Men are from Investment Mars and Women are from Investment Venus:

Further evidence of Differential Investment Performance in South Africa Based on Gender

By

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I hereby declare that I have read and understood the regulations governing the submission of Master of Commerce dissertations, including those relating to length and plagiarism, as contained in the rules of the University, and that this dissertation conforms to those regulations.

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Abstract

There is an on-going debate amongst economists as to whether or not markets are efficient. The efficient market hypothesis is predicated on the assumption that investors are rational. The growing body of research in behavioural finance has challenged the rational investor theory, by showing that certain psychological biases affect the behaviour of investors in a manner which causes them to behave irrationally at certain times.

The purpose of this paper is to gain further evidence of differential investment performance (which stems from some of these psychological biases) between genders in South Africa. A particular focus is on differences in risk aversion between genders. The data analysed suggests that men tend to hold riskier portfolios than women and tend to be more confident in their abilities than women are.

A sample of 2,380 individual investors from a South African asset manager was analysed over ten years (1 January 2003 – 31 December 2012) in order to draw conclusions on the trading behaviour, resultant returns and variances in returns earned by men and women.

The results show that there is a statistically significantly negative correlation between trading frequency and investor return. Over the ten year period analysed, there was no statistically significant difference between men and women either in returns earned or the variance of those returns. Further, there was no statistically significant difference between genders in trade frequency.

However, in certain age groups and in certain sub-periods of the data, statistically significant differences between genders in both returns and variance of returns is observed, as well as statistically significant differences between the genders of trade frequency.

Men had statistically significantly higher variances of their portfolio returns for the period from 1 January 2003 to 28 April 2006 (the period ending before the financial

crisis of 2008/9). Given that there is no significant difference in the investment returns earned by men and women in the same period, it follows that women were better investors (on a risk-adjusted basis) in this period. This may be explained by the fact that women are more risk averse than men and tend to hold less risky portfolios.

Men had statistically significantly higher returns for their portfolios for the period from 1 May 2006 to 31 August 2009 (the period ending after the financial crisis of 2008/9). Given that there is no significant difference between men and women in respect of the variances of returns over this period, it follows men were better investors (on a risk-adjusted basis) for the period ending after the financial crisis. This could be due to men, being less risk averse than women, re-allocating their portfolio to riskier assets quicker than women after the financial crisis, and being better exposed to the upside of the market recovery.

When stratifying the population into age groups to determine whether there is any differential behaviour on this basis, men in the 30 – 39 year old cohort were found to have a statistically significantly higher trade frequency than women. No other significant differences between genders within age groups were measured.

Contents

Introduction

A study in the United States by Barber and Odean (2001) highlighted how behavioural biases affected the investment returns achieved between men and women in stock portfolio returns. A replication of that study was performed by Willows (2012) for the South African environment, but by using the returns of investors in collective investment schemes at a third party asset manager. The purpose of this dissertation is to replicate Willows' (2012) study, with a different data set, in order to see whether the same behavioural biases manifest. Using a new data set will allow for further evidence either in support of, or against the conclusions reached by Willows (2012) for the South African environment.

The existing body of knowledge around the behavioural biases for men and women will be reviewed in chapter 2, focusing on how the biases manifest in each gender and the impact they have on investment decisions and returns. The paper by Willows (2012) contained a comprehensive literature review on many of these behavioural biases, and so this paper will not seek to duplicate that work, but rather, focus on risk aversion differences between genders. One of the outputs of the paper by Willows (2012) was that risk is a differentiating factor for portfolios of equal return, and so the gender differences in risk aversion will be amplified in the literature review. A summary of the major themes in the literature review by Willows (2012) will be added as an appendix.

Chapter 3 includes the research questions that will be analysed, namely:

- Does increased trading lower returns?
- Do men trade more than women?
- Do men earn lower returns than women on a risk adjusted basis?

These are the same questions posed by both Barber and Odean (2001) and Willows (2012). In assessing whether men earn lower returns than women, the variance in returns will also be tested, in order to assess returns on a “risk adjusted basis”. In addition to the papers by Barber and Odean (2001) and Willows (2012), this paper

will conduct an analysis of the portfolio allocations for each gender between equity and balanced funds, in order to give an indication of risk aversion for each gender.

Chapter 3 will also include a brief description of the approach and strategy employed, which will be linked back to findings in the literature review. Furthermore, the testing methods employed and their appropriateness will be described.

In chapter 4, the results of the data analysis will be presented in order to answer the research questions from chapter 3. The results will be stratified into age groupings, in order to see whether there are any notable findings for each age bracket, and findings will be cross-referenced to the literature review where possible to do so. Any findings requiring further analysis will be investigated and the results discussed within this chapter.

Chapter 5 will be a summary of the conclusions and results. It will also include recommended areas for future research.

Literature Review

Introduction

The efficient market hypothesis (Fama 1998; Lakonishok et al. 1997) has long been held and taught as the predominant view of how markets operate. This traditional approach seeks to understand financial markets based on a model of rational behavior by investors. According to Barberis and Thaler (2003), rationality means two things. First, when investors receive new information, they update their beliefs correctly and second, given their beliefs, investors make choices that are normatively acceptable. However, many financial phenomena have occurred which are unable to be explained by the efficient market hypothesis, such as the global financial credit crisis witnessed in 2008, as well as stock market bubbles in American and Asian markets (Ritter 2003).

Behavioural finance is a field of study which attempts to explain some of these financial phenomena that are not easily understood using the traditional efficient markets framework. Behavioural finance relaxes some of the rational behavior assumptions, in an attempt to understand why people do not always behave rationally in every circumstance.

Research has been conducted to understand why people do not always conform to the norms of rational behavior (Subrahmanyam 2007; Barberis and Thaler 2003; Feng and Seasholes 2005; Grinblatt 2009; Hoffmann et al. 2013; Lovric et al. 2008; Ritter 2003; Statman 1984), in an attempt to shed light on aspects such as: what mistakes to avoid when investing; and which behavioural biases manifest amongst investors that could potentially cause them to act irrationally. The two building blocks of behavioral finance are cognitive psychology (how people think) and the limits to arbitrage (when markets will be inefficient).

This research into the behavior of investors has shown differences in behavioural biases between men and women, and these gender differentials have an impact on financial decisions and returns (Barber and Odean 2001; Willows 2012; Charness and Gneezy 2012; Bhandari and Deaves 2006; Byrnes et al. 1999; Deaves et al. 2008; Dwyer et al. 2002). The goal of this research is to explore the impact that gender specific behavioural biases have on investment performance in South Africa.

Behavioural biases that have developed over time will be reviewed, with specific focus on those that differ between genders.

The study by Willows (2012) comprehensively covered gender differential biases in overconfidence, self-attribution and self-efficacy. Rather than repeat this review, the main findings for these topics are summarized and attached in appendix 6. However, as overconfidence as a behavioural bias is fundamental to this study, a brief literature review is included in addition to the summarized findings of Willows (2012) in appendix 6. The main portion of the literature review will focus on risk aversion differences between genders, in order to expand upon the approach adopted by Willows (2012).

Overconfidence

Human beings are overconfident about their abilities, their knowledge, and their future prospects (Barber and Odean 1999). This overconfidence can cause investors to be too certain about their own opinions, and not sufficiently consider the opinions of others. Overconfidence is the tendency to place an irrationally excessive degree of confidence in one's abilities and beliefs (Barber and Odean 1999). The private valuation of a stock will differ from that of the market as the overconfident investor places more validity on his private valuation and less on the market's valuation (Grinblatt 2009) which generates a larger willingness to trade than would be observed in a less confident investor.

A rational investor will only trade if the expected gain exceeds the transaction cost, but an overconfident investor overestimates the precision of their information, and therefore, the expected gains of trading (Barber and Odean, 2001). This was the premise behind Barber and Odean's (2001) expectation, that men would be more overconfident than women about their ability to make financial decisions, and trade more excessively than women. By trading more, men could be negatively affecting their performance more than women. Whilst the papers by Barber and Odean (1999) and (2001) show the effects that overconfidence can have on trading activity and investment returns, the papers did not test whether overconfidence was the sole cause of men overtrading.

Bhandari and Deaves (2006) and Deaves, Luders and Luo (2008) studied the effects of overconfidence by seperating overconfidence into three categories:

- Calibration-based overconfidence: the over-estimation of knowledge precision i.e. the more certain you are of your view, the less reliance you place on the views of others;
- The better-than-average effect: the tendency for most people to see themselves as smarter, or more skilled than average; and
- Illusion of Control: the exaggerated belief of control over external events.

As a result, Deaves et al. (2008) expanded on Barber and Odean's (2001) study to determine how much of a driver overconfidence was when it came to excessive trading. Deaves et al. (2008) performed a calibration test for overconfidence on a sample of investors and then asked subjects to participate in experimental asset markets. The tests were conducted on pools of finance and economic students in both Canada and Germany. Based on the three measures of confidence as per Deaves et al. (2008), no significant differences in confidence levels between genders were found for any of the measures of overconfidence, but Deaves et al. (2008), did find significant differences in trading activity, with men trading more than women in the German sample. Deaves et al. (2008) concluded that greater overconfidence does lead to increased trading activity but, after controlling for overconfidence, there is no evidence that women trade with a different frequency to men. Therefore, Deaves et al (2008) were unable to conclude that overconfidence is the sole driving force for men trading more than women. A similar conclusion was reached by Glaser and Weber (2014) who found that gender is not correlated to trading volumes.

If overconfidence cannot be said to be the sole driving force behind over-trading, other factors must be present. Grinblatt (2009) was one of the first studies to specifically focus on sensation seeking as a motivation for trade. Grinblatt's (2009) study employed comprehensive data from a validated psychological assessment to directly measure overconfidence and analyze its relationship to trading. The paper showed that investors who are most prone to sensation seeking and those who are most overconfident trade the most. Those who are sensation seekers search for novel, intense, and varied experiences generally associated with real or imagined physical, social, and financial risks. Trading fits the definition of a sensation seeking behavior. The premise for Grinblatt's (2009) paper is that if trading is motivated by

sensation seeking, those who take pleasure in sensation-seeking activities: risky driving, drugs, risky sports, gambling, etc. would trade the most.

Grinblatt (2009) measured sensation seeking as the number of automobile speeding convictions earned by an investor over a multi-year period, as driving behavior may be one of the best observed behaviors for assessing sensation seeking. Data on speeding tickets from Finland is particularly pertinent with respect to the financial risks associated with this trait. In Finland, the fine for substantive automobile violations is a function of income. Thus, those who risk breaking the law do so under severe financial penalty as well as enduring possible physical risks. Grinblatt (2009) concludes that those who are sensation seekers (as measured by the number of speeding tickets received), trade more. The more speeding tickets a person received, the more they were inclined to trade. Grinblatt's (2009) paper also looked at the link between overconfidence and trading activity, and while the paper concluded that overconfidence was also positively correlated to increased trading activity, Grinblatt (2009) concludes that the sensation seeking proxy appears to better explain increased trading levels than overconfidence does.

The literature reviewed thus far (and in appendix 6) has shown that men are more prone to the overconfidence bias than women are, and that overconfidence can lead to an increased level of trading activity. Overconfidence is not the only attribute leading to increased levels of trading, but it is a significant attribute in overtrading. Excessive trading has further been shown to harm investment results, and the literature points to the fact that women, who are less overconfident, are less likely to over trade and therefore, more likely to achieve superior investment results compared to men.

Risk aversion

A large amount of literature (Eckel and Grossman 2008; Charness and Gneezy 2012; Hibbert et al. 2008; Croson and Gneezy 2004; Johnson and Gleason 2009; Byrnes et al. 1999; Graham et al. 2002; Dwyer et al. 2002) in psychology and sociology indicates that women are more risk averse than men. It is also a common stereotype that women are more risk averse than men (Croson and Gneezy 2004). Byrnes, Miller and Schafer (1999) analyzed 150 studies from 1967 to 1997 in which the risk-taking tendencies of male and female participants were compared in a

variety of settings. These studies involved over 100,000 participants in total. Their results showed that in 14 out of 16 tasks, men were larger risk takers than women i.e. they voluntarily engaged in riskier behaviour more often than women did.

In one analysis conducted by Byrnes et al. (1999), it was shown that males took more risks even when it was clear that it was a bad idea to do so. The same analysis revealed the opposite was true for women; that is, women seemed to be disinclined to take risks even in fairly innocuous situations or when it was a good idea to take a risk. Whereas the former finding suggests that men would tend to encounter failure or other negative consequences more often than women; the latter finding suggesting that women would tend to experience success less often (Byrnes et al. 1999).

Sunden and Surette (1998), as cited in Willows (2012) studied the allocation of defined contribution plan assets and concluded that marital status was an important contributor to risk aversion. Married men and women are more risk averse than single men and women. Sunden and Surette (1998), as cited in Willows (2012) also found that single women were more risk averse than single men, after controlling for age, education, children and home ownership.

Dwyer et al. (2002) used data from a national survey of nearly 2000 mutual fund investors, and investigated whether investor gender is related to risk taking as revealed in mutual fund investment decisions. Dwyer et al. (2002) found that women exhibit less risk-taking than men in their most recent, largest, and riskiest mutual fund investment decisions and more importantly, that the impact of gender on risk taking is significantly weakened when investor knowledge of financial markets and investments is controlled in the regression equation. Specifically, Dwyer et al. (2002) examined the types of mutual funds that respondents had purchased for their largest single investment, their most recent (last) investment, and their riskiest investment.

In order to examine the level of risk within mutual fund selections, the riskiness of the fund type was coded using an ordinal ranking system. Money market and municipal money market funds were coded 0, municipal bond funds were coded 1, bond funds were coded 2, mixed/balanced funds were coded 3, and stock funds were coded 4. The 0–4 rankings correspond to the risk level (typically measured as the variance of returns (Markowitz 1991)) associated with each category, where 4 is considered the

riskiest option. The results showed that men are 5% more likely than women to be in category 4, and 3.4% less likely to be in category 0. Dwyer et al. (2002) concluded that women take less risk than men in their mutual fund investments.

Hibbert, Prakash and Lawrence (2008) tested for risk aversion on 1,382 professors. They concluded that when individuals have the same level of education, irrespective of knowledge of finance, women are no more risk averse than men and that risk aversion differences between genders was more a function of age, wealth, marital status and children. They did however find, similar to Dwyer et al. (2002) that men invest larger portions of their wealth into the asset class they deem most risky, as opposed to women, who invest smaller portions into the asset class they deem most risky.

Eckel and Grossman (2008) reviewed economics literature and compared the data across abstract gambles, contextual experiments and field studies and concluded that women are more risk averse than men. The difficulty with Eckel and Grossman's (2008) review, was that the empirical investigation on individual differences in risk taking uses a variety of methods to study the phenomenon.

Charness and Gneezy (2012) encountered the same problem when reviewing literature, in that each experiment uses a different decision problem, which makes it difficult to compare results. As a result, Charness and Gneezy's (2012) study involved data and results collected in a systematic way using thousands of observations but based on one simple investment game. In the investment game, the decision maker receives $X and is asked to choose how much of it, $Y he wishes to invest in a risky option and how much to keep. The amount invested yields a dividend of $kY (k > 1) with probability p and is lost with probability 1 − p. The money not invested $ (X − Y) is kept by the investor. The payoffs are then $ (X − Y + kY) with probability p, and $ (X − Y) with 1 − p. In all cases, p and k are chosen so that p × k > 1, making the expected value of investing higher that the expected value of not investing; thus, a risk-neutral (or risk-seeking) person should invest $X, while a risk-averse person may invest less. The choice of Y is the only decision the participants make in the experiment.

Charness and Gneezy (2012) report data from various studies using this method for testing risk aversion. The consistent result is that despite the large environmental

differences among the sets of experiments, a consistent gender difference is reported: Men choose a higher Y than women do. Some of the specifics of the data analysed, including the participants in the game, and the game details, are summarized below:

- Dreber et al. (2010): This study was conducted with highly skilled people who consider probabilities and risk quite frequently: tournament bridge players. Participants at the Fall 2008 North American Bridge Championship in Boston were recruited for the study. Two studies were performed, one which was concerned with risk taking by these individuals in their bridge decisions; and the second which examined the individuals financial risk-taking. The results showed that there were no significant gender differences in risk-taking in tournament-bridge decisions (which are not financial in nature), but there was a very large gender difference in financial risk-taking.

  Participants at the national bridge tournament first completed an incentivized bridge quiz, and then took part in the investment task. Each of 186 participants was endowed with $250, from which they could choose to invest as much as they wished in a risky asset. If successful, this asset paid 2.5 times the amount invested (i.e., k = 2.5); the chance of success was p = 1/2. Each participant kept whatever amount he or she chose not to invest.

  On average, 105 males invested $198.8 or 79.5% of the endowment. In contrast to this, 81 females invested only $120.1 or 48.0% of the endowment. The difference in investment rates was statistically significant with a p value of < 0.001. Dreber et al's. (2010) results provide evidence that, in the financial field, females are statistically more risk-averse than males.

- Apicella et al's. (2008) study considered the relationship between financial risk-taking and the ratio between the length of the 2nd (index) finger and the 4th (ring) finger; this is a biological measure thought to positively correlate with prenatal estrogen and negatively correlate with prenatal testosterone (Coates et al, 2009, as cited in Apicella et al. (2008)). In fact, such a relationship was found, with a strong positive correlation between the digit ratio and the level of investment in the risky asset. Apicella et al's. (2008) results suggest that prenatal hormones influence risk preferences more than

20 years later. Using this biological measure as a sample selection technique, a population of students at the Stockholm School of Economics was selected.

Each of 146 students (92 males and 54 females) was endowed with 1700 SEK (about $250), from which he or she could choose to invest as much as they wished in the risky asset. If successful, this asset paid 2.5 times the amount invested (i.e., k = 2.5); the chance of success was p = 1/2. Each participant kept whatever amount he or she chose not to invest.

Overall, the average investment was 1049 SEK (61.7%). Males invested 1170 SEK (68.8%) and females invested 843 (49.6%). The 19 percentage-point difference is statistically significant at a p value < 0.0001. Thus, females are seen to be statistically more risk-averse than males in Apicella et al's. (2008) study.

- Yu (2006) conducted an online and laboratory experiment. The participants in the online experiment were students who registered to participate in experiments, plus MBA students who had taken a decision making class. The participants were divided randomly into three equal-sized groups. The number of students who participated in the experiment was 114.

  Participants in the laboratory experiment were given instructions that were very similar to those of the online study. Each “investment day” took 2 min. In all treatments, participants were told that the experiment consists of 15 successive investment days. Each investment day lasted from 7:00 a.m. until midnight. In each investment day they received 100 points, and were asked to choose the portion of this amount (between 0 points and 100 points, inclusive) they wish to invest in a risky option. The rest of the points (those not invested) were accumulated in the participant’s total balance. Participants were told that at the end of the three weeks one participant would be chosen at random for actual payment, calculated as the sum of the earnings in each of the 15 investment days; this person was paid $100 for each 200 points accumulated. Investing in the risky option meant that in any particular investment day there is a p = 1/3 probability that the investment will succeed, and a 1 − p = 2/3 probability that the investment will fail. If the investment failed, the participant lost the entire amount she or he invested. If the investment was successful,

she or he received 3.5 times the amount invested (i.e., k = 3.5). The computer randomly chose whether the participant won or lost in any given day.

The results showed that there was a substantial and consistent gender differences in investment choices. The average investment for males in each condition was between 28% and 68% higher than the average investment for females, (51%) overall. This difference is substantially larger in the on-line treatments (62%) than in the lab condition (36%). Yu's (2006) paper provides strong support for the hypothesis that men invest more in the risky option than women in each of the treatments.

What Charness and Gneezy (2012) ultimately concluded based on the above investment game studies conducted across different cultures, countries, ages and levels of education, was that women made smaller investments in the risky asset than did men, and so appear to be financially more risk averse.

A similar conclusion was reached in a study by Thomas and Mueller (2000) in which the risk-taking propensity of 1800 students from Belgium, Canada, China, Croatia, Germany, Ireland, Singapore, Slovenia and the U.S was analysed. They found that risk-taking propensity varied systematically with cultural distance from the U.S., but that males exhibited greater levels of risk-taking than their female counterparts in all cultures.

An alternate conclusion was reached by Daruvala (2007) who investigated how people make choices for others in situations where the outcome may have various levels of risk. Participants were asked what value of money they would like to receive with certainty that would be equivalent to a 50% chance of receiving $30. The follow up question then asked each participant to predict the response of each of the other participants in their session. The only information a subject had on which to base their prediction was the visual clues provided by observing the others. This allowed analysis of the following issues: (i) To what extent are subjects' own risk preferences reflected in the prediction they make for the risk preferences of others? (ii) Is there a stereotype effect with regard to gender and risk. Daruvala (2007) found no significant difference in risk preferences between men and women in the experiment. Contrary to the actual choices made but consistent with the gender stereotype, both sexes predicted that women were more risk averse than men.

In a study by Johnson and Gleason (2009), they test the hypothesis that a gender difference exists in responses to risky situations, specifically among contestants on the television game show "Who Wants to be a Millionaire". Of the first nine contestants to win the grand prize on the U.S. version of the show, all were men. If all conditions supported success by both genders equally, the odds that all winners would share the same gender are only 1 in 256. What Johnson and Gleason (2009) are trying to determine with their study is whether men and women react similarly when faced with a risky situation and which gender is taking more risk on the show in order to win it.

"Who Wants to be a Millionaire" is a quiz game show in which contestants are asked increasingly difficult questions that have a monetary value attached. As contestants correctly answer a question, the monetary value attached to the question is added to their winnings, and the level of difficulty of the next question, as well as the monetary value attached, is increased. At certain points, a contestant can walk away with the prize money accumulated for each correct answer, but an incorrect answer can leave the contestant with nothing. Johnson and Gleason (2009) concluded that men do not win more earnings on average than women. The slight advantage that men have in game winnings appears to be due to the fact that they are more willing to take risks to obtain the bigger prizes. Over the course of the game, women appear to become progressively more cautious than men when deciding to answer a question. Women are therefore more apt to retire from the game as the prize value rises, adjusting their behavior more than men do. It appeared that women were winning slightly less prize money in this game precisely because they behaved in an increasingly risk-averse manner (compared to men) as the stakes rise.

The literature reviewed has shown that in general tasks (not finance specific tasks), men tend to be less risk averse than women. Factors such as marital status, age, wealth and children all influence risk aversion. Within the financial context, due to the many different types of tests for risk aversion, it is difficult to compare results, but based on a review of tests using the same method to test for risk aversion, the consistent results are that men are prepared to risk investing larger portions of their wealth into riskier assets. Even outside of the financial realm but in situations that have financial implications, such as in game shows, men take more risks than women do.

Conclusion

The literature review shows that men and women are predisposed to different behavioural biases. These biases can affect the manner in which they trade and thus, the returns they earn and the variance of those returns. The literature shows that men have a tendency to exhibit more overconfidence than women, which can lead to men over-trading. This over-trading can lower investment returns in the form of friction costs, and miss-timing the market. Overconfidence may not be the sole cause of over-trading, as other factors such as sensation seeking may better explain the link to over-trading.

In order to compare investment returns between genders, both return of the investment, as well as risk of the investment were considered. Variance of return is often used as a measure of risk for a portfolio (Markowitz 1991).

The literature shows that men are less risk averse than women and are willing to invest a larger portion of their portfolios into riskier assets. Men are expected to have portfolios more heavily weighted to riskier classes and less heavily weighted towards more risk neutral classes. If men have invested larger portions of their assets into riskier portfolios, this would suggest that men would have a larger variance in their returns earned.

Method

Research Questions

The review of literature indicates that women, on a risk adjusted basis, earn better returns than men (Barber and Odean, 2001; Willows, 2012) and that portfolios of men exhibit significantly more volatility than those of women. A risk adjusted basis of comparison means that both return and variance of return were considered. For portfolios of equal return, the one with the lower variance of return was considered to have the better investment performance. For portfolios of equal variance in return, the one with the higher return was considered to have the better investment performance.

The research questions for this study, which replicates previous work done by Willows (2012) on a new data set, are as follows:

1. Does trading frequency influence investor return?

2. Do men trade more than women?

3. Do men earn lower returns than women on a risk adjusted basis when taking variance of returns into account?

The literature reviewed suggested that over-confidence and the self-attribution bias in men led to men trading more frequently than women. This meant that men had a greater chance of mistiming the market and incurring higher friction costs. This study focuses on finding further evidence in the South African market as to whether or not differential investment results occur because of over-trading. The literature reviewed also suggested that men are less risk averse than women, so this study will also examine whether variances in returns could be explained by the riskiness of each genders' portfolio.

The null hypothesis is that there is no difference in either trading frequency or risk adjusted investment returns between men and women. If the null hypotheses are

rejected, the implication is that men could be trading more than women due to their overconfidence and heightened risk propensity and that this over-trading either lowers return, and/or increases volatility in returns.

Research Approach

Research Strategy

The main focus of this study is to add to evidence to a previous study done by Willows (2012) in South Africa regarding the difference in investment performance between genders. The structure of the research questions will be replicated from Willows (2012) and applied to a new data set. An additional analysis of each gender's portfolio allocation between equity funds and balanced funds will be performed, in order to gauge levels of risk aversion between genders.

A new data set from a different South African asset manager to the one used in Willows (2012) was obtained, with transactions relating to individual investors over a 10 year period. Similarly to Willows (2012), the South African asset manager's investment offerings are collective investment schemes or unit trusts. There are various risk categories within these units trusts, from balanced portfolios (which contain a mix of low, medium and high risk investments), to equity portfolios (consisting of predominantly higher risk investments) and offshore portfolios (which have exposure to non-South African investments). For each individual investor, the value of their exposure to each unit trust was aggregated to give a single investment return. This approach is similar to that adopted by Willows (2012) .The population of collective investment schemes in this study was four.

The asset manager provided a data set containing age, gender, transaction type, date and amount for each investor, over a 10 year period. With this as a starting point, the data was further categorised so as to exclude advised investors. This was done in order to properly examine whether investment differentials exist between genders which would not be possible to ascertain if a female investor is perhaps advised by a male, or vice versa. This approach is also consistent with Willows (2012).

The data extracted ran from 13 September 2002 to 28 March 2013. For the purpose of this study, the data is analysed within a ten year calendar period, from 1 January

2003 to 31 December 2012, as well as 3 periods of three years and four months within the ten calendar year period: 1 January 2003 to 28 April 2006; 1 May 2006 to 31 August 2009; and 1 September 2009 to 31 December 2012. Calendar periods were used for ease of presentation and understanding, and the 3 sub-periods were used in order to see if there were trends that could be identified within the main data set of ten calendar years. A ten year period is a substantially long period in which results and behavior could be smoothed over time, so the sub-periods allow for more specific analysis.

Trading frequency

'Trading' in this research is defined as making an 'investment decision'. An investment decision will include decisions such as lump sum contributions, redemptions, and transfers/switches in and out of funds, all of which involve the investor exercising an element of discretion. Debit orders and regular, automatic redemptions were excluded, apart from once off debit orders (effectively a lump sum contribution), as they only represent one decision being made and then being automatically replicated, with much less thought, if any, given to subsequent contributions/redemption. For a decision such as a monthly debit order, which just involved deciding on the amount of the investment and debit order date, the decision will only be counted once, as opposed to 12 times over a year. The other 11 months that the debit order is in effect for, involved no decision. This is in contrast to the transactions defined as investment decisions, where timing, amount and type of investment must be considered. An 'investment decision' frequency count, as defined above, will be calculated in order to assess the impact of trade frequency.

Research Method

In order to maintain confidentiality and privacy, the data provided by the asset manager did not include demographic or other detail relating to each individual investor, other than gender and date of birth, which was used to calculate investor age when stratifying the data into age groups. The age groupings used were: under 20 years of age; 20 – 29 years of age, 30 – 39 years of age, 40 – 49 years of age, 50

– 59 years of age, 60 – 70 years of age, and 70+ years of age, to closely replicate the age groupings used by Willows (2012).

From the data provided, returns for each investor were calculated and stratified into gender and age groupings as per above. The data included some 2,380 individual investors (1,327 men and 1,053 women) and over the ten year period analysed; 581 investors over the first three year and four month period (350 men and 231 women); 1,165 investors over the second three year and four month period (663 men and 502 women); and 2,167 investors over the third three year and four month period (1,194 men and 973 women).

The return was calculated using the time weighted internal rate of return method (XIRR).[1] This method differs to the internal rate of return (IRR) method in that the XIRR method takes into account the date that a cash flow occurs and calculates an annualised rate for the series of transactions. The IRR method assumes an equal spacing in cash flows i.e. every month or every year, so the XIRR method is able to give a more accurate return for investors where the cash flows occur intermittently.

This approach is considered acceptable as it standardises the return across all investors by taking into account the effects of all cash flows both into and out of all the available collective investment schemes, as well as taking into account when these flows occurred, and thus provides a comparable percentage return on investment for each investor. It also incorporates the effects of market timing, in that it makes it possible to analyse the effects of when trades took place and the impact they have on investment returns, against how the market was performing at that particular time.

In some instances it was noted that a return calculation for a particular investor was not available for all four periods being examined. In these cases, the particular

[1]The value of the XIRR is calculated as the value of ***rate*** that satisfies the following equation:

$$\sum_{j=1}^{N} \frac{P_j}{(1+rate)^{(d_j - d_1)/365}}$$

where Pj is the j'th payment, dj is the j'th payment date and d1 is the 0'th payment date.

investor was included for analysis of results over the periods for which a return was available, but excluded for analysis of results over the missing periods.

For all the data periods, a frequency distribution graph was composed in order to check for normality and large outliers. Also, as the XIRR function returns an annualised rate, for periods of investment less than one year, the XIRR annual rate was pro-rated into a period appropriate rate i.e. for a period of 3 months, the annualised XIRR rate calculated was appropriately converted into a 3 month period. For the 10 year period, the returns ranged between 0% and 177%; for the first three year and four month period, the returns ranged between 0% and 84%; for the second three year and four month period, the returns ranged between -11% and 177%; and for the third three year and four month period, the returns ranged between -2% and 307%. From the distribution graph and inspection of the data for the investors at the far end of the ranges, the returns achieved appeared normal, and the investors were retained. It is more likely that negative returns will only be apparent in the shorter three year periods, but that over the longer ten year period, returns would have evened out into net positive returns.

Lastly, in order to gauge the level of risk aversion between genders, the allocation for each investor's portfolio between the equity and balanced funds was calculated on the last day of each period. An average for each gender was calculated for all the periods analysed, as well as the age groupings within each period. Generally, a higher percentage allocation to the equity fund, and a lower percentage allocation to the balanced fund, would represent a riskier portfolio, and give an indicator of risk aversion for each gender.

The final sample is the population of investors at the asset manager between 1 January 2003 and 31 December 2012.

Research Process

The three research questions will be addressed separately below.

Does trading frequency influence investor return?

A correlation test on the number of investment decisions (independent variable) made by individual investors will be correlated against their respective returns (dependent variable) over the ten year period 1 January 2003 – 31 December 2012 in order to determine whether trading frequency i.e. number of investment decisions influences investor return. The null hypothesis (H0) is that there is no correlation between the two variables. For the population of trades made by investors over the ten year period, as shown in Appendix 1, the distribution was not normally distributed resulting in a Spearman's Rank correlation test being performed. A second Spearman's Rank correlation test will be performed when large outliers are excluded, to see whether these outliers influence the conclusion reached. The correlation co-efficient is interpreted in terms of magnitude and direction, so if there is a negative co-efficient, it would imply that the two variables move in opposite directions i.e. if trades increase, returns decrease, and vice versa. A zero co-efficient would mean the null hypothesis is accepted.

Do men trade more than women?

Visual inspection was performed on all data sets to determine whether or not the distribution of data was normal in order to decide on the appropriate statistical test to perform. For the population of trades made by investors over the ten year period, as shown in Appendix 1, the distribution was not normally distributed. As a result, a Wilcoxon rank-sum correlation test will be performed, as neither the trades or returns are normally distributed.

Do men earn lower returns than women, on a risk adjusted basis?

Using the central limit theorem again, visual frequency tests were performed on the population of investor returns in all four data sets i.e. the ten year period ending 31 December 2012, and each of the three sub-periods of three-years and four months, as well as each sub-division of data set by age. The distribution of the data appears to be non-normal for all periods and sub-divided periods by age, except for two sub-divided periods: the 20-29 year old age grouping within the ten year period, and the 70+ age grouping within the three year and four month period ending 28 April 2006.

For these two periods where the data is normally distributed, in order to assess the statistical significance of the difference in the mean returns of men and women, a t-test will be used. For all the other non-normally distributed periods, a Wilcoxon rank-sum test will be performed and the median return reported on.

As this study is assessing returns based on a risk adjusted basis, the variance of the returns is an important measure. For the two periods where the data is normally distributed, in order to assess the statistical significance of the difference in the variance of returns of men and women, an f-test will be used. For all the other non-normally distributed periods, a Levene test will be performed.

The null hypothesis is that the returns and variance of returns of both men and women are equal over the respective periods specified. For equal returns between the genders, if there is a statistically significant difference in the variance of those returns, then the gender with the lower variance in return would be a better performer on a risk adjusted basis (Markowitz 1952). Rephrased, for portfolios of equal returns, the portfolio with the lower risk is the better performing one, and the portfolio that rational investors would choose.

Ethics

A confidentiality agreement was signed by the University of Cape Town, the author of this study and the asset manager. This was done in order to ensure that the identity of the asset manager and all confidential information obtained would be protected from disclosure. No ethical clearances were required as the study has no interest in racial differences nor were any human participants used in the research.

Limitations/Risks

It is possible that an account can be opened in the name of a man or woman, yet the investment decisions can be made by his or her partner. The study could not control for the influence that partners could have on each other, apart from excluding from the population investors that were identified as “Mr and Mrs”. Based on the description, there was no way of knowing the sex of the actual investor.

Upon stratification into age groups, for the investors in the 0-19 years age group, it was decided to ignore the gender-specific conclusions, as the average age for this

grouping was 10 years, with the majority of investors (29%) below one year old. Parents often set up investments on behalf of their children or grandchildren, and so it is much more likely that the investment decisions being made for this age grouping are done by someone else on behalf of the investor. As such, it was not possible to conclude on the gender of the person making the investment decisions for this age grouping.

Results

The results of this study will be held up against Willows (2012) in order to make direct comparisons and see if further differential evidence can be identified.

Does trading frequency influence investor return?

A significantly negative correlation at the <0.0001 p-level was found (Appendix 2) between trading frequency and returns earned over the ten year period, consisting of 2,025 observations. It was decided only to look at the ten year period for this test, as opposed to the three year four month periods, in order to conclude over a longer period of time. These results are consistent with findings by Barber and Odean (2001), Deaves et al. (2008) and Willows (2012) who found that lower returns were earned by investors who traded more frequently.

The distribution of investment decisions reveals the average number of investment decisions made by men and women to be 5.32 and 5.37 respectively. Per inspection of the distribution of the sample, there were 4 outliers, which were investors with a trade frequency count above 100 trades. Re-performing the test to exclude these large outliers (men and women with trades above 100), the same significant negative correlation in trading frequency and returns was observed.

The results show that trading frequency does lower investor's return and would suggest that a value investing approach, whereby investors adopt a buy-and-hold attitude, is a superior methodology to one in which investors rely on vigorous trading to maximise their returns. The reason a buy-and-hold strategy may be superior can be explained by two phenomena, namely friction (trading costs) and the effects of mistimed trades. Barber and Odean (2001) state that men trade more than women as a result of their overconfidence, and thus incur higher friction costs. Mistimed trades (buying high and selling low, or buying into overpriced assets and selling out of cheap assets) is another common phenomenon supported by Barber and Odean (1999) who found that stocks that investors sold outperformed those that they

bought. They reasoned that this was brought about due to investors' overconfidence and enjoyment derived from trading.

Do men trade more than women?

No significant difference was found in trading between genders i.e. men and women traded with equal frequency. This result suggests that overconfidence may not play as big a role in determining returns as suggested in the literature reviewed, which showed that men were more overconfident than women and traded more. With no significant differences in trading frequency between genders, the impact of friction (trading costs) would not necessarily be the factor that differentiated returns between genders. It is more likely that one of the other behavioural biases will be more dominant for this sample, such as risk aversion differences between genders.

There was no statistically significant difference found between the frequency of trades conducted by men and by women (Appendix 3.1) for the 10 year period from 1 January 2003 to 31 December 2012. Men in the 30-40 year age bracket however, were found to trade significantly more than women. These findings are similar, but not as pronounced as those of Barber and Odean (2001) and Willows (2012), which showed that men traded significantly more than women for the whole period analysed and also in almost all the age groupings.

Bhandari and Deaves (2006), Bengtsson, Persson and Willenhag (2005), Beyer (1998) and Grinblatt (2009) all found a link between overconfidence and trading activity, in that overconfident people (both men and women) trade more. They further found that men generally exhibit more overconfidence than women, which would suggest that men trade more than women. Barber and Odean (1999), Deaves et al. (2008) and Willows (2012) found that men traded more aggressively and frequently than women and as a result, men were more inclined to miss-time trades and incur higher friction costs.

The results for this study find that no significant difference exists between the frequency of trades between men and women for the whole period analysed, similar

to the research conducted by Glaser and Weber (2014) and Deaves et al. (2008) whose papers both suggested that, whilst overconfidence did lead to an increase in trading, it could not be concluded that overconfidence was solely responsible for influencing trading behavior. After controlling for overconfidence, Glaser and Weber (2014) and Deaves et al. (2008) both found no evidence that women trade with a different frequency to men. This would suggest that the impact of miss-timing trades and friction costs may be minimal when it comes to determining which gender achieves better investment returns.

The data for this study was limited to a small number of collective investment schemes. This might explain the finding in this paper of no statistical difference in trading frequency between genders on an overall basis (except for in the 30-39 year old age grouping). For this study, the population of investment options consisted of four collective investment schemes, whereas for Barber and Odean (2001), the universe of investment options was based on the US equity stock exchange market and thus, far larger. Collective investment scheme investors are more likely to be less active than investors in individual shares, thus limiting the opportunity for behavioral biases to filter through to investment performance. The studies conducted by Deaves et al. (2008) and Willows (2012) also consisted of a wider range of investment options for the participants. With limited options to choose from in the data used for this study, the difference in trade frequency between genders is expected to be less pronounced than that of Willows (2012), Barber and Odean (2001) and Deaves et al. (2008).

Do men earn lower returns than women on a risk adjusted basis?

As this study is based on a risk adjusted return, the results will be analysed in two sections: Median returns achieved and variance in returns achieved.

Median returns achieved

There was no statistically significant difference found between the returns earned by men and by women over the 10 year period ending 31 December 2012, over the 3 year four month period ending 28 April 2006, or over the 3 year four month period

ending 31 December 2012. For the 10 year period ending 31 December 2012, both men and women had a median annualised return of 17% (Appendix 3.2). For the 3 year four month period ending 28 April 2006, men earned a median annualised return of 36% and women earned a median annualised return of 38% (Appendix 3.2). For the 3 year four month period ending 31 December 2012, men and women both earned a median annualised return of 20% (Appendix 3.2).

The only period for which there was a statistically significant difference found between the returns earned by men and by women, was for the 3 year four month period ending 31 August 2009, in which men earned a median annualised return of 3% and women earned a median annualised return of 2% (Appendix 3.2).

Variance in returns

There was no statistically significant difference found between the variance in returns earned by men and by women over the 10 year period ending 31 December 2012, in the 3 year four month period ending 31 August 2009, or in the 3 year four month period ending 31 December 2012. For the 10 year period ending 31 December 2012, men had an annualised standard deviation of returns of 11.14% and women had an annualised standard deviation of returns of 9.93% (Appendix 3.2). For the 3 year four month period ending 31 August 2009, men had an annualised standard deviation of returns of 11.88% and women had an annualised standard deviation of returns of 8.64% (Appendix 3.2). For the 3 year four month period ending 31 December 2012, men had an annualised standard deviation of returns of 16.94% and women had an annualised standard deviation of returns of 13.82% (Appendix 3.2). The only period for which there was a statistically significant difference found between the annualised standard deviation of returns earned by men and by women, was for the 3 year four month period ending 28 April 2006, in which men had an annualised standard deviation of returns of 20.64% and women had an annualised standard deviation of returns of 18.31% (Appendix 3.2).

Overall, no differences were found in the risk adjusted returns between men and women in any of the periods, except for the three year four month period ending 28 April 2006, where women were better investors, and the three year four month

period ending 31 August 2009, where men were better investors. A further analysis was done to determine the average percentage of each gender's portfolio investment in equity funds compared to balanced funds. The assessment was done on the last day of each of the periods analysed. Equity funds are more risky than balanced funds, and so, if each gender is achieving equal returns but there is a difference in the variance of returns, this can potentially be explained by examining the riskiness of each portfolio.

Analysis of results

For the full ten year period ending 31 December 2012, the average portfolio investment allocation in the equity fund and balanced fund was 42% and 29% respectively, for women. This was in comparison to 47% and 28% for men. Consistent with the findings of Eckel and Grossman (2008), men have invested a larger allocation of their portfolio into riskier assets, and a smaller allocation of their portfolio into more risk neutral assets, in comparison to women.

The explanation for why women achieved better risk adjusted returns for the 3 year four month period ending 28 April 2006 might relate to the fact that women are more risk averse than men and therefore hold less risky portfolios. For this period in which men had statistically significant higher variance of returns, the average portfolio investment allocation for women in the equity and balanced fund was 57% and 42% respectively. This was in comparison to 57% and 40% for men. Whilst there is an equal investment allocation to equity, men have invested a smaller portion of their portfolio into the safer balanced fund. The equal allocation of portfolio investment into equity funds would help explain why the returns earned over the period had no statistically significant difference. Men have invested the remaining 3% into the more risky feeder fund, with women investing the remaining 1% into the feeder fund. The smaller allocation by men to the balanced fund might also help explain why their portfolio returns had higher variances than those of women.

The explanation for why men achieved better risk adjusted returns for the 3 year four month period ending 31 August 2009 might relate to the financial crisis, which was

prevalent at the end of 2008 and beginning of 2009. Numerous studies such as Barber et al. (2009), Feng and Seasholes (2005), Grinblatt and Keloharju (2001) and Odean (1998) support the fact that investors tend to sell risky assets and move their wealth to more riskless assets (such as money market investments) during financial crashes. As a result, it might have been the case that women (being more risk averse), kept their money in riskless assets for longer, and that men traded into riskier assets sooner than women, and thus were able to earn higher returns as the market recovered from the financial crisis. These findings are consistent with those of Willows (2012).

A contrasting study by Hoffmann et al. (2013) found that investors continue to trade and do not de-risk their investment portfolios during the crisis. Investors also do not try to reduce risk by shifting from risky investments to cash. Instead, investors use the depressed asset prices as a chance to enter the stock market. Although this study offers a different view, it still supports the general view of risk and return, in that investors with riskier portfolios should expect better returns than investors with less risky portfolios.

For the 3 year four month period ending 31 August 2009, the average portfolio investment allocation in the equity fund and the balanced fund was 47% and 41% respectively for women. This was in comparison to 51% and 35% for men. Men had invested a higher portion of their portfolios into the riskier equity fund, and a smaller portion of their portfolios into the more risk neutral balanced fund. Whilst there was no significant difference in the variance of returns earned between the genders, men earned a significantly higher return, due to their portfolios being invested in more risky assets.

Summary of results

In relation to the research question of whether trading frequency influences investor return, the results showed that a negative correlation exists between trade frequency and investor returns. The more an investor trades, the more he lowers his return.

The null hypothesis held true for trading frequency in that men and women were found to trade with equal frequency. The conclusion to be reached is that, whilst the literature on overconfidence is relevant and true in certain instances, other behavioral biases such as differences in risk aversion, may be more significant in differentiating investor performance between genders.

For the last research question, men were not found to earn lower returns than women on a risk adjusted basis for any of the periods analysed other than in the three year four month period ending 28 April 2006. On an overall basis, for the full ten year period ending 31 December 2012, there is no statistically significant difference in returns or variance of returns earned between men and women, suggesting that the null hypothesis holds true and there is no difference between the genders in their risk adjusted investment returns. For the three year four month period ending 31 August 2009, men earned better risk adjusted returns than women.

Gender differentials based on age

The data for this research paper was further stratified into age groupings, with the same statistical tests performed within these groupings to determine which gender earns better risk adjusted returns, as well as statistical tests on the number of trades made to determine which gender trades more. The age groupings used were: 20 – 29 years of age, 30 – 39 years of age, 40 – 49 years of age, 50 – 59 years of age, 60 – 69 years of age, and 70+ years of age. Investors whose age could not be determined were excluded from any testing on this stratified basis.

All samples were visually tested for normality (Appendixes 1.2.1 – 1.2.8) in order to decide on the type of statistical test to use to compare the mean: the Wilcoxon rank sum test for non-normal distributions or the t-test for normal distributions. The F-test will be used for the variance calculation for normal distributions and the Levene test for non-normal distributions. A confidence interval was set at 95%.

The objective of doing an age analysis was to determine whether or not the trading frequency, return earned or variance in return between men and women within

different age groupings is any more or less statistically significant than the overall sample. The objective of this analysis was not to assess whether statistically significant differences in trading frequency, returned earned or variance in return are observable between the age groupings per say.

Between 20 and 30 years of age

No statistically significant differences were found between the number of trades made by men in comparison to women. Women earned statistically significant higher returns in comparison to men in the three year four month period ending 28 April 2006 (Appendix 4.2.1 and 4.2.2). Men were found to have statistically significantly higher variances in returns earned for the three year four month period ending 28 April 2006, implying that women in this age grouping are better investors on a risk adjusted basis. The findings for this age group support those of Willows (2012) for the same age group. Willows (2012) noted that the higher variance in return for men could be contributed to the fact that they were trading significantly more than women, but the findings of this study suggest that the impact of trade frequency on variability of returns may be minimal, due to the fact that no significant difference was found in trade frequency between men and women for this age group.

The variance in return for men in this age group is 21.95 and for women it is 15.92. This is in comparison to the variance in return for the whole cohort of men of 20.36 and the whole cohort of women of 18.31. Men in this age group have shown a higher than average variance in return, and women in this age group have shown a lower than average variance in return.

Barber and Odean (2001) found that younger investors are less risk averse and more willing to take on riskier portfolios, due to their desire to maximise long run returns. It appears as if this is particularly true of men, and less so of women for the 20 – 30 year old age group. Beyer (1998) found that women are less overconfident when the domain is more male orientated and Fan and Wang (2002) found that women are perceived as more conservative investors and are offered less risky investments by brokers. As this is the age group when investors are predominantly

entering the job market for the first time, one may conclude that women are more risk averse than men, until such a time as they feel comfortable in the investment domain. One would then expect that the longer women spent in the financial domain, the less pronounced the effect of the risk aversion bias would exist, and that in subsequent age groups, the difference in variance between genders would be less evident.

However, looking at the portfolio allocations for this age grouping, women have invested 77% and 23% into the equity and balanced funds respectively, compared to men, who have a 72% and 28% allocation. Women have a higher allocation than men in the risky equity fund, and a lower allocation than men in the more risk neutral balanced fund, meaning their portfolio is less risk averse than those of men. The results of this age grouping thus appear to be an anomaly not easily explainable by risk aversion or trading frequency and should be investigated in subsequent research as such an investigation is beyond the scope of this study.

Between 30 and 40 years of age

Men in this age group were found to trade significantly more than women, supporting the findings of Barber and Odean (2001) and Willows (2012) and suggesting that the overconfidence bias might be more pronounced in this age group. Hibbert et al. (2008) found that once women are older than 30, they are significantly more risk averse than men and Hibbert et al. (2008) found that this risk aversion of women then decreases as they get older. These findings might explain why men were found to trade significantly more than women in this period, as between the age of 30 and 40, the risk aversion differential between the genders is at its highest. This is consistent with the portfolio allocations as per appendix 5, where this age grouping has the 2nd highest differential in portfolio allocation between genders. Over the whole ten year period, women in this age group have invested 7% less than men in the equity fund and 5 % more in the balanced funds. Only the 50-59 year old age grouping has a bigger differential in investment allocations between funds.

No statistically significant differences were found between the returns earned or variance in returns earned by men in comparison to women in any one of the four

time-periods analysed (Appendix 4.3.1 and 4.3.2). Even though men traded significantly more than women, with no difference in risk adjusted returns, it further implies that the impact that excess trading has on returns is minimal.

Between 40 and 50 years, 50 and 60 years and 60 and 70 years of age

No statistically significant differences were found between the number of trades made by men in comparison to women, nor in the returns earned or variance in returns earned by men in comparison to women in any one of the four time-periods analysed (Appendix 4.4.1 to 4.6.1 and 4.4.2 to 4.6.2). This supports the findings of Hibbert et al. (2008) which suggested that as women get older, the differences in risk aversion and overconfidence between the genders decreases.

Over 70 years of age

No statistically significant differences were found between the number of trades made by men in comparison to women, nor in the returns earned by men in comparison to women in any one of the four time-periods analysed (Appendix 4.7.1 and 4.7.2).

Men were found to have statistically significantly higher variances in returns earned for the three year four month period ending 28 April 2006. The variance in return for men in this age group is 17.51 and for women it is 6.92. This is in comparison to the variance in return for the whole cohort of men of 20.36 and the whole cohort of women of 18.31. Men in this age group have shown a slightly less than average variance in return against the whole cohort, and women in this age group have shown a much lower than average variance in return against the whole cohort. As investors approach retirement age (65 years old in South Africa), they should be in a position where they have maximised their wealth accumulation, and should be re-aligning their portfolio to more stable stocks with lower risk and variance in return. This is consistent with Yoo (1994) who noted that retired investors hold less risky portfolios.

Whilst the finding of a higher variance in return by men in comparison to women in this age group is the same as that in the 20-30 year old age group, the reasons appear different. In the 20-30 year old age grouping, men were found to have a higher than average variance in return compared to the average of the whole cohort of men, which is not the case in the above 70 years of age grouping. Also, in the 20-30 year old age group, women had a slightly lower than average variance in return in comparison to the average of the whole cohort of women, whilst in the above 70 years of age grouping, women have a significantly lower variance in return of 6.92 compared to the average of the whole cohort of women, who have a variance in return of 18.31. This significantly lower than average variance for women against the whole cohort could be indicative of their statistically significantly lower variance in return compared to men.

For this age grouping, men have a 52% portfolio allocation to the equity unit trust compared to women with a 54% portfolio allocation to the equity unit trust. Men also have a 46% portfolio allocation to the balanced fund, which is equal to women, who also have a portfolio allocation of 46% to the balanced fund. It thus appears as if women have a slightly more risky portfolio than men, and so the higher variance in returns shown by men is not explained through increased trading or risk aversion. This anomaly should be investigated in subsequent research as such an investigation is beyond the scope of this study.

Conclusion

The table below presents a summary of the results of all statistical tests performed across all age grouping as well as for the total sample:

Age Group	Total	20-29	30-39	40-49	50-59	60-69	Over 70
Trade frequency			M				
Return *10/2012*							
3/2006		W					
3/2009	M						
3/2012							
Variance in return *10/2012*							
3/2006	M	M					M
3/2009							
3/2012							

M: Men's **trade frequency**; **return earned**; or **variance in return** is statistically significantly higher than that of women at a 95% confidence level.

W: Women's **trade frequency; return earned**; or **variance in return** is statistically significantly higher than that of men at a 95% confidence level.

10/12: Ten year period from 1 January 2003 to 31 December 2012

3/2006: Three year 4 month period from 1 January 2003 to 28 April 2006

3/2009: Three year 4 month period from 1 May 2006 to 31 August 2009

3/2012: Three year 4 month period from 1 September 2009 to 31 December 2012

For all age groups within the ten year period ending 31 December 2012, on a risk adjusted basis, no statistical differences in investment performance can be found between male and female investors. No differences in this period were found in trade frequency between the genders, except for in the 30 to 40 year age group where men were found to trade significantly more than women. This was consistent with the

literature reviewed which stated that men tend to trade more than women, due to overconfidence.

Within the three year four month period ending 28 April 2006, on a risk adjusted basis, women in the 20 to 30 year age group and in the above 70 year old age group were found to be better investors than men, which was consistent with the finding for the whole cohort of investors over that period.

For all age groups within the three year four month period ending 31 August 2009, and three year four month period ending 31 December 2012, on a risk adjusted basis, no statistical differences in investment performance can be found between male and female investors.

Trading frequency was found to have a statistically significant negative correlation with returns, which the literature review attributed to friction costs and mistiming trades. This finding is consistent with that of Willows (2012). In contrast to Willows (2012), who had men trading more than women, no statistically significant differences were found in trade frequency between genders. For the 10 year period analysed, the null hypothesis holds true in that there is no difference in investment performance between genders. This is in contrast to Willows (2012) who found that women were better investors on a risk adjusted basis.

When stratifying the data into shorter periods, a result consistent with Willows (2012) became apparent, in that women outperformed men in the period immediately preceding the financial crisis (a bull market) and men outperformed women in the period following the financial crisis (a bear market).

Recommendations for future research

From the data provided, it was not possible to determine the marital status of investors, and thus, no further insight was able to be obtained regarding risk profiles and returns of singles versus married couples. The literature review suggested that marital status was a significant attribute in determining risk aversion between genders, and new conclusions and trends could be identified if this was an additional stratified group.

On a risk adjusted basis, no differences in investment performance could be found between the genders, apart from just before the financial crisis where women performed better, and just after the financial crisis, where men performed better. As the sample analysed included four years before the financial crisis (2003 to 2006) and four years post the financial crisis (2009 to 2012), and no significant differences in investment performance were found for the whole period from 2003 to 2012, an area for further research may be to investigate the reasons why men perform better than women in bear markets, and worse than women in bull markets. Two anomalies were identified in the three year and four month period ending 28 April 2006, in which women over the age of 70, and women between the age of 20-29 were found to have significantly lower variance in returns in comparison to men and the average returns of women for the whole cohort. This was not easily explained through trading volume or risk aversion and requires further investigation.

The sample of investors used in this study was sourced from only one asset manager and as such, the behaviour of investors in this sample may well vary when compared with another sample from other asset managers. As was done in this study, where the findings of Willows (2012) were expanded upon by using data from a new asset manager, an improved meta-analysis could be conducted where data is sourced from more asset managers, in order to expand the sample and compare results.

Lastly, the sample of investors could be stratified further for classifications such as dependants versus no dependants, race/ethnicity, were such information available. Such factors could well have an impact of the risk profiles of the investors and would have allowed a greater degree of comparison between genders.

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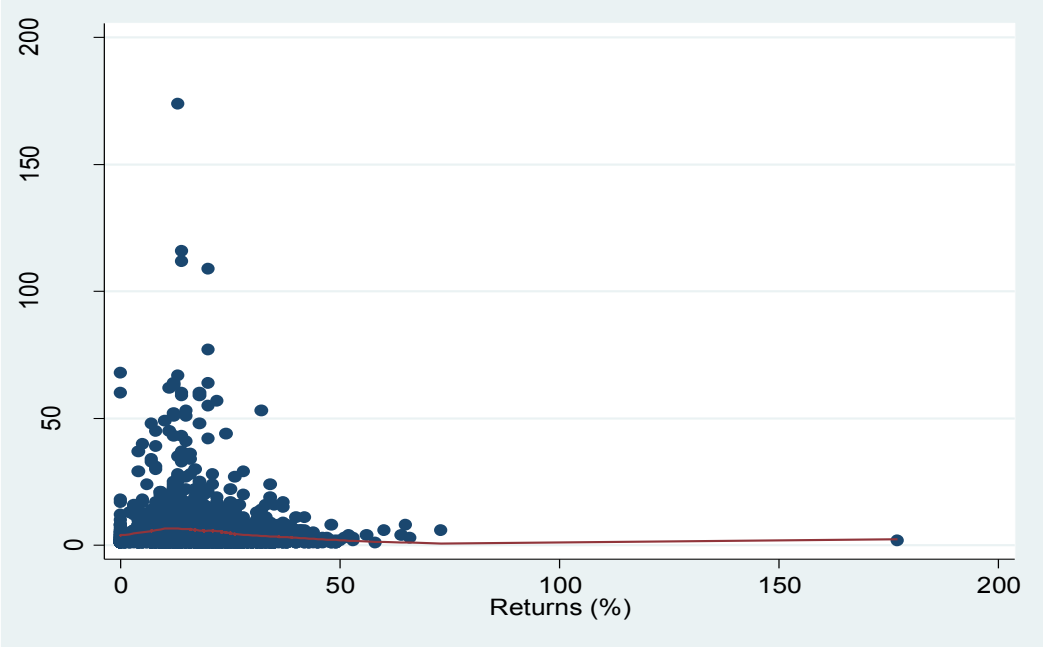
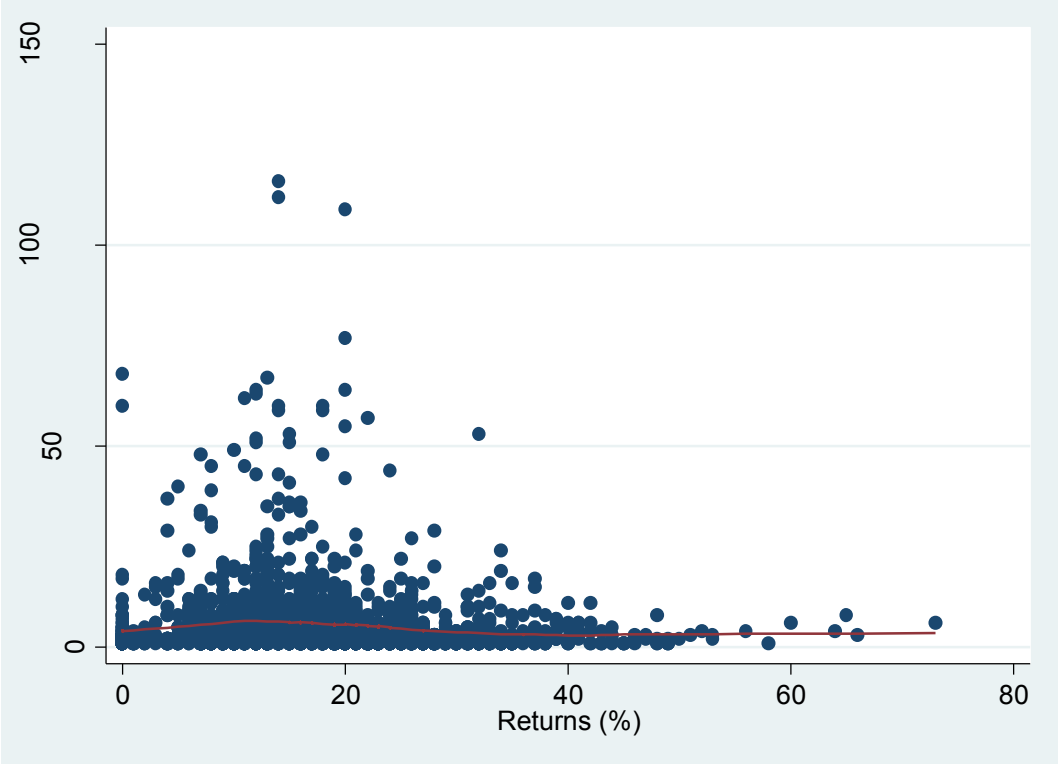
Appendixes

Appendix 1: Visual test for normal distribution

1.1.1: Distribution of trades

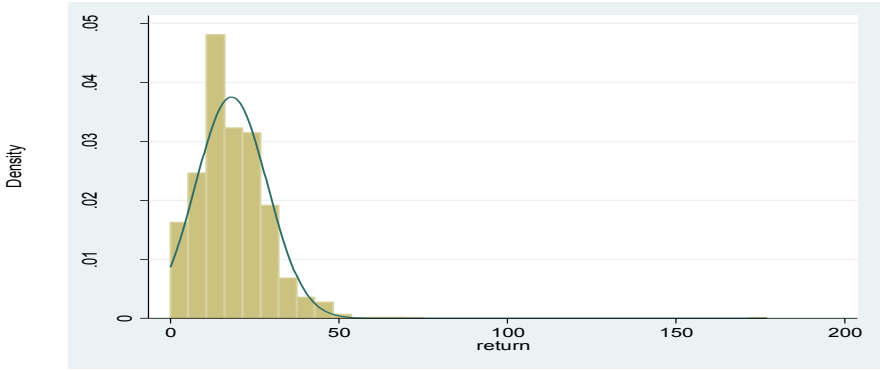


1.1.2: Distribution of trades (excluding largest outliers)

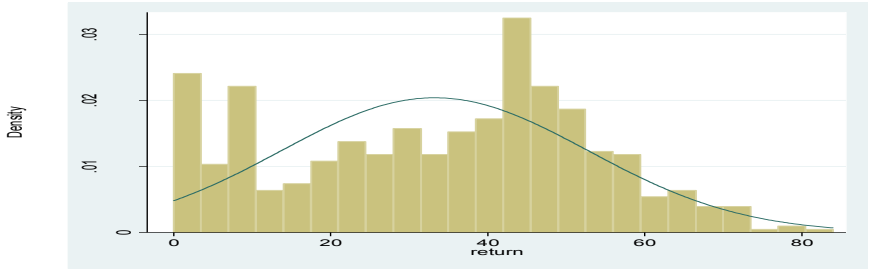


1.2.1: Distribution of investor returns – all investors

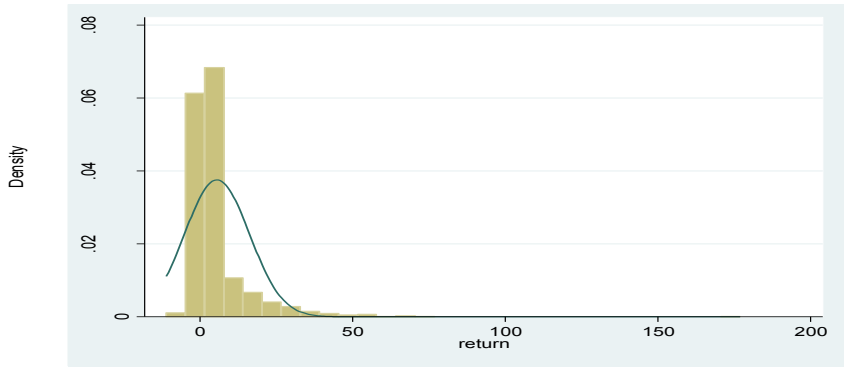
Ten year period: 1 January 2003 to 31 December 2012



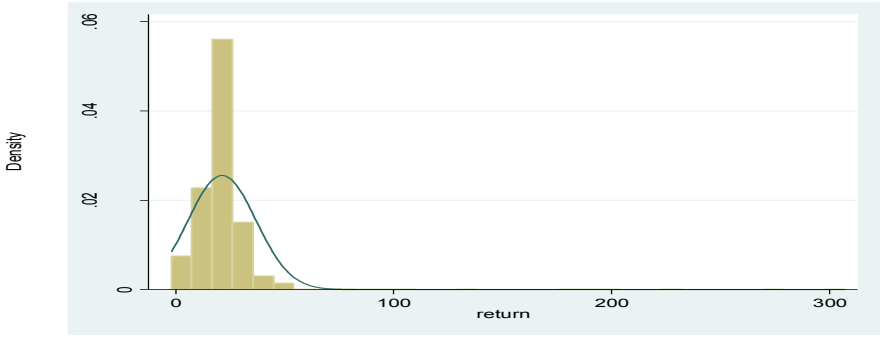
Three year four month period: 1 January 2003 to 28 April 2006



Three year four month period: 1 May 2006 to 31 August 2009

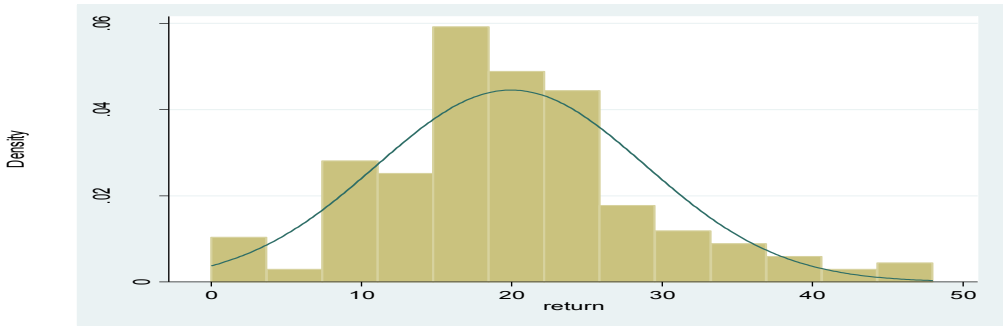


Three year four month period: 1 September 2009 to 31 December 2012

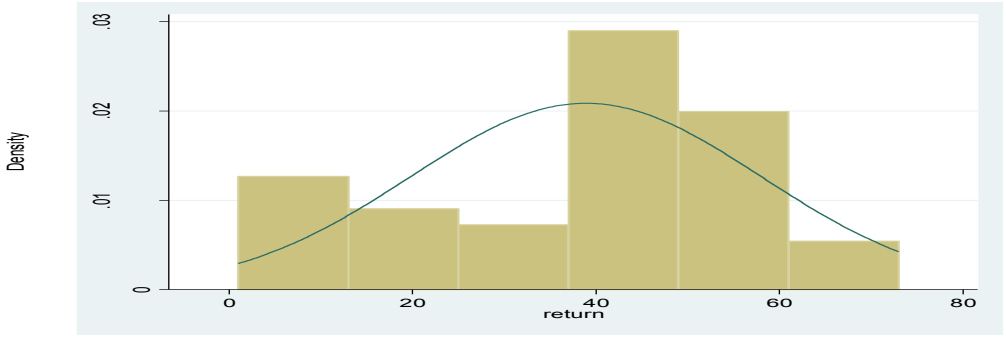


1.2.2: Distribution of investor returns – Investors under the age of 20

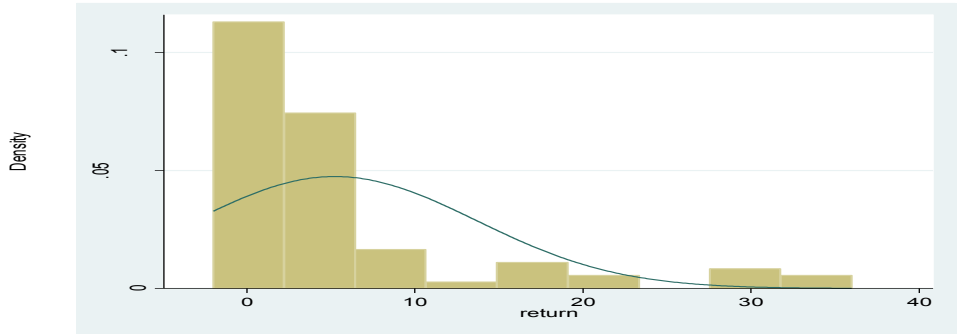
Ten year period: 1 January 2003 to 31 December 2012



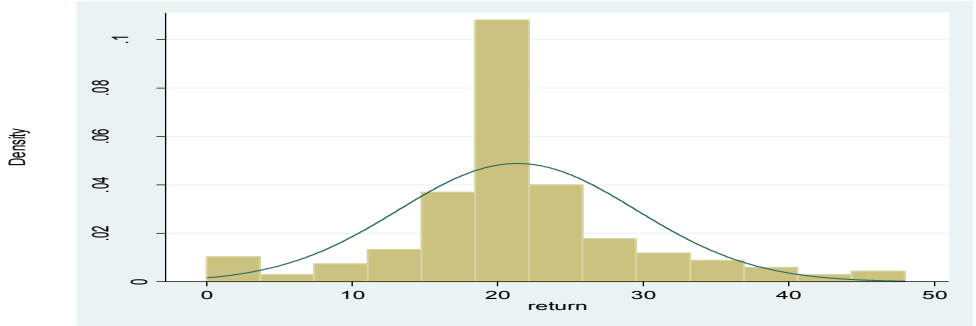
Three year four month period: 1 January 2003 to 28 April 2006



Three year four month period: 1 May 2006 to 31 August 2009

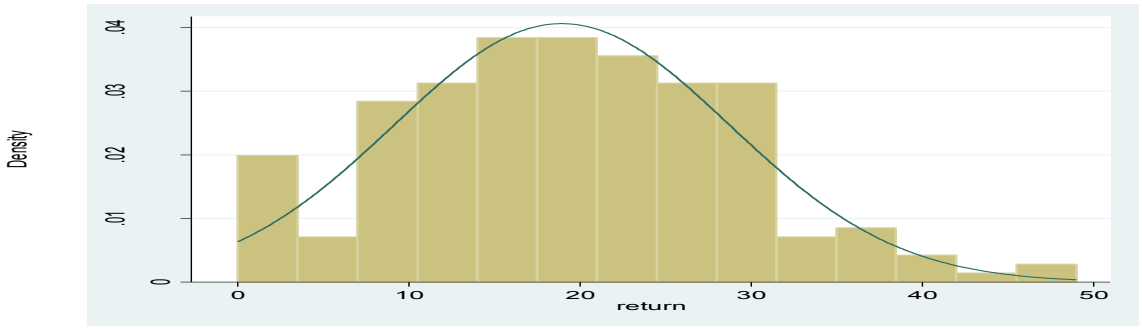


Three year four month period: 1 September 2009 to 31 December 2012

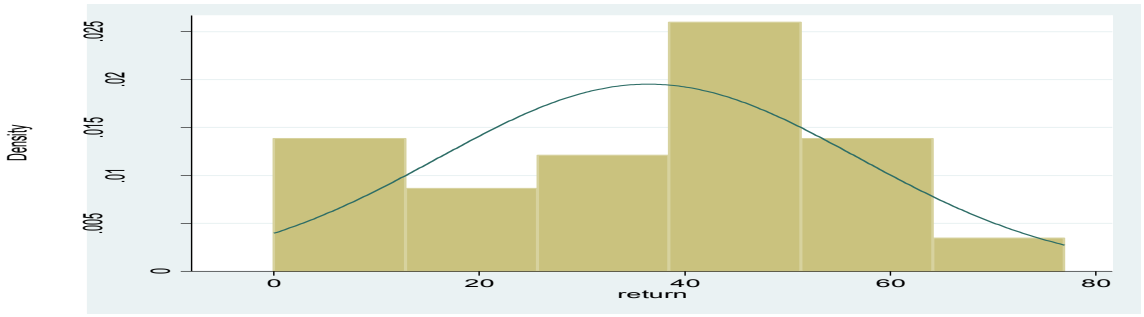


1.2.3: Distribution of investor returns – Investors between the age of 20 and 30

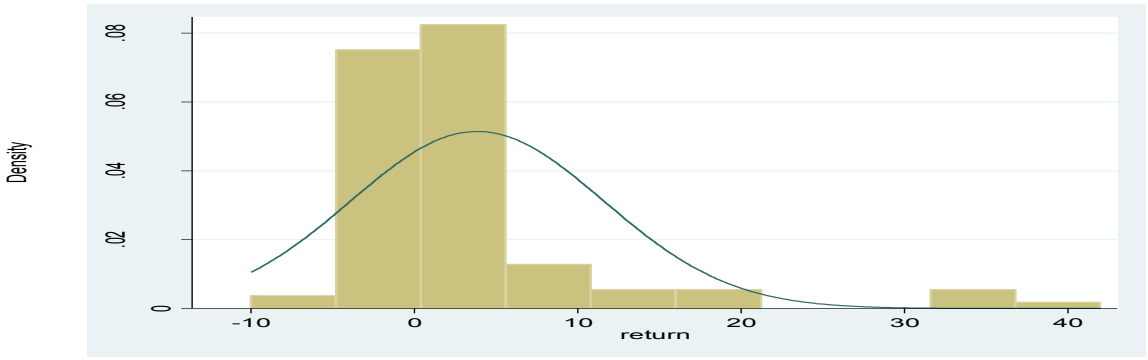
Ten year period: 1 January 2003 to 31 December 2012



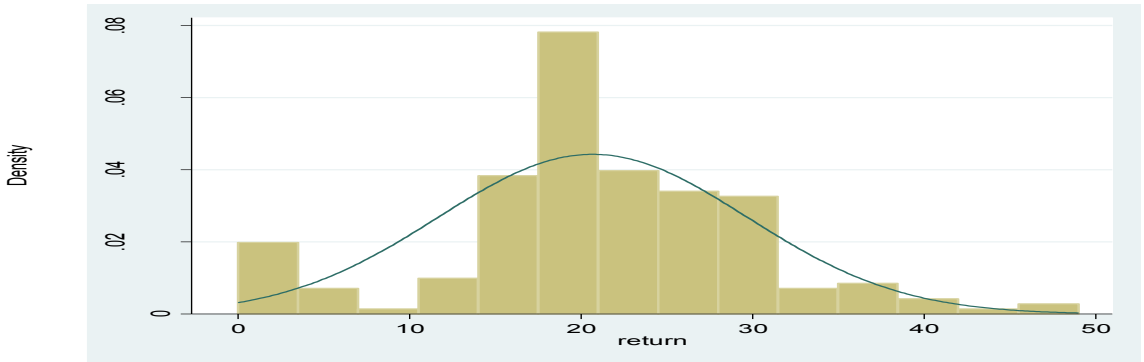
Three year four month period: 1 January 2003 to 28 April 2006



Three year four month period: 1 May 2006 to 31 August 2009

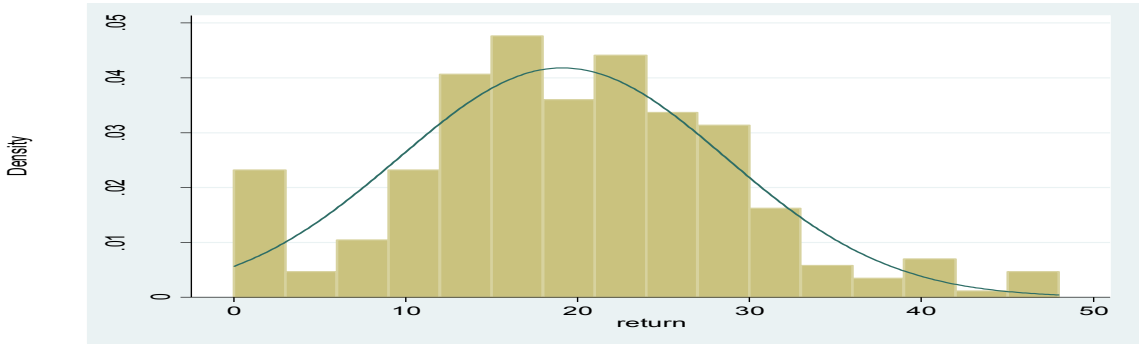


Three year four month period: 1 September 2009 to 31 December 2012

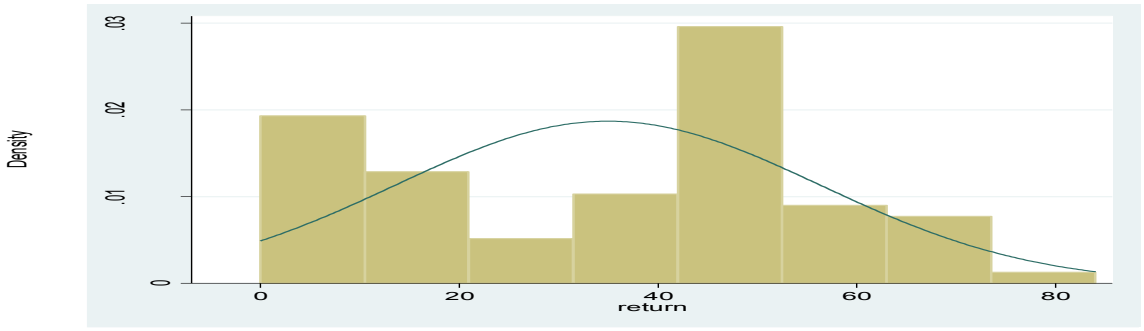


1.2.4: Distribution of investor returns – Investors between the age of 30 and 40

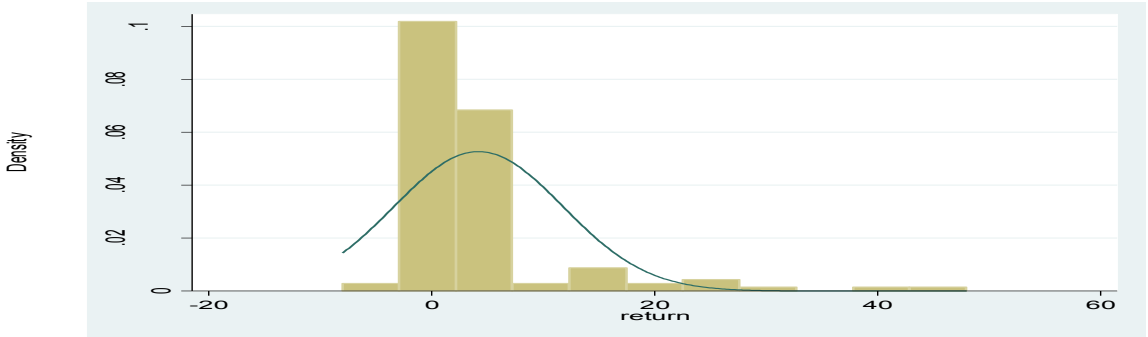
Ten year period: 1 January 2003 to 31 December 2012



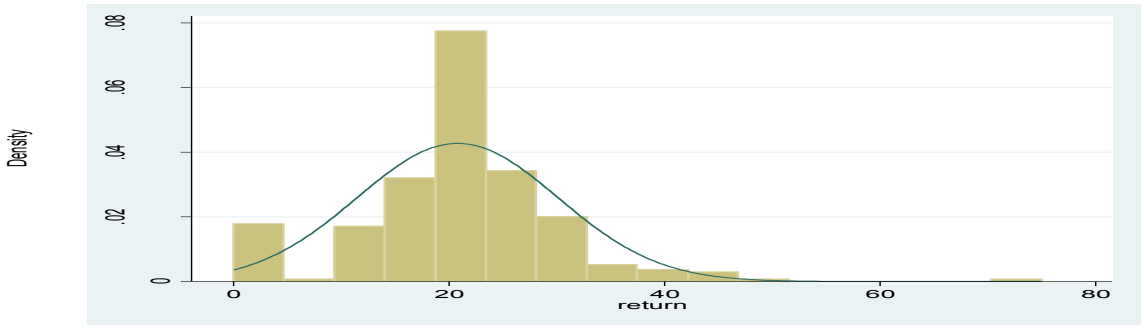
Three year four month period: 1 January 2003 to 28 April 2006



Three year four month period: 1 May 2006 to 31 August 2009

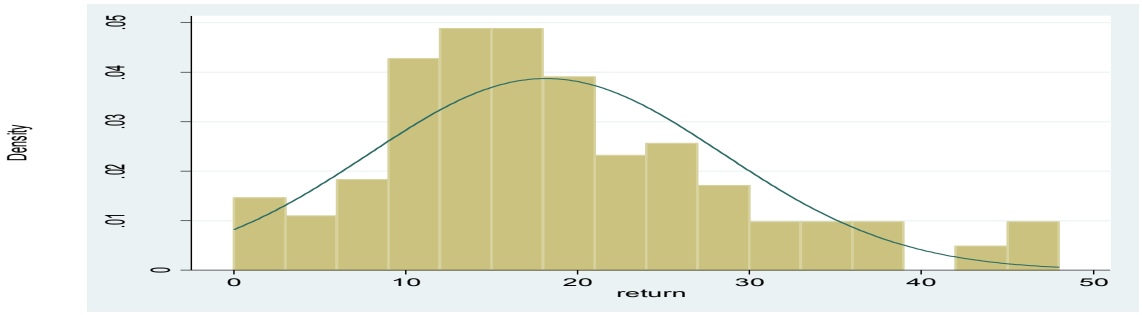


Three year four month period: 1 September 2009 to 31 December 2012

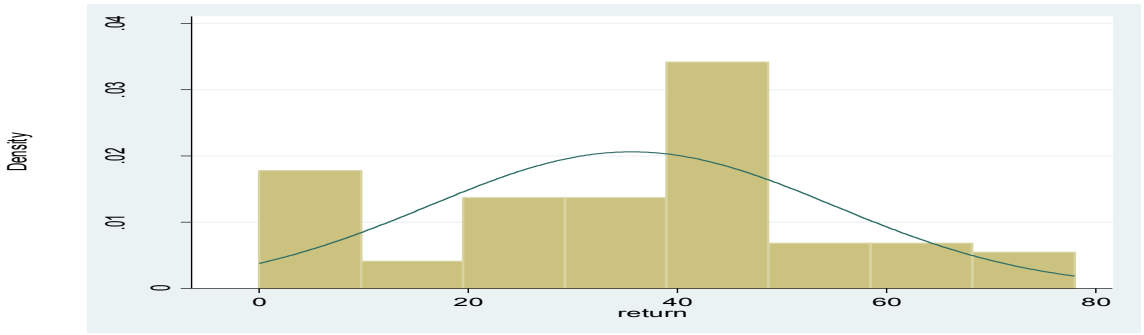


1.2.5: Distribution of investor returns – Investors between the age of 40 and 50

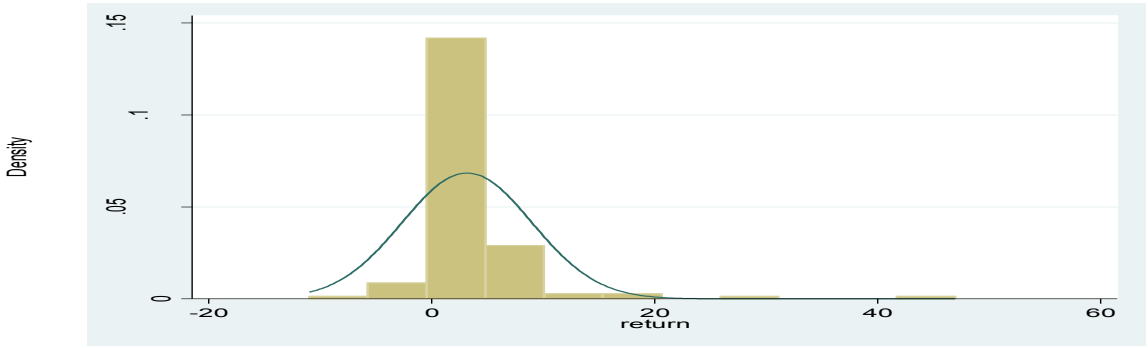
Ten year period: 1 January 2003 to 31 December 2012



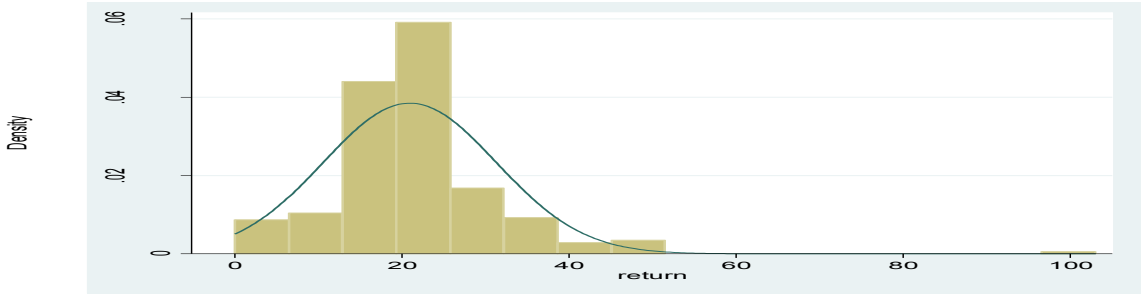
Three year four month period: 1 January 2003 to 28 April 2006



Three year four month period: 1 May 2006 to 31 August 2009

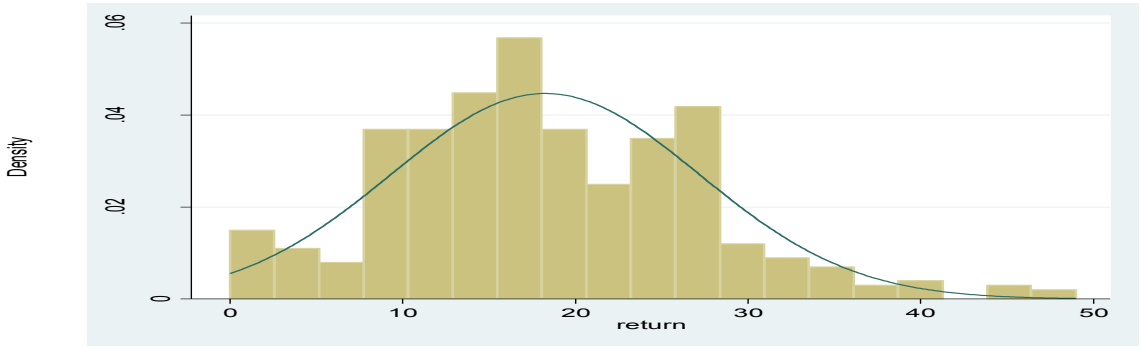


Three year four month period: 1 September 2009 to 31 December 2012

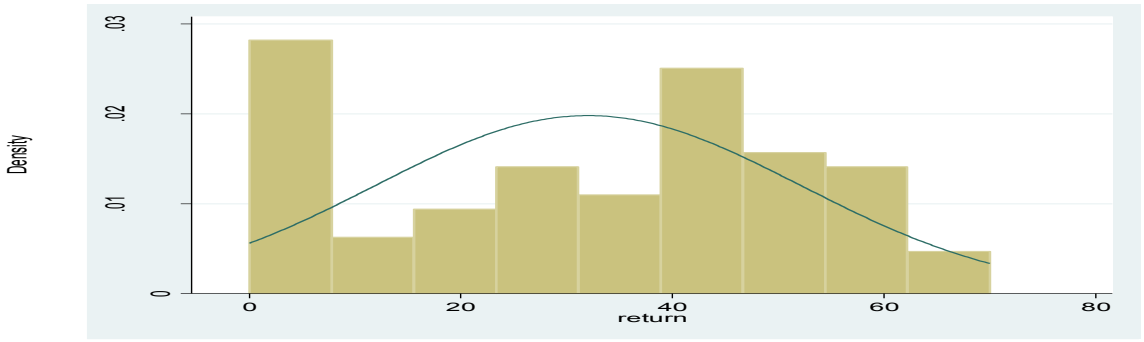


1.2.6: Distribution of investor returns – Investors between the age of 50 and 60

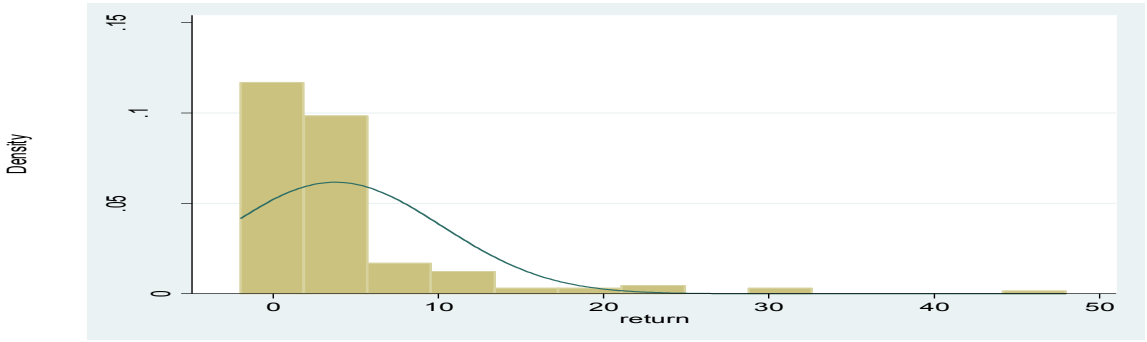
Ten year period: 1 January 2003 to 31 December 2012



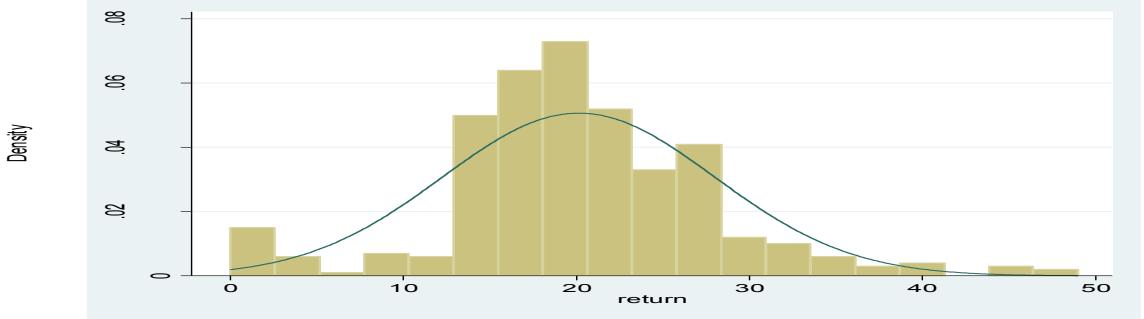
Three year four month period: 1 January 2003 to 28 April 2006



Three year four month period: 1 May 2006 to 31 August 2009

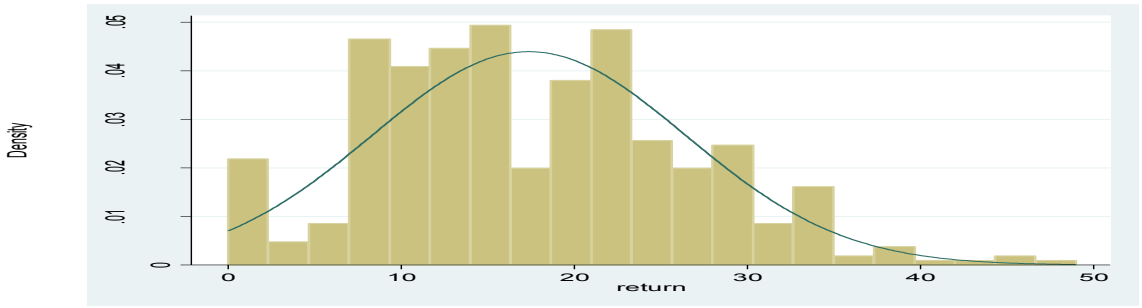


Three year four month period: 1 September 2009 to 31 December 2012

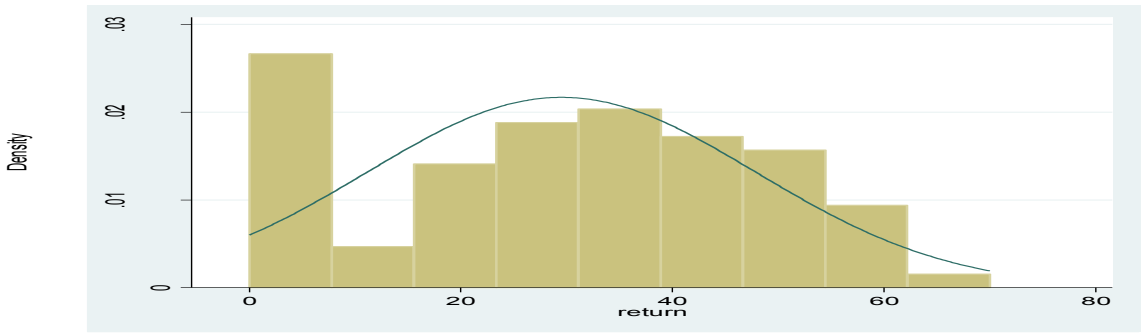


1.2.7: Distribution of investor returns – Investors between the age of 60 and 70

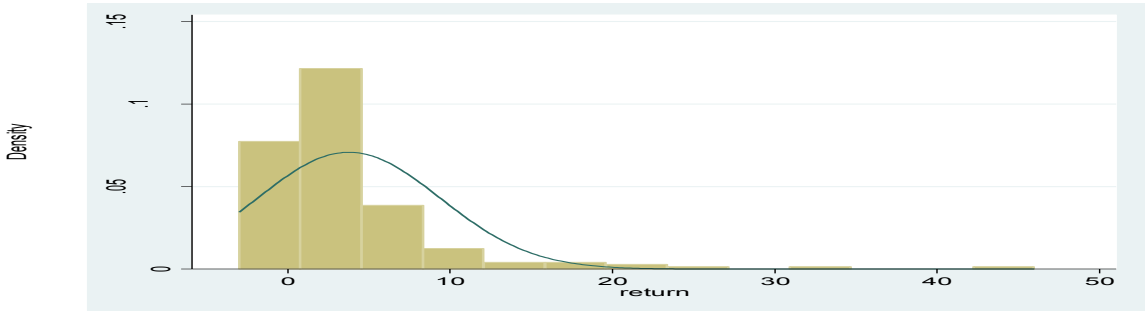
Ten year period: 1 January 2003 to 31 December 2012



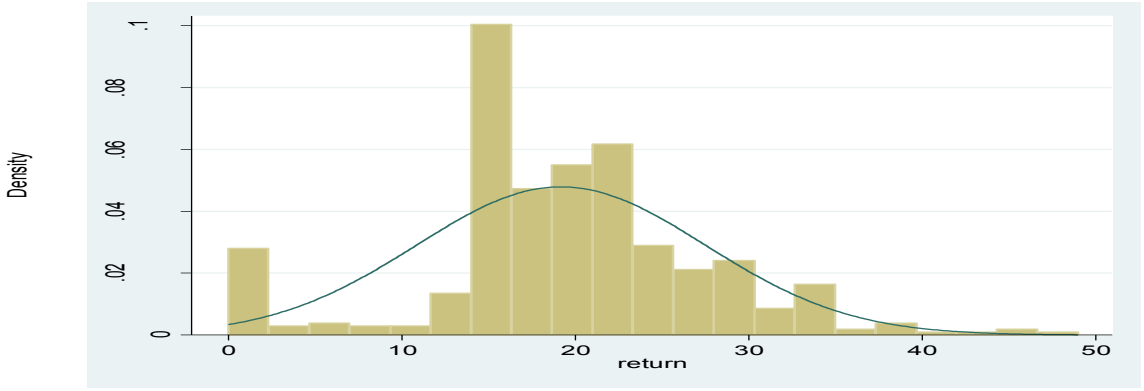
Three year four month period: 1 January 2003 to 28 April 2006



Three year four month period: 1 May 2006 to 31 August 2009

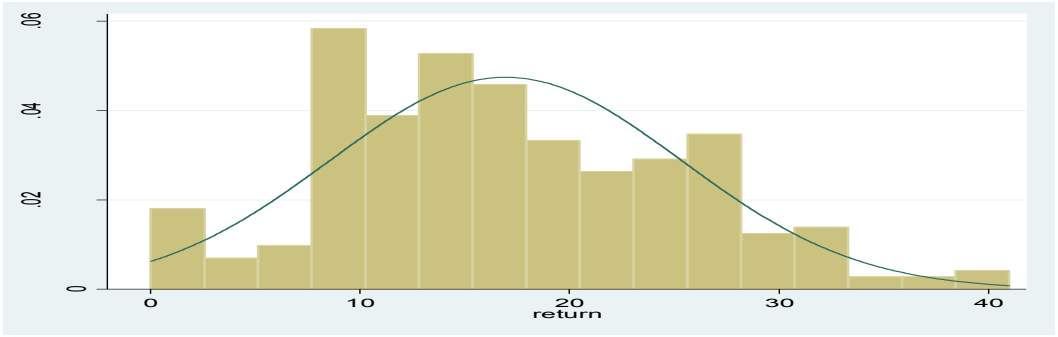


Three year four month period: 1 September 2009 to 31 December 2012

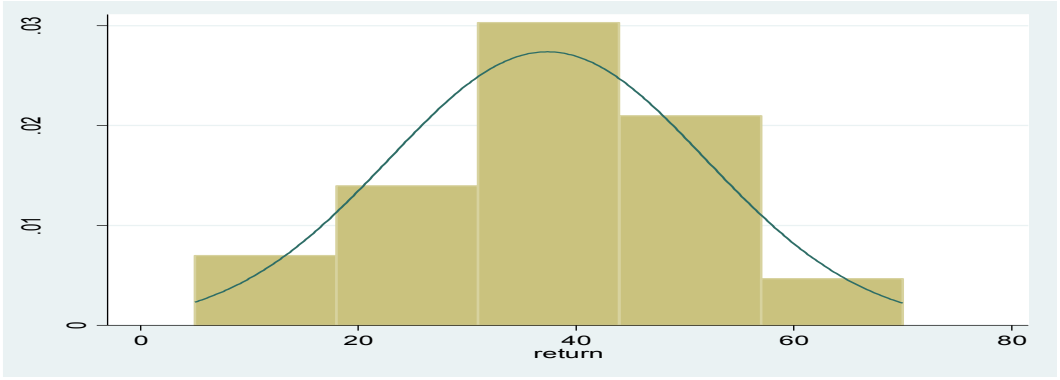


1.2.8: Distribution of investor returns – Investors over the age of 70

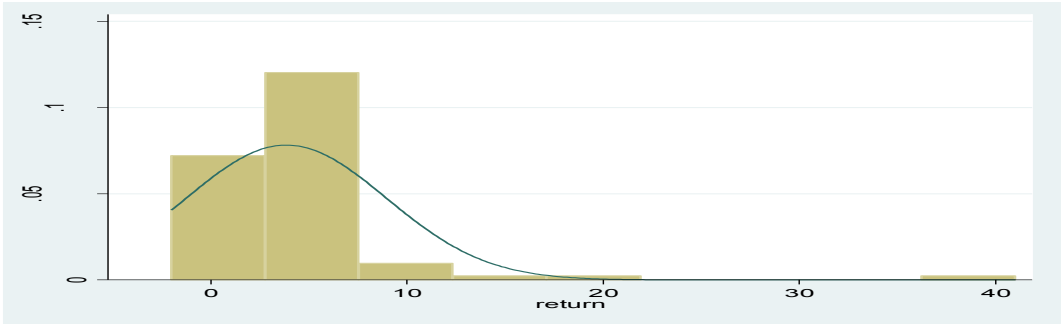
Ten year period: 1 January 2003 to 31 December 2012



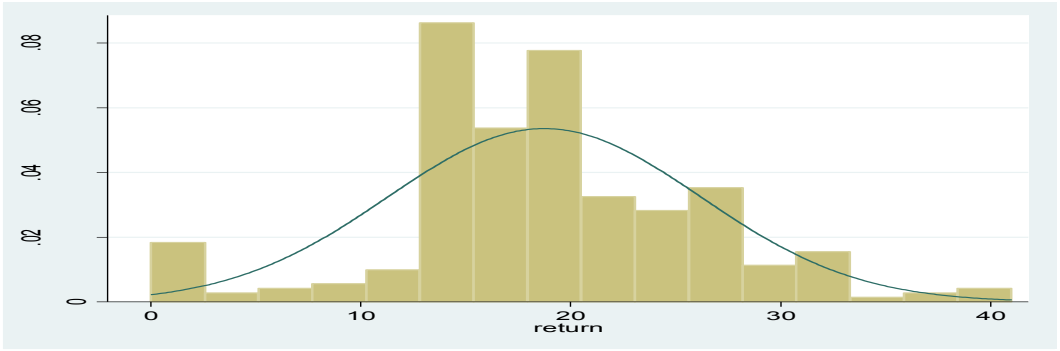
Three year four month period: 1 January 2003 to 28 April 2006



Three year four month period: 1 May 2006 to 31 August 2009



Three year four month period: 1 September 2009 to 31 December 2012



Appendix 2: Statistical test: Correlation between trade frequency and return

	Number of observations	Spearman's Rho	P
Full sample	2025	-0.1228	<0.0001
Excluding largest outliers	2023	-0.1222	<0.0001

Conclusion: There is a statistically significant negative relationship between trade frequency and return; however, the correlation is weak.

Appendix 3: Statistical tests for the periods

3.1: Two-sample for median number of trades for the 10 year period

	Number of observations	Maximum	Median and IQR	Standard Deviation	Z	P
Men	1,078	116	3 (IQR: 1–6)	8.42		
Women	947	174	2 (IQR: 1-5)	11.03		
Total	2,025				1.73 [z]	0.083

[z] Calculated using Wilcoxon rank-sum test which is a two-tailed test. An unpaired z-test with one tail will be performed as the numbers of data points within the two samples being compared are different and we expect the mean to move in only one direction

Conclusion: There is no statistically significant difference in trade frequency of men and women.

3.2: Two sample for median return and variance in return

		Number of observations	Median and IQR	Z	P	W	P	Standard deviation
10 Years: 1 January 2003 - 31 December 2012	*Men*	1,327	17 (IQR:12- 24)					11.15
	Women	1,053	17 (IQR: 11-24)					9.93
	Total	2,380		0.722 [z]	0.470	0.10 [w]	0.75	
3 ¼ Years: 1 January 2003 - 28 April 2006	*Men*	350	36 (IQR: 15-48)					20.36
	Women	231	38 (IQR: 20-47)					18.31
	Total	581		-0.448 [z]	0.654	4.48 [w]	0.03	
3 ¼ Years: 1 May 2006 - 31 August 2009	*Men*	663	3 (IQR: 0-6)					11.88
	Women	502	2 (IQR: 0-5)					8.64
	Total	1,165		2.764 [z]	0.005	3.14 [w]	0.08	
3 ¼ Years: 1 September 2009 - 31 December 2012	*Men*	1,194	20 (IQR: 16-25)					16.94
	Women	973	20 IQR (16-25)					13.82
	Total	2,167		-0.526 [z]	0.599	0.28 [w]	0.60	

Z: Calculated using Wilcoxon rank-sum test which is a two tailed test.

W: Calculated using Levene's test which is a robust test for equality of variance for non-normally distributed data.

Conclusions:

10 Years: 1 January 2003 - 31 December 2012- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 January 2003 - 28 April 2006- No statistically significant difference in returns earned, but women had a statistically significant lower variance in the returns they earned, so were better investors on a risk adjusted basis for this period.

3 ¼ Years: 1 May 2006 - 31 August 2009- Men earned a statistically significant higher median return as compared to women, with no statistically significant difference in the variance of the returns earned. Men are better investors on a risk adjusted basis for this period.

3 ¼ Years: 1 September 2009 – 31 December 2012- No statistically significant difference in returns earned, or in the variance of the returns earned.

Appendix 4: Age Groupings

4.1: Under 20 years of age

4.1.1: Two-sample for median number of trades for the 10 year period

	Number of observations	Maximum	Median and IQR	Standard Deviation	Z	P
Men	49	21	2 (IQR: 1–5)	4.15		
Women	111	112	2 (IQR: 1-4)	13.20		
Total	160				-0.29 [z]	0.768

[z] Calculated using Wilcoxon rank-sum test which is a two-tailed test. An unpaired z-test with one tail will be performed as the numbers of data points within the two samples being compared are different and we expect the mean to move in only one direction

Conclusion: There is no statistically significant difference in trade frequency of men and women.

4.1.2: Two sample for median return and variance in return

		Number of observations	Median and IQR	Z	P	W	P	Standard deviation
10 Years: 1 January 2003 - 31 December 2012	*Men*	87	19 (IQR:14- 25)					8.29
	Women	96	20 (IQR: 15-24)					9.52
	Total	183		-0.571 [z]	0.568	0.47 [w]	0.49	
3 ¼ Years: 1 January 2003 - 28 April 2006	*Men*	27	47 (IQR: 16-59)					21.23
	Women	19	39 (IQR: 23-47)					16.00
	Total	46		1.161 [z]	0.245	1.31 [w]	0.26	
3 ¼ Years: 1 May 2006 - 31 August 2009	*Men*	44	3 (IQR: 0-8)					7.84
	Women	42	2 (IQR: 0-4)					9.05
	Total	86		0.859 [z]	0.390	0.11 [w]	0.74	
3 ¼ Years: 1 September 2009 - 31 December 2012	*Men*	87	21 (IQR: 17-25)					7.69
	Women	96	20 IQR (18-24)					8.58
	Total	183		-0.272 [z]	0.785	0.11 [w]	0.74	

Z: Calculated using Wilcoxon rank-sum test which is a two tailed test.

W: Calculated using Levene's test which is a robust test for equality of variance for non-normally distributed data.

Conclusions:

10 Years: 1 January 2003 - 31 December 2012- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 January 2003 - 28 April 2006- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 May 2006 - 31 August 2009- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 September 2009 – 31 December 2012- No statistically significant difference in returns earned, or in the variance of the returns earned.

4.2: Between 20 and 30 years of age

4.2.1: Two-sample for median number of trades for the 10 year period

	Number of observations	Maximum	Median and IQR	Standard Deviation	Z	P
Men	94	51	2 (IQR: 1–4)	6.88		
Women	81	22	2 (IQR: 1-4)	4.10		
Total	175				0.33 [z]	0.745

[z] Calculated using Wilcoxon rank-sum test which is a two-tailed test. An unpaired z-test with one tail will be performed as the numbers of data points within the two samples being compared are different and we expect the mean to move in only one direction

Conclusion: There is no statistically significant difference in trade frequency of men and women.

4.2.2: Two sample for median return and variance in return

		Number of observations	Median and IQR	Z	P	W	P	Standard deviation
10 Years: 1 January 2003 - 31 December 2012	*Men*	115	18.53					10.16
	Women	86	19.48					9.39
	Total	201		-0.675 [t]	0.500	1.17 [f]	0.44	
3 ¼ Years: 1 January 2003 - 28 April 2006	*Men*	26	35 (IQR: 7-49)					21.96
	Women	19	48 (IQR: 31-52)					15.92
	Total	45		-1.989 [z]	0.046	4.42 [w]	0.04	
3 ¼ Years: 1 May 2006 - 31 August 2009	*Men*	57	2 (IQR: 0-4)					8.66
	Women	48	2 (IQR: 0-4)					6.62
	Total	105		-0.056 [z]	0.955	0.10 [w]	0.75	
3 ¼ Years: 1 September 2009 - 31 December 2012	*Men*	115	20 (IQR: 17-27)					9.19
	Women	86	20 IQR (18-25)					8.81
	Total	201		0.086 [z]	0.931	0.54 [w]	0.46	

T: Calculated using an unpaired t-test (Alternate hypothesis being that women earn higher returns than men)

F: Calculated using F-test

Z: Calculated using Wilcoxon rank-sum test which is a two tailed test.

W: Calculated using Levene's test which is a robust test for equality of variance for non-normally distributed data.

Conclusions:

10 Years: 1 January 2003 - 31 December 2012- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 January 2003 - 28 April 2006- Women had statistically significant higher returns earned than men, and women had a statistically lower variance in their returns, meaning they were better investors on a risk adjusted basis for this period.

3 ¼ Years: 1 May 2006 - 31 August 2009- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 September 2009 – 31 December 2012- No statistically significant difference in returns earned, or in the variance of the returns earned.

4.3: Between 30 and 40 years of age

4.3.1: Two-sample for median number of trades for the 10 year period

	Number of observations	Maximum	Median and IQR	Standard Deviation	Z	P
Men	126	60	3 (IQR: 2–6)	8.23		
Women	94	60	2 (IQR: 1-5)	9.00		
Total	220				2.27 [z]	0.023

[z] Calculated using Wilcoxon rank-sum test which is a two-tailed test. An unpaired z-test with one tail will be performed as the numbers of data points within the two samples being compared are different and we expect the mean to move in only one direction

Conclusion: Men have a statistically significant higher number of trades than women for this period.

4.3.2: Two sample for median return and variance in return

		Number of observations	Median and IQR	Z	P	W	P	Standard deviation
10 Years: 1 January 2003 - 31 December 2012	*Men*	162	19 (IQR:14- 25)					9.06
	Women	125	19 (IQR: 12-25)					10.16
	Total	287		0.104 [z]	0.917	2.69 [w]	0.10	
3 ¼ Years: 1 January 2003 - 28 April 2006	*Men*	49	39 (IQR: 11-49)					22.00
	Women	25	44 (IQR: 22-49)					19.74
	Total	74		-1.094 [z]	0.274	1.46 [w]	0.23	
3 ¼ Years: 1 May 2006 - 31 August 2009	*Men*	92	2 (IQR: 0-5)					5.96
	Women	43	1 (IQR: 0-4)					10.28
	Total	135		1.339 [z]	0.180	0.66 [w]	0.42	
3 ¼ Years: 1 September 2009 - 31 December 2012	*Men*	161	21 (IQR: 18-25)					9.28
	Women	125	21 IQR (17-25)					9.42
	Total	286		-0.349 [z]	0.727	0.87 [w]	0.35	

Z: Calculated using Wilcoxon rank-sum test which is a two tailed test.

W: Calculated using Levene's test which is a robust test for equality of variance for non-normally distributed data.

Conclusions:

10 Years: 1 January 2003 - 31 December 2012- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 January 2003 - 28 April 2006- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 May 2006 - 31 August 2009- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 September 2009 – 31 December 2012- No statistically significant difference in returns earned, or in the variance of the returns earned.

4.4: Between 40 and 50 years of age

4.4.1: Two-sample for median number of trades for the 10 year period

	Number of observations	Maximum	Median and IQR	Standard Deviation	Z	P
Men	114	116	2 (IQR: 1–6)	13.68		
Women	103	174	2 (IQR: 1-8)	20.09		
Total	217				0.25 [z]	0.804

[z] Calculated using Wilcoxon rank-sum test which is a two-tailed test. An unpaired z-test with one tail will be performed as the numbers of data points within the two samples being compared are different and we expect the mean to move in only one direction

Conclusion: There is no statistically significant difference in trade frequency of men and women.

4.4.2: Two sample for median return and variance in return

		Number of observations	Median and IQR	Z	P	W	P	Standard deviation
10 Years: 1 January 2003 - 31 December 2012	*Men*	152	16 (IQR:12- 24)					10.79
	Women	121	16 (IQR: 11-23)					9.69
	Total	273		0.706 [z]	0.480	1.04 [w]	0.31	
3 ¼ Years: 1 January 2003 - 28 April 2006	*Men*	38	40.5 (IQR: 31-48)					19.79
	Women	37	32 (IQR: 14-42)					18.04
	Total	75		1.956 [z]	0.050	0.02 [w]	0.89	
3 ¼ Years: 1 May 2006 - 31 August 2009	*Men*	66	2 (IQR: 0-5)					7.35
	Women	65	2 (IQR: 0-4)					3.46
	Total	131		0.928 [z]	0.353	3.24 [w]	0.07	
3 ¼ Years: 1 September 2009 - 31 December 2012	*Men*	150	20 (IQR: 15-24)					11.66
	Women	118	20 IQR (15-23)					8.47
	Total	268		0.986 [z]	0.324	1.65 [w]	0.20	

Z: Calculated using Wilcoxon rank-sum test which is a two tailed test.

W: Calculated using Levene's test which is a robust test for equality of variance for non-normally distributed data.

Conclusions:

10 Years: 1 January 2003 - 31 December 2012- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 January 2003 - 28 April 2006- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 May 2006 - 31 August 2009- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 September 2009 – 31 December 2012- No statistically significant difference in returns earned, or in the variance of the returns earned.

4.5: Between 50 and 60 years of age

4.5.1: Two-sample for median number of trades for the 10 year period

	Number of observations	Maximum	Median and IQR	Standard Deviation	Z	P
Men	153	62	2 (IQR: 1–5)	8.02		
Women	150	109	3 (IQR: 1-6)	13.07		
Total	303				-0.74 [z]	0.459

[z] Calculated using Wilcoxon rank-sum test which is a two-tailed test. An unpaired z-test with one tail will be performed as the numbers of data points within the two samples being compared are different and we expect the mean to move in only one direction

Conclusion: There is no statistically significant difference in trade frequency of men and women.

4.5.2: Two sample for median return and variance in return

		Number of observations	Median and IQR	Z	P	W	P	Standard deviation
10 Years: 1 January 2003 - 31 December 2012	*Men*	204	18 (IQR:12- 25)					9.08
	Women	185	18 (IQR: 12-24)					8.77
	Total	389		0.376 [z]	0.706	0.07 [w]	0.79	
3 ¼ Years: 1 January 2003 - 28 April 2006	*Men*	46	34.5 (IQR: 19-48)					20.03
	Women	36	36 (IQR: 11.5-47.5)					20.57
	Total	82		0.056 [z]	0.955	0.20 [w]	0.65	
3 ¼ Years: 1 May 2006 - 31 August 2009	*Men*	85	2 (IQR: 0-4)					7.57
	Women	84	2 (IQR: 0-4)					5.09
	Total	169		0.379 [z]	0.704	1.23 [w]	0.27	
3 ¼ Years: 1 September 2009 - 31 December 2012	*Men*	203	20 (IQR: 17-25)					8.16
	Women	185	20 IQR (16-24)					7.56
	Total	388		0.991 [z]	0.321	0.37 [w]	0.54	

Z: Calculated using Wilcoxon rank-sum test which is a two tailed test.

W: Calculated using Levene's test which is a robust test for equality of variance for non-normally distributed data.

Conclusions:

10 Years: 1 January 2003 - 31 December 2012- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 January 2003 - 28 April 2006- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 May 2006 - 31 August 2009- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 September 2009 – 31 December 2012- No statistically significant difference in returns earned, or in the variance of the returns earned.

4.6: Between 60 and 70 years of age

4.6.1: Two-sample for median number of trades for the 10 year period

	Number of observations	Maximum	Median and IQR	Standard Deviation	Z	P
Men	219	52	2 (IQR: 1–6)	7.90		
Women	173	63	2 (IQR: 1-5)	6.26		
Total	392				1.01 [z]	0.313

[z] Calculated using Wilcoxon rank-sum test which is a two-tailed test. An unpaired z-test with one tail will be performed as the numbers of data points within the two samples being compared are different and we expect the mean to move in only one direction

Conclusion: There is no statistically significant difference in trade frequency of men and women.

4.6.2: Two sample for median return and variance in return

		Number of observations	Median and IQR	Z	P	W	P	Standard deviation
10 Years: 1 January 2003 - 31 December 2012	*Men*	258	16 (IQR:12- 23)					8.99
	Women	193	16 (IQR: 10-24)					9.21
	Total	451		0.469 [z]	0.638	1.08 [w]	0.30	
3 ¼ Years: 1 January 2003 - 28 April 2006	*Men*	50	30 (IQR: 10-46)					19.59
	Women	32	32.5 (IQR: 16-42.5)					16.64
	Total	82		0.057 [z]	0.954	1.66 [w]	0.20	
3 ¼ Years: 1 May 2006 - 31 August 2009	*Men*	117	3 (IQR: 0-5)					4.16
	Women	75	2 (IQR: 0-4)					7.40
	Total	192		0.625 [z]	0.532	1.31 [w]	0.25	
3 ¼ Years: 1 September 2009 - 31 December 2012	*Men*	254	19 (IQR: 15-23)					8.28
	Women	190	19 IQR (14-24)					8.41
	Total	444		0.084 [z]	0.933	0.25 [w]	0.62	

Z: Calculated using Wilcoxon rank-sum test which is a two tailed test.

W: Calculated using Levene's test which is a robust test for equality of variance for non-normally distributed data.

Conclusions:

10 Years: 1 January 2003 - 31 December 2012- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 January 2003 - 28 April 2006- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 May 2006 - 31 August 2009- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 September 2009 – 31 December 2012- No statistically significant difference in returns earned, or in the variance of the returns earned.

4.7: Over 70 years of age

4.7.1: Two-sample for median number of trades for the 10 year period

	Number of observations	Maximum	Median and IQR	Standard Deviation	Z	P
Men	139	53	3 (IQR: 1–6)	8.42		
Women	105	77	3 (IQR: 1-5)	8.09		
Total	244				0.47 [z]	0.638

[z] Calculated using Wilcoxon rank-sum test which is a two-tailed test. An unpaired z-test with one tail will be performed as the numbers of data points within the two samples being compared are different and we expect the mean to move in only one direction

Conclusion: There is no statistically significant difference in trade frequency of men and women.

4.7.2: Two sample for median return and variance in return

		Number of observations	Median and IQR	Z	P	W	P	Standard deviation
10 Years: 1 January 2003 - 31 December 2012	*Men*	164	15 (IQR:11- 23.4)					8.77
	Women	117	18 (IQR: 11-24)					7.86
	Total	281		-1.351 [z]	0.176	0.04 [w]	0.84	
3 ¼ Years: 1 January 2003 - 28 April 2006	*Men*	21	35.86					17.51
	Women	12	40					6.92
	Total	33		-0.7811 [t]	0.440	6.41 [†]	0.003	
3 ¼ Years: 1 May 2006 - 31 August 2009	*Men*	55	4 (IQR: 1-5)					3.59
	Women	32	3 (IQR: 2-4)					7.04
	Total	87		0.671 [z]	0.502	0.22 [w]	0.64	
3 ¼ Years: 1 September 2009 - 31 December 2012	*Men*	161	17 (IQR: 14-23)					7.72
	Women	115	19 IQR (15-24)					7.07
	Total	276		-1.396 [z]	0.162	0.23 [w]	0.63	

T: Calculated using an unpaired t-test (Alternate hypothesis being that women earn higher returns than men)

F: Calculated using F-test

Z: Calculated using Wilcoxon rank-sum test which is a two tailed test.

W: Calculated using Levene's test which is a robust test for equality of variance for non-normally distributed data.

Conclusions:

10 Years: 1 January 2003 - 31 December 2012- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 January 2003 - 28 April 2006- No statistically significant difference in returns earned, but women have a statistically significant lower variance in their returns, meaning they are better investors on a risk adjusted basis for this period.

3 ¼ Years: 1 May 2006 - 31 August 2009- No statistically significant difference in returns earned, or in the variance of the returns earned.

3 ¼ Years: 1 September 2009 – 31 December 2012- No statistically significant difference in returns earned, or in the variance of the returns earned.

Appendix 5: Portfolio risk

5.1: Percentage allocations of portfolios between equity and balanced funds

	Men: Equity	*Women: Equity*	*Men: Balanced*	*Women: Balanced*
10 Years: 1 January 2003 - 31 December 2012	47%	42%	28%	29%
3 ¼ Years: 1 January 2003 - 28 April 2006	57%	57%	40%	42%
3 ¼ Years: 1 May 2006 - 31 August 2009	51%	47%	35%	41%
3 ¼ Years: 1 September 2009 - 31 December 2012	47%	43%	27%	29%

5.2: Percentage allocations of portfolios between equity and balanced funds (Age Groups)

Age Groupings		0-19	20-29	30-39	40-49	50-59	60-69	70+
10 Years: 1 January 2003 - 31 December 2012	*Men: Equity*	61%	63%	60%	55%	45%	32%	30%
	Women: Equity	63%	57%	53%	47%	39%	26%	30%
	Men: Balanced	17%	18%	17%	22%	22%	39%	44%
	Women: Balanced	14%	20%	22%	25%	31%	42%	34%
3 ¼ Years: 1 January 2003 - 28 April 2006	*Men: Equity*	80%	72%	69%	62%	57%	38%	52%
	Women: Equity	77%	77%	77%	64%	40%	35%	54%
	Men: Balanced	20%	28%	28%	31%	40%	56%	46%
	Women: Balanced	20%	23%	22%	36%	54%	54%	46%
3 ¼ Years: 1 May 2006 - 31 August 2009	*Men: Equity*	78%	70%	66%	57%	52%	30%	31%
	Women: Equity	79%	61%	67%	48%	43%	22%	43%
	Men: Balanced	17%	27%	26%	25%	36%	50%	55%
	Women: Balanced	18%	30%	26%	39%	44%	57%	51%
3 ¼ Years: 1 September 2009 - 31 December 2012	*Men: Equity*	61%	63%	60%	55%	45%	32%	31%
	Women: Equity	63%	57%	53%	48%	39%	26%	30%
	Men: Balanced	17%	18%	17%	22%	22%	40%	44%
	Women: Balanced	14%	20%	22%	26%	31%	42%	35%

Appendix 6: Summarisation from Willows (2012) literature review

Out of all the behavioural biases that this literary review researched, it was found that overconfidence[2], self-efficacy[3], self-attribution[4] and riskiness[5] to be those that displayed the strongest difference between men and women. Furthermore, the literature reviewed showed that the time it took to make a decision (Powell and Ansic, 1997), the use of resources (Hira and Loibl, 2008; Loibl and Hira, 2006, 2011), the time spent in the market (Powell and Ansic, 1997), the inclination to sell (Barber and Odean, 2001; Feng and Seasholes, 2005, 2008) as well as the frequency of trading[6] to also present some particular gender differentials.

6.1: Overconfidence

A human being, being egoistic, will strongly believe that their chosen actions are essential in the further advancement of their goal (Friedrichs and Opp, 2002), and tend to overestimate his or her own skills and chances of success (Cheng, 2007; Rammstedt and Rammsayer, 2002; Ricciardi and Simon, 2000).

Evidence of overconfidence was found in a study by Fischhoff, Slovic and Lichtenstein (1977) whereby a group of people were asked to assign a percentage to whether they thought they got an answer right or wrong whilst answering general knowledge questions. The results showed extensive consistency of overconfidence. Benos (1998) found that overconfidence came about from an individual overestimating the accuracy of his or her own information. This overestimation could then lead to overly positive self-evaluations, which are often unrealistic (Weinstein, 1980), resulting in overconfidence.

Estes and Hosseini (1988) found that when it came to the realm of investment decisions, confidence was mostly explained by gender. After controlling for age, education, ability, experience and when the expected outcomes of the different

[2] Barber and Odean, 2001; Bengtsson et al., 2005; Bhandari and Deaves, 2006; Estes and Hosseini, 1988; Gysler et al., 2002; Hira and Loibl, 2008; Powell and Ansic, 1997; Subrahmanyam, 2008

[3] Barber and Odean, 2000, 2001; Biais, Hilton, Mazurier, and Pouget, 2005; Busch, 1995a, 1995b; Chen, Greene, and Crick, 1998; Endres et al., 2008; Gysler et al., 2002; Hira and Loibl, 2008; Jones and Tullous, 2002; Lewellen, Lease, and Schlarbaum, 1977; Rammstedt and Rammsayer, 2002

[4] Barber and Odean, 2001; Beyer, 1998; Minter, Gruppen, Napolitano and Gauger, 2005

[5] Bernasek and Shwiff, 2001; Block, 1983; Charness and Gneezy, 2007; Croson and Gneezy, 2009; Eckel and Grossman, 2002, 2008a; Feng and Seasholes, 2008; Hira and Loibl, 2008; Holt and Laury, 2002; Jianakoplos and Bernasek, 1998; Levin, Snyder, and Chapman, 1988; Moore and Eckel, 2003; Olsen and Cox, 2001; Pompian and Longo, 2004; Powell and Ansic, 1997; Schubert et al., 1999; Sunden and Surette, 1998; Yao and Hanna, 2005; Zinkhan and Karande, 1991

[6] Agnew, Balduzzi, and Sunden, 2003; Baker, 2010; Barber and Odean, 2001; Feng and Seasholes, 2005, 2008; Hira and Loibl, 2008; Odean, 1999

investments were held equivalent, women's confidence was found to be lower than that of men.

A decade later, a study performed by Powell and Ansic (1997), in which participants earned remuneration dependant on a contingent outcome, was followed by a survey in order to assess the participants' responses. The results showed that women felt less confident at the beginning of the study and were more disposed to attribute any good performance to luck. This was found regardless of their prior experience or education. Irrespective of the consideration the participants earned from the study, no difference was found between their perceptions of their performance.

In an attempt to identify significant personal and environmental factors that influence investment behaviour, based on gender, the following results were found by Hira and Loibl (2008):

- Men felt more confident (70% of men vs. 50% of women) or knowledgeable (70% of men vs. 50% of women) regarding investments and indicated that they regularly review their performance against relevant benchmarks (66% of men vs. 49% of women).

- Men were found to be more confident in their investing abilities (70% of men vs. 62% of women). Women's confidence equals that of men's when feedback is immediate and clear. The stock market, however, is an area which is very ambiguous and uncertain and this influences a women's opinion of herself in the sense that her confidence in investment decisions is lower.

- Men were more likely to make investment changes when they found that their investment did not deliver the returns that they were expecting. This behaviour supports Barber and Odean's (2001) study that men hold unrealistic beliefs about how high their returns will be, due to their inherent overconfidence and are more impulsive and willing to act on too little information.

6.2: Self-efficacy and self-attribution bias

Self-efficacy relates to an individual's belief in his or her own competence (Busch, 1995a, 1995b). Self-attribution bias is a phenomenon whereby humans tend to attribute any successful outcomes to skill and any unsuccessful outcomes to bad luck (Hirshleifer and Ying Luo, 2001).

Men's overconfidence has been suggested in self-estimated intelligence (Furnham, 2001). Men tend to constantly estimate their actual own intelligence to be higher than that of women, even though actual results do not support this presumption. This result was supported by a study performed by Rammstedt and Rammsayer (2002). Conventional intelligence i.e. IQ did not differ between men and women and it was found that men actually outperformed women only in the field of mathematics (Endres et al., 2008).

Using a complex financial decision task, Gysler et al. (2002) found that men initially perceived that their knowledge of a task was higher than women did, regardless of whether they had acquired the necessary knowledge to perform the task. If was further found that as men acquired the relevant knowledge, they become less confident in their own abilities and more risk-averse.

While both men and women expect that they will outperform the market with their portfolios, men expect that they will outperform to a greater extent (Barber and Odean, 2001). Men have been found to make more frequent transactions, spend more time and money on security analysis, rely less on brokers, anticipate higher returns and believe that returns are more predictable than women do (Hira and Loibl, 2008; Lewellen et al., 1977).

Psychology literature has also shown that gender differentials exist in individual perception of abilities. Women have been found to underestimate their abilities more than men, and this difference is more pronounced in tasks which are perceived to be more male-specific. Investing is an example of an environment which is more male-specific as it has historically been dominated by males (Barber and Odean, 2001). It would follow from this that a women's perception of herself would be even lower in a task such as investing because when women perform a task well, Minter et al.

(2005) found that they attributed it to good luck, whilst men attributed it to their skill. However, when women performed a task poorly, they attributed it to their lack of skill, whilst men attributed it to bad luck.

Further arguments have arisen that gender effects in decision making are contingent and dependent on each individual's sensitivity to his or her self-efficacy. Empirical studies have found that self-efficacy is positively associated with risk taking and that individuals with a higher belief in their own competence will steer towards taking more risks than those with a lower perceived capability (Wiley, Whytel, Saks, and Hook, 1997; He et al., 2008).

The literature appears to show consistently that gender differentials exist in the risk preference of men and women (Powell and Ansic, 1997) and that men have been found to buy riskier stock than women (Bernasek and Shwiff, 2001; Feng and Seasholes, 2008; Hira and Loibl, 2008). Differences in risk tolerances are noted amongst married and single men and women with single males displaying the highest risk tolerance, followed by married males, then unmarried females and lastly married females (Yao and Hanna, 2005). Whilst both biological/evolutionary and social/cultural theories have been found to be suggestions of the phenomenon (Olsen and Cox, 2001), the risk aversion of women has been noted across cultures (Zinkhan and Karande, 1991), regardless of differential framing (Eckel and Grossman, 2002; Powell and Ansic, 1997) and women have further been found to be perceived by both men and women as the more risk-averse gender (Eckel and Grossman, 2008a).

6.3: Over-trading

Agnew et al. (2003) investigated the trading behaviour of 401(k) investors and found that men invested more in equities and traded more actively than women. Men traded 56% more than women, while the average number of annual trades is 0.28 for men and 0.18 for women. Marital status was also found to be statistically significant with married investors trading more than single investors (0.28 vs. 0.21 times a year). Older participants, in comparison to their younger counterparts, were found to trade more frequently. Individuals below 35 years of age trade, on average, 0.17 times per year whilst those individuals in the 55-64 years age group trade 0.60 times per year. An exception was noted in the 65 years and older age group, who only

traded 0.03 times per year. As an individual approaches retirement their financial wealth should have grown over time and the need to reallocate to safer and lower-risk funds might explain the increased trading activity, while, once retired i.e. over 65 years old, they should merely be withdrawing an annuity from their investment. These models of behaviour appear to be quite rational (Agnew et al., 2003).

Odean (1999) examined 10,000 discount brokerage accounts from January 1987 till December 1993 and found that, on average, investors trade 1.44 times per year, significantly higher than the results reported by Agnew et al. (2003). This could be attributable to the fact that the range of choices within a discount brokerage are significantly higher than in a 401(k) plan. Two years later, Barber and Odean (2001) found women to hold slightly smaller common stock portfolios than men ($18,371 vs. $21,975), and that women turned their portfolios only 0.53 times annually in comparison to men who turned theirs 0.77 times annually.

Men were found to be more actively engaged investors than women in a study by Hira and Loibl (2008), with 58% of men (as opposed to 51% of women) indicating that they altered the amounts they had invested in the previous year, and 61% of men (as opposed to 44% of women) indicating that they had altered their asset allocations over the preceding year. While both men and women were involved in money management tasks, this was found to be more predominant amongst women (60% as opposed to 42% men), with more men being in charge of investing-related activities

Feng and Seasholes (2005) found that men traded more than women but once certain control variables were put in place, gender became less apparent in an individual's propensity to trade. Three years later, Feng and Seasholes (2008) performed another study to determine who would sell a stock first between a man and woman (if they held the same stock). Feng and Seasholes (2008) found that men were 20.73% more likely to sell. This result is significant but lower than the result provided by Barber and Odean (2001) who found that men traded 45% more than women, upon analysing account data from a large discount brokerage house from February 1991 through to January 1997. Barber and Odean (2001) predicted that overconfident traders would trade more frequently than they should and

concluded that owing to men being more overconfident than women, men would trade more than women.

Odean (1998) concluded that overconfident traders will believe in a security more than they should and subsequently trade more than could be expected of the theoretical 'rational' trader. The result of this is that traders reduce their expected utility. One year later Odean (1999) again reported that the worst performers are those that trade the most. Barber and Odean (2000) investigated households with accounts at a large discount brokerage house from 1991 to 1996 and found that those investors that traded the most earned an annual return of 11.4%, which was below the market return of 17.9% and concluded that individual investors pay a penalty when trading actively, Another year later, Barber and Odean (2001) found that both men and women reduced their returns through trading, but that men did so by 0.94 percentage points more than women per year (as their average turnover rate for common stocks was 1.5 times that of women). These differences were more pronounced between single men and single women, as single men were found to trade 67% more than single women, which in turn, reduced the returns of single men by 1.44 percentage points per year relative to single women.

6.4: The effect of gender differentials on investment results

The study performed by Powell and Ansic (1997) awarded financial compensation to participants based on their state of wealth at the end of the study. Although the difference was not significant, the results still showed that the mean women's consideration at the end of the study was greater than that of men.

Feng and Seasholes (2008) found that the stock men purchased performed worse by 1.33 basis points per day than the stock women purchased. However, the stock that men sold dropped in value by 1.21 basis points more than the stock women sold. Statistically, the overall performance between men and women showed no difference.

Barber, Lee, Liu and Odean (2009) examined the transactions and underlying order dates from traders in the Taiwanese stock market and found that the stock that individuals sold tended to outperform those that they bought. Barber et al. (2009)

gave two reasons as to why uninformed investors were trading speculatively: overconfidence and entertainment. This conclusion is supported in an earlier study whereby Barber and Odean (2001) concluded that the difference in performance between men and women was as a result of confidence and risk aversion by overconfident men and women. Barber and Odean (2001) challenged the theory that the differences could have resulted from risk aversion alone.

6.5: Conclusion

The fact that behavioural biases exist is conclusive in the literature reviewed for this particular study. The literature appears to show consistently that men are more overconfident than women, and that overconfidence leads to over-trading. There are conflicting views, however, on whether over-trading is as a result of overconfidence alone, or as a result of men being more prone to take risks or whether both points of view are relevant. Most existing research concludes that over-trading lowers returns, but there is insufficient consistent evidence to support this statement.