from all sources where possible. However, the I-Net and PSG Online data were used more often as the primary source of data and the data from Sharenet, Profile Media and FinSwitch was used to verify the primary data for completeness and accuracy. All the raw primary data requested from the data providers was for daily NAV prices excluding income distribution information; this information was requested and supplied separately to be included in the actual calculation of returns.

The daily NAV price data received from each vendor was compared and checked relative to the others for completeness and accuracy. This comparison between the different data vendors was made fairly easy, as all the data vendors were able to supply a daily NAV price data dump in a usable Excel format. PSG Online also provided a free CD of their database and Sharenet provided free access to their online database for a two-month period. FinSwitch provided free access to their online database with no time limitation, but this database only went as far back as 2006.

The NAV price data supplied by the vendors was very consistent overall; all the data providers sell their data as a means of business and they spend considerable effort to ensure that the data are accurate. Where a price difference was identified between vendors for a specific period, this was compared to the rest of the vendors for the same period and the price shared by the majority of the vendors was accepted as the correct price for that period. There were a few instances of this happening, especially in the earlier years of the sample period, the period 2000 to 2004. Establishing the correct price to use for a specific period was made easier due to the larger group of data vendors that was available.

A major issue encountered, fairly consistently with all the data vendors, was that none of the vendors kept historical data for a fund that had closed down. This historical data are, in most cases deleted. The reason provided by the data vendors was that none of their paying clients require this data and it takes up valuable space on their databases. Secondly, when a new unit trust fund is launched the data vendors do not record data for the new fund from the same time period, with some data vendors only recording data months after the fund had been launched.

The reasons for these actions have not been established. The latter was not a substantial issue in compiling the database used in the study, due to the availability of multiple data sources.

### 3.3 Calculation of returns

In the calculations of a fund's returns, the first month's returns of a new fund that started in the sample period (2000 to 2011) are excluded from the total sample, as it is unlikely to be comparable to its peers. New funds can be started in the middle of a month, distorting the first month's return. New funds initially have larger than intended cash holdings for a longer time period before it is allocated to trading activities; this can also distort the first month's returns. For every other month,  $t$ , the discrete monthly returns ( $r_t$ ) are calculated using the NAV price at the end of each month as follows:

$$\text{Monthly Returns } (r_t) = \frac{P_t}{P_{t-1}} \left( 1 + \frac{d_t}{P_{tr}} \right) - 1$$

$P_t$  = NAV price at the end of the month

$P_{t-1}$  = NAV price at the end of the previous month

$d_t$  = Distribution per unit paid during the month

$P_{tr}$  = Price at which the distribution was reinvested

All fund returns are calculated using the net asset value (NAV) price, which is net of fund expenses like management and audit fees. This calculated monthly return is then converted into continuous returns by taking the log of the value relatives i.e. the natural log of  $(1 + r_t)$ . The return for one or more holding periods can be calculated by taking the inverse of the log of the sum of the continuous monthly returns minus 1. The formula for this is:

$$r_h = e^{\sum_{t=1}^n \ln(1 + r_t)} - 1$$

### 3.4 Risk adjusted returns

The focus of this study is South African domestic general equity funds, but funds in the same fund category can have different volatility due to fund size, degree of liquidity and, to a lesser extent, investment style. Fund returns in this study are also ranked based on returns in excess of the risk borne by each fund. The Sharpe ratio is used as the risk-adjusted measure for evaluating fund performance. The benefits of using the Sharpe ratio to compare fund performance relative to each other are that it can be used without the risk of the relative rankings of the fund returns being a function of a market benchmark. In this study the Sharpe ratio calculated over 36 months is used in the 3-year contingency table test. The historical Sharpe ratio used in this study is calculated as follows:

$$S_p = \frac{r_p - r_f}{\sigma_p}$$

$r_p$  = geometric mean monthly return achieved by the fund over the period

$r_f$  = geometric mean monthly risk-free return over the same period

$\sigma_p$  = standard deviation of monthly fund returns over the same period

### 3.5 Period studied

The performance persistence test in this study will be performed several times with formation and holding periods of 6 months, 1 year, 2 years and 3 years. Random starting points for the test were used and formation and holding periods of different lengths were also combined to increase the robustness of the results. Funds with a performance history of less than 1 year have been excluded from the study, on the basis that they would have no impact on the results of this study.

### 3.6 Survivorship bias

Although every effort was made to include all South African domestic equity unit trust funds in this study sample, it was not possible. The return data in this sample period are not completely free of survivorship bias. Considerable effort was made, using multiple sources, firstly to identify all unit trusts funds that ever existed during this period (2010 to 2011) and secondly, to find the daily NAV prices and income distribution information for these funds. All unit trust funds that ever existed during this period were identified; this was done by comparing the ASISA year-end fund listings from 2000 to 2011.

All funds that merged or changed names during this period are included in the sample period. Funds, which changed their fund category at any time during the sample period are included if these joined the domestic general equity fund category and excluded if these left the domestic general equity fund category. The reason for this is that all data providers move these funds with their performance history to the new fund category. A number of unit trust funds were identified as having been closed completely. Not all the data providers close the same funds at the same time and a large number of these funds were identified and included in the study sample; these were mostly funds that closed from 2006 onwards. A few funds that closed prior to this period were deleted by the data providers; contact was made with the actual management companies which, in the majority of the cases, were reluctant to provide the data.

### **3.7 Contingency tables of winners and losers**

The hypothesis in this study is tested using contingency tables analysis to measure the degree of independence of data from two different periods: the formation period and the holding period. Contingency table tests similar to those performed by Kahn and Rudd (1995) have been used to classify funds as either winners or losers. In this study unit trust funds are ranked on raw returns and the Sharpe ratio and winners are defined as those funds that beat or equalled the mean rate of return. These results will be tested for statistical independence using the chi-square test. The Chi-square test statistic measures the probability of independence, but if the null hypothesis of independence is rejected it does not indicate the direction or strength of the implied dependence relationship. Therefore, a Cross-Product ratio (CPR) is also calculated to measure the degree and direction of independence.

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## Chapter 4 – Results and Interpretation

### 4.1 Results and Interpretation

Implementing the methodologies of Kahn and Rudd (1995), which were repeated in the Collinet study (2001), the results of winning and losing domestic general equity funds over a 12-year period were summarised in a 2x2 contingency tables. The contingency table shows the number of funds that were winners in both periods (WW), losers in both periods (LL), winners then losers (WL) and losers then winners (LW). The degree of positive persistence is determined by the extent to which the WW and LL cells outnumbered the WL and LW cells.

The test was repeated using four different holding periods and different ending months for consecutive 6, 12, 24 and 36 month periods. In each test run the formation period and holding period are the same length and, for each period length studied, four different ending points were used to test the sensitivity of the results. In the contingency Table 3 below tests that resulted in the null hypothesis of independence (the hypothesis) being rejected at the 1% level of significance are marked with an asterisk.

Table 3: Frequencies of repeat performance and related statistics

Period Length (Month)	Ending Month	No. of Observations (n)	% WW	% LL	Percentage of persistence	Chi-Square Statistic	Chi-Square p value	Cross Product Ratio (CPR)	CPR Z Statistic	Normal Probability Value (CPR Z statistic)
<b>Results based on raw returns</b>										
6*	Dec-11	626	28.43%	27.32%	55.75%	8.28	0.0040	1.5878	2.8720	0.9980
6	Oct-11	596	27.85%	26.85%	54.70%	5.27	0.0217	1.4586	2.2930	0.9891
6	Aug-11	581	27.88%	27.19%	55.08%	6.01	0.0142	1.5048	2.4488	0.9929
6	Jul-11	574	27.87%	27.18%	55.05%	5.88	0.0153	1.5014	2.4208	0.9923
12	Dec-11	269	27.88%	25.28%	53.16%	1.06	0.3030	1.2863	1.0293	0.8348
12	Sep-11	264	27.65%	25.00%	52.65%	0.72	0.3936	1.2341	0.8526	0.7787
12	Jun-11	256	27.73%	24.61%	52.34%	0.55	0.4567	1.2050	0.7440	0.7371
12	Mar-11	248	27.42%	24.60%	52.02%	0.40	0.5248	1.1757	0.6358	0.6894
24	Dec-11	135	33.33%	22.96%	56.30%	1.83	0.1759	1.6034	1.3501	0.9078
24	Jun-11	99	28.28%	25.25%	53.54%	0.48	0.4870	1.3233	0.6945	0.7162
24	Dec-10	97	28.87%	25.77%	54.64%	0.81	0.3653	1.4463	0.9040	0.7967
24	Jun-10	92	29.35%	26.09%	55.43%	1.07	0.3008	1.5429	1.0327	0.8362
36	Dec-11	79	25.32%	27.85%	53.16%	0.32	0.5681	1.2941	0.5705	0.6572
36	Jun-11	48	25.00%	35.42%	60.42%	2.45	0.1172	2.6154	1.5480	0.9396
36	Dec-10	44	27.27%	34.09%	61.36%	2.52	0.1117	2.7273	1.5715	0.9425
36	Jun-10	42	28.57%	35.71%	64.29%	3.79	0.0514	3.6000	1.9095	0.9740
<b>Results based on Sharp returns</b>										
36*	Dec-11	79	26.58%	29.11%	55.70%	1.64	0.1994	1.8295	1.2773	0.8947
36	Jun-11	48	20.83%	41.67%	62.50%	2.43	0.1190	2.5974	1.5408	0.9386
36	Dec-10	44	20.45%	43.18%	63.64%	2.62	0.1053	1.0473	1.5964	0.9459
36	Jun-10	42	21.43%	40.48%	61.90%	2.05	0.1520	2.5500	1.4167	0.9209
Chi-Square Statistic is significant at the 1% Level of significance										

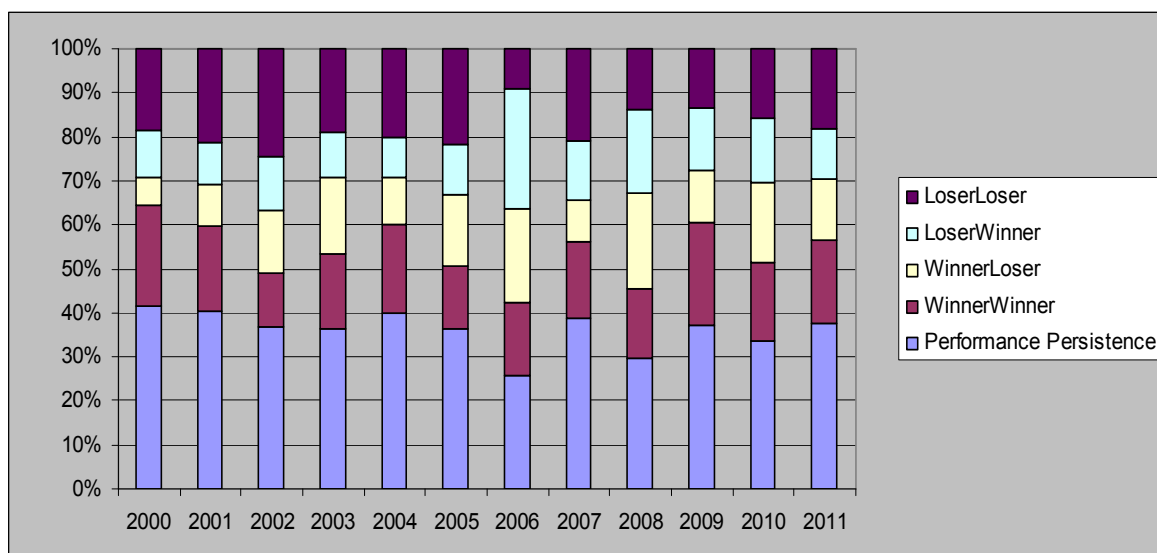
To test if the relationship between winners and losers from one period to the next period is positive or negative, the cross product ratio (CPR) was used and, in evaluating the degree of independence of this relationship, the  $\chi^2$  statistic was used. All the tests run were highly sensitive to the time period selected and ending dates chosen; changing these can have a significant impact on the results of a test being run. For this study the ending dates for all four different holding periods were kept the same as per the original study for consistency and comparability.

Results from this study based on the p-values of the Chi-square statistic found that independence cannot be rejected at the 1% level for any of the holding periods tested. Furthermore, the null hypothesis of independence can also not be rejected at the 10% level for any of the periods tested. No evidence of long running winner-winner or loser-loser persistence was found and, based on the chi-square statistics, no conclusive evidence was found that performance repeats over any of the holding periods tested: 6 months, 1, 2 and 3 years.

Results based on the cross product ratio were however very different to those based on the p-values of the Chi-square statistic. The CPR calculation of  $(WW \times LL) / (WL \times LW)$  gives a ratio of 1, with a ratio greater than 1 indicating performance persistence, and a ratio less than 1 indicating performance reversal. Results from the CPR calculations for all four holding periods uncovered evidence of repeat winners and repeat losers, with the combined percentage for winner-winner and loser-loser being above 50% and ranging between 52% and 64% for all the holding periods tested. This highlights that there is evidence that, in the long run, a fund's past performance is positively related to its future performance.

This phenomenon was consistent through all the holding periods under review, with no overall reversals in results for any holding period tested. All the tests run for the cross product ratio were highly sensitive to the time period selected and ending dates chosen. The summaries of the test results are provided below in figures 2 to 5 and Tables 4 to 7.

Figure 2: Winners and losers over consecutive 6 month holding periods

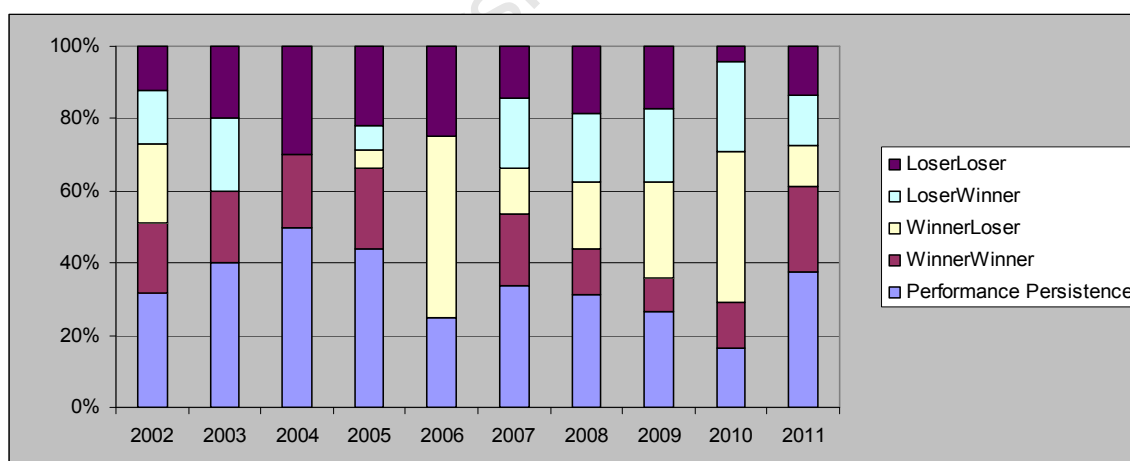


For the consecutive 6 month holding periods tested all the years, except for 2006 and 2008, had over 50% of the funds with positive repeat performance rates. The highest number of funds repeating past performance was in the year 2000, with 71% of funds. For the years 2006 and 2008 the percentage of funds not repeating past performance was 65% and 58% respectively. The average percentage of funds repeating past performance for the consecutive 6 month holding periods tested was 55%. See below the list of top ten best performing funds and top ten worst performing funds for this period.

Table 4: Fund rankings over consecutive 6 month periods

Top Ten Funds Over Consecutive 6 month Periods		
Fund Ranking	JSE Code	Fund Name
1	OMAA	Old Mutual Active Quant Equity Fund - A
2	PEAB4	Prescient Equity Active Quant Fund - A1
3	OGEN	Oasis General Equity Fund
4	ABSG	Absa Growth FoF
5	MTLE	Metropolitan General Equity Fund
6	OCEF	Oasis Crescent Equity Fund
7	OMHY	Old Mutual High Yield Opportunity Fund
8	PSGG	PSG Equity Fund - A
9	GDSE	STANLIB Multi-Manager Equity Fund - A1
10	PAWC	PSG Konsult Creator FoF - A
Bottom Ten Funds Over Consecutive 6 month Periods		
Fund Ranking	JSE Code	Fund Name
1	HUEF	Huysamer Equity Fund - A1
2	STMMAA	STANLIB Multi-Manager All Stars FoF - A
3	MHGE	Harvard House General Equity Fund
4	INDT	Indequity Technical Fund
5	KAIE	Kagiso Islamic Equity Fund
6	MCGP	Contego B6 Growth Plus Fund
7	PPSE	PPS EQUITY FUND
8	MEEA1	Mergence Equity Fund - Class A1
9	DWAA2	Dynasty Wealth Accumulator FoF - A2
10	MCEA1	Mazi Capital Equity Fund - A1

Figure 3: Winners and losers over consecutive 1 year holding periods

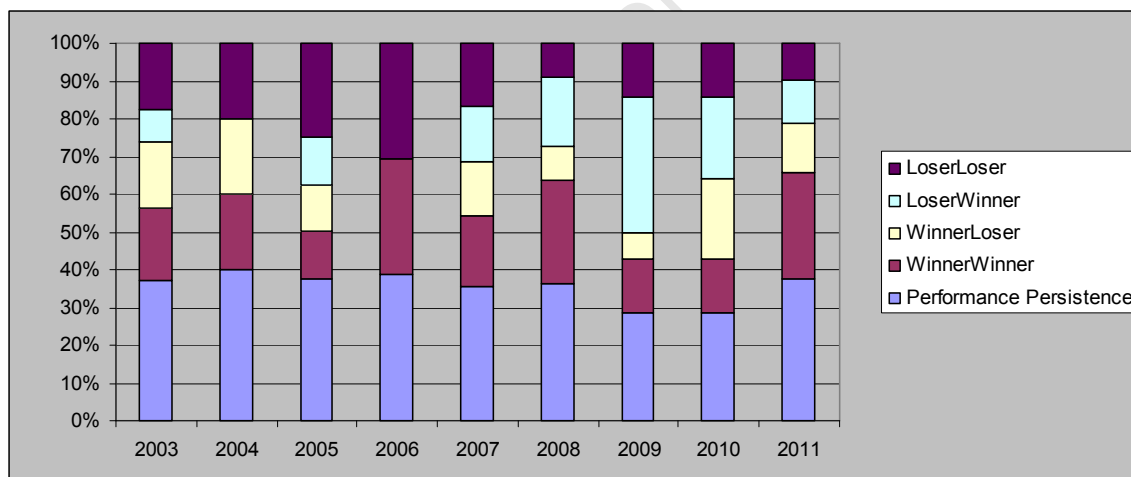


The consecutive 1 year holding periods test had the highest number of funds with negative repeat performance rates; funds not repeating their past performance. The results however contrasted with years of extreme high repeating rates, and years with low repeating rates. The years from 2003 to 2005 all had a positive repeating performance rate which was followed with 3 years of negative repeating performance rates. The average percentage of funds repeating past performance for the consecutive 1 year holding periods tested was 54%. See Table 5 for the list of top ten best performing funds and top ten worst performing funds for this period

Table 5: Fund rankings over consecutive 1 year periods

Top Ten Funds Over Consecutive 1 Year Periods		
Fund Ranking	JSE Code	Fund Name
1	MTLE	Metropolitan General Equity Fund
2	OMHY	Old Mutual High Yield Opportunity Fund
3	PRUO	Prudential Equity Fund
4	SNTR	SIM General Equity Fund - R
5	RMAE	RMB Private Bank Equity Fund
6	OGEN	Oasis General Equity Fund
7	FEQF	Foord Equity Fund
8	ASEF	Absa Select Equity Fund
9	NQCE	Nedgroup Investments Quants Core Equity Fund - A
10	ABSG	Absa Growth FoF
Bottom Ten Funds Over Consecutive 1 Year Periods		
Fund Ranking	JSE Code	Fund Name
1	MCCF	Clade Cash Flow Weighted Equity Fund
2	MNEF	NeFG Equity Fund
3	27FA1	27Four Active Equity Fund - A1
4	VGEF	Efficient Active Quant Fund
5	NFEA2	NFB Equity Fund - A2
6	MVLT	Verso Long Term SA Equity Fund
7	RWOCA	Lynx Opportunities FoF - A1
8	KAIE	Kagiso Islamic Equity Fund
9	PTSAE	Personal Trust SA Equity Fund
10	PPSE	PPS EQUITY FUND

Figure 4: Winners and losers over consecutive 2 year holding periods



The consecutive 2 years holding periods test had the highest number of funds with positive repeat performance rates, with the majority of the funds repeating past performance. For the years that had negative repeat performance rates, the percentage was relatively high, with the years 2009 and 2010 being just above 40%. The average percentage of funds repeating past performance for the consecutive 2 year holding periods tested was 56%. See Table 6 for the list of top ten best performing funds and top ten worst performing funds for this period.



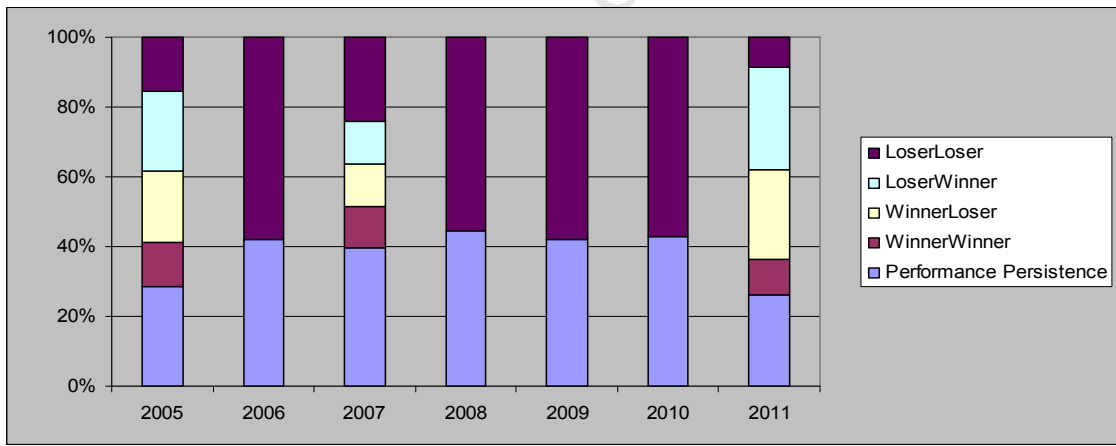
Table 6: Fund rankings over consecutive 2 year periods

Top Ten Funds Over Consecutive 2 Year Periods		
Fund Ranking	JSE Code	Fund Name
1	ABSG	Absa Growth FoF
2	MCGP	Contego B6 Growth Plus Fund
3	GIGE	Coris Capital General Equity Fund
4	CORG	Coronation Equity Fund - R
5	FNBG	FNB Growth Fund
6	TREF	IP Equity Fund
7	NDBG	Nedgroup Investments Equity Fund - R
8	OCEF	Oasis Crescent Equity Fund
9	OMTL	Old Mutual Investors Fund - R
10	PRUO	Prudential Equity Fund

Bottom Ten Funds Over Consecutive 2 Year Periods		
Fund Ranking	JSE Code	Fund Name
1	PEAB4	Prescient Equity Active Quant Fund - A1
2	STNA	STANLIB Nationbuilder Fund - A
3	PAWC	PSG Konsult Creator FoF - A
4	STSEA	STANLIB Shariah Equity Fund - A
5	MEME	Momentum Best Blend Specialist Equity Fund - A
6	PRES	Plexus RAFI Enhanced SA Strategy Fund - A1
7	BCEA2	BJM Multi-Manager Equity Fund - B1
8	DIEF	DiscOvery Equity Fund
9	SMEFA	Stewart Macro Equity FoF - A
10	MLAG	Lion of Africa General Equity Fund

Figure 5: Winners and losers over consecutive 3 year holding periods based on Sharpe ratios



The consecutive 3 years holding period test using Sharpe ratio instead of the raw returns in evaluating the funds as winners and losers, had the highest average rate of funds repeating past performance with 64%. The years 2006 to 2009 had consecutive years of positive repeat performance rates. The relatively high positive performance rates might be due to the small number of funds in the sample periods that had performance data going back far enough. See Table 7 for the list of top ten best performing funds and top ten worst performing funds for this period.

Table 7: Fund ranking over consecutive 3 year periods based on Sharpe ratios

Top Ten Funds Over Consecutive 3 Years Periods based on Sharp ratios		
Fund Ranking	JSE Code	Fund Name
1	ABSG	Absa Growth FoF
2	FNBG	FNB Growth Fund
3	TREF	IP Equity Fund
4	MTLE	Metropolitan General Equity Fund
5	NDBG	Nedgroup Investments Equity Fund - R
6	OMAA	Old Mutual Active Quant Equity Fund - A
7	OMGR	Old Mutual Growth Fund - R
8	OMTL	Old Mutual Investors Fund - R
9	OMTC	Old Mutual Top Companies Fund
10	PRUO	Prudential Equity Fund
Bottom Ten Funds Over Consecutive 3 Years Periods based on Sharp ratios		
Fund Ranking	JSE Code	Fund Name
1	KEAF	Kagiso Equity Alpha Fund
2	NQCE	Nedgroup Investments Quants Core Equity Fund - A
3	INDT	Indequity Technical Fund
4	VAGE	Efficient Equity Fund
5	MAME	Matador Equity FoF
6	MCEF	Cannon Equity Fund
7	MOEF	Maestro Equity Fund
8	MSSR	Sasfin Equity Fund
9	FIEU	Element Islamic Equity Fund - A
10	PBEB2	MI-Plan IP Beta Equity Fund - B2

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## Chapter 5 - Summary and conclusion

### 5.1 Summary of hypothesis test results

The core objective of this updated study was to retest the hypothesis, *can the performance of a unit trust fund in one period be used to predict the performance of that unit trust fund in the subsequent period*, as it was tested in the original study done by Collinet (2001).

Based on the p-values of the Chi-square statistics, no conclusive evidence was found that performance repeats over any of the holding periods tested, that is, 6 months, 1, 2 or 3 years. Therefore the null hypothesis of there being no relationship between the relative performance (ranking) of a fund in the formation period and the relative performance of that fund in the subsequent holding period could not be rejected for any of these holding periods tested.

On an individual test level, the null hypothesis is rejected for the first test run in the series of tests for the consecutive 6 month holding periods. As this result was highly sensitive to the end date chosen and, based on the fact that similar results could not be reproduced for all other holding periods tested, it is being disregarded.

The overall results of the updated study are somewhat comparable to the Collinet (2001) study, although in the Collinet study the null hypothesis was rejected for the complete consecutive 6 month holding periods tested, as evidence of short-term performance persistence was found for this period.

The results for the consecutive 1, 2 and 3 year holding periods tested were inconclusive and the null hypotheses for these periods could not be rejected; this finding is in line with that of the updated study. In conclusion it was found that results for performance persistence studies over longer time periods are highly sensitive to the beginning and ending dates selected in the test being performed.

## 5.2 Research limitations

It is important to note the limitations involved in preparing this thesis. As previously discussed, the updated study was not completely free of survivorship bias, due to the difficulty in sourcing data for the funds that were identified as having closed down over the study period (2000 to 2011). It is, however, impossible to ascertain the impact, if any, that the inclusion of these funds would have had on the overall results of this study.

The total number of funds used in the updated study at the end of December 2011, was almost double the number of funds used in the original study at the end of December 1999. The updated study included the majority of the funds that were available from the total fund population over the study period to provide meaningful results that are comparable to that of the original study.

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# Appendix 1

## Contingency table results

This appendix reports the results of the contingency tables test described in section 3.7. Using adjacent evaluation periods of different lengths, funds are classified as *winners* if they earn a return equal to or in excess of the mean return of all funds and *losers* if the return less than the mean. Implementing the methodologies of Kahn and Rudd (1995), which were repeated in the Collinet study (2001), the results of winning and losing domestic general equity funds over a 12-year period were summarised in a 2x2 contingency tables. The contingency table shows the number of funds that were winners in both periods (WW), losers in both periods (LL), winners then losers (WL) and losers then winners (LW). The degree of positive persistence is determined by the extent to which the WW and LL cells outnumbered the WL and LW cells. The resulting cell counts are then compared to the count that would be expected if returns were random. The cell count differences are evaluated for statistical significance using a chi-square test.

### Content

Period Length (Month)	Starting Month	Ending Month	Number of periods	Sample Size (n)	Run Number
<b>Results based on raw returns</b>					
6	Jan-00	Dec-11	24	626	1
6	Jan-00	Oct-11	24	596	2
6	Jan-00	Aug-11	23	581	3
6	Jan-00	Jul-11	23	574	4
12	Jan-00	Dec-11	12	269	5
12	Jan-00	Sep-11	12	264	6
12	Jan-00	Jun-11	11	256	7
12	Jan-00	Mar-11	11	248	8
24	Jan-00	Dec-11	6	135	9
24	Jan-00	Jun-11	6	99	10
24	Jan-00	Dec-10	5	97	11
24	Jan-00	Jun-10	5	92	12
36	Jan-00	Dec-11	4	79	13
36	Jan-00	Jun-11	4	48	14
36	Jan-00	Dec-10	4	44	15
36	Jan-00	Jun-10	3	42	16
<b>Results based on Sharp returns</b>					
36	Jan-00	Dec-11	4	79	17
36	Jan-00	Jun-11	4	48	18
36	Jan-00	Dec-10	4	44	19
36	Jan-00	Jun-10	3	42	20

**Winners and Losers using raw returns with formation and holding periods of 6 Months**

**TEST PARAMETERS (Run Numbers)**

Formation period length (in month)  
 Holding period length (in month)  
 No. of consecutive evaluation periods  
 Roll Forward period (in month)  
 Last month in test period

1
6
6
22
6
Dec-11

2
6
6
22
6
Oct-11

3
6
6
22
6
Aug-11

4
6
6
22
6
Jul-11

**SUMMARY STATISTICS**

Start Month  
 Period covered (years)  
 Sample size ( no. of evaluations)  
 No. of funds at beginning of first holding period  
 No. of funds at beginning of last holding period

Dec-11  
 11  
 626  
 29  
 83

Oct-11  
 11  
 596  
 29  
 83

Aug-11  
 11  
 581  
 29  
 83

Jul-11  
 11  
 574  
 29  
 83

**CONTINGENCY TABLE RESULTS**

**Actual**

Formation Winner  
 Formation Loser  
 Total

Holding Winner	178	142	Total	320
Holding Loser	135	171		306
	313	313		626

Holding Winner	162	135	Total	297
Holding Loser	126	158		284
	288	293		581

Holding Winner	160	133	Total	293
Holding Loser	125	156		281
	285	289		574

**Expected**

Formation Winner  
 Formation Loser  
 Total

Holding Winner	160	160	Total	320
Holding Loser	153	153		306
	313	313		626

Holding Winner	147	150	Total	297
Holding Loser	141	143		284
	288	293		581

Holding Winner	145	148	Total	293
Holding Loser	140	141		281
	285	289		574

**Chi-sq**

Formation Winner  
 Formation Loser  
 Total

Holding Winner	2.03	2.03	Total	4.05
Holding Loser	2.12	2.12		4.24
	4.14	4.14		8.28

Holding Winner	1.48	1.46	Total	2.94
Holding Loser	1.55	1.52		3.08
	3.03	2.98		6.01

Holding Winner	1.45	1.43	Total	2.88
Holding Loser	1.51	1.49		3.00
	2.96	2.92		5.88

**Test for independence**

p-value (Ch-squared test)  
 Cross Product Ratio (Odds Ratio)  
 Log-Odds  
 CPR Z-statistic (log odds/std error)  
 Normal probability value (CPR Z statistic)  
 Percentage of persistence

0.0040  
 1.5878  
 0.4623  
 2.8720  
 0.9980  
 55.75%

0.0217  
 1.4586  
 0.3775  
 2.2930  
 0.9691  
 54.70%

0.0153  
 1.5014  
 0.4064  
 2.4208  
 0.9923  
 55.05%



**Winners and Losers using raw returns with formation and holding periods of 1 Year**

**TEST PARAMETERS (Run Numbers)**

Formation period length (in month)  
 Holding period length (in month)  
 No. of consecutive evaluation periods  
 Roll Forward period (in month)  
 Last month in test period

5
12
12
11
12
Dec-11

6
12
12
11
12
Sep-11

7
12
12
11
12
Jun-11

8
12
12
11
12
Mar-11

**SUMMARY STATISTICS**

Start Month  
 Period covered (years)  
 Sample size ( no. of evaluations)  
 No. of funds at beginning of first holding period  
 No. of funds at beginning of last holding period

Dec-11
11
269
29
79

Sep-11
11
264
29
79

Jun-11
11
256
29
79

Mar-11
11
248
29
79

**CONTINGENCY TABLE RESULTS**

**Actual**

Formation Winner	75	65	Total	140
Formation Loser	61	68	Total	129
Total	136	133	Total	269

Holding Winner	73	64	Holding Loser	64
Holding Winner	61	66	Holding Loser	66
Total	134	130	Total	264

Holding Winner	71	64	Holding Loser	64
Holding Winner	58	63	Holding Loser	63
Total	129	127	Total	256

Holding Winner	68	63	Holding Loser	63
Holding Winner	56	61	Holding Loser	61
Total	124	124	Total	248

**Expected**

Formation Winner	71	69	Total	140
Formation Loser	65	64	Total	129
Total	136	133	Total	269

Holding Winner	70	67	Holding Loser	67
Holding Winner	64	63	Holding Loser	63
Total	134	130	Total	264

Holding Winner	68	67	Holding Loser	67
Holding Winner	61	60	Holding Loser	60
Total	129	127	Total	256

Holding Winner	66	66	Holding Loser	66
Holding Winner	59	59	Holding Loser	59
Total	124	124	Total	248

**Chi-sq**

Formation Winner	0.25	0.26	Total	0.51
Formation Loser	0.27	0.28	Total	0.55
Total	0.52	0.54	Total	1.06

Holding Winner	0.17	0.18	Holding Loser	0.18
Holding Winner	0.19	0.19	Holding Loser	0.19
Total	0.36	0.37	Total	0.72

Holding Winner	0.13	0.13	Holding Loser	0.13
Holding Winner	0.14	0.15	Holding Loser	0.15
Total	0.27	0.28	Total	0.55

Holding Winner	0.10	0.10	Holding Loser	0.10
Holding Winner	0.11	0.11	Holding Loser	0.11
Total	0.20	0.20	Total	0.40

**Test for independence**

p-value (Ch-squared test)  
 Cross Product Ratio (Odds Ratio)  
 Log-Odds  
 CPR Z-statistic (log odds/std error)  
 Normal probability value (CPR Z statistic)  
 Percentage of persistence

0.3936
1.2341
0.2104
0.8526
0.7787
52.65%

0.4567
1.2050
0.1865
0.7440
0.7371
52.34%

0.5248
1.1757
0.1619
0.6358
0.6894
52.02%

**Winners and Losers using raw returns with formation and holding periods of 2 Years**

**TEST PARAMETERS (Run Numbers)**

Formation period length (in month)  
 Holding period length (in month)  
 No. of consecutive evaluation periods  
 Roll Forward period (in month)  
 Last month in test period

9
24
24
5.5
24
Dec-11

10
24
24
5.5
24
Jun-11

11
24
24
5.5
24
Dec-10

12
24
24
5.5
24
Jun-10

**SUMMARY STATISTICS**

Start Month  
 Period covered (years)  
 Sample size ( no. of evaluations)  
 No. of funds at beginning of first holding period  
 No. of funds at beginning of last holding period

Dec-11
11
135
29
68

Jun-11
11
99
29
68

Dec-10
11
97
29
68

Jun-10
11
92
29
68

**CONTINGENCY TABLE RESULTS**

**Actual**  
 Formation Winner  
 Formation Loser  
 Total

Holding Winner	Holding Loser	Total
45	30	75
29	31	60
74	61	135

Holding Winner	Holding Loser	Total
28	23	51
23	25	48
51	48	99

Holding Winner	Holding Loser	Total
28	22	50
22	25	47
50	47	97

Holding Winner	Holding Loser	Total
27	21	48
20	24	44
47	45	92

**Expected**  
 Formation Winner  
 Formation Loser  
 Total

Holding Winner	Holding Loser	Total
41	34	75
33	27	60
74	61	135

Holding Winner	Holding Loser	Total
26	25	51
25	23	48
51	48	99

Holding Winner	Holding Loser	Total
26	24	50
24	23	47
50	47	97

Holding Winner	Holding Loser	Total
25	23	48
22	22	44
47	45	92

**Chi-sq**  
 Formation Winner  
 Formation Loser  
 Total

Holding Winner	Holding Loser	Total
0.37	0.45	0.81
0.46	0.56	1.02
0.83	1.00	1.83

Holding Winner	Holding Loser	Total
0.11	0.12	0.23
0.12	0.13	0.25
0.23	0.25	0.48

Holding Winner	Holding Loser	Total
0.19	0.20	0.40
0.20	0.22	0.42
0.40	0.42	0.81

Holding Winner	Holding Loser	Total
0.25	0.26	0.51
0.27	0.29	0.56
0.52	0.55	1.07

**Test for independence**

p-value (Ch-squared test)  
 Cross Product Ratio (Odds Ratio)  
 Log-Odds  
 CPR Z-statistic (log odds/std error)  
 Normal probability value (CPR Z statistic)  
 Percentage of persistence

0.1759
1.6034
0.4722
1.3501
0.9078
56.30%

0.4870
1.3233
0.2801
0.6945
0.7162
53.54%

0.3653
1.4463
0.3690
0.9040
0.7967
54.64%

0.3008
1.5429
0.4336
1.0327
0.8362
55.43%

Winners and Losers using Sharp Ratio with formation and holding periods of 3 Years

**TEST PARAMETERS (Run Numbers)**

Formation period length (in month)  
 Holding period length (in month)  
 No. of consecutive evaluation periods  
 Roll Forward period (in month)  
 Last month in test period

17
36
36
3.67
36
Dec-10

18
36
36
3.67
36
Jun-11

19
36
36
3.67
36
Dec-10

20
36
36
3.67
36
Jun-10

**SUMMARY STATISTICS**

Start Month  
 Period covered (years)  
 Sample size ( no. of evaluations)  
 No. of funds at beginning of first holding period  
 No. of funds at beginning of last holding period

Dec-10
11
79
29
51

Jun-11
11
48
29
51

Dec-10
11
44
29
51

Jun-10
11
42
29
51

**CONTINGENCY TABLE RESULTS**

**Actual**

Formation Winner  
 Formation Loser  
 Total

Holding Winner	Holding Loser	Total
21	11	32
24	23	47
45	34	79

Holding Winner	Holding Loser	Total
10	7	17
11	20	31
21	27	48

Holding Winner	Holding Loser	Total
9	6	15
10	19	29
19	25	44

Holding Winner	Holding Loser	Total
9	6	15
10	17	27
19	23	42

**Expected**

Formation Winner  
 Formation Loser  
 Total

Holding Winner	Holding Loser	Total
18	14	32
27	20	47
45	34	79

Holding Winner	Holding Loser	Total
7	10	17
14	17	31
21	27	48

Holding Winner	Holding Loser	Total
6	9	15
13	16	29
19	25	44

Holding Winner	Holding Loser	Total
7	8	15
12	15	27
19	23	42

**Chi-sq**

Formation Winner  
 Formation Loser  
 Total

Holding Winner	Holding Loser	Total
0.42	0.56	0.98
0.29	0.38	0.67
0.71	0.94	1.64

Holding Winner	Holding Loser	Total
0.88	0.69	1.57
0.48	0.38	0.86
1.37	1.06	2.43

Holding Winner	Holding Loser	Total
0.98	0.75	1.73
0.51	0.39	0.89
1.49	1.13	2.62

Holding Winner	Holding Loser	Total
0.72	0.60	1.32
0.40	0.33	0.73
1.12	0.93	2.05

**Test for independence**

p-value (Ch-squared test)  
 Cross Product Ratio (Odds Ratio)  
 Log-Odds  
 CPR Z-statistic (log odds/std error)  
 Normal probability value (CPR Z statistic)  
 Percentage of persistence

0.1994
1.8295
0.6041
1.2773
0.8947
55.70%

0.1190
2.5974
0.9545
1.5408
0.9386
62.50%

0.1053
2.8500
1.0473
1.5964
0.9209
63.64%

0.1520
2.5500
0.9361
1.4167
0.9209
61.90%