

**TRADING IN CHAOS: ANALYSIS OF ACTIVE  
MANAGEMENT IN A FRACTAL MARKET**

by

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## **DECLARATION**

I, Prince Kwasi Sarpong, declare that:

- i. The research reported in this dissertation, except where otherwise indicated, is my original research.
- ii. This dissertation has not been submitted for any degree or examination at any other university.
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Student's signature.....

# **DEDICATION**

This dissertation is dedicated to my family in appreciation of their support and patience.

## **ACKNOWLEDGEMENTS**

I thank God for His protection and guidance throughout the period of my study. My sincere gratitude goes to Professor Mabutho Sibanda and Professor Merle Holden for their support and direction.

## ABSTRACT

Many Nobel Laureates and thousands of academic papers have espoused the concept that risk is compensated by return. However, the low volatility anomaly - the phenomenon where low-risk stocks display markedly higher returns than the market portfolio on a risk-adjusted basis and vice versa - contradicts this basic finance principle of risk-return trade-off and is possibly one of the greatest anomalies in finance. Among the explanations for this anomaly are, the behavioural bias of overconfidence, agency problems and the type of manager compensation. This study investigates and confirms the low volatility anomaly on the Johannesburg Stock Exchange (JSE) using the risk-adjusted return measure of the Sharpe ratio. According to the Efficient Market Hypothesis, this is not expected to happen and consequently offers no explanation for this phenomenon. This study applies the Fractal Market Hypothesis (FMH) formalised within the framework of Chaos Theory, to explain the existence of the low volatility anomaly on the JSE.

Building upon the Fractal Market Hypothesis to provide evidence on the behaviour of returns time series of selected indices of the JSE, the BDS test is applied to test for non-random chaotic dynamics and further applies the rescaled range analysis to ascertain mean reversion, persistence or randomness on the JSE. The BDS test confirms that all the indices considered in this study are not independent and identically distributed. Applying the re-scaled range analysis, the FTSE/JSE Top 40 and the FTSE/JSE All Share Index appear relatively efficient and riskier than the FTSE/JSE Small Cap Index, which exhibits significant persistence and appears to be less risky and less efficient contrary to the popular assertion that small cap indices are riskier than large cap indices.

The study further analyses the three fundamentals of the FMH namely, the impact of information, the role of liquidity and time horizon on the top 40 and small cap indices. Information is not uniformly distributed among the two indices as the FTSE/JSE Top 40 index receives more publications from sources such as newspapers, online publications and journals as well as JSE issued news and historical company news. The FTSE/JSE Top 40 also receives more analyst coverage than the FTSE/JSE Small Cap Index. Using the absolute and normalised volume of trade as a proxy for liquidity, the FTSE/JSE Top 40 index exhibits a relatively higher level of liquidity than the FTSE/JSE Small Cap index. The study finds that domestic equity fund managers in South Africa hold in their portfolios, a disproportionately greater percentage

of FTSE/JSE Top 40 companies relative to other companies on the JSE and concludes that these managers contribute to the low volatility anomaly on the JSE. The study further concludes that in line with the FMH, lack of information and the illiquidity of the FTSE/JSE Small Cap attracts long-term investors who become the dominant class of investors on the index and are compensated for taking on the risk of illiquidity in the form of illiquidity premium and low volatility. The highly liquid FTSE/JSE Top 40, which has relatively high availability of information on the other hand attracts different classes of investors with differing horizons who take opposite sides of each trade as different classes of investors interpret the same set of information differently. The high liquidity and information leads to high volatility as investors continually adjust their holdings with the emergence of new information. The high volatility and subsequent underperformance of the FTSE/JSE Top 40 therefore is a cost of efficiency and liquidity (liquidity discount).

Studies on the FMH are generally focused on market crashes. This study provides a novel approach by using the FMH to explain the low-volatility anomaly. This synthesis of the FMH and the low volatility anomaly provides an alternative technique of evaluating risk and also provides insights into the efficiency of financial markets and contributes to the literature on the FMH as well as the low volatility anomaly.

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# **CHAPTER ONE**

## **INTRODUCTION AND OVERVIEW**

This chapter presents an introduction and overview of the thesis and discusses the aim, objectives, scope and the structure of the thesis.

### **1.1 Introduction**

The 2007-2009 Global Financial Crisis has rekindled debates on the fundamental finance theories and their underlying assumptions particularly the Efficient Market Hypothesis and the assumption of rational investors. Classical financial theories however, continue to remain relevant even after the crisis. Eugene Fama popularly referred to as the father of modern finance won the 2013 Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel Prize generally called the Nobel Prize in Economics together with Robert J Shiller and Lars Peter Hanson.

Starting with the modest concepts that at the core of all investment decisions is risk, that diversification is key to investing successfully, and that it is difficult to beat the market, classical finance theories and models remain the intellectual core of a myriad of powerful innovations in investment and in risk management (Bernstein 2007;2011). Even though the emergence of behavioral finance has challenged a significant number of underlying assumptions of classical finance, Daniel Kahneman, winner of the 2002 Nobel Prize in Economics, and highly regarded for his works in psychology of judgement and behavioral finance, observed that behavioral models could be very essential to institutional design, however it still remains unclear whether ultimately, they are going to have remarkable explanatory power for asset prices. (Bernstein, 2007).

Notable among the underlying theories of classical finance is the Efficient Market Hypothesis (EMH). The EMH argues that security prices fully incorporate all available information and therefore always trade at their fair value, making it impossible to purchase undervalued securities or sell them at inflated prices. According to the EMH, it is thus highly unlikely to outperform the market through stock picking or market timing. The only way to get higher returns is to buy riskier investments (Fama, 1970, Fama and MacBeth, 1973, Malkiel, 1991, Malkiel, 2003, Yalcin, 2016). Contrary to the assertions of the EMH, the active management



sector of the asset management industry is centred on the belief that asset managers can outperform the market because the market does not always incorporate all relevant information into asset prices. The active management industry therefore make use of among other strategies, fundamental analysis and analysts' recommendations and opinions as well as publications by both analysts and academics in making portfolio decisions. The active management industry remains a significant player in the asset management industry and the activities of active managers in turn significantly affect the behaviour of financial markets.

Studies on the low volatility anomaly have contracted the notion that it is possible to obtain higher returns without taking on higher risks. The low volatility anomaly is defined as the phenomenon where low-risk stocks display markedly higher returns than the market portfolio on a risk-adjusted basis, while high-risk stocks underperform significantly on a risk-adjusted basis (Blitz and Van Vliet, 2007, Baker et al., 2011, Blitz et al., 2013, Oladele and Bradfield, 2016). This anomaly was discovered from two different sources - an academic source and an applied investment source (Marmer, 2015). From the academic perspective, the low volatility anomaly is attributed to the empirical testing of the capital asset pricing model (CAPM) by pioneering academics who found that "high-beta securities had significantly negative intercepts and low-beta securities had significantly positive intercepts, contrary to the predictions of the traditional form of the model." (Jensen, Black and Scholes, 1972: 44). The low volatility anomaly, from an applied investment perspective on the other hand can be attributed to Haugen and Heins (1972) who discovered that monthly returns of stocks with lower variances over the long run, outperform stock portfolios with higher variance. Even with evidence of continuing critical empirical tests of the CAPM and the early claims of Haugen and other scholars, it took almost two decades before academic interest was reawakened on the concept of low volatility investing (Marmer, 2015).

In 1991, Edgar Peters formalized FMH within the context of chaos theory to explain investors' heterogeneity regarding their investment horizons (Peters, 1994). The concept of fractals emanates from the mathematics of fractal geometry and describes how a fragmented geometric shape can be broken down into smaller parts that still replicate the whole (Peters, 1994). FMH describes how financial markets behave similarly, with patterns repeated over different time periods, be it days, weeks, months or even business cycles (Peters, 1994; Velasquez, 2009). The FMH posits that history repeats itself therefore, previous events that happened in financial

markets in the past will occur again in future (Peters, 1994). Subsequent to the financial crisis of 2008, the FMH has gained traction as it has become evident that financial crises keep recurring more often than predicted by traditional finance theories. The FMH considers the role of liquidity, investor horizons and the effect of information through a complete business cycle (Velasquéz, 2009). Whereas the EMH provides no clarification for the low risk anomaly, this study applies the FMH to offer an explanation to the low volatility anomaly on the JSE.

## **1.2 Context of the Study**

In a study on the Dow Jones Industrial average, Lento (2013) found that the fractal nature of time-series is related to the profitability of different types of trading rules and therefore investors who understand the fractal nature of time-series should alter their investment strategies between contrarian and trend trading rules when the Hurst exponent is less than 0.5 and greater than 0.5 respectively. Where we are is a function of where we have been (Peters, 1991). The past therefore influences the present. For example, even though it is widely believed that the toss of a coin is fair and unbiased, with an equal probability of the coin landing heads or tail, Diaconis et al. (2007) provide empirical evidence to prove that in tossing a coin in the hand, the outcome is biased towards turning up the same way it started – with a probability of 51%.

Several studies have shown that financial markets possess feedback systems and fractals and suggest that the assumptions of classical finance do not properly explain behaviours and characteristics of financial markets (Peters, 1991, Mandelbrot, 1997, Velasquéz, 2009b, Buchanan, 2013, Anderson and Noss, 2013). Time series of capital market prices seem to exhibit fractal properties. The implication is that, under enlargement, their patterns turn out to be increasingly complex, and appears to repeat itself, showing a pattern that is similar qualitatively to that of the overall structure (Anderson and Noss, 2013). Peters (1991) defines a fractal as an object in which the parts are in some way related to the whole.

The behaviours of financial time series however do not occur in a vacuum but are as a result of the trading behaviours of the various market participants ranging from individual traders, professional day traders and professional asset managers. Arguably the asset management industry is the most significant player in capital markets. In South Africa, institutional investors

account for 40% of shareholding with largest shareholders on the JSE being government employees through the Government Employees Pension Fund (GEPF) (Ambrosi, 2014). The total household savings in South Africa, which consists of collective investment portfolios (mutual funds), insurance companies and retirement funds amounted to R 8.1 trillion (\$700 billion) as at December 2014 according to the Association for Savings and Investment South Africa (ASISA) (ASISA, 2015) compared to the JSE's total market capitalization of R 9.9 trillion as at the same period.

The behaviour of the time series of the various indices of the JSE will therefore be heavily influenced by the trading behaviours of the various players in the South African asset management industry.

### **1.3 Statement of the Problem**

Neoclassical economics and classical finance are based inter alia on the assumption of rational individuals, efficient markets and market equilibrium. These assumptions imply that markets correctly reflect prices and quickly adjust to new information making it impossible to profit from trading based on such information. In recent years however, as the financial crises are occurring more frequently than can be explained by traditional finance theories, questions are being asked about these assumptions. The MPT describes how risk-averse investors can put together portfolios that maximize expected return for on a given level of risk, stressing that risk is a fundamental part of higher reward. MPT however, is dogged with the low volatility anomaly, where low risk assets outperform high risk assets on a risk adjusted basis and is arguably one of the greatest anomalies in finance. Behavioural biases, agency problems, management compensation style etc. have been offered as an explanation for the low volatility anomaly.

The FMH has been proposed as an alternative to the Efficient Market Hypothesis, however, studies on the FMH have been overly focused on financial crises while ignoring other market anomalies. To date, there is no existing study on the FMH that attempts to explain financial market anomalies in normal times where there are no crises.

## 1.4 Aim

The aim of this study is to investigate the existence of the low volatility anomaly on the JSE and provide an alternative explanation for the low volatility anomaly on the JSE.

## 1.5 Research Objectives

The objectives of the study are as follows:

- To investigate the existence of the low volatility anomaly on the JSE
- To determine whether the times series of equity prices on the JSE are independently and identically distributed (*iid*).
- To establish the fractal characteristics of the JSE
- To investigate whether the selected indices of JSE exhibit a random walk
- To ascertain the factors that may contribute to the low volatility anomaly on the JSE
- To investigate whether the FMH explains the low volatility anomaly on the JSE

## 1.6 Research Questions

- Does the low volatility anomaly exist on the JSE?
- Are financial time series on the JSE independently and identically distributed (*iid*)?
- Does the JSE exhibit fractal characteristics?
- Do the selected indices of JSE exhibit a random walk?
- What factors contribute to the low volatility anomaly on the JSE?
- Does the FMH explain the low volatility anomaly?

## 1.7 Scope of the Study

The study investigates the low volatility anomaly on the JSE by applying the Sharpe ratio. The study further investigates chaos on the JSE by first applying the BDS test and then the re-scaled range analysis. Brock, Dechert and Scheinkman (1996) developed the BDS test which tests for correlation integral which measures how frequent temporal patterns are repeated in a given time series i.e. to spot non-linear dependence (chaos). One benefit of the BDS test is that it does not require any distributional assumptions on the series to be tested. The study further applies the modified rescaled range (R/S) analysis pioneered by Hurst (1951) reviewed by

Peters (1994) and Howe, Martin and Wood (1997). A Hurst Exponent ( $H$ ) of 0.5 denotes the series under investigation exhibits characteristics in line with the random walk theory. An  $H$  greater than 0.5 denotes persistence while an  $H$  lower than 0.5 denotes anti-persistence. The study applies the re-scaled range analysis to derive the Hurst Exponent for the FTSE/JSE All Share, FTSE/JSE Top 40 and FTSE/JSE Small Cap indices. Once  $H$  is computed, the autocorrelation within the time series ( $CN$ ) is computed as well. The  $CN$  represents the percentage of movements in the time series that can be explained by historical information (Peters, 1994). A  $CN = 0$  signifies randomness in the time series under consideration pointing to a weak-form efficient market where historical information cannot be relied on to outperform the market.

The study further analyses the quarterly portfolio holdings of general equity mutual funds to investigate the proportion of their portfolios dedicated to selected indices. According to Baker and Haugen (2012), two of the reasons for the low-volatility anomaly are the structure of managers' remuneration and agency problems that lead fund managers to include high volatility stocks in their portfolios. This is to confirm whether South African fund managers contribute to the low-volatility anomaly on the JSE.

The study investigates liquidity, availability of information and differing time horizons which are fundamental to the FMH to offer an explanation for the low volatility anomaly on the JSE. Analyses of the number of analysts covering stocks in the FTSE/JSE Top 40 and the FTSE/JSE Small Cap indices are also conducted using data from McGregor BFA. Further, the frequency of publication for companies in the FTSE/JSE Top 40 and the FTSE/JSE Small Cap over the previous one year from 1<sup>st</sup> January 2015 to 31<sup>st</sup> December 2015 also using data from McGregor BFA is conducted. A broad definition of publications is used which according to McGregor BFA, includes news from sources such as newspapers, online publications and journals as well as JSE issued news and historical company news relating to the companies.

Finally, in order to compare the volume of trade between the FTSE/JSE Top 40 and the FTSE/JSE Small Cap, the study normalizes the volume of trade for both indices by dividing the total volume of trade for each index for the year ended 31 December 2002 to 31 December 2014 and divide this by the total free float stocks in the index in line with Ranguelova et al. (2015). The study applies this normalized measure of volume of trade to work out an average monthly number for each index. The normalised volume of trade serves as a proxy for liquidity.

## **1.8 Significance of the Study**

To date, studies on the FMH are concentrated on financial market crashes with no consideration for periods where markets are not in a crisis/panic situation albeit functioning inefficiently. The low volatility anomaly for example, represents one of such circumstances where markets behave contrary to how they are expected to behave according to traditional theories. This study applies the FMH to explain the low volatility anomaly and provides a unique synthesis of the FMH and the low volatility anomaly. It also applies the FMH to explain a phenomenon other than a market crash.

## **1.9 Structure of the Thesis**

The thesis is structured as follows:

- **Chapter One**

Chapter one is an introduction to the topic of this thesis and explains the main concepts as well providing the background to this study. It explores the major concepts relevant to the study from the classical concept of efficient markets to the FMH which has been proposed as alternative to the EMH to explain financial market behaviours and also a discussion of the low volatility anomaly. This chapter presents the rationale for the study and outlines its contributions to the academic literature on the low volatility anomaly and the FMH.

- **Chapter Two**

The chapter is a review of literature on the historical background of classical finance theories and the established body of thoughts in classical finance. It explores the fundamental theories of classical finance developed over the years and how these theories transformed into very influential tenets in finance both in academia and industry. The chapter also discusses various criticisms of classical finance and empirical evidence of the anomalies that point out flaws in the underlying theories of classical finance.

- **Chapter Three**

This chapter discusses an alternative theory on the behaviour of financial markets. Although classical finance theories are based among other assumptions on rationality of market participants, efficient markets, and normal distribution, from the history of financial crises, it

becomes evident that financial market participants cannot be construed to be rational as suggested by classical finance and events that are assumed to be anomalies keep recurring more often than can be explained by classical finance theories. The chapter discusses chaos theory and the FMH which argues that differing investment horizons, liquidity and availability and interpretation of information inter alia determines the behaviour of financial markets.

- **Chapter Four**

Chapter four presents a discussion of financial crises, discussing some theories behind the occurrence of financial crises as well as a history of financial crises beginning with the tulip mania in the Netherlands, through to the Great Recession.

- **Chapter Five**

This chapter begins with an introduction to behavioural finance, discussing its origins and delves into the various behavioural biases that investors are prone to thereby making them behave contrary to what classical financial theories assume. The chapter further discusses arguments against the assumption that all behavioural biases are intuitively detrimental to optimal decision making. The chapter concludes by arguing that the various schools of thought contribute to the development of finance.

- **Chapter Six**

Chapter six presents a general overview of the asset management industry. With increasing calls for a classification of particular segments of the asset management industry as Systemically Important Financial Institutions (SIFIs), a drive to protect the global financial systems by averting the failure of such SIFIs, or, in the event of a failure, curbing the subsequent adverse effects. The asset management industry plays a significant role in the stability or otherwise of financial markets.

- **Chapter Seven**

Chapter seven presents a discussion of the Johannesburg Stock Exchange. The chapter provides a brief history of the JSE, its business model as well as some major developments on the JSE. The chapter further discusses the JSE as an efficient market and reviews literature on the

market efficiency of the JSE. The chapter also provides a brief review of literature on the spill over effects of international markets on the JSE

- **Chapter Eight**

This chapter discusses the data selected for the study and the methodology the study adopts in testing for the existence of the low volatility anomaly on the JSE as well as testing for non-linearity and chaos on the JSE. Once the existence of chaos or otherwise is established on the JSE, the study sets out to investigate the fractal nature of selected indices and how the FMH describes the low volatility anomaly on the JSE by analysing liquidity, flow of information, the portfolio structure of equity fund managers and volatility patterns of the selected indices.

The study applies the Sharpe ratio to measure the risk-adjusted performance of the selected indices of the JSE. This is to determine whether the low volatility anomaly exists on the JSE. The study then applies the BDS test to investigate whether the time series of the JSE are *iid*. To achieve the third objective, the study applies the rescaled range analysis to determine the fractal nature of the JSE. The variance ratio test is the used to test the Random Walk Hypothesis. To investigate the factors that contribute to the low volatility anomaly on the JSE, the study analyses the extent of analysts' coverage, the frequency of publication and the volume of trade of the companies in the selected indices to achieve the fifth objective of the study. Finally, the study reviews the main arguments of the FMH and compares it with the findings of the stated objectives to ascertain whether there is empirical evidence to support the arguments of the FMH.

- **Chapter Nine**

Chapter nine presents the findings of this study on chaos on the JSE over the period of the study. The chapter also presents the findings on the low volatility anomaly on the JSE and a synthesis of the FMH and the low volatility anomaly by applying the underlying assumptions of the FMH to explain the low volatility anomaly.

- **Chapter Ten**

Chapter ten, the final chapter, summarizes the study and draws conclusions based on the findings.



## **1.10 Summary**

This chapter presented an introduction and background to this study. The problem statement, the objectives, scope and significance of the study is also presented. As the Efficient Market Hypothesis fails to explain the frequency of financial market crises and other market anomalies, the Fractal Market Hypothesis has been suggested as an alternative to the Efficient Market Hypothesis. Studies on the FMH however are overly concentrated on financial market crashes while ignoring other market anomalies. This study applies the FMH to explain the low volatility anomaly on the Johannesburg Stock Exchange.

The following chapter discusses classical finance theories and the assumptions underlying these theories. The chapter also provides some historical background to classical finance theories and also discusses criticisms of classical finance theories and assumptions.

# **CHAPTER TWO**

## **CLASSICAL FINANCE**

Classical finance remains the bedrock of modern finance. In this study, we use the term classical finance and neoclassical finance interchangeably to represent rational finance which traces its roots to the rationality assumption of neoclassical economics (Beukes, 2011). Haugen (1999) offers a description of the evolution of finance as a distinct discipline and identifies three schools of thought namely, old, modern and new finance. The old finance school of thought is based on the nature of financial claims and the analysis of financial statements. Modern finance is centred on valuation and asset pricing rooted in rational economic behaviour. Under the paradigm of modern finance, the market is efficient, any inefficiency is short-lived and quickly eliminated through arbitrage. The pillars of classical finance are Miller and Modigliani's arbitrage principles, Markowitz's portfolio principles of Markowitz, Linter, Sharpe and Black's capital asset pricing theory and the Black, Scholes and Merton's option-pricing theory (Statman, 1999).

### **2.1 Introduction**

The aim of the chapter is to review theoretical and empirical literature on classical finance and analyze the various criticisms of classical financial theories relevant to this study. Inter-alia, the chapter discusses major finance theories such as the EMH, the modern portfolio theory (MPT), capital asset pricing model (CAPM), multifactor pricing models and the arbitrage pricing theory.

The chapter further points out the inadequacy of the existing classical finance theories to explain major financial crises that have bedeviled financial markets over the years and delivers the background to the rise of behavioral finance as an alternative approach.

### **2.2 Classical Finance Theories**

Classical financial theories still remain relevant even after the Global Financial Crisis. This is evident in the fact that Eugene Fama, popularly referred to as the father of modern finance, won the 2013 Nobel Prize in Economics together with Robert J Shiller and Lars Peter Hanson.

Starting with the modest notion that risk is at the core of all investment decisions, that diversification is key to successful investing, and that markets are difficult to beat, classical finance theories and models still remain the intellectual core of a myriad of powerful innovations in financial and risk management (Bernstein 2007, Bernstein 2011, Asness 2014).

Even though the emergence of behavioral finance has challenged a significant number of underlying assumptions of classical finance, Daniel Kahneman 2002 Nobel Prize in Economics winner notable for his works in psychology of judgement and behavioral finance observed that behavioral models could be very essential to institutional design, however it still remains unclear whether ultimately, they are going to have remarkable explanatory power for asset pricing. (Bernstein, 2007).

In defense of classical finance, 1997 economics Nobel prize winner, Myron Scholes, argues that much of the blame for the recent financial crisis should be placed on those who pushed finance theories too far in practice and not on theories and models of economists (The Economist, 2009).

Furthermore, 1995 winner of Nobel Prize in Economics, Robert Lucas, in an article in the *Economist* titled “In Defense of the Dismal Science” puts up a rebuttal of the criticism that the financial crisis provides evidence of the failure of economics stating: “One thing we are not going to have, now or ever, is a set of models that forecasts sudden falls in the value of financial assets,... This is nothing new. It has been known for more than 40 years and is one of the main implications of Eugene Fama's efficient-market hypothesis” (Lucas, 2009).

While acknowledging the relevance of classical finance, the head of research and strategy at PGGM, a Dutch pension fund - Jaap van Dam – asserts that there is still a need to have a solid theoretical base, albeit equally important that these teachings are accompanied with the warning: “just a theory.”, while helping students to appreciate the limitations of the dogma (Fabozzi, Focardi and Jonas, 2014). It is therefore probable that classical finance theories will still remain the bedrock of finance both in academia and in the finance industry as majority of both academics and practitioners still admit that these theories continue to be relevant despite the wave of criticism these theories have faced subsequent to the financial crisis.

## 2.3 Historical Background

In earlier periods, economists were not enthusiastic on analyzing markets theoretically, given that earlier ideas concerning financial markets were regarded as based on intuition, that were largely devised by practitioners. Financial markets were regarded more as casinos than proper markets (Beukes, 2011). According to Bernstein (2007), the collection of models, concepts, ideas, and systems expressed in the theoretical configuration of modern finance (what he refers to as Capital Ideas) emerged between 1952 and 1973 and owe almost everything to Alfred Marshall one of the founders of neoclassical economics.

In the beginning of the 1950s, there were two mainstreams that formed the foundations of modern finance. First is Corporate Finance, set forth by Modigliani and Miller (1958). Then the other, centered on portfolio risk and return, commonly called the Modern Portfolio Theory, pioneered by Markowitz (1952), with later contributions from Tobin (1958) and Sharpe (1964) (Saino, Savoia and Famá 2013). The predominant insight that brought it all about is that investors are only interested in portfolio returns and not about the idiosyncrasies of specific assets. The behavior of portfolios replaced the demand curves for singular stocks and modern finance as we now know it was born (Cochrane, 2009).

In 1952, Nobel Laureate Harry Markowitz, a graduate at the University of Chicago, mathematically established that placing one's investments in one security is an excessively risky strategy and that diversification is the closest any investor or asset manager can ever come to getting a free lunch (Bernstein and Boggs, 1997). Prior to this seminal work, serious journals regarded equity investment as too dubious and speculative for sober academic work (Bernstein and Boggs, 1997). Rumours had it that when he wrote his thesis, people in his department said it was nothing (Fama, 2013). In the defense, Milton Friedman suggested: "Harry, I don't see anything wrong with the math here, but I have a problem. This isn't a dissertation in economics, and we can't give you a PhD in economics for a dissertation that's not economics. It's not math, it's not economics, it's not even business administration." (Bernstein, 1993: 102).

Markowitz (1952) rebuffed the idea that investment portfolios should be based solely on the maximum expected return, since espousing this principle may cause two assets that have similar returns being allotted to the portfolio without any analysis of the risk. He further points out that a portfolio having the greatest expected return is not necessarily the portfolio with the least risk. After Markowitz's seminal work, Tobin (1958) went a step further by adding to

Markowitz approach, the concept of money which led to the Two-Fund Separation Theorem. Tobin suggested that investors would diversify their investments between a single portfolio made up of risky assets and a risk-free asset with different risk appetites leading to differing combinations of the risk-free asset and risky assets. Tobin (1958) argued, using Keynesian Theory as a starting point, that investors select positions that fall between total investment in the risk-free asset and the portfolio of risky assets noting that investors prefer liquidity for two main purposes namely: 1) individual inelasticity to the expected interest rate and 2) uncertainty with regards to future interest rates. This implies that investors prefer liquidity because of the unpredictability of market risk or asset price fluctuations which may culminate in loss of wealth.

The portfolio selection process according to Tobin (1958) is an amazingly simple matter, a procedure that begins with Markowitz's efficient frontier<sup>1</sup>. In line with Markowitz, the riskiest portfolio is the one at the top, is not diversified, and includes only one security. However, as one comes down the frontier, the portfolio becomes progressively diversified by holding many securities. Just as Markowitz (1952), Tobin (1958) allowed for a risk-free lending rate in the process although Tobin (1958) took it a step further. One however reaches the end of what one can add to the portfolios on the frontier and therefore, further than that point is a composition of portfolios with an increasing amount of the risk-free asset.

Tobin (1958) established that investors made their decisions through a combination of the portfolio of risky assets located on the efficient frontier with the risk-free asset leading to the Two-Fund Separation Theorem which asserts that two investment choices made by individuals are separate and independent and these choices are made of:

- i. Ascertaining the most efficient risky asset portfolio
- ii. Identifying the proportion of resources to be assigned to the risk-free asset and risky assets

The Two-Fund Separation theorem is Tobin's ultimate contribution which shows that the most efficient portfolio of risky investments is independent of individual preferences relating to risk. The only difference between an investor with a lower risk tolerance and an investor with a

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<sup>1</sup> The efficient frontier is the assortment of efficient portfolios from highest to lowest risk or from highest to lowest expected return

higher risk tolerance is the proportion of risk-free asset in the investor's portfolio (Elton and Gruber, 1997; Dimson and Mussavian, 1999; Bodie, Kane and Marcus, 2014).

The CAPM originated from the economic theory devised from the works of Sharpe (1964), Lintner (1965), Treynor (1962)<sup>2</sup>, and Mossin (1966) and it is possibly the most significant model to emerge in the early 1960s, which solved the strenuous mathematical calculation encumbrance of Markowitz's Modern Portfolio Theory . In 1990, Bill Sharpe won the Nobel Prize in Economics, in recognition of a paper he had published twenty-six years earlier in 1964 and also the primary accomplishment that won him the award. Sharpe's original article which appeared in the *Journal of Finance* with the title, "Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk" (Sharpe, 1964). The model posits that for any security, the expected return should be equal to the expected return of the market in excess of the return on a risk-free security, multiplied by the extent to which the security in question fluctuates in sync with the market (Bernstein, 2011). The measure of the extent to which a security fluctuates in sync with the market is the security's "beta"<sup>3</sup>, which reflects the contribution of the security to the portfolio's overall degree of riskiness (Bernstein, 2011).

CAPM has two key messages if you critically analyze the model. First is the fact that it is imperative to consider a broadly diversified portfolio. This notion gave prominence to the idea of index funds (Bernstein, 2007, Bernstein, 2011). Secondly, one has to bear a higher beta value if one expects a higher return. In an interview with the *CFO Magazine*, William Sharpe argued that the broader version of CAPM encompasses what type of risk one should expect to be rewarded for in the long-term and this will be the risk of performing badly in bad times and therefore if there is any reward for bearing risk, it just about has to be that. It is this, or otherwise the world makes no sense at all because if such risk is not rewarded, then there is no justification to believe that there is the existence of risk premium for equities rather than putting one's money in the bank (Sharpe, 2000). Sharpe therefore posited that in the world of CAPM therefore, beta measures how badly one will do in bad times meaning high beta portfolios or securities will perform exceptionally poorly if the market drops (Sharpe, 2000).

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<sup>2</sup> Unpublished manuscript

<sup>3</sup> Mathematically a security's beta equals the covariance of the security's returns with that of the market divided by the market's returns variance.

Stephen A. Ross (1976) introduced the "arbitrage pricing theory" or APT which tackles some of the limitations of the CAPM. Ross posited that the fundamental thought behind the arbitrage price theory was not his unique concept, rather, this concept was the fundamental principle of all of rational finance theory which is: if the risk-return profiles of two securities are the same, then the price of these two securities must also be the same. If this is not so, then an arbitrage opportunity would exist, which would grant investors opportunities to earn excess profits by buying the low-priced security and disposing it off at the higher price.

The idea behind the APT is that the completely distinctive fluctuations in a security's returns must not carry any prices for risk because such risk can be diversified away by holding properly diversified portfolios. Therefore, expected returns on any security should be linked to the covariance of the security with the common elements or "factors" only (Cochrane, 2009). According to the APT, the expected return of a security is linear function of some theoretical market indices or several macro-economic factors and a factor-specific beta co-efficient represents sensitivity to variations in each factor.

An arbitrage is essentially a risk-free profit. The APT is centered on the law of one price. Arbitrage presupposes that investors seek to take advantage of any excess profit opportunities, and in response, prices adjust therefore when a security deviates from its fundamental value, market participants react in such a way that prices revert to their fundamental values (Ross, 1976). This assumption is also applied in option pricing theory proposed by Merton (1973) and Black and Scholes (1973), who utilized arbitrage in their analyses.

At the University of Chicago, Lawrence Fisher and James Lorie in 1960, started a programme of research on the prices of securities and created the *Center for Research in Security Prices* (CRSP), with a number of PhD students which included Eugene Fama. Eugene Fama was among the pioneers who utilized modern digital computers in conducting empirical finance research, and was the first to use the term 'efficient markets' (Durlauf and Blume, 2008). Eugene Fama developed the EMH through a published Ph.D. thesis in 1965 (Fama, 1965a). In 1970, Fama published an evaluation of the theory and a confirmation of the hypothesis as well as refining the theory and adding the definitions for the three kinds of market efficiency (Fama, 1970). Fama operationalized the EMH, arguing that if markets were working efficiently, then all public (and some private) information relating to any asset would be reflected immediately in its price.

The models and theories reviewed in this section among other models and theories paved the way for the formalization of financial economics as an established sub-discipline of economics which was accomplished through amalgamation of the findings from modern probability theories, financial econometrics and economic equilibrium and paving the way for the creation of associations between the focal ideas of equilibrium in economics and empirical results in finance and in so doing, opening the way for the creation of theoretical interpretations for empirical results (Jovanovic, 2008).

## **2.4 Mean Variance Theory and Capital Asset Pricing Model (CAPM)**

The fundamental principle of the mean-variance portfolio theory is the idea that investors can assess the risk-return trade-off of investment opportunities centered on the variances, expected returns, and correlations of those assets. Harry Markowitz (1952) is credited for this theory and according to Burton (1998:3), “Markowitz came along and there was light”. Prior to Harry Markowitz’s 1952 treatise on portfolio selection, there existed no theory on portfolio construction, the whole process was replete with just folklore and rules of thumb until Markowitz first made risk the cornerstone of portfolio management (Bernstein, 2007).

The mean variance theory forms the foundations of modern portfolio theory (MPT) which is a finance theory which aims at the maximization of expected return of a portfolio for a given level of portfolio risk, or minimize portfolio risk over a given level of portfolio expected return, by selecting varying proportions of a number of assets. Harry Markowitz advanced MPT in a 1952 paper (Markowitz, 1952) and a book in 1959 (Markowitz, 1959). According to Miller (1999), portfolio selection, as envisaged and published by Markowitz (1952), could be construed as the “big bang” of modern finance. Markowitz methodically developed what is now known as the risk-return trade-off in investment decision-making and mathematically deriving portfolios selection rule for the first time. Markowitz (1952) provided solutions to the questions of how to quantify risk, how to minimize risk and maximize returns and how capital should be allocated among different asset classes. This methodology formed the basis for all the subsequent theories regarding how risk can be quantified, how financial markets operate and how capital should be allocated by corporations (Bernstein, 1993).



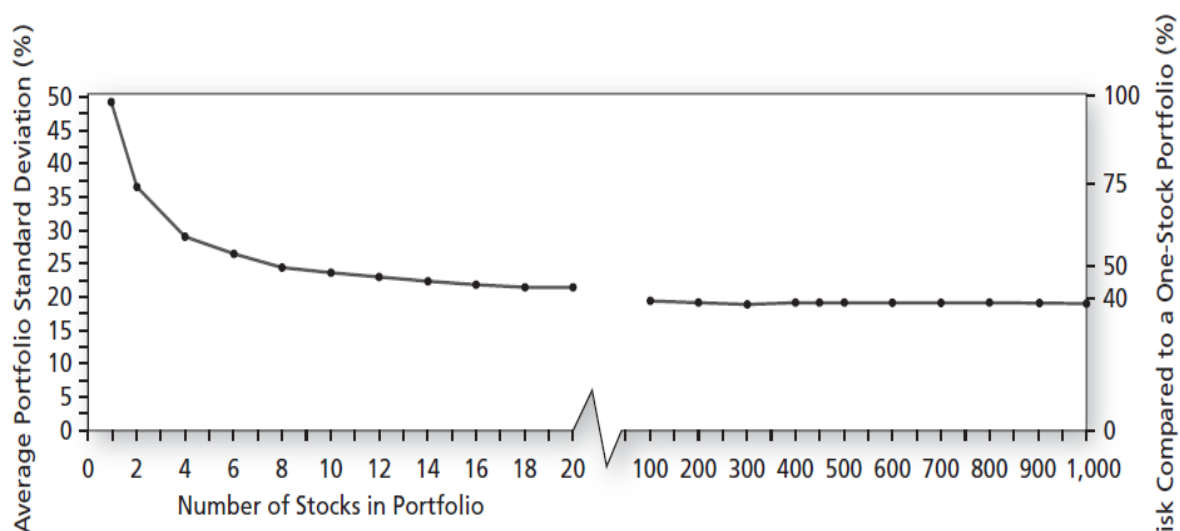
- **Description of the MPT**

Underlying Assumptions (Elton and Gruber, 1997, Francis and Kim, 2013):

- All investors are risk averse (investors will choose less risk over more risk for any given level of expected return). Again, for a given level of risk, investors prefer more return to less return. It is however important to note that to some extent, all investors are risk averse even though investors may differ in their level of risk aversion.
- No taxes or transactions costs.
- Expected returns for all assets are known.
- For all assets, the variances and covariances of returns are known.
- To determine optimal portfolios, investors need to know only the variances, covariances and expected returns. Skewness, kurtosis, and all other elements of a distribution can be ignored by investors.

The fundamental takeaway of the MPT is that investors should not focus on individual assets' risk and return in a portfolio but rather, each asset should be selected based on its variations in returns relative to variations in the returns of all the other securities in the portfolio (Francis and Kim, 2013). MPT again describes how combining a number of risky securities can still lead to a low risk for the portfolio, as long as their price variations of the assets in the portfolio are not perfectly positively correlated.

**Figure 2.1: Effects of Portfolio Diversification**



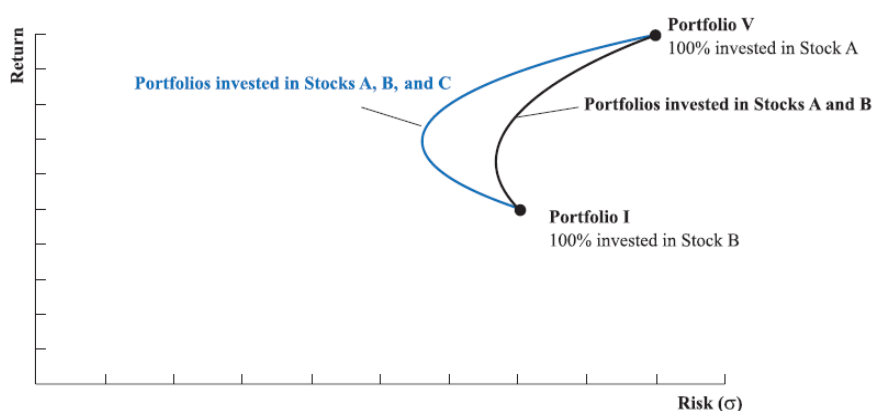
Source: Adopted from Meir Statman (1987), cited in Bodie, Kane and Marcus (2014: 207)

Figure 2.1 depicts the effect of portfolio diversification. The figure shows that portfolio risk actually reduces with diversification although the power of diversification is limited by the systematic risk.

The process of portfolio construction can be generalized to the situation of many risky assets and a risk-free security. This process can be broken down into three parts (Bodie et al., 2014). First, there is the identification of the combination of risk and return available from the group of risky assets. Second in the process is identifying the portfolio weights that make up the steepest capital asset line (CAL)<sup>4</sup> representing the optimal portfolio of risky assets. The final process involves choosing a complete portfolio through a combination of the optimal portfolio with the risk-free security.

The first step is to determine the risk–return opportunities available to the investor. The investor first ascertains the risk-return options available as given by the minimum-variance frontier of risky securities which is a graph of the least possible variance that can be achieved for a given level of portfolio expected return. With the input data for variances, covariances and expected returns available, the minimum-variance portfolio can be calculated for any desirable expected return. Figure 2.2 depicts the minimum variance frontier in a two-asset scenario where, the only assets to be considered are Stocks A and B and the three-asset scenario which includes Stock C. The benefits of diversification increase as the correlation between Stock C is not perfectly positive with either Stock A or Stock B.

**Figure 2.2: How Increasing the Number of Assets Affect Portfolio Diversification**



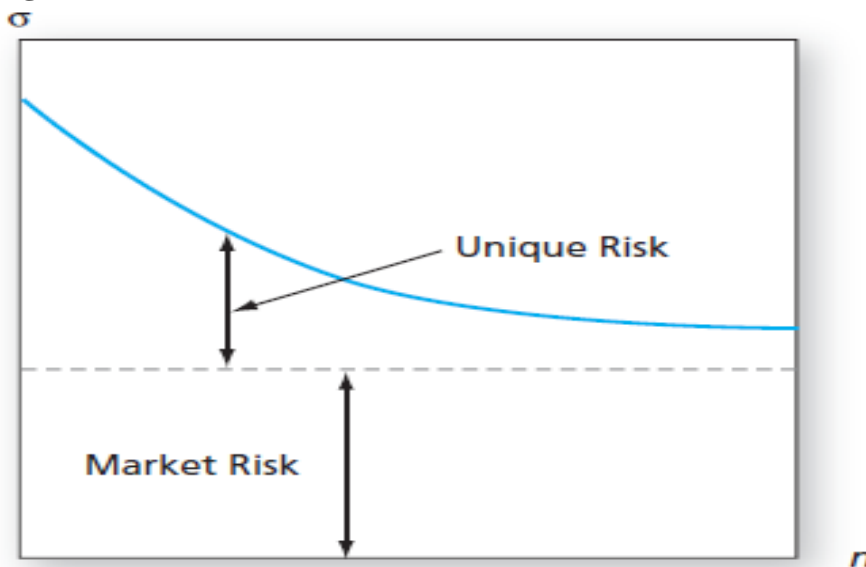
**Source:** Level II CFA Study Guide (2015: V5-137)

<sup>4</sup> A graph depicting all feasible combinations of risk and accompanying return of a risk-free and risky asset.

The total risk, can be separated into systematic risk which is the covariance of the asset's return with that of the return of the market portfolio and non-systematic risk. Systematic risk is the only relevant risk for decision making purposes. Figure 2.4 illustrates how diversification minimizes non-systematic risk for portfolios. The return variance of the portfolio is the total risk for the portfolio which is the systematic risk and the non-systematic risk. The horizontal axis illustrates the number of assets held in the portfolio.

Extensive diversification however cannot eliminate risk in situations where common elements of risk affect all firms. In Figure 2.3, the standard deviation of the portfolio falls with an increase in the number of securities, but does not be reduce to zero. Risk can be categorised as market risk or systematic risk and non-systematic risk. The market risk is the risk that lingers even after diversifying extensively, this risk is attributable to the market and is also is also called the systematic or non-diversifiable risk. On the other hand, certain risks can be eliminated through diversification these risks are firm-specific risks and are referred to as diversifiable risk or unsystematic risk. There are empirical studies that support this analysis (Bodie, Kane and Marcus, 2014).

**Figure 2.3: The Elements of Portfolio Risk**



**Source:** Bodie, Kane and Marcus (2014: 207)

As the number of asset held in the portfolio increases, the level of non-systematic risk is gradually eliminated or diversified away. This is supported by studies of different classes of

assets. A portfolio size of 20 randomly chosen assets for example, can completely remove any non-systematic risk and thereby leaving only the systematic risk (Drake and Fabozzi, 2010).

In summary, one can improve a portfolio's risk-return trade-off by increasing the number of investable securities, and for any given level of return, the minimum variance portfolio will depend on:

1. the individual assets' expected returns,
2. the variance of each asset
3. the correlations among the returns of the asset in the portfolio, and
4. the number of assets in the portfolio.

### **Problems with the CAPM and Mean-Variance Theory**

The CAPM and the Mean-Variance Theory are two pillars of modern finance, however, these models have been strongly criticized on both theoretically and empirically. The critique theoretically is that expected utility is fallacious, and some of the other assumptions underlying the models are invalid, and, paradoxical choices may be made if one adheres to the Mean-Variance Theory (Levy, 2010). Empirically, the models are further criticized because rates of returns of assets are not normally distributed and the CAPM has only mediocre explanatory power (Levy, 2010).

Allais (1953) shows that when using Expected Utility Theory in making decisions between pairs of alternatives, especially for those involving small probabilities, there may be some evidence of paradoxes (popularly known as the Allais paradox<sup>5</sup>) within Expected Utility Theory casting doubts on the validity of the Expected Utility Theory which among other assumptions, forms the foundation of the Mean-Variance Theory and CAPM. This paradox inspired the idea of using decision weights. Kahneman and Tversky (1979) suggest Prospect Theory as a substitute theory to the Expected Utility Theory. They posit that investors misrepresent probabilities, make choices based on variations in wealth, are prone to loss aversion and tend to maximize the anticipation of an S-shaped value function containing a risk-

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<sup>5</sup> Maurice Allais published a paper on a survey he had carry out with a hypothetical game. In the survey, subjects with in-depth knowledge of probability theory of probability and construed to behave rationally consistently violated the Expected Utility Theory. The game and its results are popularly referred to as the Allais Paradox.

seeking segment. Normative economic theories could be more appropriate for agents of artificial sort than for human agents, since Artificial Intelligence better adhere to idealized assumptions of rationality than people (Parkes and Wellman, 2015).

Levy, Giorgi and Hens (2012) however, argue that although the Cumulative Prospect Theory and Prospect Theory conflict with the Expected Utility Theory, and violates some of the underlying assumptions of the CAPM, the CAPM's Security Market Line (SML) is intact in the Cumulative Prospect Theory framework and therefore, the CAPM is also intact in Cumulative Prospect Theory framework.

Baumol (1963), Leshno and Levy (2002) Levy, Leshno and Leibovich (2008), and Levy (2012) opine that the Mean Variance Theory is sufficient but it is not a necessary rule for investment decisions, and therefore not an optimal rule, precipitating an elimination of a segment, or some segments, of the efficient frontier away from the efficient set. The market portfolio consequently may be also removed from the efficient set, leading to a vague conclusion on the CAPM.

## **2.5 Random Walk Hypothesis**

For many years, economists, finance academics and statisticians have been involved in developing and testing models of stock price behaviour. One of the important model that has emerged from this is the theory of random walks. Random walk is a stochastic process generated by the successive addition of independent, identically distributed (*iid*) random variables and is one of the main and well-studied topics in probability theory.

In finance, random walk was made popular by Burton Malkiel, in a 1973 book, *A Random Walk Down Wall Street*. "Taken to its logical extreme, it means that a blindfolded monkey throwing darts at a newspaper's financial pages could select a portfolio that would do just as well as one carefully selected by the experts" (Malkiel, 1999: 24).

The principle is that investors react promptly to any advantageous information in financial markets and thereby removing any profit opportunities. The implication is that asset prices always reflect all the information available therefore no profit can be obtained from trading solely based on information (Lo and MacKinlay, 2011).

Random walk and the EMH however do not mean the same thing as a random walk of asset prices does not necessarily mean the market is efficient or investors are rational rather, random walk implies that changes in asset prices are independent from each other (Brealey, 2012). Cuthbertson and Nitzsche (2005) give a more technical definition of a random walk, expressing a random walk with a drift ( $\delta$ ) as a stochastic series  $X_t$  that behaves as:

$$X_t = \delta + X_{t-1} + \varepsilon_{t+1} \quad \varepsilon_{t+1} \sim iid(0, \sigma_\varepsilon^2)$$

The drift is simply the weighted average of probabilities for each price variation of the asset in the subsequent period.

Smith (2008) tested the random walk hypothesis for 11 stock exchanges in Africa namely, Botswana, Ghana, Côte d'Ivoire, Kenya, Egypt, Mauritius, Nigeria, Morocco, South Africa, Tunisia and Zimbabwe from January 2000 to September 2006 applying a joint variance ratio tests with finite-sample critical values and rejects the *iid* random walk hypothesis in all the 11 stock exchanges. The weekly returns in 4 of the selected stock exchanges (Nigeria, Egypt, South Africa and Tunisia) exhibit a martingale difference sequence. Smith (2008) concludes that liquidity is a major factor in determining whether a stock exchange follows a random walk.

## 2.6 Efficient Market Hypothesis (EMH)

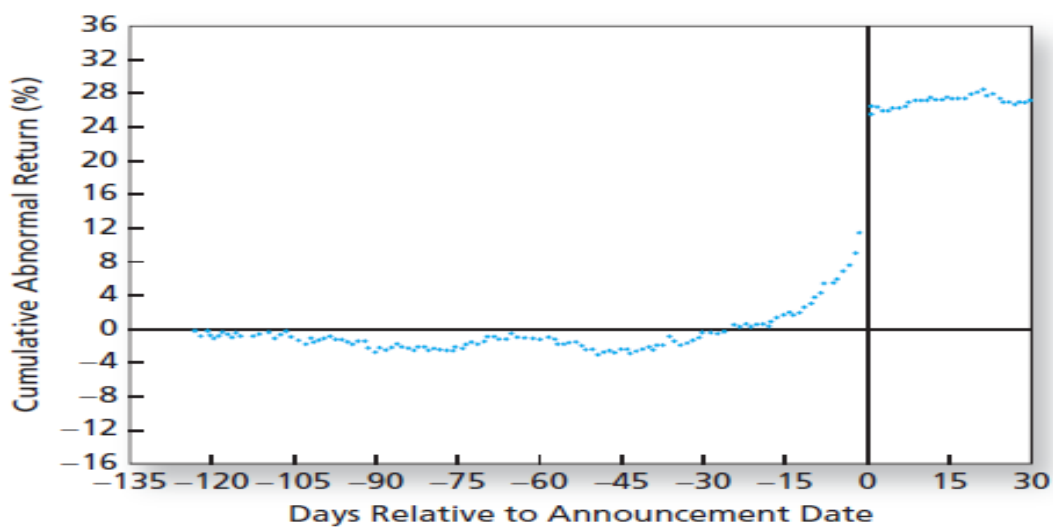
Prior to Fama's EMH, no theory existed to explain why financial markets are so hard to beat, the recognition of such a possibility was non-existent (Bernstein, 2007). Eugene Fama is credited with the first use of the term 'efficient market' (1965a) even though there is evidence that the concept was independently developed by Eugene Fama and Paul Samuelson (Samuelson, 1965) from two considerably unrelated research works which propelled both of them along two separate courses resulting in a number of other breakthroughs and achievements, all emerging from their related study, the EMH (Durlauf and Blume, 2008).

In Fama's 1965 paper titled: "Random Walks in Stock Market Prices," (Fama, 1965b), he cites, inter alia, his prior study of serial correlations in the daily price fluctuations of 30 stocks that made up the Dow Jones Industrial Average index ("The Behavior of Stock Market Prices" (Fama, 1965a)). His conclusion was that the daily fluctuations had a very minimal positive correlation, approximating zero for all practical purposes. Fama (1965b, 56) defines efficient markets as:

“...a market where there are large numbers of rational profit maximizers actively competing, with each trying to predict future market values of individual securities, and where important current information is almost freely available to all participants.”

Figure 2.4 shows how in an efficient market, stock prices respond to new information plotting the response to prices of sampled firms targeted for takeover. The acquiring firms in majority of takeovers paid a substantial premium over the prevailing market prices, therefore any relevant information on an attempted takeover should trigger the stock price increase.

**Figure 2.4: How Stock Prices Respond to New Information**



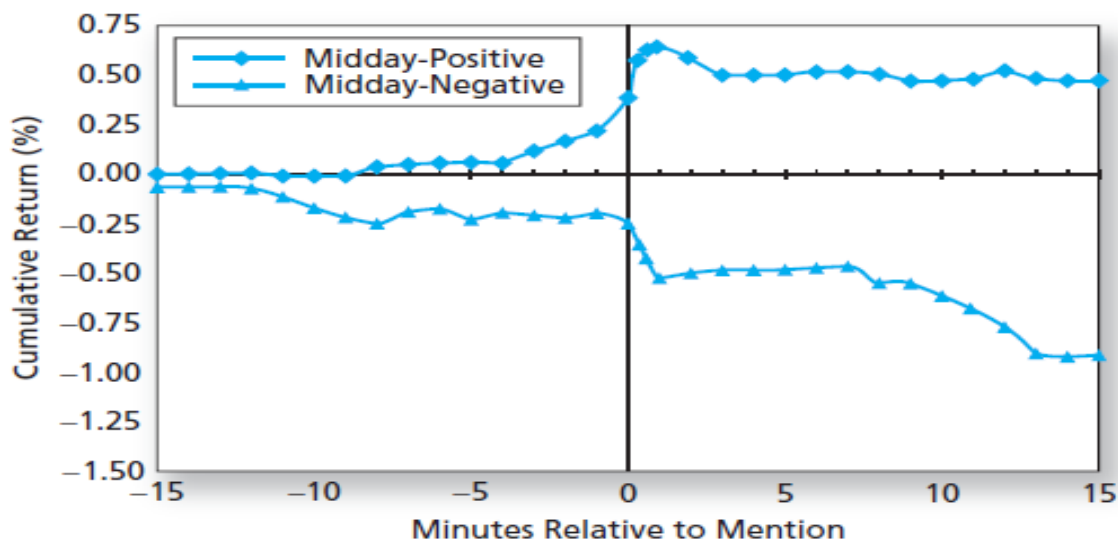
**Source:** Adopted from Keown and Pinkerton (1981), cited in Bodie, Kane and Marcus (2014: 351)

The figure displays how stock prices increase spectacularly on the day the news is made public but there is no further movement in prices after the date of the announcement, implying that prices incorporate the new information, which by the end of the trading day, includes the probable enormity of the takeover premium.

Patell and Wolfson (1984) provide a more dramatic confirmation that swift reaction to new information may be found in intraday prices proving that majority of the stock price reaction to announcements of corporate dividends or earnings happens within ten minutes of the announcement. A study by Busse and Green (2002) provides a good demonstration of such

rapid assimilation. Busse and Green (2002) tracked minute-by-minute equity prices of companies that appeared on the “Morning” or “Midday Call” segment of business news television channel CNBC. Minute 0 in Figure 2.6 represents the time the equity is mentioned on the show at midday.

**Figure 2.5: How Stock Price React on CNBC Report**



**Source:** Adopted from Busse and Green (2002), cited in Bodie, Kane and Marcus (2014:352)

The line above represents the average price variation of equities that get positive reports, and the line below shows returns on equities that receive negative reports. From the above graph, it can be observed that the line on top levels off, demonstrating that the news has been fully incorporated by the market within five minutes of the news while within 12 minutes, the line below also levels off.

In the Swedish market, Hartman and Rodestedt (2010) find that adjustments to new information by the market as measured in volatility peaks within the first minute and within three minutes after the new information, more than half of the adjustments to normality is completed while full adjustment takes thirty-five minutes after the release of the information.

Kurov, Sancetta, Strasser and Wolfe (2015) studied the behaviour of the prices of equity index and the Treasury futures around the dissemination of macroeconomic announcements of the



United States and discovered that out of the eighteen market-moving announcements, seven exhibited evidence of informed trading prior to the official time of release with prices drifting towards the correct direction about thirty minutes before the announcement time.

Notable literature relating to the EMH though began earlier in 16<sup>th</sup> century with renowned Italian mathematician, Girolamo Cardano, in his book *Liber de Ludo Aleae* (The Book of Games of Chance) argued: “The most fundamental principle of all in gambling is simply equal conditions, e.g. of opponents, of bystanders, of money, of situation, of the dice box, and of the die itself. To the extent to which you depart from that equality, if it is in your opponents favour, you are a fool, and if in your own, you are unjust” (Cardano, c 1564).

In 1828, Robert Brown the Scottish botanist, discovered that viewed under a microscope, pollen grains suspended in water had a swift oscillatory movement (Brown, 1828). French stockbroker, Jules Regnault, noted that the longer one holds a security, the more likely it is to win or lose on its price fluctuations which is proportional directly to the square root of time (Regnault, 1863). Jules Regnault, an amateur mathematician and a broker on the Paris Bourse, was one of the earliest to make a formal expression on market efficiency in a book written in 1863. Regnault, by personal observation and by force of logic argues that the market price of an asset at any particular time reflects the ‘wisdom of the crowd’ and therefore speculators who trade on the imperfections of the market were being delusional. He asserts that one can only make a profit by trading on private information not available to other market participants. By using probability theory, he estimated the “gamblers ruin” problem - the number of times an uninformed trader has to trade before losing all his money. Regnault is also regarded as the first person to argue that market efficiency implies that security prices follow a random walk (Shamshir and Mustafa, 2014). Using data from both French and British bonds, Regnault tested this theory and therefore the first empirical researcher to verify a “random walk” in asset prices.

Renowned English economist John Maynard Keynes opined that investors are rewarded for bearing risk rather than not for knowing better than the market, this assertion is a consequence of the EMH.

Fama (1970) defines three kinds of market efficiency – weak-form, semi-strong-form and strong-form efficiency - each based on a differing conception of what kind of information set is construed to be pertinent in the statement: “a market in which prices ‘fully reflect’ all available information is called ‘efficient’”.

- **Weak-form Efficient Market**

In weak-form efficient market, analysing information relating to past prices cannot be used to predict future prices. Therefore, in the long-run, one cannot earn excess returns by applying investment strategies that are based on historical data or the historical share prices. In a weak-form efficient market, technical analysts will be unable to consistently deliver excess returns, even though some kinds of fundamental analysis could still be able to deliver excess returns. Share prices do not exhibit any serial dependencies therefore future price fluctuations are defined solely by information that is not contained in the time series of price. The implication is that the time series of prices follow a random walk. In a weak-form efficiency it is not necessary for prices to be at or near equilibrium, however, investors will still not be able to persistently profit from market 'inefficiencies' (Drake and Fabozzi, 2010).

Many findings have shown a noticeable inclination for stock markets to 'trend' for weeks or longer (Saad, Prokhorov and Wunsch, 1998; Hamori, 2012; Pring, 2014). Furthermore, there is evidence of a positive correlation between the time period and the degree of trending (Granger and Morgenstern, 2001) although the EMH asserts that barring any changes in fundamental information, all price movements are random.

In academic finance, there exist an extensive literature dealing with the momentum effect first identified by Jegadeesh and Titman (1993,2001) who discovered that equities that have performed well over a period of 3 to 12 months, maintain such performance over the next 3 to 12 months and vice versa. The momentum effect, based simply on historical stock returns, provides a strong evidence against the weak-form efficient market, and has been detected in the stock returns of many countries (Garg and Varshney, 2015, Birru, 2015, Choi and Kim, 2014, Asness et al., 2013, Fama and French, 2012).

Jefferis and Smith (2005) using weekly data starting from the third week of January 1990 to the last week of June 2001, applied a GARCH approach with parameters that vary with time, implemented a test of evolving efficiency (TEE) and reported changes in weak form efficiency through time on selected stock exchanges in Africa. The TEE showed that the JSE exhibited weak form efficiency over the period of the study whereas three stock exchanges namely the Casablanca Finance Group (CFG) 25 of Morocco, the EFG Price Index of Egypt and, the S&P/IFC Global Index for Nigeria exhibited weak form efficiency towards the end of the period of the study (1999 for Morocco and Egypt and from early 2001 for Nigeria.). However,

the Nairobi Stock Exchange of Kenya and Zimbabwe Stock Exchange showed no movement towards weak form efficiency whereas the SEMDEX of Mauritius displays a slow drift towards eliminating inefficiency.

- **Semi-strong-form Efficient Market**

In a semi-strong-form efficient market, prices of securities adjust rapidly to information that is publicly available in an unbiased fashion, therefore investors cannot persistently earn excess by trading on such information. The implications for a semi-strong form efficient market is that one cannot rely on fundamental analysis or technical analysis techniques to consistently produce excess returns (Drake and Fabozzi, 2010).

- **Strong-form Efficient Market**

In strong-form efficient market, prices of securities incorporate all information, both public and private, and therefore no investor can earn excess returns. It implies that even corporate insiders cannot profit from using private information. Strong-form efficient market builds and incorporates the weak-form efficient market and the semi-strong form efficient market. Given that there are legal barriers that may prevent private information from becoming public, for example insider trading laws, strong-form efficiency may be impossible, except in the situation where these laws are collectively ignored (Drake and Fabozzi, 2010).

The semi-strong efficient market differs from the strong efficient market, in a strong form efficient market, market participants cannot even profit from inside information (Harder, 2010). This implies that in a strong form efficient market the management of a company who are regard as insiders cannot benefit from inside information if they chose to trade the shares of their company even after they decide without making the information public, to carry out what they perceive to be a profitable takeover. A strong form efficient market will foresee future event and such information would have been incorporated in security prices in an objective and unbiased way before even those considered insiders make any trading decision (Clarke et al. 2001).

## **2.7 Arbitrage Pricing Theory (APT) and the Multi Factor Models**

The CAPM which is a single factor asset pricing model has been criticized as too restrictive. It is only reasonable to assume that a more precise representation of systematic risk, that allows

for different securities to show different sensitivities to its various factors, would be a more useful modification of the single-factor model.

Stephen Ross (Ross, 1976) proposed a general theory of asset pricing, the Arbitrage Pricing Theory (APT) that posits that the expected return of a financial securities can be depicted as a linear function of several theoretical market indices or macro-economic factors with sensitivity to variations in each factor represented by a beta coefficient that is factor-specific. The APT assumes a linear relationship between the factors and asset returns even though it does not point out not point out what the factors are.

Ross's APT is based on three key assumptions:

- (1) asset returns can be explained by systematic factors
- (2) there are adequate securities to diversify away unsystematic risk; and
- (3) arbitrage opportunities cannot persist in properly functioning security markets.

The nonexistence of arbitrage is arguably one of the most essential fundamental assumptions of classical finance. Arbitrage is simply the simultaneous trading of assets at different prices in different markets with the arbitrageur making profits while bearing no additional risk by buying at a low price in one market and concurrently selling at a high price in another market (Focardi and Fabozzi, 2004, Huberman, 2005, Gromb and Vayanos, 2010).

## 2.8 The Fama-French Three-Factor Model

Fama and French (1996) derived another multi-factor model known as the Fama-French Three-Factor model which at present is the principal approach to identifying factors for sources of systematic risk (Bodie et al., 2014). This model applies firm traits that appear on empirical grounds to be representation of exposure to market or systematic risk. The factors selected are variables have in the past predicted average returns accurately and may therefore be depicting risk premiums. The Fama and French three-factor model is given as:

$$R_{it} = \alpha_i + \beta_{iM}(K_{Mt} - R_{ft}) + \beta_{iSMB}SMB_t + \beta_{iHML}HML_t + e_{it}$$

Where:

$R_{it}$  = The expected returns of the portfolio

$K_{Mt}$  = The return of the market portfolio

$R_{ft}$  = Risk-free rate

SMB = Small Minus Big, the difference between the return of a portfolio of large stocks and a portfolio of small stocks.

HML = High Minus Low, the difference between the return of a portfolio high book-to-market-value ratio stocks and the return of a low book-to-market ratio stocks portfolio.

The market index in this model captures systematic risk emanating from macroeconomic factors. Although HML and SMB are in themselves not obvious candidates for pertinent risk factors, it is argued that they may be proxies for more fundamental yet-unknown variables. Fama and French for example, posit that firms in distress financially are more likely to have high book-to-market value ratios and small stocks may be more sensitive to variations in business conditions hence, these variables may portray sensitivity to macroeconomic risk factors.

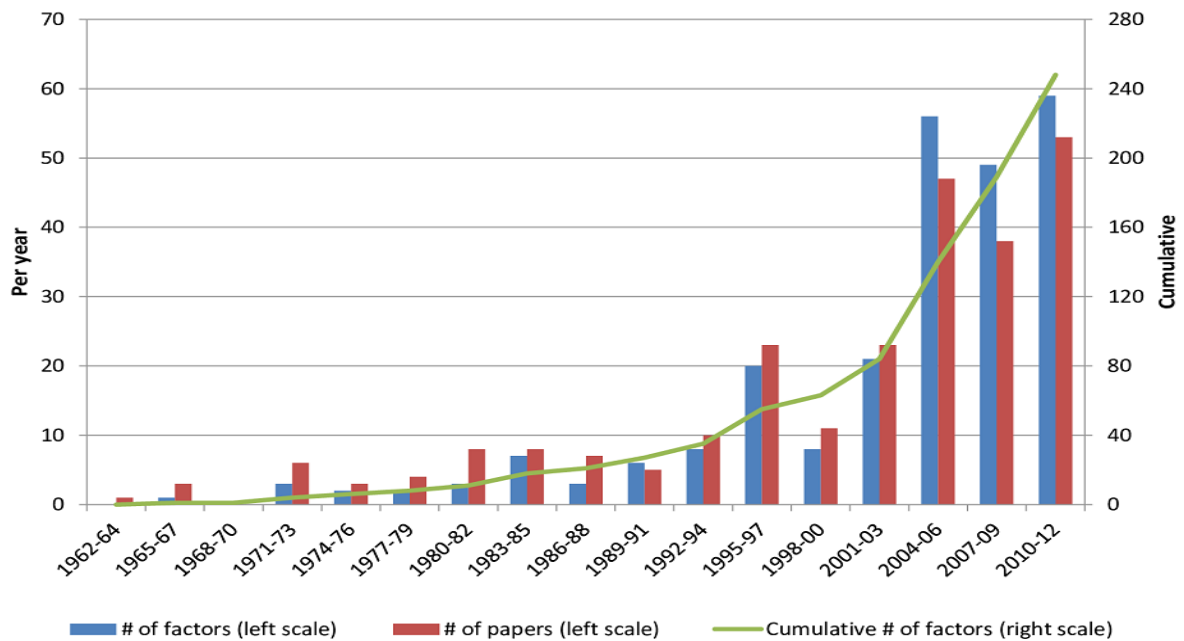
Black (1993) however argues that whenever researchers continuously scan the database of asset returns when searching for explanatory factors, they can eventually unearth past “patterns” that purely are due to chance, a practice commonly referred to as data-snooping. Black (1993) further points out that since discovery, the return premiums to factors like firm size have turned out to be inconsistent. Fama and French however have proved that the book-to-market and size ratios have in various time periods and markets over the world predicted average returns therefore diminishing possible effects of data-snooping (French, 2015).

With regards to factors, there are at least 316<sup>6</sup> factors that have been tested by financial market researchers that explain the cross-section of expected returns (Harvey, Liu and Zhu, 2015). In fact, Cochrane (2011), describes this as “a zoo of new factors”. Figure 2.6 shows the growth in the publications of factors over the years.

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<sup>6</sup> Appendix D presents a detailed list of all the factors

**Figure 2.6: Factors and Publications**



**Source:** Harvey, Lui and Zhu (2015: 19)

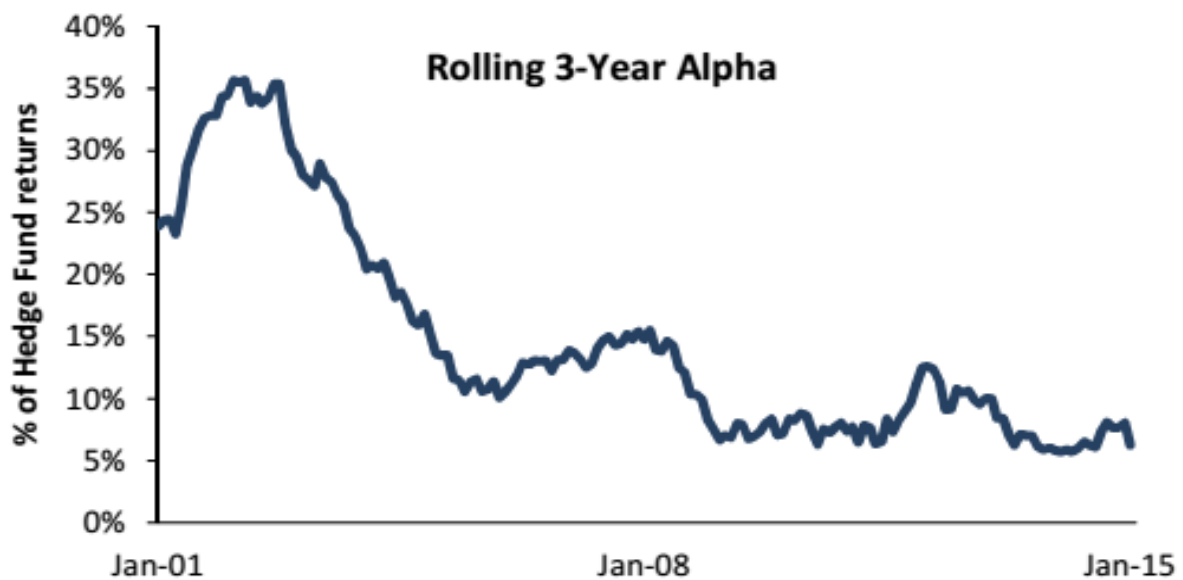
Harvey, Lui and Zhu (2015) argue that many of the factors discovered are only significant by chance and therefore, it is a dangerous mistake in asset pricing tests to apply the typical statistical significance cutoffs such as a t-statistic exceeding 2.0.

Furthermore, McLean and Pontiff (2016) studied the return predictability of 97 factors that academic studies have shown to forecast the cross-section of stock returns using out-of-sample and post-publication and found that factors lose 26% of their power after discovery. This *inter alia*, may be attributed to the effects of data mining. Factors further lose 32% of their predictability power after they appear in academic papers suggesting that investors only learn about this mispricing only after they have been published in academic papers. Financial markets can therefore not be construed to incorporate all relevant information since factor models purely reflect risk-return trade-offs and should not be affected by the publications done by academics.

Rangelova, Feeney and Lu (2015) discovered that there has been a significant decline in alpha as shown in Figure 2.7. Hedge funds included in the HFRI Composite index in 2001 achieved a rolling 3-year alpha of 25%, peaking at around 35% in 2002, before declining and finally

plateauing between 5 and 10% after 2008. Strategies that required lower entry barriers, for example long/short equities, suffered the steepest alpha generation decay as a result of more players entering the industry. In the long/short equities strategy group however, Figure 2.8 shows managers focusing on small and mid-cap equities generated more alpha and experienced less alpha decay relative to their peers concentrating on large-caps since mid-2004.

**Figure 2.7: Alpha Generation Decay: HFRI Composite from January 2001 – January 2015**



**Source:** Adopted from Investcorp, Bloomberg, cited in Ranguelova, Feeney and Lu (2015: 1)

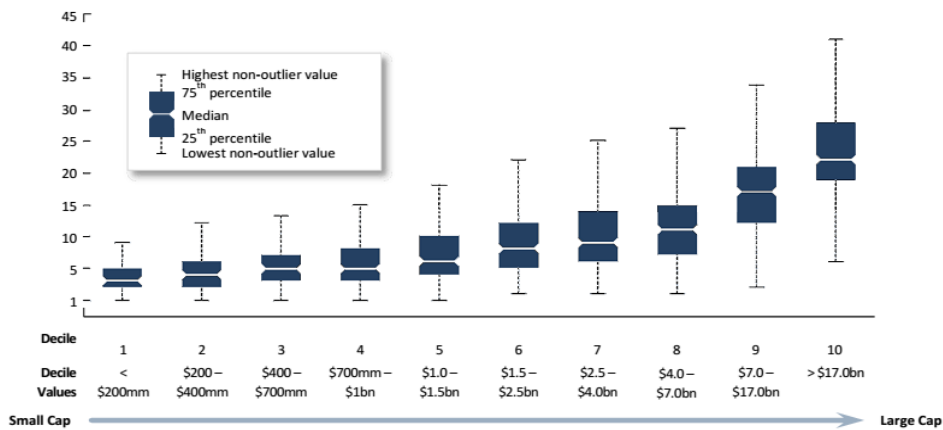
It is well known that the small-cap equities offer a more attractive opportunity for generating alpha through investing in “under the radar” equities discovered by talented stock pickers. Managers who concentrate on small and mid-cap equities benefit from the “structural alpha” existing in this segment by exploiting lingering inefficiencies such as the quality of information for example, fewer analysts and less frequent publication of research reports on these stocks, and the limited volume and also, from a playing field that is less crowded relative to that of large cap equities (Ranguelova et al., 2015). Figure 2.9 shows that the number of analysts assigned to small cap equities as at March 2015 were far fewer than the number of analysts assigned to large cap equities.

**Figure 2.8: Less Alpha Decay in Small-Cap Hedge Fund Strategies from January 2001 – January 2015**



Source: Adopted from Investcorp, Bloomberg, cited in Rangelova, Feeney and Lu (2015: 1)

**Figure 2.9: Number of Analysts per Market Cap Size Decile (March 2015)**



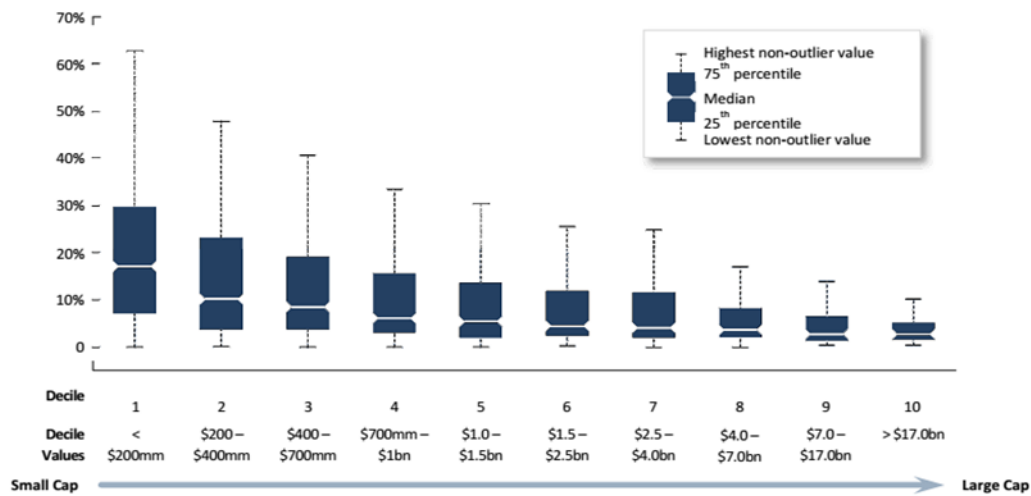
Source: Adopted from Investcorp, cited in Rangelova, Feeney and Lu (2015: 4)

Rangelova et al. (2015) compiled data from Capital IQ data service to tally the number of publications for the largest 10 and smallest 10 smallest companies of the Russell 2000 and the S&P 500 indices over a period of 30 days, three months, six months and one year. Defining publications as earnings estimates, research reports, research notes, fixed income reports, and articles on industry overview as they relate to the selected companies, financial models, initiation of coverage memos, notices of rating change and reporting results summaries. The study reports that there is a significant difference in publication frequency for constituents of



the two indices (Figure 2.10). There were on average, 36 publications for a large S&P 500 stock compared to just 10 for a large Russell 2000 stock.

**Figure 2.10: Dispersion of Analyst Forecasts per Market Cap Size Decile (March 2015)**



**Source:** Adopted from Investcorp, cited in Rangelova, Feeney and Lu (2015: 6)

The dispersion of analysts’ forecasts for companies with market capitalizations of \$7 billion or more diverge in a tight range of less than 10% increasing monotonically as the size of the market capitalization drops. This implies smaller companies attract less analyst attention, leading to limited coverage by few analysts. Therefore, there are structural inefficiencies in the U.S. small-cap equity market that can be exploited to generate alpha (Rangelova et al., 2015).

## 2.9 Low Volatility Anomaly

The low volatility anomaly can be defined as the phenomenon where low-risk stocks display markedly higher returns than the market portfolio on a risk-adjusted basis, while high-risk stocks underperform significantly on a risk-adjusted basis (Blitz, Pang and Van Vliet, 2013). This anomaly was discovered from two different sources - an academic source and an applied investment source (Marmer, 2015). From the academic perspective, the low volatility anomaly is credited to the empirical testing of the capital asset pricing model (CAPM) by pioneering academics who found that “high-beta securities had significantly negative intercepts and low-beta securities had significantly positive intercepts, contrary to the predictions of the traditional form of the model.” (Jensen, Black and Scholes, 1972: 44). The low volatility anomaly, from

an applied investment perspective on the other hand can be attributed to Haugen and Heins (1972) who discovered that monthly returns of stocks with lower variances over the long run, outperform stock portfolios with higher variance. Even with evidence of continuing critical empirical tests of the CAPM and the early claims of Haugen and his colleagues, it took almost two decades before academic interest was reawakened on the concept of low volatility investing (Marmer, 2015).

The traditional theories of asset pricing do not explain these patterns. Possibly, beta might just be a wrong measure of risk. The CAPM is only a one-equilibrium measure of risk and return based on unrealistic assumptions. Over the past decades, however, academics have dedicated extensive efforts into creating rational models with the aim of finding the “right” measure of risk. A lot of these current models make the CAPM mathematics appear antiquated. Regardless of advanced computational capability, the new models face a difficult battle (Barker, Bradley and Wurgler, 2011).

Romer (2015) cautions against ‘mathiness’ - the misuse of mathematical analyses to disguise an ideological agenda backed by unrealistic assumptions - and points out how economists usually stick to science but sometimes stray into academic politics. Economists fancy themselves as scientists, and believe that practitioners could reach dispassionate conclusions. However, “The problem is, you can’t look at the data objectively most of the time... You have prior beliefs that are methodological or ideological about the impact of things, and that inevitably color the assumptions you make.” (Peterson, 2016).

Anthony Randazzo and Jonathan Haidt surveyed 131 economists and found that their response to moral questions predicted their response to empirical questions. For example, an economist who describes “fairness” as equality of outcome may be more likely to conclude that austerity hurts growth, or single-payer healthcare bends the cost curve (Randazzo and Haidt, 2015). Milton Friedman, debating Walter Heller on PBS, argued: “I doubt very much that there are any value-free economists. But that doesn’t mean that there cannot be value-free economics” and such a thing “is no more likely to exist than is the frictionless world of high school physics problems.” (Friedman, 1979, 7:55). According to Russ Roberts, whereas in science, “the old saw is that progress comes one funeral at a time, with adherents of old theories dying off, economics does not work that way. There’s still Keynesians. There’s still monetarists. There’s

still Austrians. Still arguing about it. And the worst part to me is that everybody looks at the other side and goes ‘What a moron!’ ...That’s not how you debate science.” (Peterson, 2016).

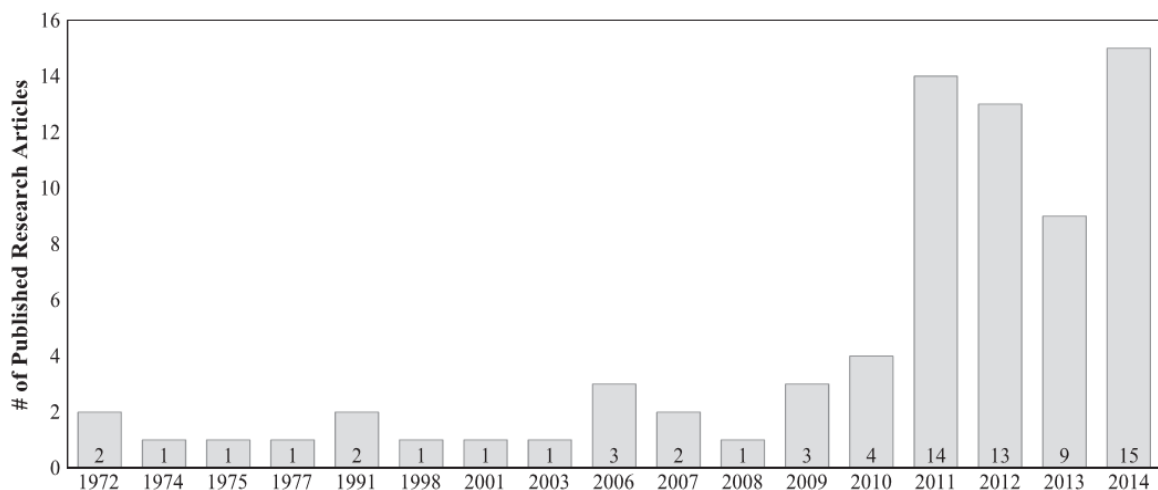
John Maynard Keynes in reviewing Professor Tinbergen’s book, *Statistical Testing of Business Cycle Theories*, argued that

“No one could be more frank, more painstaking, more free from subjective bias or parti pris than Professor Tinbergen. There is no one, therefore, so far as human qualities go, whom it would be safer to trust with black magic. That there is anyone I would trust with it at the present stage, or that this brand of statistical alchemy is ripe to become a branch of science, I am not yet persuaded. But Newton, Boyle and Locke all played with Alchemy. So let him continue”

Keynes (1939: 156).

Leamer (1983) in a paper, “Let’s Take the Con Out of Econometrics,” argues that in drawing inferences from data as expressed by econometrics, it becomes necessary to make capricious assumptions.

**Figure 2.11: Sample of Published Research on Low Volatility Strategies**

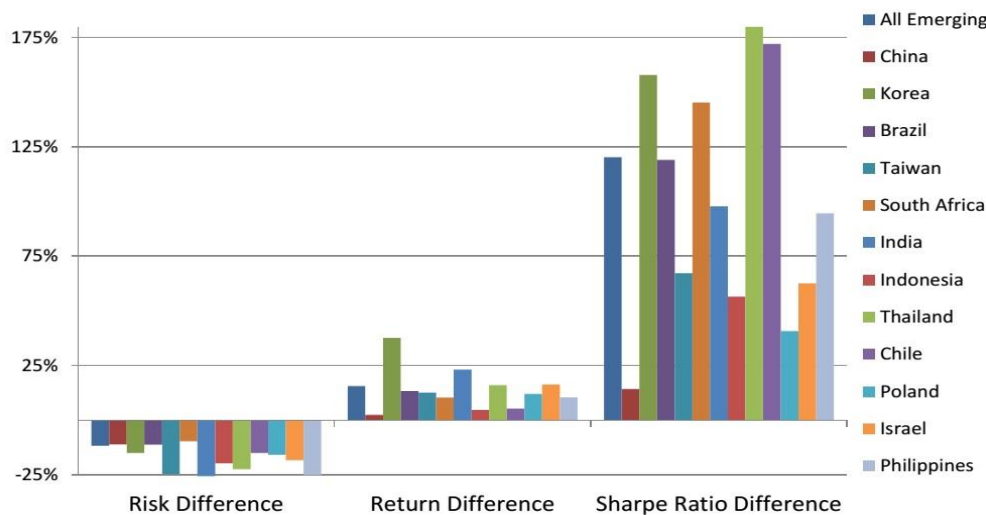


Adopted from Hillsdale Investment Management, cited in Marmar (2015: 18)

Blitz and Van Vliet (2007), Baker and Haugen (2012) and Frazzini and Pedersen (2014) significantly contributed to the literature on the low volatility effect and documented their

results in global equity markets, as well as distinguishing and disentangling a volatility effect different from the classic value, size and momentum effects, and offering possible explanations for this effect. Figure 2.11 shows a growing number of studies on the low-volatility anomaly since it was first reported in 1972. Figure 2.12 shows the differences in risks, returns as well as risk adjusted returns between low risk and high risk securities in selected developed countries while Figure 2.13 shows the differences in risks, returns as well as risk adjusted returns between low risk and high risk securities in selected developing countries.

**Figure 2.12: Emerging Markets Performance (Lowest to Highest Risk Decile) 1990 – 2011**



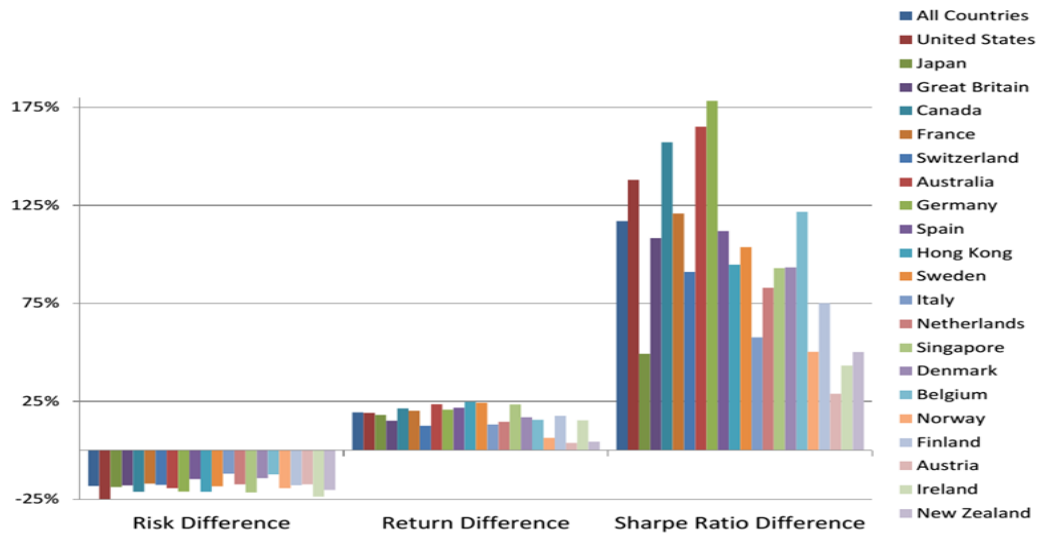
**Source:** Baker and Haugen (2012: 7)

Baker et al. (2011) grouped the top 1000 stocks by market capitalization tracked by the Center for Research in Security Prices (CRSP) according to trailing volatility and beta into five quintiles and found that stocks with the lowest volatility also had the highest returns concluding that over the long-term, low-risk portfolios outperforming high-risk portfolios is conceivably the most critical anomaly in finance and the extent of its magnitude defies the basic conception of a risk–return trade-off. Figure 2.14 shows the performance of the investments in the various quintiles.

Frazzini and Pedersen (2014) propose an investment strategy of betting against beta (BaB) whereby an investor takes a long position on low beta equities and a short position on high beta equities. In their study, they found that a BaB strategy produces a high risk-adjusted return. Corroborating the findings of Frazzini and Pedersen (2014), Auer and Schuhmacher (2015)

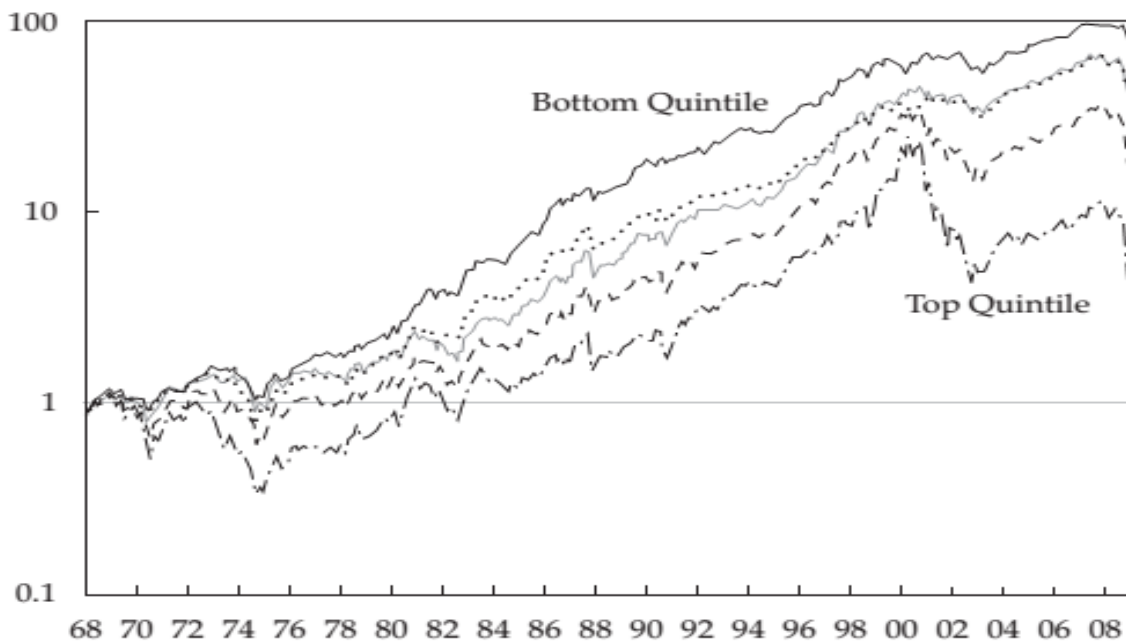
selected the 30 constituent equities of the Dow Jones Industrial Average over 1926–2013 and investigated the existence and exploitability of the liquidity anomaly. The study confirms the existence of this anomaly of an inverse relationship between risk and return.

**Figure 2.13: Developed Markets Performance (Lowest Risk Decile - Highest Risk Decile 1990– 2011**



Source: Baker and Haugen (2012: 5)

**Figure 2.14: The Value of \$ 1 invested in 1968**

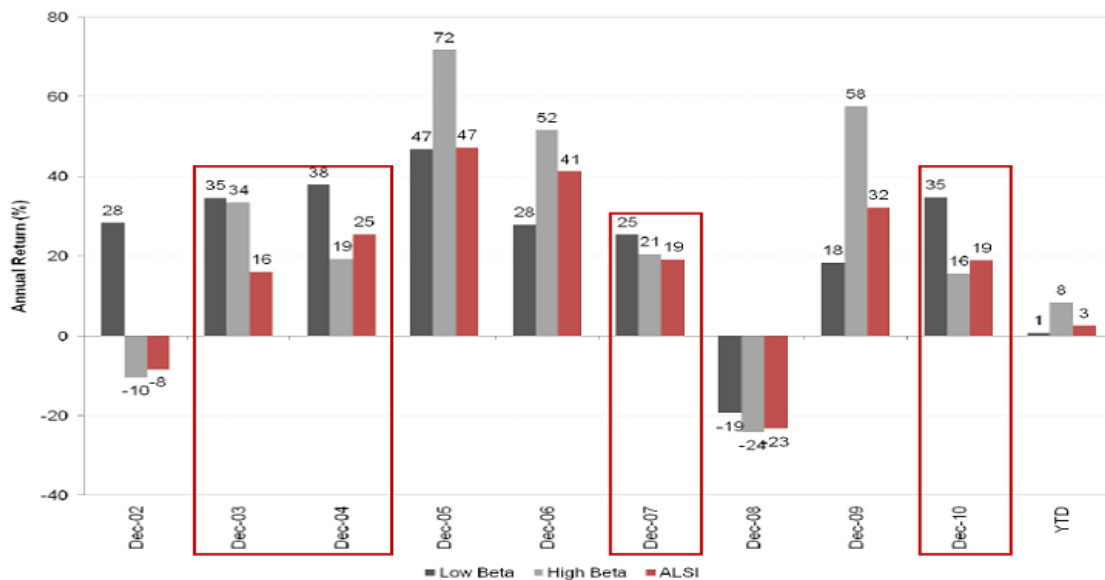


Source: Baker et al (2011: 3)

They further conclude that this anomaly is exploitable by taking a long position on the 15 stocks with the lowest betas and shorting the remaining 15 with the highest beta and in the process, generating significant abnormal returns. The general asset-pricing factors of momentum, size and book-to-market does not explain the exploitability of this anomaly.

In South Africa, the first evidence of the low volatility anomaly on the JSE was reported by Rensburg and Robertson (2003), who concluded that there is a negative correlation between a stock’s beta and its return. Strugnell et al. (2011) also confirmed the existence of the low volatility anomaly on the JSE applying a more refined estimate of beta. Khuzwayo (2011) constructed low beta versus high beta portfolio of stocks made up of the Top 100 JSE stocks from 2001 to 2011 and matched their performance with the All share index (ALSI). His study concluded that low beta portfolios outperformed both high beta portfolios and the ALSI during periods of overall market underperformance in the market (Figure 2.15).

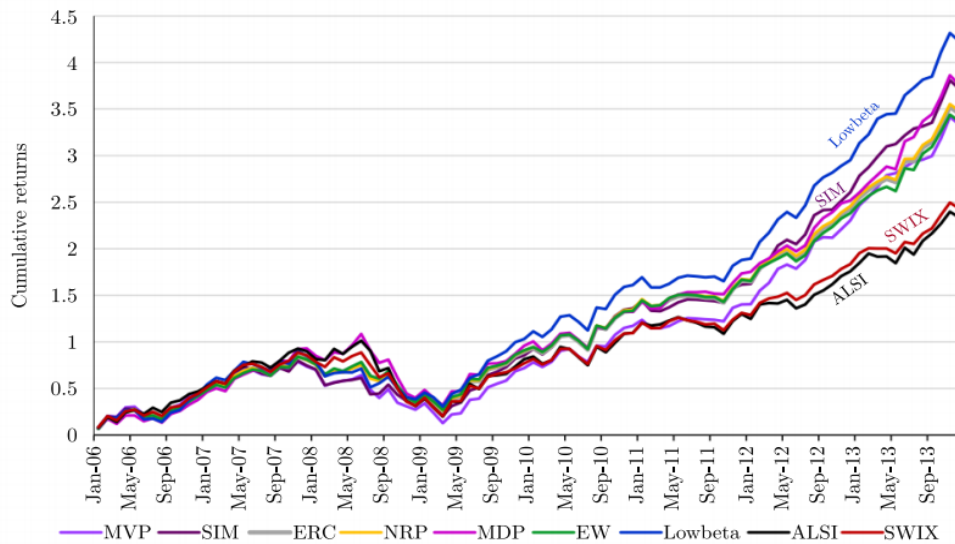
**Figure 2.15: Annual performance of low beta versus high beta baskets (December 2001-May 2011)**



**Source:** Adopted in Khuzwayo (2011), cited in Oladele (2014: 11)

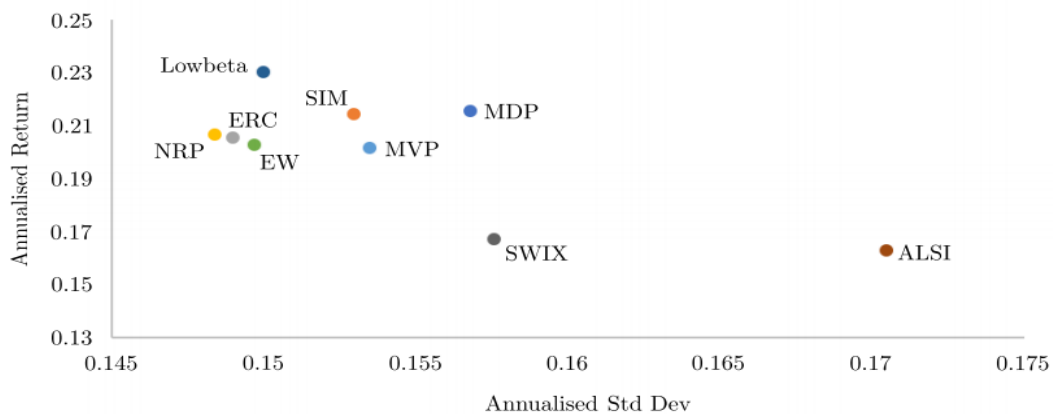
Oladele and Bradfield (2016) analysed low volatility portfolios and used sectors rather than individual stocks as the foundation for portfolio construction. Their study concluded that low volatility portfolios outperformed the JSE All Share index based on their Sharpe ratios (Figure 2.16 & Figure 2.17).

**Figure 2.16: Out-of-sample cumulative returns of the FTSE/JSE sector-based low volatility portfolios January 2006–December 2013.**



Source: Oladele and Bradfield (2016: 67)

**Figure 2.17: Risk-return plot of the sector-based low volatility portfolios, January 2006–December 2013.**



Source: Oladele and Bradfield (2016: 67)

Muller and Ward (2013) re-examined style variables including size, momentum, liquidity return on equity by using an improvised data set and methodology and concluded that portfolios built using univariate ranked styles display considerable effects over 1985 to 2011. The study also finds persistent and significant excess returns in the following variables: earnings yield,

momentum, price to book, dividend yield, return on capital, cash-flow to price, liquidity, interest cover and return on equity and concluded that there is no evidence of the size effect, with the exception of fledgling companies.

Several explanations have been given to the low risk anomaly. Among the explanations given are:

- Agency problems
- Type of manager compensation
- Overconfidence bias

- **Agency Problems**

Baker and Haugen (2012) posit that the low volatility anomaly can be explained by:

- a. Agency problems between investment managers in an organization
- b. investment managers and their clients

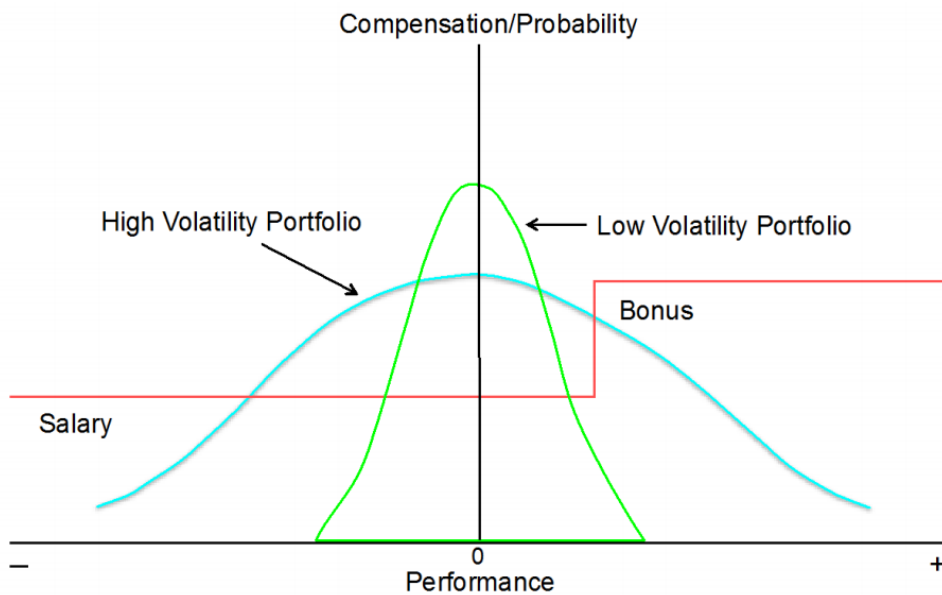
There are significant issues that exist among investment managers that can create excess demand for highly volatile stocks. Regular investment committee meetings which are central to the portfolio building process serve as a guide for constructing portfolios. Normally at such meetings, a team of analysts, each assigned to a particular industry or sector tries to make a case for a stock she believes must form part of the model portfolio. Analysts persistently failing to make their case may end up being terminated and are therefore susceptible to recommending equities for which a compelling case can be made. Such equities are typically noteworthy because they receive media attention and the flow of new information on these equities is comparatively intense therefore exhibiting higher than average volatility. As analysts aim to impress their colleagues, they would make a case for the inclusion of stocks with higher than average volatility in the model portfolio. The interesting characteristics of such equities offer the chance to easily explain their inclusion in the portfolio to their clients. Asset managers may recognise that the stocks being recommended are newsworthy, while being oblivious of their high volatility as most managers are not quantitative. These agency issues therefore create demand for highly volatile stocks by professional investors and in the process leading to the prices of such stocks to be overvalued with suppressed future expected returns.



- **Type of Manager Compensation**

Figure 2.18 illustrates a manager remuneration schedule where the manager receives a basic salary and also a bonus when there is a satisfactory performance. Two probability distributions are superimposed on this figure. One for a portfolio that is volatile and the other a less volatile portfolio. It is evident that there is an increase in the expected value of compensation if the manager selects a more volatile portfolio (Baker and Haugen, 2012).

**Figure 2.18: Option-Like Manager Compensation**



**Source:** Baker and Haugen (2012: 11)

- **Overconfidence bias**

Overconfidence is another prevalent bias that underlies the choice of high-volatility stock (Fischhoff, Slovic, and Lichtenstein 1977; Alpert and Raiffa 1982). Stocks that have wide-ranging opinions will likely have relatively more optimistic shareholders and trade at higher prices, which lead to suppressed future returns (Diether, Malloy, and Scherbina, 2002)

## 2.10 Efficiently Inefficient Market

EMH posit, that prices reflect all relevant information all the time, however, if that is the case then no market participant will try to beat the market, market participants will all resort to passive investing and eventually the market becomes inefficient. Pedersen (2015) proposes that financial markets are efficiently inefficient arguing that markets are inefficient but to an

efficient extent. In an efficiently inefficient market, competition among professional investors make financial markets almost efficient but remain inefficient so that they are compensated for their costs and risks. Asness and Liew (2014) believe that markets are reasonably efficient and disagree with markets reflecting all relevant information. An efficient market also efficiently reflects irrational investors' desires.

The assumption of market efficiency has promoted the move to index-linked investments as professional managers on average underperform the market. As index-linked investing disregards idiosyncrasies of individual companies except for the characteristics that are pertinent to the methodology of index-weighting such as market capitalization, the transactions of index-linked investments largely affect all securities within the given index. As a result, index-linked investments create an environment where trading decisions of individual securities are driven mainly by the overall market trends like investors' sentiments instead of company-specific events such as earnings surprise or profit. Bolla, Kohler and Wittig (2016) concluded in a study that a market environment characterized by a large number of index-related investments may exhibit amplified co-movement of securities in the given index and, consequently increasing the vulnerability in that financial market. Bolla et al. (2016) further discovered that growth in index-linked investing leads to an increase in risk commonalities (e.g. a higher co-movement among assets implies higher risk commonality) which is both statistically and economically significant. In regions in their early stages of index-related investing, large-cap companies are more affected by the growth in index-related investing whereas regions with a more mature index investing markets, experience a spill over of the effects of index-related investing (risk commonalities) to small-cap companies as well (Bolla et al., 2016).

Engelberg and Parsons (2011) analysed how investors in nineteen local markets in the United States simultaneously react to the same set of information i.e., the release of earnings of firms of the S&P 500 Index and find that the existence or absence coverage of local media is strongly correlated to the size and probability of local trading. Engelberg and Parsons (2011) also find a strong relationship between trading patterns and the local pattern of media coverage. Earnings reported on Wednesday by the San Francisco Chronicle for example stimulates trade in the Bay Area with the entire set of events shifting to Atlanta when the same event is reported by the Journal Constitution on Thursday providing evidence of a pure media effect on investors.

## 2.11 Joint Hypothesis Problem

The Joint Hypothesis problem asserts that testing for efficient market is impossible or at best difficult because any efforts to test for market efficiency must include an equilibrium asset pricing models and one can only measure 'abnormal' returns by applying these pricing models to predict expected returns. Therefore, any inconsistency in evidences on market returns may be because of bad asset pricing model, market inefficiency or both (Campbell et al., 1997). Alajbeg, Bubaš and Šonje (2012) opine that the efficient market hypothesis is not a “falsifiable” theory<sup>7</sup>, because the methodology applied in defining an informationally efficient market is axiomatic and provides a theoretical prediction to the behaviour of security prices under certain assumptions that do not aim at reflecting the actual market conditions. This methodology does not provide any criteria in the actual market on what is efficient and may therefore need extensive extension before the efficient market hypothesis can become a falsifiable empirical theory. In summary, the Joint Hypothesis problem implies that market efficiency is not testable.

## 2.12 Summary

The assumptions and theories of classical finance still remain relevant in both academia and in the industry as the models are continually taught at finance faculties in universities and being applied by practitioners in various sectors such as asset management, risk management and personal financial planning. The upsurge of investments in index funds is testament to the dominance of classical finance despite the barrage of criticisms of the underlying theories. In an article titled *The Great Divide*, Asness and Liew (2014) conclude that despite the criticisms of the EMH, it has contributed immensely towards the understanding of finance and economics in general than any other single idea over the past 50 years and prior to EMH, finance was not even a science and barely even an abstract art therefore, the splitting of the 2013 Nobel Prize in Economics between Eugene Fama an EMH pioneer and Robert Shiller an EMH critic (and Lars Hansen for his contribution to asset price analysis) is a vote of confidence by the Nobel committee in the EMH as well as an acknowledgement of its deficiencies. The following chapter discusses chaos theory and the Fractal Market Hypothesis which provide alternative description of financial market behaviour.

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<sup>7</sup> Falsifiability implies the ability to subject a theory to criticism and empirical testing to prove it false (POPPER, K. R. 1959. *The Logic of Scientific Discovery*. London: Hutchinson.)

# CHAPTER THREE

## CHAOS THEORY AND FRACTAL MARKET HYPOTHESIS

Although classical finance theories are based among other assumptions on rationality of market participants, efficient markets, and normal distribution, from the history of financial crises, it becomes evident that financial market participants cannot be construed to be rational as suggested by classical finance and events that are assumed to be anomalies keep recurring more often than can be explained by classical finance theories. This chapter presents an alternative theory on the behaviour of financial markets which provides a different hypothesis on the behaviour of financial markets.

### 3.1 Introduction

The rate at which financial crises repeat themselves over time in similar and recurring ‘greed-panic’, ‘boom-bust’ patterns throughout history irrespective of technological advancements are contrary to those suggested by classical finance theories. For example, as pointed out by Mallaby (2010: 105):

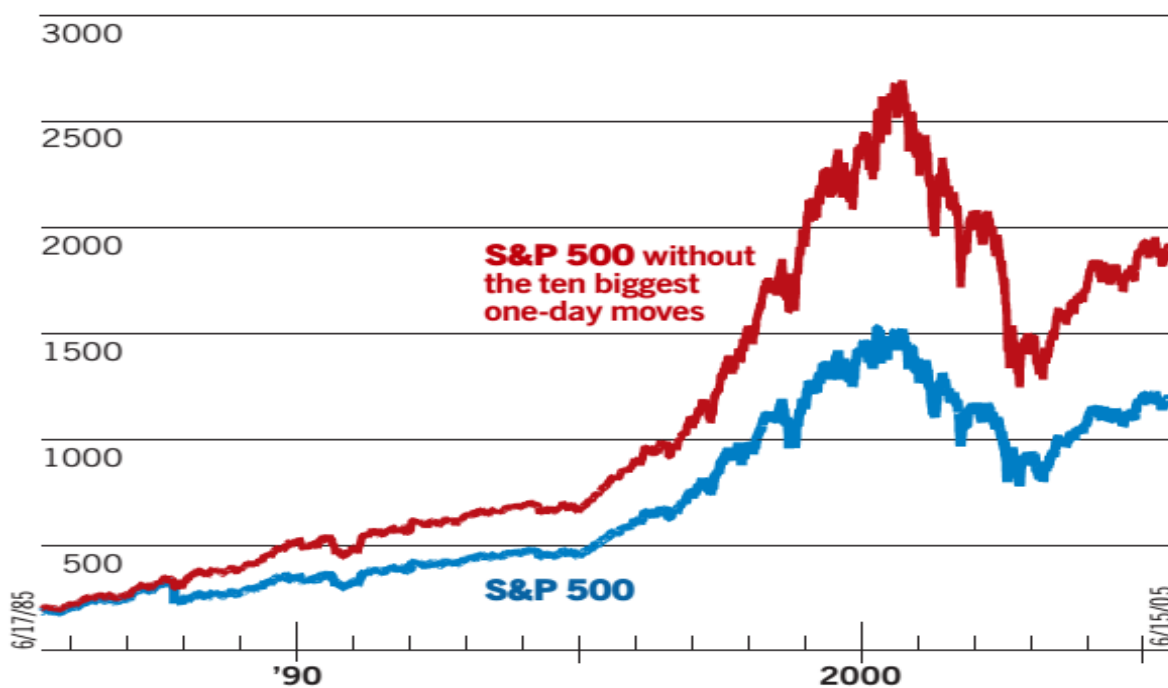
“...a plunge of the size that befell the S&P 500 futures contracts on October 19 [1987] had a probability of one in  $10^{160}$ —that is, a ‘1’ with 160 zeroes after it. To put that probability into perspective, it meant that an event such as the crash would not be anticipated to occur even if the stock market were to remain open for twenty billion years, the upper end of the expected duration of the universe, or even if it were to be reopened for further sessions of twenty billion years following each of twenty successive big bangs.”

Velasquéz (2009) proposes adapting Chaos Theory and Fractal science to explain financial phenomenon as this new theory would be able to explain the “messiness” of financial markets of today with the implication that the underlying assumptions of several classical finance theories such as the rationality of market participants, efficient markets and models of equilibrium have to be discarded.

### 3.2 Shortcomings of Classical Finance

Financial crises, such as the ones that occurred in 1987, 1998, 2000 and then recently in 2007, have been brushed off as anomalies by proponents of the Efficient Market Hypothesis (EMH) who maintain that markets remain informationally efficient. However, the frequency with which these crises occur cannot be explained by the underlying assumptions of an efficient market. Mandelbrot (2012) proves that the substantial one-day market fluctuations cannot be brushed aside as anomalies when estimating risk or forecasting returns since removing the ten largest one-day fluctuations from the S&P 500 over a period of 20 years, gives a very different kind of market reality and therefore these big moves do matter.

**Figure 3.1: The S&P without the Ten Biggest One-Day Moves**



Source: Mandelbrot and Taleb (2005: 11)

Mandelbrot and Taleb (2005) argue that the measures of risk such as standard deviation, value-at-risk, variance, correlation etc., as given by classical finance are not helpful in truly measuring risk as these measures are built on the statistical device of the bell curve which disregards big market fluctuations. They argue that these measures of risk “focus on the grass and miss out on the (gigantic) trees” therefore the infrequent and large deviations such as the failure of Enron in

2001 or the astonishing rise of Cisco in the 1990s which have significant impacts on long-term returns are disregarded (Mandelbrot and Taleb, 2005:99).

Although a study by Bendel, Smit and Hamman (1996) provides a special impetus on the behaviour of the stock market time series using a variety of indices, results were somehow mixed across indices. However, evidence of long-run persistence in the overall share returns were observed suggesting that future returns are influenced by past returns at least in the long term (Bendel, Smith & Hamman, 1996) which cultivates the need for further interrogation of the behaviour of share returns in modern economies.

The Chief Financial Officer (CFO) of Goldman Sachs – Bill Bonner – writing in *Money Week* about the series of events that occurred in August 2007 stated that “Things were happening then that were only supposed to happen about once in every 100,000 years. Either that...or Goldman’s models were wrong.” (Bonner, 2007). However, the United States Treasury Secretary during the crisis - Henry Paulson - states that the situation could have been worse (Paulson, 2010). Warren Buffet credits Henry Paulson together with Ben Bernanke, Timothy Geithner and Sheila Bair (Chairman of the FDIC) for the sterling management of the crisis - (Paulson, 2010). In his book *The Improbability Principle*, renowned British statistician, Hand (2014a) argues that the law of “probability lever” can trigger a slight variation in circumstances to have a colossal impact on probability and thereby transforming a minute probability into a massive one. He concludes that when scientific theory fails to match the observation, the reason could be that there is a problem of measurement with the data or that such theory is erroneous.

Some economists often argue that American economist and Nobel laureate Milton Friedman validated the idea that making outrageously inaccurate assumptions is actually a sensible way to approach science, an argument famously referred to as Friedman’s “F-Twist” which has contributed significantly to warping the nature of economic theories (Buchanan, 2013). Milton Friedman is arguably the most influential economist of the twentieth century (The Economist, 2006). Pfleiderer (2014) proposes subjecting a model to real world “filters” to ascertain the connection between the model’s assumptions and what is known in the real world describing models that have dubious associations with the real world as “chameleons”.

Classical finance theory is based, inter alia, on the assumptions of investors being rational, of informationally efficient markets and market equilibrium. Equilibrium infers the nonexistence of emotional forces like greed and fear, which trigger the economy to evolve and to adjust to

new conditions. Peters (1991: 5) claims that equilibrium infers the nonexistence of emotional forces like greed and fear, which triggers the economy to evolve and to adjust to new conditions. Regulating such human tendencies, he admits are desirable to minimise their effects but doing away with them however “would take away the life out of the system, including the far from equilibrium conditions that are necessary for development”

Corroborating the assertions of Peters (1991), American physicist and former editor of the international journal of science *Nature* and the *New Scientist* magazine, Mark Buchanan reasons that the assumption of equilibrium in economics and finance is “...a crazy state of affairs, something more or less equivalent to physics in the Middle Ages...” and contends that all kinds of financial crises from flash crashes to global financial meltdowns are similar to storms in the socioeconomic systems (Buchanan, 2013).

As financial crises are becoming pervasive, the assumption of efficient markets is increasingly being criticised. Some academics have turned to Chaos Theory to provide an explanation to the behaviour of financial markets. Chaos theory is the study of systems that appear to follow a random behaviour, even though they are actually part of a deterministic process, and the random behaviour is given by their typical sensitivity to initial conditions that leads the system to unpredictable dynamics. One of the founders of chaos theory, Edward Lorenz, summarises this theory elegantly: “Chaos: when the present determines the future, but the approximate present does not approximately determine the future” (Hand 2014: 45). Financial markets are non-linear dynamic systems characterised by positive feedback and fractals, and therefore “what happened yesterday influences what happens today” (Peters, 1996:9). Peters (1996) therefore proposed the Fractal Market Hypothesis (FMH) for modelling financial markets.

With the underlying classical assumptions of financial markets behaviour being heavily criticised, Buchanan (2013) suggests adopting a disequilibrium view of financial markets, claiming that the disequilibrium view submits that the crashes of 6 May 2010 or of October 1987 or of 2007–2008 were not any more abnormal than the March 2011 earthquake in Japan or the April 1906 quake in San Francisco. Market economies are self-referential and self-propelling systems intensely propelled by expectations and perceptions, and these systems regularly foster explosive amplifying feedbacks. Buchanan (2013) asserts that it is not easy to foretell the instant when a bubble will collapse, and equilibrium economics has resolved, therefore, that bubbles do not exist. A classic example is the refusal of Eugene Fama to admit

to the existence of bubbles, for example in an interview in November 2013 on National Public Radio's *Planet Money*. Fama states that the word 'bubble' drives him crazy given that there is nothing to prove that anyone can predict when prices will go down, claiming that markets work and so bubbles cannot be predicted (Fama and Shiller, 2013).

The first comprehensive research on daily stock returns was done by Fama (1965) who discovered that stock returns were negatively skewed, therefore more observations were in the left-hand tail than in the right-hand. Furthermore, the tails appeared fatter and the peak round the mean was higher than what the normal distribution predicted. According to Corhay and Rad (1994), empirical findings reveal the existence of non-linear dependencies that the random walk model fails to explain. Sterge (1989), in an additional study of financial futures prices of treasury bonds, treasury notes and Eurodollar contracts, finds the same leptokurtic distributions. Sterge (1989) notes that "very large (three or more standard deviations from the norm) price changes can be expected to occur two to three times as often as predicted by normality." i.e., they have fat tails.

British hydrologist H.E. Hurst published a paper in 1951 with the title "Long-Term Storage Capacity of Reservoirs", which dealt with modelling of reservoirs, while he was trying to find a way to model the river Nile levels so that architects could build a reservoir of appropriate size (Peters, 1996). This work by Hurst paved the way for a statistical methodology that distinguishes random from non-random systems and for identifying the persistence of trends – a methodology referred to as rescaled range analysis (R/S analysis) (Mansukhani, 2012).

While researching the fractal nature of financial markets, Mandelbrot chanced on Hurst's work and recognised its potential and therefore introduced it to fractal geometry (Mansukhani, 2012). The Hurst exponent measures long-term memory of time series. The exponent relates to the autocorrelations of a given time series, and the rate at which such autocorrelations diminish as the lag between pairs of values increases. According to Peters (1996), a higher value of  $H$  depicts less noise and more persistence and a more distinct trend than lower values with higher values showing less risk albeit exhibiting abrupt changes.

Financial data are also virtually always not normally distributed even though most econometric techniques assume that they are. High frequency data regularly encompass additional 'patterns' which are the consequence of the way the market operates, or the way prices are documented (Brooks, 2008). Peters (1991) describes capital markets as an evolving system similar to any



natural system such as the earth that needs to be in disequilibrium in order to survive. He states for example that equilibrium in any system implies the death of the system pointing out that “The moon is in equilibrium. The moon is a dead planet.” (Peters, 1991: 4)

Former chief economist of the World Bank and former United States treasury secretary Lawrence Summers in a study with David Cutler and James Poterba concluded that large moves in the stock markets occur in days without any recognisable major news announcements or information therefore casting doubts on the assertion that movements in stock prices are fully explicable by information about discount rates and future cash flows (Cutler, Poterba and Summers, 1988). The work of Cutler et al was instigated by a presidential address by Richard Roll (1988) to the American Finance Association where he drew the conclusion that only about one-third of market indices variations are as a result of economic influences (Cornell, 2013).

Fair (2002) extended the work of Cutler et al (1988) by spotting big variations in records of the futures contracts of the S&P 500 over less than five-minute periods, and matching them to pieces in newswire reports. Searching for related news in the Associated Press Newswire, Dow Jones News Service, *Wall Street Journal* and *New York Times*, his findings showed that most significant market movements do not appear to be associated with any plausible information emanating from news. Overall, among the 1,159 events, he was only able to locate plausible news reports for just 69 concluding that it is difficult to point out why some variations are as a result of new information reaching the market and why some are not.

Buchanan (2013) maintains that just as in any natural dynamic system, positive feedbacks – the process by which minor variations in a particular system can become increasingly large – better explains the dynamics of financial markets. He cites the flash crash of May 2010 as an example of how between the opening of the market and noon, the Dow Jones Industrials had plummeted by 2.5 percent as a result of a trade by a single investor – Waddell and Reed Financial Inc. – selling \$ 4.1 billion E-mini stock index futures through a computer program which sold the futures little at a time spread over the day to prevent prices from being driven down as selling has the effect of driving down prices. Regardless of how cautious the computer program was designed to trade, the action of this single investor triggered an explosive series of events that eventually led to the flash crash. The consequence was that in three and half minutes, the stock of Proctor & Gamble lost a third of its value, the stock of Accenture plummeted to less than a penny per share and the Dow Jones Industrial Average lost 9.2 percent

of its value in a few minutes making it the largest drop ever in such a short time. This incident was reported by Bowley (2010) in the *New York Times* as “Lone \$4.1 Billion Led To “Flash Crash” In May”.

Eugene Fama, addressing the 65<sup>th</sup> CFA Institute Annual Conference held in Chicago however defended the Efficient Market Hypothesis asserting (Harrison, 2012):

“...I don’t think it was a financial disaster that caused an economic disaster. I think you can’t reject the hypothesis that it was an economic disaster that caused the financial disaster... It’s hard to think that if there wasn’t a pretty significant recession that the financial system would come crashing down.”

However, economist and Nobel laureate Paul Krugman claims that the “efficient market theory” is the reason why many economists fail to acknowledge the housing bubble even though text book economics always put forward the “EMT as a baseline, not a revealed truth.” (Krugman, 2013).

While classical finance assumptions view incidents such as market crashes as isolated cases and abnormal, studies by Nanex – a company that records data on all types of financial activities – suggest that these kinds of events are pervasive in the financial market of the United States. According to Buchanan (2013), Nanex documented 139 perplexing moves in individual stocks in the first three months of 2011 with stocks falling one percent or more within a second and recovering thereafter. There were 1818 crashes in 2010 and 2715 in 2009. The flash crash of May 2010 attracted attention simply because of its magnitude.

Farrell (2013) reports that although there has not been any major flash crash since 2010, flash crashes have nearly become a daily occurrence with stocks rapidly plunging and making an immediate rebound. Stocks of companies such as Apple (AAPL), Berkshire Hathaway (BRKA), Aon Plc. (AON) and Hanesbrands (HBI) all experienced quick drop in prices and a quick rebound with Hanesbrands’ stock losing 3% in less than a half second and immediately rebounding on February 5, 2013. Even though such mini crashes are not made public by the stock exchanges, most active traders claim at least a dozen such crashes on a daily basis (Farrell, 2013).

Thurner, Farmer and Geanakoplos (2012) posit that fat tails are caused by the purchasing of assets with leverage and margin calls, maintaining in their study that when funds do not trade with leverage, asset price fluctuations are uncorrelated and normally distributed across time. Increasing leverage leads to amplified price fluctuations, fat tailed distributions and the display of clustered volatility. This volatility according to Thurner et al. (2012) are as a result of nonlinear feedback which intensifies large downward movement of prices which at the extreme cases cause crashes even though the effect can be seen at every time scale which produces a power law of asset price disturbances.

### **3.3 CHAOS THEORY**

Chaos theory studies systems that appear to follow a random behaviour, but form part of a deterministic process. The random nature is because of sensitivity to preliminary situations that move the system to a state of random dynamics. This random dynamic is however restricted by a higher deterministic framework and therefore there always is some form of order that underlies such unpredictable dynamics. “In Chaos there is order, and in order there lies chaos” (Sardar and Abrams, 2005: 18).

The adoption of Chaos Theory as a major paradigm in science saw immense advancement for scientific research by opening up the possibility to investigate the complexities and roughness in natural systems which prior to were not possible given the rigid assumptions, methodological reductionism and mathematical formalism of preconceived ideas. This theory however was rejected in the field of finance and economics as that would have rendered all statistical tools for analysis obsolete. This rejection however has led to the use of inadequate language and methods in addressing current complexities in financial markets (MacKenzie, 2006).

Mathematicians were historically the first to show interest in chaos theory and works involving dynamic deterministic systems generating random behaviours have been carried out since the 1800s. Biologists have been using chaotic deterministic systems to study the evolution of populations from the 1970s (May, 1976).

### **3.4 Fractal Market Hypothesis (FMH)**

A fractal is a figure that comprises parts that are similar to the main figure itself, therefore appearing approximately the same regardless of the scale observed. Scaling a fractal up or down

by the same amount still results in self-similar patterns. Figure 3.2 below is a fractal generated by adjoining the middle points of a triangle to create four different triangles with the one in the centre cut out later. The process is carried on infinitely until the final figure is observed.

**Figure 3.2: The Sierpinski Triangle**



**Source:** Mandelbrot and Hudson (2014)

Benoit Mandelbrot, who is regarded as the father of fractal geometry, first discovered the distinguishing characteristics of fractals in financial time series, but many economists rejected his ideas so he lost interest in fractals in finance, and turned to physics. In the field of physics, he developed the fractal geometry of nature (Velasquéz, 2009). Mandelbrot spotted that the variance of prices misbehaved, culminating in abnormally big changes. This behaviour was manifested in “fat-tail” and high-peak distributions, which commonly followed a power law with the implication that graphs will not descend toward zero as strikingly as a Gaussian curve. However, the most distinctive property was that these leptokurtic (fat-tail and high-peak) distributions seemed unchanged irrespective of time scale (weekly, monthly or yearly). Mandelbrot therefore concluded that “the very heart of finance is a fractal” (Mandelbrot and Hudson, 2014:147).

However, an MIT professor and efficient market theorist - Paul Cootner – pointed out that “Mandelbrot, like Prime Minister Churchill before him, promises us not utopia but blood, sweat, toil and tears. If he is right, almost all of our statistical tools are obsolete— least squares, spectral analysis, workable maximum-likelihood solutions, all our established sample theory, closed distribution functions. Almost without exception, past econometric work is meaningless.” (Cootner, 1964: 337).

Peters (1994), followed up on his earlier criticism of the EMH (Peters, 1991) and proposed the FMH, a hypothesis that offers a new method for modelling the deterministic characteristics and conflicting randomness of financial markets. The FMH appears to be a robust theoretical input

that provides an explanation of the discontinuity, turbulence and non-periodicity that typify financial markets.

The FMH has as its cornerstone, a focus on the heterogeneity of investors with regard to their investment horizons. Financial markets consist of the investors with varying investment horizons spanning a few seconds up to several years. Investors with diverse investment horizons react differently to information. A particular set of information can be interpreted by a short-term investor as a sell signal but interpreted by a long-term investor as a buy opportunity. Differing investment horizons ensures that financial markets function in a stable manner. The presence of investors with various investment horizons is vital for a stability and smooth operation of financial markets (Rachev, Weron and Weron, 1999, Weron and Weron, 2000). FMH posits that during stable periods of financial markets, all the different horizons are equitably represented therefore there is a smooth clearing of demand and supply on the market. Conversely, during highly volatile periods such as in a crisis, even some long-term horizon investors switch to short-term horizon which becomes the dominant horizon therefore the demand and supply of the differing groups of investors are not cleared efficiently.

Kristoufek (2012) concluded in a study on the three most liquid indices in the United States - DJIA, NASDAQ and S&P 500 – that the EMH does not sufficiently explain the behaviour of financial markets during the Global Financial Crisis, arguing however that the FMH provides an adequate explanation of the behaviour of financial markets during this period. Kristoufek (2013) further posit that short investment horizons characterised the most turbulent periods of the Global Financial Crisis, this mismatch between short and long term investment horizons led to liquidity problems which is in line with the assertions of the FMH. Dar, Bhanja and Tiwari (2015) also test the assertion of a dominant investment horizon during financial crises. Using the wavelet power spectra based on continuous wavelet framework in line with Kristoufek (2013), Dar et al (2015) conclude that equity markets around the world exhibited the dominance of higher frequencies during the period of the crises, thereby, validating the assertions of Fractal Market Hypothesis.

Van der Merwe (2015) defines a liquid market as one in which large volumes of trade can be executed immediately with minimal effect on prices. Fisher Black (1971), co-author of the Black-Scholes option pricing model, defined a liquid market as one where:

- There is always a bid-ask price for investors who want to immediately trade small amounts of stocks.
- There is a small difference between bid and ask prices.
- Investors trading large amounts of stocks, without any special information, can do so over a long period at prices that are on average, not different from current market prices.
- Investors can trade large blocks of stock immediately, perhaps at a premiums or discounts dependent on the size of the block with larger blocks attracting larger premiums or discounts.

Financial markets provide a stable and liquid environment, that facilitate trading activities. Financial markets create this stability through “investors with different horizons, different information sets, and consequently, different concepts of ‘fair price’” (Peters 1994: 43).

Investors with differing time horizons will evaluate information differently. For example, since day traders are only concerned with the daily prices of securities, they will focus mainly on recent trends while ignoring information concerning prices of such securities in the long-term. Investors with long-term horizons however, will set long-term investment objectives and will therefore be more interested in the long-term prospects. As a result of this differences in investment horizons, investors will have diverse opinions on what a fair price is. Consequently, information that flows into financial markets impact each investment horizon differently. For example, new information that may lead to a decline in prices in the short-term triggering a sell signal among short-term investors may attract long-term investors who will take the opposite side of the trade and thereby providing stability in the market. They buy these stocks because they regard such information as noise and therefore willing to bear the short term distress (Peters, 1994).

Generally, investors share the same degree of risk once with subsequent adjustments for the range of investment horizons. In fact, such “shared risk explains why the frequency distribution of returns look the same at different investment horizons” (Peters 1994: 46), and is responsible for the fractal nature of financial markets. The market will become unstable if it loses its “fractal” nature. Market failures may occur when there are major uncertainties in long-term expectations. Wars, political crisis and natural disasters for example, can alter the fundamentals of financial markets. In such periods, long-term investors affected by such events, will adopt a short-term approach or totally avoid investing in the market. Shortening positions leads to a dry

up of liquidity and subsequently a critical period where markets become highly volatile. Peters (1994) posits that so far as market participants with differing investment horizons are active in the market, a panic in one group can be easily contained by other horizons who will view such event as an opportunity to buy or sell. Conversely, if the market wholly assumes the same horizon, or a crucial segment of the market stay away from market activities, then the market will become unstable. In this situation, the non-existence of liquidity eventually culminates in a panic.

**Table 3.1: Comparing the EMH and FMH**

	<b>EFFICIENT MARKET HYPOTHESIS</b>	<b>FRACTAL MARKET HYPOTHESIS</b>
<b>Emphasis</b>	Fair asset prices and efficient markets	Liquidity
<b>Market cycles and memory</b>	Past events have no effect on future prices as markets behave in a random manner	The path of the market is determined by past events thereby exhibiting deterministic order making short-term predictions possible.
<b>Market</b>	Market has a single equilibrium and always in equilibrium with deviations that are highly infrequent and negligible deviations.	There are different equilibria for each investment horizon therefore the market cannot reach just a single equilibrium
<b>Distribution</b>	Normal distribution	Fat tails and high peaks

On the JSE, Jefferis and Smith (2005), adopting a GARCH methodology with time varying parameters, and employing a test of evolving efficiency (TEE) over the period 1990 to 2001, concluded that the JSE is weak form efficient. Smith (2008), however, rejects the random walk hypothesis on the JSE, using tests of four joint variance ratios. Adelegan (2003, 2009) also finds the Nigeria Stock Exchange (NSE) to be informationally inefficient, by testing the reaction of market participants to changes in dividend policies of listed firms.

### **3.5 Summary**

Whereas the EMH assumes a single investment horizon, the FMH assumes several investment horizons with investors in the various horizons assuming the “counter-positions” thereby providing liquidity in the market all the time therefore ensuring stability of the market. The FMH therefore provides an alternative hypothesis on the behaviour of financial markets and provides an explanation to why financial markets fail leading to financial crises whereas the EMH simply brushes these crises aside simply as anomalies.

The following chapter discusses financial crises. The chapter looks into why financial crises keep recurring, provides a description of the different categories of financial crises and reviews some noteworthy financial crises that have occurred over time.



## **CHAPTER FOUR**

### **FINANCIAL CRISES**

Contrary to classical finance theories, financial markets have over the years exhibited inefficiencies with market participants repeatedly making sub-optimal decisions with debilitating consequences. This chapter discusses the causes of financial crises and some major crises portraying centuries of irrational choices that have all culminated in financial crises with remarkable similarities regardless of the period or country in which such crises occurred. Among other crises, this chapter discusses the tulip mania as happened Holland in the seventeenth century, the eighteenth century South Seas bubble, the boom and bust of the stock market the 1920s resulting in the Great Depression, the dotcom boom and crash of 1996 to 2000, more recently, the 2002 -2007 sub-prime mortgage housing crisis that led to the Great Recession.

#### **4.1 Why Financial Crises Keep Recurring**

Accurate valuation of assets is very crucial in financial markets. According to classical economics, prices are determined by negotiation between rational buyers and rational sellers regarding the worth of such assets and are therefore rightly priced to reflect their fundamental values. History has however proven time and again that at regular intervals, prices can significantly deviate from their fundamental values culminating in bubbles and eventual crashes with catastrophic circumstances. These circumstances are precipitated by a particular event, expectation, or some novel developments that kick starts rapid appreciation of asset price. The rise in asset price attracts more investors seeking to profit from such asset and therefore feeding into the rapid price acceleration. The momentum generated further attracts even more investors. During such periods, the new investors disregard or are totally oblivious of the sustainability of such rapid price acceleration, and only buy with the intention to sell at an even higher price.

There is also a deeply rooted belief among market participants that “financial crises are things that happen to other people in other countries at other times; crises do not happen to us, here and now. We are doing things better, we are smarter, we have learned from past mistakes.” During such periods, the rules of fundamental valuations are no longer applied. (Reinhart and Rogoff, 2009: 1). Reinhart and Rogoff (2009) describe this as the ‘this-time-is-different

syndrome' where market participants are convinced that circumstances that precipitated prior financial crises are clearly known and understood and have no semblance to their own situation and therefore are insulated from the recurrence of such crises. Throughout the history of financial markets however, all major crises have striking similarities: a failure to acknowledge the precariousness and capriciousness of confidence in what former United States Federal Reserve Chairman Allan Greenspan refers to as 'irrational exuberance'. In a speech at the Annual Dinner and Francis Boyer Lecture organized by the American Enterprise Institute during the 1990s Dot-com bubble, Greenspan (1996) intimated: "...how do we know when irrational exuberance has unduly escalated asset values, which then become subject to unexpected and prolonged contractions as they have in Japan over the past decade?". 2013 Economics Nobel Laureate Robert Shiller believes that the overall market is driven by psychology (Shiller, 2016), on the contrary, Eugene Fama a co-winner of the 2013 Economics Nobel Laureate contends that such contractions are not as a result of market inefficiencies but rather the, markets displaying efficiency by foretelling impending economic crisis as financial crises always precede economic downturns or recessions and the crash tends to be more severe, the bigger the recession. The market is therefore simply predicting bad times which is exactly what one will expect from an efficient market – predicting as accurately as possible what is going to happen to the economy (Fama, 2016).

Donald Rapp on the other hand argues that the process through which booms transform into bubbles and subsequent busts are as a result of, usually, a legitimate basis for the expectation of substantial future growth. For example, in the 1920s, the extensive electrification and the growth in the use of automobiles and development of highways, or the advent of, and proliferation of personal computers as well as the internet in the 1990s. This attracts huge investments of new money, in the process producing a boom which develops into a bubble as the initial basis for such investments is increasingly supplanted by momentum trading where speculators get involved and mainly invest because they expect persistent appreciation in the price of the asset regardless of its fundamentals. More speculators get sucked into this vacuum as asset prices steadily appreciate and ultimately, when such rate of appreciation reaches unsustainable proportions, the bubble busts (Rapp, 2014). Jeffrey Gundlach, CEO and CIO of DoubleLine – an asset management firm in the United States - further argues that recessions do not drive financial markets, it is rather, the other way around (Krisiloff, 2016).

In what they describe as “the illusion of a perpetual money machine”, Sornette and Woodard (2010) argue that the ‘this-time-is-different syndrome’ coupled with financial innovations can lead to acceleration of wealth. However, just as in physics, the perpetual motion machine violates the fundamental laws and is impossible, similarly, it is impracticable for an economy expanding at a real rate of 2–3% per annum to keep generating a profit of 10–15% per annum. The overall growth in wealth has to be equal to the rate of growth of the economy.

In describing why financial markets are dogged with boom-bust phenomena, George Soros applies his General Theory of Reflexivity. He argues that reflexivity creates a feedback loop between valuations and the fundamentals being valued. This feedback can be positive or negative. A negative feedback draws market prices and the underlying reality of fundamentals closer together. Negative feedback is self-correcting. This can go on indefinitely and if the fundamentals remain the same, it may ultimately lead to an equilibrium where the fundamentals are accurately reflected in market prices. A positive feedback on the other hand is self-reinforcing. It cannot however, go on forever unlike a negative feedback because eventually, market prices will deviate so much from reality that market participants would recognize them as unrealistic. When this tipping point is finally reached, a self-reinforcing process in the opposite direction ensues. This is how boom-bust phenomena are created in financial markets (Soros, 2010).

## **4.2 Financial Instability Hypothesis (FIH)**

Hyman Minsky (1992) proposed the FIH which argues that financial crises are pervasive in capitalism mainly because in times of economic prosperity borrowers and lender tend to be increasingly optimistic and reckless. This excessive optimism and recklessness create financial bubbles which eventually bust. Capitalism therefore is disposed to moving from periods of stability to instability. Minsky posits that during periods of prosperity when cash flow of corporations increases beyond what is necessary to defray debt, a speculative frenzy builds up, and consequently debts rise beyond what can be paid off from incoming revenues, eventually leading to financial crisis. Banks and other lenders tighten the availability of credit, due to such speculative borrowing bubbles, even to companies that can pay back such loans and subsequently, the economy contracts. According to Minsky (1974), one of the fundamental characteristics of the economy, is that its financial markets swing between fragility and

robustness which are part of the mechanism that creates business cycles. Financial markets slowly moving from stability to fragility then followed by crisis, is sometimes describes as "Minsky moment" and refers to Minsky's academic work in this field. According to economist and Wall Street money manager Henry Kaufman, Minsky provided some great insights in the 1960s and 1970s when the relationship between the economy and financial markets were not well understood and showed that financial markets can move to excess frequently (Uchietelle, 1996). FIH, which is a model of the credit system incorporates many ideas already promulgated by Alfred Marshall, John Stuart Mill, Irvin Fisher and Knut Wicksell (Kindleberger and O'Keefe, 2001).

Given these inevitable financial market swings, and the accompanying booms and busts in a free market economy, Minsky proposed among other tools, government interventions through regulation and central bank actions. Minsky opposed the deregulation that characterized the 1980s in the United States and stressed the primacy of the Federal Reserve as the lender of last resort and while arguing against the excessive growth of private debt in financial markets (Uchietelle, 1996).

### **4.3 Categories of Financial Crises**

According to Reinhart and Rogoff (2009), financial crises can be classified quantitatively or by event.

#### **4.3.1 Quantitative Definition of Financial Crises**

Inflation crises, currency crashes, currency debasements and the bursting of asset price bubbles are crises that can be quantitatively defined.

- **Inflation Crises**

Many studies apply a twelve-month threshold of 40% or greater, as a sign of an event of high inflation. A hyperinflation also refers to periods of monthly inflation rate of 40% or greater. However, for periods before World War II, even a 40% per year threshold is considered too high and a 20% threshold more appropriate since inflation rates were very low during such period particularly before the introduction of fiat currency. The median inflation rates were 0.5% per annum for 1500 – 1799 and 0.71% for 1800-1913. These pre WWII inflation rates were relatively low compared to 5% for 1914-2006 (Reinhart and Rogoff, 2009).

- **Currency Crashes**

Frankel and Rose (1996) define a currency crash as a depreciation of at least 25% of the nominal exchange rate which is also at least 10% increase in the nominal rate of depreciation. Reinhart and Rogoff (2009) believe this is the most frugal definition as it is not dependent on other factors like reserve losses and interest rate hikes but believe that similar to inflation, the threshold to periods prior to WWII may be too high and suggest a threshold of 15%. Eichengreen, Rose, Wyplosz, Dumas and Weber (1995) posit that political instability, budget deficits and current account deficits, rapid growth of money and increase in price precede devaluations.

- **Currency Debasement**

The forerunner to modern foreign exchange crises and inflation was currency debasement during the period when the principal means of transaction was metallic coins (Reinhart and Rogoff, 2009). It describes the act of decreasing the value of a currency. Debasement is principally used in reference to commodity monies like silver or gold coins. There is a debasement of a coin when the quantity of silver, gold, nickel, copper is reduced.

- **Bursting of Asset Price Bubbles**

When the prices of assets or other securities rise aggressively and persistently that they far surpass valuations supported by fundamentals (forming asset bubbles), there is a likely subsequent and sudden collapse (when the bubble bursts).

### **4.3.2 Financial Crises by Event**

Financial crises that are described by event are those that cannot be readily described in a strict quantitative sense. They are: bank crises, external debt crises and domestic debt crises (Reinhart and Rogoff, 2009).

- **Bank Crises**

Banking crises consist of either waves of costly bank failures or panics and were historically rare compared to the present. Panics and waves of failures do not always occur together, they are not random events, they do not usually accompany business cycles or errors of monetary policy and cannot be viewed as the unavoidable result of human nature or the liquidity altering

make up of bank balance sheets. It is rather the risk-inviting microeconomic rules established by government that have always been the fundamental added necessary condition to creating a propensity for banking crises (Calomiris, 2009). Banking crises are classified by event as opposed to quantitatively due to the nonexistence of a long-range data of time series that will permit dating banking crises quantitatively (Reinhart and Rogoff, 2009).

- **External Debt Crises**

According to the International Monetary Fund, gross external debt is the amount of disbursed and outstanding liabilities of a country to nonresidents. Depending on the contract, the principal may be paid with or without interest, or interest paid with or without the principal (IMF, 2003). External debt crises involve downright default on a government's external debt obligations issued under the jurisdiction of another country.

- **Domestic Debt Crises**

Domestic public debt is issued under the legal jurisdiction of the issuing country. This debt in most countries, historically, has been almost always issued in the local currency and mainly held by residents. Relative to external debt, there exists very little information on sovereign defaults on domestic public debt. Prior to the 1980s and even recently, cross-country data on domestic debt remains exotic (Reinhart and Rogoff, 2011). Domestic debt crises usually do not involve powerful external lenders. This may be the reason why lots of incidents of domestic debt crises go unnoticed and also the little representation in academic literature (Reinhart and Rogoff, 2009).

## **4.4 SOME NOTEWORTHY FINANCIAL CRISES**

This section discusses the different kinds of financial crises that have occurred through history starting with the tulip mania in the Netherlands in 1636–1637 when trading tulips was a national mania leading otherwise rational investors into mortgaging a great deal of valuable assets to invest in tulips. The section ends with a discussion of the recent Global Financial Crisis.

### 4.4.1 Tulip Mania

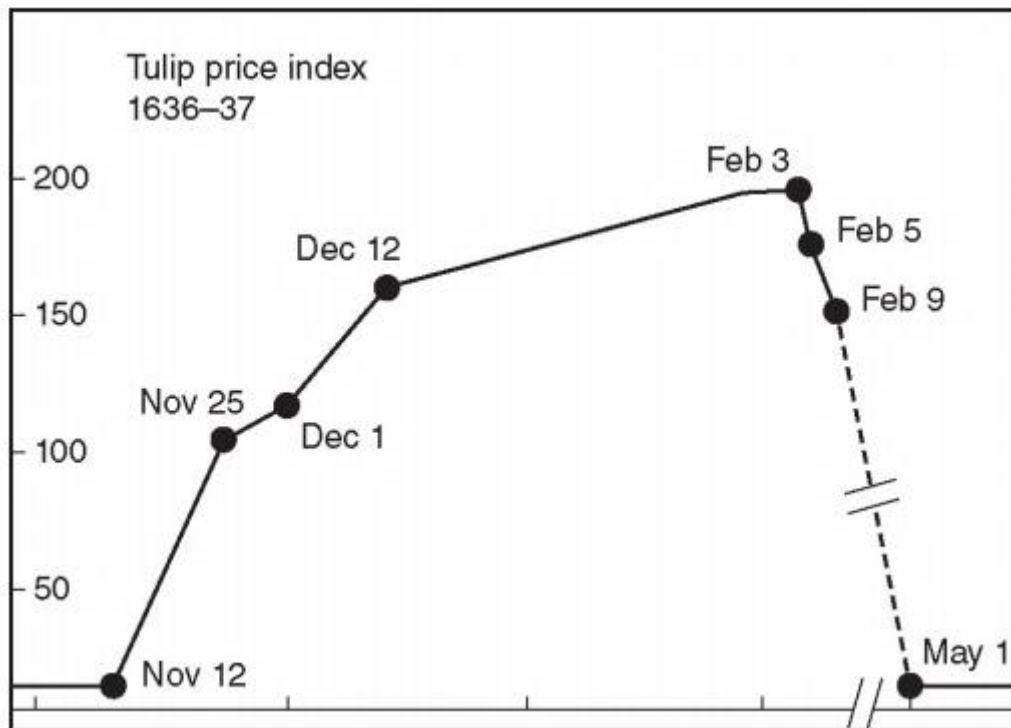
There are very few financial crises more popular in the history of financial crises than the tulip mania that captivated the people of Holland in the early 1500s. Tulip was introduced in Europe by the ambassador of Ferdinand I, Ogier de Busbecq, Holy Roman Emperor to the Sultan of Turkey. He sent the first tulip seeds and bulbs from the Ottoman Empire to Vienna in 1554 (Knight, 2014). Tulip bulbs soon were in circulation in many parts of Holland (Brunt and Walsh, 2005) with its popularity gaining momentum around 1593 after Carolus Clusius, a Flemish botanist established the hortus academicus where he took up a position at the University of Leiden. There he discovered that the bulbs could withstand the harsh conditions of the Low Countries (Dash, 2011, Goldgar, 2008).

The bulbs were placed into three categories: the single coloured, the multi-coloured, and the “bizarres” which were the most popular and rarest tulip. What made the tulips unique was as a result of a virus called breaking virus that inhibited the ability of the flower to have uniformity of petal color. The virus was so named because it breaks the lock of the plant on a single petal color without killing the plant but causing striking effects in the form of mosaic-like flames of colour on the petals (Knight, 2014).

It could take approximately 7 to 12 years of cultivation from a seed to a flowering bulb and produced only one or two offsprings in a year and the parent bulb lasted a few years before it perished. Cultivating the regular tulips was a very challenging task and even more challenging to cultivate the rare varieties as the virus weakened the flower, usually preventing it from creating clones thus any bizarre variety needed new plants to be cultivated from seeds. The period of time needed for the growth of the plant made the most appealing varieties continue to remain rare (Knight, 2014).

The virus had beautiful effects on the flowers and made them highly coveted and given the scarcity, they were expensive. Growers gave their new varieties glorifying titles. Some earlier forms had the prefix of admiral and often combined with the names of the growers: for example, Admiral van der Eijck was probably the most coveted among around fifty of such varieties. General was also a prefix that was used for about thirty other types of tulips and later varieties had even more flamboyant names (Dash, 2011).

**Figure 4.1: Tulip Price Index**



**Source:** Thompson (2007: 101)

As the flowers became increasingly popular, professional cultivators paid very high prices for the bulbs especially the ones with the virus. By 1634, speculators began to enter the market, partly as a result of demand from France (Garber, 1989). The contract price for the rare bulbs soared progressively throughout 1636, and by November that year, even the common, "unbroken" bulbs experienced tremendous price increases as well, such that any tulip could sell for some hundreds of guilders. During this same year, a formal futures market was created where contracts to trade bulbs during the end of the season were available where parties were not required to put up an initial margin and there was no mark-to-market margin as well. All the contracts were with individual counter-parties and not the Exchange. These contracts were known as "wind trade", since no bulbs actually changed hands. The whole business was not carried on in the Exchange itself but rather conducted on the margins of Dutch economic life (Goldgar, 2008).

In Amsterdam, the Calvinists viewed with consternation and trepidation the extent of speculative fever creeping up in the country. The virtues of moderation, hard work and



discretion had been discarded for the alluring and easy profits that came from trading in paper. A single bulb could trade for as much as the equivalent of 10 times the annual salary of an experienced craftsman and an entire estate could be traded for one “bizarre” bulb (Knight, 2014).

The tulip had become the fourth major export of Holland by 1636 as the prices kept increasing due to speculations in the futures market by traders who had never seen the bulbs. Many traders made fortunes while others had their fortunes wiped out overnight (Schama, 1988). During the winter of 1636-37, the tulip mania reached its peak. Some bulbs were reported to have changed hands about ten times within a day although no deliveries were made to complete any of these. In Haarlem, buyers for the first time, failed to pitch up at a scheduled tulip auction. This might have been as a result of Haarlem experiencing a spate of the bubonic plague. This plague might have in part created a society of fatalistic risk-takers allowing the speculation to increase rapidly in the first place, this same plague might have also led to the bursting of the bubble (Garber, 2001).

If the rapid increase in tulip prices was momentous, the decline in the prices was all the more so. In just a week, a bulb that had sky-rocketed 26 folds by January 1637 had its value drop by about 95%. Citizens requested that the government do something about the situation but this proved futile. The Dutch judges viewed all the tulip contracts in circulation to be nothing than gambling debts therefore there was no recognition of such contracts in the legal system therefore buyers were not considered liable for agreed-upon prices to sellers as such contracts were not enforceable (Knight, 2014).

#### **4.4.2 The South Sea Bubble**

Britain found itself highly indebted in prosecuting the War of Spanish Succession (1701-1714). During an internal audit, it was discovered that the various bonds owed amounted to £9 million with no specific means of defraying the debt. The prospects of the government bonds being honoured were so poor that they were priced at around 50% discount in the public market (Knight, 2014). A scheme was created in 1711, as a form of private organization that will take over the debt and manage it. The capitalization was supposed be simple as the company would be created with a trading monopoly backed by the government and allowed to trade in South

America with the Spanish colonies a zone commonly known as the South Seas. This new entity was therefore named The South Sea Company (Knight, 2014).

The South Sea Company was officially known as The Governor and Company of the merchants of Great Britain, trading to the South Seas and other parts of America, and for the encouragement of fishing (Dale, 2004) was formed as a public-private partnership aimed at consolidating and reducing the cost of Britain's national debt.

The South Sea itself was the main appeal of the South Sea Company. Lucrative trade routes granted by Spain and sailed by Britain. The company made it appear as if the all that was required was to load some ships with clothes and wool, sail to South America, exchange with the natives for some precious metals and gems and return them to Britain. It was however impossible to make such lucrative gains when one looked at the true details of the treaty with Spain. The agreement allowed Britain to provide on a yearly basis, 4,800 slaves to the Spanish colonies for 30 years. The constraints were extremely strict for other merchandise. The treaty stipulated that Britain would be allowed just a single ship of at most 500 tons for any given year and 25% of the profits including 5% of the balance must be paid to the King of Spain if the trade from such ship proved to be profitable. Such monopoly could not possibly be lucrative given such strict treaty. The prospects were further worsened by the war that broke out between Spain and Britain. The few assets in South America owned by South Sea Company were confiscated, leading to a loss of £300,000. At this point, the company was merely an office in Britain that held government bonds (Knight, 2014).

Similar to the Louisiana territory of France, there existed an intense sense of enigma on the ability of Britain to gain prospective riches in South America. Generally, they believed that the supposedly primitive people of South America would happily trade mountains of jewels and gold and for comparatively valueless fleece and wool clothing of Britain. This turned out to be a false expectation. In fact, it was after seven years since the creation of South Sea Company before a trading ship finally sailed to trade. This trade had nothing to do with precious metals but rather, slaves (Knight, 2014).

Stories of the John Law's successes in France generated similar eagerness in Britain concerning some new frontiers of enterprise and finance. Rumors of soaring value of Law's bank stocks inspired hopes in Britain. 1720 began with increasing interests in publicly traded company stocks similar to the enthusiasm in the United States for technology company stocks some 275

years later (Knight, 2014). The company's stock increased tremendously in value, reaching a peak in 1720 before finally collapsing at the end of the summer of 1720 dropping by a factor of 8 in September. Many people in Britain lost all their money (Rapp, 2014).

Adam Smith commented on the South Sea Bubble that "They had an immense capital dividend among an immense number of proprietors. It was naturally to be expected, therefore, that folly, negligence, and profusion should prevail in the whole management of their affairs. The knavery and extravagance of their stock-jobbing operations are sufficiently known [as are] the negligence, profusion and malversation of the servants of the company" (Smith, 1776: 703-4).

It is reported that Isaac Newton, in the spring of 1720 stated: "I can calculate the motions of the heavenly bodies, but not the madness of people." On April 20, he sold his stocks in the South Sea Company for £7000 making a 100% profit. Later, he was swept by the mania and bought larger number of stocks near the market peak loosing £20,000 eventually. (Carswell, 1961: 131,199).

Some Dutch speculators however, profited from the bubble. For example, in April 1720, David Leeuw sold his holdings of South Sea stocks and purchased the stocks of Bank of England and East India Company and by the end of the same month. Dutch banker Crellius commented that Exchange Alley (a venue for the trading of shares and commodities) resembled "nothing so much as if all the Lunatics had escaped out of the Madhouse at once" (Wilson,1941:103,124).

The major aspect of The South Sea Company's business plan, which was to make profits from a trade route monopoly a was an illusion. After the crash, parliamentary enquiry was held to investigate its causes. Some politicians were humiliated, and people who were known to have made unlawful profits from the company had their assets impounded in proportion to their gains. The company was then restructured and operated for over a century after the crash with its headquarters in Threadneedle Street in London, in this street today the Bank of England can be found. During the period of this event, the company was also a private company that dealt in national debt and therefore consolidated its position after the crash as banker to the British government (Thornbury, 1878).

### **4.4.3 The Mississippi Bubble**

John Law (1705) circulated his economics treatise titled *Money and Trade Considered*, arguing against the use of currency backed by precious metal and in favour of fiat currency since the

use of fiat currency stimulates commerce. Smith (2004) discussed that the two fundamental concepts in this treatise were: (1) circulation of credit acts similarly as conventional currency, and (2) money supply stimulates commercial activity.

Some economists consider John Law to be the world's first Keynesian i.e., a person who believes that to address economic slowdown, there is a need for increased government spending (Knight, 2014). It is believed that the word millionaire emerged during the mania of Law and his Mississippi Scheme (Knight, 2014).

The Mississippi Bubble debacle began in 1715, when the French government was on the verge of insolvency as a result of debts accumulated during the Spanish Succession War. The government of France, headed by a group of regents as then King Louis XV was only five years of age, frantically tried to find a solution. The Duke of Orléans and leader of the group sought council of John Law who happened to be his friend. John Law, an early theorist of monetary economics viewed this as an opportunity to put into practice his monetary theory. Law received permission from the government of France in 1716 to create a national bank - Banque Générale - which received deposits of silver and gold and in return, issued "paper" bank notes which were not legal tender but acceptable as such since they were redeemable in the official currency of France. The reserves of Banque Générale was built up through issuance of stock and from the profits earned from managing the finance of the government of France (Colombo, 2012).

John Law established the Mississippi Company and obtained a monopoly to trade with Louisiana from the government of France which also included a plan to reduce the debt payments made by the government. The economy was in a very bad state and the government bonds were trading at a huge discount. John Law reached an agreement with the government of France that allowed him to trade shares in his company to the public for the government bonds at par value, and in turn the government would pay lower interests on the bonds he acquired. This agreement appeared beneficial to all parties however, in reality, the bondholders were trading discounted papers which at least, had tangible values for papers at par value but backed only by speculations and dreams (Rapp, 2014).

Initial response by the public was lukewarm, so Law added extra attractive terms, such as the exclusive rights to raise tobacco, trade in slaves and several merchandises coming from the Senegal (then a French colony) paid for with shares that have been newly issued. Law

aggressively hyped the prospects of the company with intense advertisements resembling a modern campaign of public relations and carried on a vast array of financial schemes that saw the stock rising steadily as interest from the public heightened (Rapp, 2014). The stock bubble created a buying frenzy of luxury items in reflecting a change in consumption patterns as a result of the dramatic increase in stock prices (Smith, 2004). Around the same period as the South Seas bubble, the Mississippi Company experienced a similar cycle where a runaway bubble was followed by a crash (Rapp, 2014).

#### **4.4.4 The Panic of 1837**

This panic occurred in the United States and triggered a major recession that dragged on into the 1840s. Wages, price and profits declined while unemployment increased. During this period, there was lots of pessimism among people. This panic had both foreign and domestic origins. Practices of speculative lending in the western states, coupled with a drastic fall in price of cotton, a bursting of land bubble, restrictive lending policies in Britain and international specie flows were all responsible for the crisis (Roberts, 2012). Banks in New York restricted specie payments on May 10, 1837 and would no longer permit the redemption of commercial paper in specie at par value. Regardless of the brief 1838 recovery, the recession continued unabated for about seven years. Businesses failed, prices declined, banks collapsed and lots of workers were laid off with unemployment reported to be 25%. The period of 1837 to 1844 was characterised by years of deflation in prices and wages (Rousseau, 2002).

#### **4.4.5 The Rich Man's Panic of 1907**

The Panic of 1907 which occurred in the United States is also referred to as Knickerbocker Crisis or the 1907 Bankers' Panic (Donaldson, 1988), was a crisis that occurred over a period of three weeks, and witnessed an almost 50% decline of the New York Stock Exchange from its previous year's peak. This precipitated a panic creating numerous runs on trust companies and banks. The panic later spread throughout the country when many local and state businesses and banks became bankrupt. Depositors losing their confidence and dry up of market liquidity by some banks in New York City were the major causes of the run and aggravated by side bets at bucket shops that were unregulated (Braunstein, 2009). The panic was set off by a failed bid to corner the market on the stocks of United Copper Company in October 1907. The banks that lent monies for this scheme experienced runs when the bid failed which later spread to

associated trusts and banks, and led to the collapse of New York City's third largest trust – the Knickerbocker Trust Company.

Had it not been for financier JP Morgan who intervened and pledged a sizeable sum of his money and as well as convincing other New York banks to do likewise to prop up the banking system, the panic might have even deepened further (Norton et al., 2011). The United States had no central bank during this period to implement policies that would provide market liquidity. The crisis had largely subsided by November only to be supplanted with a further crisis which was as a result of a big brokerage firm heavily borrowing and using the stock of Tennessee Coal, Iron and Railroad Company (TC&I) as collateral. The following year, the father-in-law of John D. Rockefeller, Jr., Senator Nelson W. Aldrich, set up and chaired a commission that investigated the crisis and proposed future solutions which led to the Federal Reserve System being established (Wells, 2004).

#### **4.4.6 The Great Depression**

The great depression of the 1930s in the United States is probably the most famous financial crisis in the world and had more enduring effects, lasted longer and ran deeper, than any other financial catastrophe in the history of the United States. The economic thinking forged during this period still dominates global financial structures to this day (Knight, 2014).

The depression began in the United States, after heavy decline in stock prices that started around September 1929, and made global news when the stock market collapsed on October 29, 1929 popularly referred to as Black Tuesday. Worldwide GDP fell by about 15% between 1929 and 1932. The magnitude of the depression becomes even clearer when compared to the Great Recession when worldwide GDP from 2008 to 2009 declined by less than 1% (Demeri, 2015). Some economies began recovering by mid-1930s although the negative impact of the depression remained until the start of World War II in many countries (Lowenstein, 2015).

The Dow Jones Industrial Average remained mostly unchanged for the first twenty years of the twentieth century although it experienced five distinct cycles of boom-and-bust. Had one invested on the first day of trading in 1900 in the Dow Industrials, her investments would have remained virtually the same in September 1921 (Knight, 2014).

According to Knight (2014), the subsequent appreciation in stock prices ensued in three phases:

The first phase, lasted from 24 August 1921, to 21 October 1926, and saw appreciation in stock values by about 60%, an annual compound rate of approximately 10%. This period saw a healthy and steady appreciation in stock prices which were mostly uninterrupted by the jolts witnessed in the prior two decades.

The second phase witnessed price appreciations which in retrospect, could be described as a bubble. Between the period of October 1926 and June 1928, stock values gained an additional 50% and a 20% annual gain. In this phase, stock price appreciation rates doubled.

Between June 1928 and August 1929 was the final phase, where the Dow Industrial appreciated by approximately 90% in a span of a little over one year. Thus, annual gains were almost triple that of the prior period as well as nine times what was witnessed from 1921 to 1926. Around this period, stocks became very popular, and people in positions of leadership for example Herbert Hoover, then United States Commerce Secretary, worried over the “orgy of mad speculation” that he was witnessing (Knight, 2014: 159). Moorhouse (1928: 676-677) in an article titled *What’s Wrong with Wall Street?* Published in the North American Review, wrote:

“Millionaires have been made many times over with the unprecedented rise of certain individual stocks. Of a list of twenty well-known stocks which have increased from 600 to 6,000 percent during the last ten years, twelve famous names appear above the 1,000 percent mark, with one outstanding motor stock heading the list with a 6,493 percent increase. No wonder our nation has gone stock market mad.”

However, Roger Babson, a respected economist, cautioned on September 5, 1929, almost at the exact peak of the market that (Knight (2014: 161-162)

“More people are borrowing and speculating today than ever in our history. Sooner or later a crash is coming and it may be terrific. Wise are those investors who now get out of debt and reef their sails This does not mean selling all you have, but it does mean paying up your loans and avoiding margin speculation. ... Sooner or later the stock market boom will collapse like the Florida boom. Some day the time is coming when the market will begin to slide off, sellers will exceed

buyers, and paper profits will begin to disappear. Then there will immediately be a stampede to save what paper profits then exist.”

Another highly respected economist and Yale professor, Irvin Fischer on the other hand is reported to have said that “stock prices are not high and Wall Street will not experience anything in the nature of a crash” (Shaw, 2015:95). On September 3, 1929, the Dow Jones Industrials reached a peak at 386.10 and began a gentle daily slide virtually, although no day was large enough to be interpreted as a panic. However, 50% of the value of the Dow Industrials was wiped between the peak of September 3 and November 11 with the greater parts of the decline taking place on October 23 when the market closed at 305.90; October 28 close of: 260.60 and October 29 close of 230.10. Ultimately, the market declined by 90% percent in two years’ time when on July 8, 1932, the final nadir of 40.60 was reached (Knight, 2014).

#### **4.4.7 The Latin American Debt Crisis**

During the 1970s and 80s, the global economy plunged into recession and oil prices increase astronomically, leading to a tipping point for many Latin American countries and some other developing countries as a result of an acute liquidity crunch. During 1973-74, petroleum exporting countries, flooded with lots of cash when oil prices increased, invested these monies with international banks and the banks in turn 'recycled' a significant portion of this capital as loans to governments in Latin American. The sudden increase in oil prices led many countries to borrow to cover the high prices. Believing these high prices would persist and permit them to pay off their additional debts, the oil producing countries also began borrowing heavily from these banks for further developments (Vincent and Melissa, 1994).

Increasing interest rates in Europe and the United States in 1979 led to increases in debt payments making debt payments difficult for the indebted countries (Schaeffer, 2003). Furthermore, exchange rate deterioration with the US dollar meant Latin American governments owed enormous amounts in their respective national currencies, which had lost purchasing power (Timmons, 2013) coupled with a decline in world trade during 1981, the prices of primary resources, Latin America's biggest export, also fell (Timmons, 2013).

Although the huge foreign debt build-up occurred over several years, the crisis actually started when international financial markets realised that the Latin American countries would be



unable to honour their debts. This became evident in August 1982 when Jesus Silva-Herzog, the Finance Minister of Mexico, announced that Mexico was not in a position to honour its debt (Pastor, 1987) and unilaterally declared a 90-day moratorium and further requesting a renegotiation of periods of payment as well as new loans in order to honour its existing obligations (Bruner and Simms, 1987, Bernal, 1991).

As a result of Mexico defaulting on its debt obligations, majority of commercial banks significantly reduced or stopped offering new loans to many Latin American countries. Given that a significant percentage of the loans to Latin America were short-term, a crisis arose when a quest to refinance was declined therefore billions of dollars in loans that prior to could be refinanced by the banks, were now due immediately. In order to avoid a financial panic, the banks restructured the debts and offered new loans with very strict terms in addition to requirements that the countries accept interventions from the IMF (Bruner and Simms, 1987, Bernal, 1991). Eventually, the United States and the IMF brokered a debt relief, admitting that the indebted countries cannot honour in full the considerable sums they owed (Krugman and Obstfeld, 2016).

#### **4.4.8 The Asian Financial Crisis**

In July 1997, the greater part of East Asia experienced a crisis which raised fears of a global economic meltdown as a result of financial contagion. This crisis began in Thailand when the Thai baht collapsed after the government of Thailand was forced to switch the baht to a free-floating currency due to insufficient foreign currency to support a currency peg to the U.S. dollar. During this period, Thailand had acquired a massive foreign debt that made the country practically bankrupt even prior to the collapse of its currency (EuroMoney, 1997). Majority of southeast Asian countries experienced currency depreciation, massive decline in stock markets and a significant increase in private debt (Yamazawa, 1998, Hunter et al., 2012).

The countries that were suffer the most from the crisis were Indonesia, South Korea and Thailand whereas the Philippines, Hong Kong, and Laos also were affected but on a lesser scale.

In some Association of Southeast Asian Nations (ASEAN), the foreign debt-to-GDP ratios increased from 100% to 167% from 1993 to 1996. During the worst period of the crisis, this ratio increased beyond 180%. However, in South Korea, the ratios increased from 13% to

21% and rose as high as 40%. Only in South Korea and Thailand did debt service-to-exports ratios increase (Asian Development Bank, 2003).

In Indonesia, President Suharto was forced to step down after 30 years in power, due to prevalent rioting that followed the sharp increase in prices caused by the devaluation of the rupiah. Growth in the Philippines almost dropped to zero in 1998. It was only Taiwan and Singapore that proved fairly insulated from the crisis, although both suffered severe hits in passing, the later was as a result of its size and geographic position between Indonesia and Malaysia. By 1999, analysts reported signs of economic recovery (Pempel, 1999).

#### **4.4.9 Russian Crisis of 1998**

On 17 August 1998, the Russian government and the Central Bank defaulted on its debt and devalued the ruble. The crisis was caused by a chronic fiscal deficit, a high and fixed exchange rate between the ruble and other foreign currencies aimed at avoiding public turbulence and a decline in productivity (Melloni, 2007). The economic consequences of the first war in Chechnya, which was estimated at about \$5.5 billion excluding the cost of rebuilding the ruined Chechen economy, also played a role in the crisis. The Russian economy had shown signs of improvement in the first half of 1997, but soon after, the difficulties began to intensify gradually (van de Wiel, 2013).

Russian foreign exchange reserves were severely affected by two external shocks, the fall in the demand and consequently, the price of crude oil and non-ferrous metals, and the Asian financial crisis (Hsu, 2013).

On 13 August 1998, the Russian currency, stock and bond markets experienced massive declines as a result of fears of a devaluation of the ruble and a domestic debt default. These fears were as a result of ongoing interest rate increases, capital outflows and a decline in investor confidence in emerging markets. Annual yields on bonds denominated in Russian Rubbles rose to more than 200%. Further, stock prices declined more than 75% since the beginning of the year to August.

The government also announced a set of emergency measures on August 17 aimed at preventing an escalation of the crisis. These measures included devaluing the ruble, defaulting on short-term Treasury Bills, and domestic long-term bonds, and a 90-day moratorium on payments to foreign creditors by commercial banks (van de Wiel, 2013).

The Russian Central Bank on September 2, 1998, decided to eliminate the currency corridor and made the ruble a free-floating currency. Consequently, the ruble depreciated sharply losing two thirds of its value in 3 weeks. The strong depreciation led to a rapid increase in prices with inflation in 1998 rising to 27.6% and 85.7% in 1999. Social unrest increased as a result of increases in food price (van de Wiel, 2013).

The Russian Deputy Minister of Finance, Mikhail Kasyanov on November 20, 1998, declared that Russia would only be able to repay less than \$10 billion of its \$17 billion foreign debt. In 1998, the economy contracted by 5.3% and per capita GDP was at its lowest level since the establishment of the Federation of Russia in 1991. Restructuring of sovereign debts occurred in 1999 and 2000 with an agreement with the IMF for \$ 4.5 billion loan, concluded in July 1999, to aid the country regain access to international capital markets. Subsequently, as a result of the Ruble's sharp depreciation, which continued in 1999, and an increase in oil prices, the economy recovered quickly and grew by 6.4%, 10% and 5.3% in 1999, 2000 and 2001 respectively. Inflation also fell from 85.7% in 1999 to 20.8% in 2000 and then 21.5% in 2001. The 13% unemployment rate in 1998 also decreased to 9% in 2001 (van de Wiel, 2013).

#### **4.4.10 The Dot Com Bubble**

From 1997 to 2000, there was a buildup of a historic speculative bubble popularly referred to as the dot-com bubble. During this period, many new internet-based companies also known as dot-coms were founded. Companies could experience sharp stock price increases by simply attaching an “e-” prefix to their names or a “.com”, which one author called “prefix investing.” (Masnick, 2003).

The Chairman of the Reserve Bank, Allan Green Span had noticed excessive speculation on the stock market with some trepidation and on December 5, 1996, made his famous “Irrational Exuberance” speech as he witnessed asset prices rapidly escalate (Greenspan, 1996). Central bankers were in a dilemma in determining whether the rapid escalation in asset prices were as a result of a bubble build up or prices were merely reflecting improving fundamentals. After all, the EMH was the dominant theory and Greenspan for example was an ardent believer in market efficiency (Bilginsoy, 2014). During the late 1990s, the Federal Reserve Bank resolved that a pre-emptive attempt to quell the bubble was out of its reach and instead, defined its role

as applying monetary policy to shield the overall economy from any spillover effect that may arise in the event of a financial shock (Greenspan, 2008).

**Figure 4.2: The Nasdaq Composite's Astonishing Appreciation**



**Source:** Knight (2014: 354)

The bubble reached a peak on March 10, 2000 with the NASDAQ Composite rising 220% in a period of 37 months. This rapid appreciation is even considered moderate as the NASDAQ is considered to be broad an index to capture the dot-com effect since it includes all technology

companies some of which are classified as part of the “old” economy (Bilginsoy, 2014). Ofek and Richardson (2002, 2003) point out 400 “pure” internet stocks that appreciated by about 500% over the same period. The bubble collapsed soon after. Some companies, such as pets.com and Webvan, failed completely while others – such as Cisco, saw their stock prices declining massively (Goldman, 2010).

#### **4.4.11 The Great Recession**

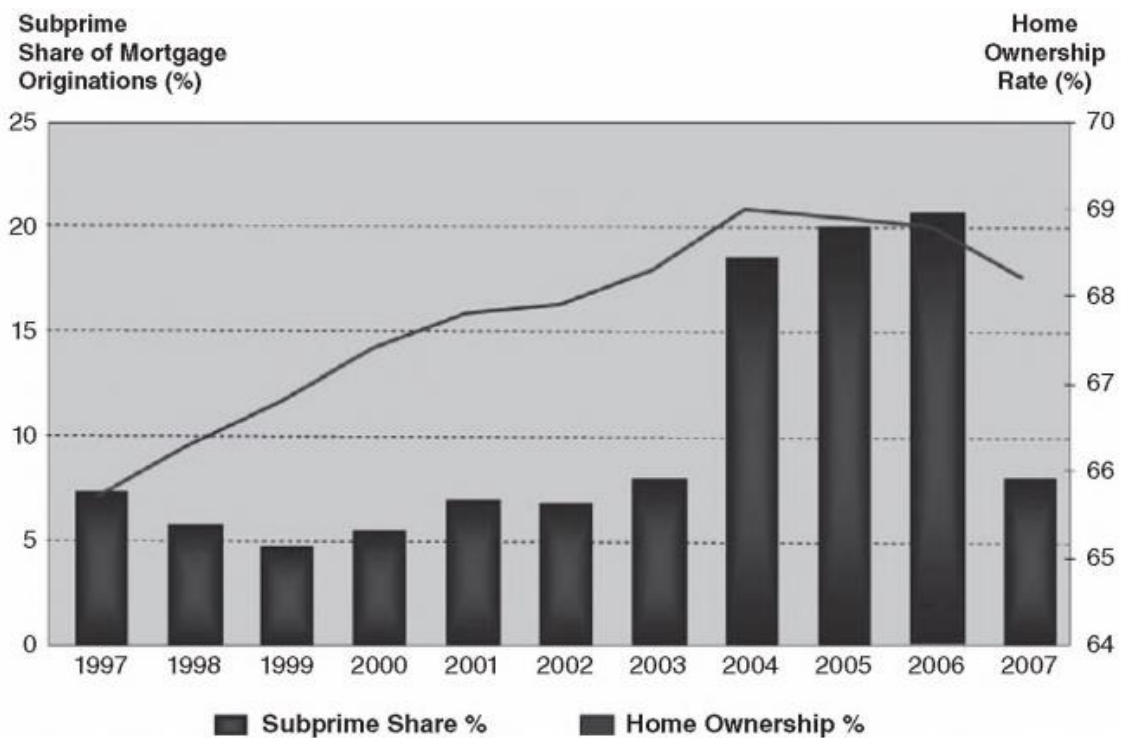
The United States faced a deep and lengthy recession after the dot-com crisis and the consequent bear market. Allan Greenspan, then chairman of the Federal Reserve, through a succession of aggressive interest rate cuts, replaced one bubble – dot-com bubble - with another -real estate bubble. By considerably lowering the interest rates and standards of lending, the government of the United States escalated a colossal credit bubble which encouraged consumer spending and fueled rapid real estate price appreciation as well as the global economy, which eventually crashed and led to the worst financial crisis since the Great Depression (Knight, 2014).

According to Knight (2014), the seeds of the Great Recession were planted 80 years prior, during the Great Depression. Roosevelt’s administration acknowledged the importance of the housing industry to the whole economy. This is because of the fact a vibrant housing industry has a positive impact on other quarters of the economy namely: timber, consumer appliances, professional trades as well as the other services and materials needed for building and furnishing a home.

The Federal National Mortgage Association (FNMA), generally called “Fannie Mae” was established in 1938 in line with Roosevelt’s New Deal with a mandate to buy up mortgages from the banks, convert these mortgages into securities which are then sold to investors in the secondary public markets (Hagerty, 2012). The banks then could still have a decent cash reserve available for lending as opposed to it being locked up in a slow albeit continual stream of cash flow spanning a 3- year period. Fannie Mae was a government-sponsored entity (GSE), but it was also an independent corporation and became a publicly traded corporation in 1968. Federal Home Loan Mortgage Corporation (“Freddie Mac”), another GSE was established in 1970 to buy mortgages from the secondary market, convert them into securities, and sell them as mortgage backed securities (MBS) (Acharya et al., 2011).

The United States federal government has a history of offering incentives for purchasing and owning homes. As an affirmation of policy, the government in 1992, stipulated that a portion of mortgage purchases by Fannie Mae and Freddie Mac be committed to purchasing affordable housing with the goal of helping low-income Americans who otherwise would not have qualified, to obtain mortgages. The government further directed a portion of mortgage purchases by the Department of Housing and Urban Development (HUD) should be committed to affordable housing. By 2008, Fannie Mae and Freddie Mac had committed 58% of mortgage purchases to affordable housing, up from 30% in 1992. The two institutions eventually had \$5 trillion in low-income as well as minority loan commitments (Knight, 2014, Pezzuto, 2016).

**Figure 4.3: US Mortgage Lending from 1997 - 2007**



**Source:** U.S. Census Bureau and Harvard University (2008: 4)

Apart from mortgage interest qualifying for deduction for tax purposes, there was an additional benefit of tax-free capital gains included in the tax code for homeowners initially introduced in July 1978 which allowed up to \$100,000 tax-free capital gain for people who are 55 years or older. The tax exemption increased to \$250,000 and \$500,000 for an unmarried person and for a married couple respectively in 1997 (Burman, 2010, Knight, 2014).

This ignited interest in investing in real estate. Falling interest rates also fuel the increase in mortgage loans which encouraged people to invest in real estate. Interest rates was above 18% in 1982 for customers with some high creditworthy records. However, over the following three decades, interest rates declined persistently. After the dot-com crisis, the Federal Reserve adopted an assertive stance on reducing interest rates, and reduced its interest rate to 1%. As interest rates dropped mortgage payments became affordable (Knight, 2014).

Despite the economic slump in 2001—2002 the oil-producing countries, and the world in general still had lots of cash, and were seeking places to invest this wealth. Persistent decline in interest rates meant the \$70 trillion invested in fixed-income vehicles were generating paltry rates of return. These monies were meant for safe, non-speculative reasons, and the managers were constantly seeking investments offering relatively higher yields as well as safety. The creative finance industry designed Credit Default Swaps (CDS) and Collateralized Debt Obligations (CDOs) which were made up subprime mortgages which in turn were given the blessings of the ratings agencies as high-grade securities. These monies seeking higher yields were poured into the creative investments although some underlying mortgages were classified as SIVA (Stated Income, Verified Assets) where the borrowers could declare any amount of income they pleased and only had to prove they had a job and cash in their bank accounts; NIVA (No Income, Verified Assets) where only a proof of bank account was retired to secure a mortgage; NINA (No Income, No Asset) where no proof of assets or income was required to secure a mortgage (Knight, 2014).

With the Dot-com crises and the September 11 attacks now years away, and the United States economy performing very well, the Reserve Bank started making upward adjustments to interest rates which was at a historical low of 1%. This was done in small steps but consecutively for 17 times, increasing the Fed rate from 1% in 2004, to 5.25% in 2006 (Knight, 2014). Increasing interest rates implied increasing payments for mortgages all over the country, and majority of these had adjustable mortgage rates. The situation was even grimmer worse for those with subprime loans, as the low “teaser” rates, were replaced with even higher interest rate payments upon expiration (Knight, 2014).

Eventually, the safety of these investment vehicles was exposed when the default rates of the underlying mortgages began to increase triggering panic and eventually a crisis. The year 2008 was the severest stage of the mortgage meltdown and financial crisis, with trillions of dollars

wiped out in the United States. Several banks and other financial institutions heavily exposed to these securities collapsed or had to seek bailout from their governments. Notable among these banks and financial institutions were Lehman Brothers which was acquired by Nomura Holdings, Bear Stearns also acquired by JP Morgan Chase, Fannie Mae, Freddie Mac, which were bailed out by the United States government.

## **4.5 Summary**

The history of financial crises reveal that financial market participants can behave irrationally and make suboptimal and detrimental choices. Further, market participants keep repeating the same irrational behaviours over time proving that history in fact repeats itself as the FMH posits therefore previous events that happened in financial markets in the past will occur again in future. It is also evident that financial crises also have the potential of spilling over into other markets. The following chapter describes the behavioural biases that cause market participants to repeatedly behave in ways that are deemed irrational and consequently have detrimental effects that can spill over into other markets.



# **CHAPTER FIVE**

## **BEHAVIOURAL FINANCE**

Chapter 3 discussed the Chaos Theory in finance and the FMH, which subsequent to the Global Financial Crisis, have been gaining popularity again. The FMH explains the characteristics of financial time series but does not offer an explanation as to why financial markets behave the way they do. This chapter discusses behavioural finance, which studies the effects of psychology on the behaviour of finance practitioners and the effects on financial markets subsequently and why financial markets are not efficient. Behavioural finance describes the underlying psychology that cause market participants to behave in certain ways that directly influence the behaviour of financial markets.

Several studies challenged the classical finance theories, culminating in a new school of thought in finance. The new finance doctrine focuses on market inefficiencies, mainly by applying behavioral models. Eugene Fama however contends that behavioural finance is simply a branch of classical finance, because all it does is criticize the efficient markets model claiming therefore, he is possibly the most important behavioral finance figure, because there is no behavioural finance without him and the efficient markets model (Fama and Thaler, 2016). Fama argues that there is no testable and full-blown behavioural asset pricing model (Fama and Thaler, 2016). There is however an emergence of behavioural asset pricing models (Shefrin and Statman, 1994, Duran and Caginalp, 2008, Lux, 2008, Shefrin, 2008)

This chapter begins with an introduction to behavioural finance, describing its origins and delves into the various behavioural biases that investors are prone to thereby making them behave contrary to what classical financial theories assume.

### **5.1 Introduction**

A parent will pay a certain amount of money to minimize her the risk of her child contracting a debilitating disease from 10% to 5% and even be willing to pay an additional twice or thrice as much to push the said risk from 5% to 0%. This decline from 5% to 0% is so much more valuable to the parent than the decline from 10% to 5%, this is because it offers more than just a 5% reduction in risk; it brings certainty. To the parent therefore, 0% and 100% weigh far more heavily in the mind than what mathematical models argue they should. Although this

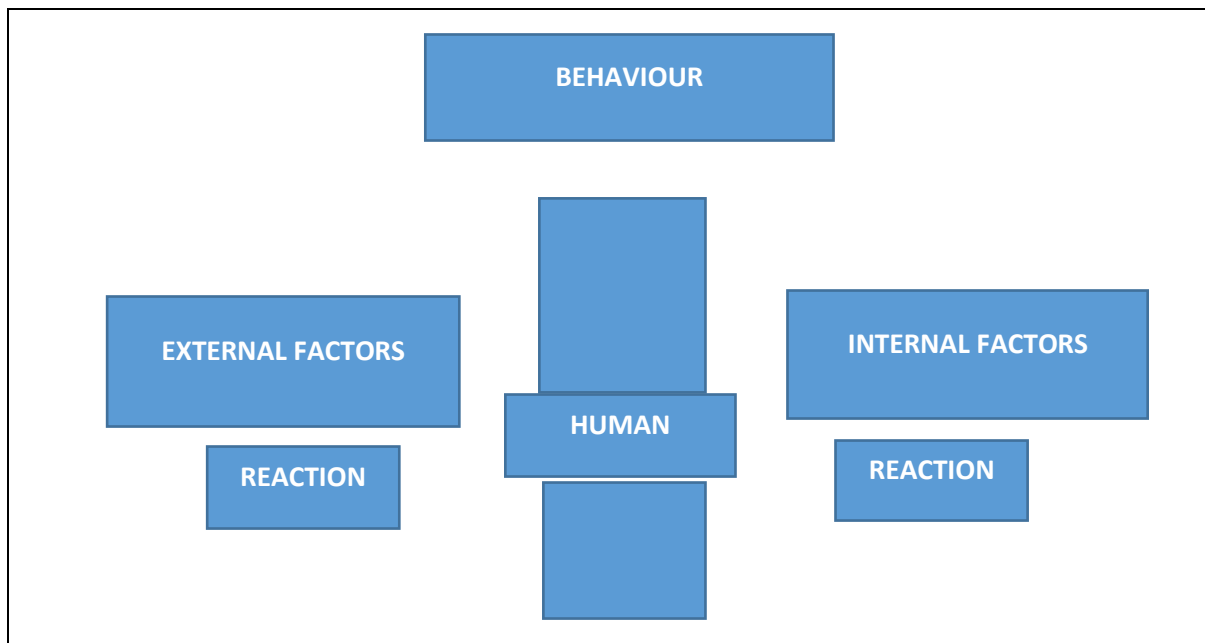
premium paid is considered irrational under the rational model of classical finance, it is consistent with the psychology of worry where parents are willing to pay a premium for certainty (Kahneman, 2011). Lottery players are motivated to pay a dollar for lottery tickets that on average pay only 50 cents due to the appeal of the benefits of hope and the appeal of the benefits of hope also motivate employees to receive stock options instead of salaries, irrespective of the fact that stock options, on average, are worth less than salaries foregone (Statman, 2014). Statman (2010: 8) posits that:

“We want more from our investments than a reasonable balance between risk and return. We want to nurture hope for riches and banish fear of poverty. We want to win, be number one, and beat the market. We want to feel pride when our investments bring gains and avoid regret when they inflict losses. We want the status conveyed by hedge funds, the virtue conveyed by socially responsible funds, the patriotism conveyed by investing in our own country, and the loyalty conveyed by investing in the companies that employ us. We want financial markets to be fair, but we search for an edge that would let us win. We want to leave a legacy for our children when we are gone. And we want to leave nothing for the tax man.”

Although Harry Markowitz won the Nobel Prize in economics in 1990 for his contribution to the mean-variance portfolio to MPT, when Markowitz had to make his own investment decisions for his retirement, he did not apply his Nobel Prize-winning approach! Instead, he applied a simple rule of thumb known as  $\frac{1}{N}$  where the investor allocates her capital equally among N number of asset classes. In an interview, Markowitz admitted that he wanted to steer clear of regrets: “I thought, ‘You know, if the stock market goes way up and I’m not in, I’ll feel stupid. And if it goes way down and I’m in it, I’ll feel stupid.’ So I went 50-50.” (Markowitz, 2011).

According to Skinner (1953), it is difficult to analyse human behaviour as a result of its tremendously complex nature and based on mainly cause-result relation. People take actions due to the multifarious effect of both external and internal stimulants/drive and demonstrate certain actions/reaction.

**Figure 5.1: Development of Behaviour**



**Source:** Kıyılar and Acar (2009)

Over time, the tension between the ideal concept of human rationality and the reality of our daily lives has become a progressively critical issue. To what extent do we know about how in the real world, people make decisions and choices and how divergent are the disparities between the real world and the theoretical assumptions? Do those differences even matter? It was only in the 1960s that systematic efforts were made to provide answers to the questions. The field of behavioural finance began to take shape when psychology professors Daniel Kahneman and Amos Tversky happened to compare their life experiences and notes which subsequently led to collaborations that brought about a competing version to the rational model of classical finance on how under conditions of uncertainty, individuals make decisions (Bernstein, 2007). Figure 5.1 depicts the development of behaviour and how both external and internal factors influences the behaviour of an individual.

## **5.2 What Is Behavioural Finance?**

Behavioural finance can be simply defined as applying principles of psychology to finance. Behavioural finance is based on the assumption of ‘normal people’ instead of ‘rational people’ in classical finance and propounds behavioural portfolio theory and behavioural asset pricing instead of mean-variance portfolio theory and CAPM and other classical finance models which

suggest that expected returns are only determined by risk (Statman, 2014). Statman (2014) further posits that in the argument of efficient markets, behavioural finance differentiates hard-to-beat markets from rational markets a delineation that is often blurred in classical finance, and examines why so a large number of investors believe that they can beat the market expanding the field of finance beyond market efficiency, portfolios and asset pricing and poised continuous expansion while abiding by the scientific rigours introduced by classical finance.

Although behavioural finance have gained a huge amount of popularity and recognition as it points out the flaws in classical finance, Thaler (2015) however argues that classical finance theories should not be discarded as they still remain relevant as a starting point for models that are more realistic and in some special situations where the problem at hand is simple or the actors in the economy possess the highly specialized relevant skills, the model can offer a good approximation of what pertains I the real world. This may however not be the case even when the economic actors possess these highly specialized and relevant skills as pointed out in the Allais Paradox where French economist and 1988 Nobel Prize in Economics winner Maurice Allais proved that even highly trained economists were susceptible to choice problems and behaviours inconsistent with that suggested by the Expected Utility Theory (Allais, 1953). However, Thaler (2015) argues that for the most part of economic theories, the assumption of rationality is not a critical one irrespective of the level of expertise of the market participants.

Statman (2014) points out that whereas the building blocks of classical finance are:

- People are rational
- Market efficiency
- The design of portfolios should be guided by mean-variance rules of portfolio theory and
- Standard asset price theories describe expected returns with the differences in returns attributable to the differences in risk.

Behavioural finance on the other hand is based on alternative foundations replacing each of the foundations of classical finance. The four alternative foundations are:

- People are normal
- Markets are inefficient although hard to beat

- Portfolios are designed according to the rules of behavioural portfolio management
- Behavioural asset pricing theory describes expected returns and with differences in expected returns explained by more than the differences in risk.

Normal investors want three kinds of benefits from their investments namely utilitarian, expressive and emotional benefits. Utilitarian benefit answers the question, ‘What does the investment offer me and my pocketbook?’ For investments, the utilitarian benefits are in increasing wealth with low risk and high returns. Expressive benefit answers the question ‘What does the investment portray about me to others and to myself?’ and depicts values, tastes, and status. For example, environmental mutual funds, express environmental responsibility, whereas a hedge fund, just like a stately Bentley expresses high status. Emotional benefit also answers the question ‘How does the investment make me feel?’ An environmental mutual fund makes one feel virtuous, whereas an investment in a hedge fund makes one feel proud (Statman, 1999,2010).

### **5.3 A History of Behavioural Finance**

The argument on the irrationality of investors has existed for a very long time and possibly, the most popular historical example of investors’ irrationality can be traced to the sixteenth century when a man named Conrad Giestner introduced tulip bulbs to Holland. The tulips were beautiful and difficult to obtain and thrilled consumers and in the process, become a status symbol for the elite. In the early periods, most buyers bought the flowers simply because of its aesthetic value, with speculators eventually joining the trade to make profits. Trading activities in tulips rocketed, and tulip bulbs were eventually filed on the local market exchanges. As speculative trading increased, people sold everything they owned in order to acquire tulips, with the hope that the value would continue to soar (Pompian, 2006). As speculators begun to liquidate their holdings, the prices of tulips weakened and eventually plunged by 90% within a month with investors defaulting on their tulip contracts and incurring huge losses (Pompian, 2006).

According to Pompian (2006), it was during the mid-eighteenth-century with the beginning of the classical period in economics, nonetheless, that people began to analyse the human aspect of economic decision making, subsequently laying the foundations for behavioural finance. It

was during this same time that the concept of utility emerged as a measure of the satisfaction associated to the consumption of a good or a service.

Besides the well-known *Wealth of Nations* by Adam Smith (1776b), His book, *The Theory of Moral Sentiments* (Smith, 1759) focused more on the psychology of the individual rather than on the creation of wealth in markets. Adam Smith (1759) explained the emotional and mental foundations of human interaction, which included economic interaction. While the classical economists believed that the behaviour of people could be modelled in mathematical terms and completely rational. Others, such as Adam Smith, argued that each human was born with an innate moral compass, which influences externalities such as logic or law. Adam Smith posited that an “invisible hand” guided both economic and social conduct however, the viewpoint of economic decision making by individuals being “perfectly rational” was never part of Smith’s argument (Pompian, 2006). When dealing with financial issues, *The Theory of Moral Sentiments* focused on factors such as shame, pride, insecurity, and egotism:

“It is the vanity, not the ease, or the pleasure, which interests us. But vanity is always founded upon the belief of our being the object of attention and approbation. The rich man glories in his riches, because he feels that they naturally draw upon him the attention of the world, and that mankind are disposed to go along with him in all those agreeable emotions with which the advantages of his situation so readily inspire him... The poor man, on the contrary, is ashamed of his poverty. He feels that it either places him out of the sight of mankind, or, that if they take any notice of him, they have, however, scarce any fellow-feeling with the misery and distress which he suffers. He is mortified upon both accounts. For though to be overlooked, and to be disapproved of, are things entirely different, yet as obscurity covers us from the daylight of honour and approbation, to feel that we are taken no notice of, necessarily damps the most agreeable hope, and disappoints the most ardent desire, of human nature.” (Smith, 1759: 28).

The classical economic assumption of rationality however prevailed over the role of psychology in economic decision making and became the mainstream until the expanding

field of experimental economics analysed theories of individual choice, and begun questioning the theoretical foundations of perfect rationality.

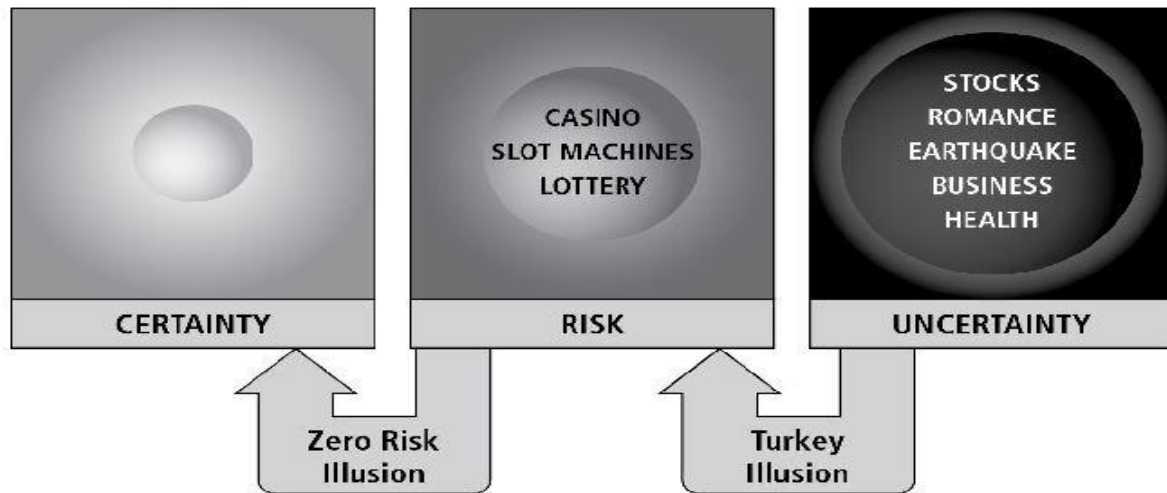
## **5.4 Risk and Uncertainty**

Although classical finance theories make no distinction between risk and uncertainty, renowned German psychologist Gerd Gigerenzer advocates that a clear distinction should be made between the two (Gigerenzer, 2014). The US Secretary of Treasury Henry Paulson, on March 2008 Henry Paulson, confirmed: “Our financial institutions, banks and investment banks, are strong. Our capital markets are resilient. They’re efficient. They’re flexible.” (Makridakis, Hogarth and Gaba, 2009:796). The financial crisis shortly escalated thereafter. Gigerenzer (2014) posits that the risk models that motivated Henry Paulson’s belief failed to anticipate the magnitude of the bubble, akin to the turkey enjoying being fed freely continuously by the farmer and not anticipating the thought of Thanksgiving (Gerd Gigerenzer refers to this as Turkey Illusion and confusing a world of risk with a world of certainty as the Zero-Risk Illusion).

By promoting an incorrect sense of certainty, known risk models can promote rather than avert crises. Gigerenzer (2014) entreats people to learn to live with uncertainty suggesting that the first step towards this is to gain an understanding of the difference between known risk and unknown risks. Figure 5.2 illustrates the two types of illusions of certainty. The first describes confusing a world of risk with that of certainty, this is known as the zero-risk illusion. The second kind of illusion is confusing a world of uncertainty with that of known risk, this is known as the turkey illusion or the calculable-risk illusion. In each of the cases, the illusion is shown with an arrow that move from right to left (Gigerenzer, 2014).

University of Chicago economist Frank Knight (1921) distinguished between risk and uncertainty defining risk as outcomes that can be insured against and uncertainty, sometimes also referred to as Knightian uncertainty as risk that cannot be measured or calculated and argued that uncertainty must be radically viewed in a distinct sense from risk. Although some scholars disagree with Frank Knight arguing that there is always the possibility to create subjective probabilities thereby allowing uncertainty to be reduced to risk.

**Figure 5.2: Risk, Uncertainty and the Illusions of Certainty**



**Source:** Gigerenzer (2014: 37)

However, according to Savage (1954) the father of modern Bayesian decision theory, and to whom this rebuttal is often attributed, this is only applicable to “small worlds” where everything is known and would be “utterly ridiculous” to adapt his theory to large worlds, and even to simple questions as planning a family picnic. (Savage, 1954;16).

In November 2008, the Queen of England, Queen Elizabeth II posed the question “how come nobody could foresee it” referring to the financial crisis of 2007-09, during her visit to the London School of Economics. In response, a letter was drafted by Professor Tim Besley of London School of Economics and a member of the Bank of England Monetary Policy Committee and Professor Peter Hennessey of University of London concluded (Besley and Hennessey, 2009: 3):

“...in summary, Your Majesty, the failure to foresee the timing, extent and severity of the crisis and to head it off, while it had many causes, was principally a failure of the collective imagination of many bright people, both in this country and internationally, to understand the risks to the system as a whole.”

The former governor of the Bank of England, Mervin King (2016) argues in his book, *The End of Alchemy*, that the financial crisis of 2007-09 reflects not only a failure of institutions or individuals but also a failure of the fundamental ideas of current economic policymaking.



Principal among these ideas is the nature of uncertainty and risk. One fundamental assumption in economics and finance is the idea that individuals rationally attach probabilities to possible future outcomes and estimate the likely effects on their wellbeing (utility as they seek to maximize that utility. King (2016) contends that in a world of what economists refer to as “radical uncertainty”, it may not always be possible to estimate the expected utility of an action as there is no way of ascertaining the probabilities of all possible future events.

In the words of Donald Rumsfeld (2002), then United States Secretary of Defence, “there are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns – the ones we don't know we don't know.”

## **5.5 Investor Biases and Heuristics**

Behavioural biases can be described abstractly, in the same way as systematic errors in judgement (Pompian, 2006), whereas a heuristic is any kind of ‘rule of thumb’ or a simple rule of behaviour through which a problem is solved (Cartwright, 2014). Gigerenzer (2014) uses the term behavioural biases and heuristics interchangeably describing them as are rules of thumb that provide shortcuts to methodical research or calculations. In their book *Judgment Under Uncertainty: Heuristics and Biases*, Kahneman, Slovic and Tversky (1982) presented ground-breaking studies in decision making under uncertainty claiming that when evaluating probabilities, people depend on limited number of heuristics which lessen the complex tasks of calculating probabilities and forecasting values to easier judgmental operations. Gilovich, Griffin, & Kahneman (2002) in their book *Heuristics and Biases: The Psychology of Intuitive Judgment*, offered some of the most prominent study on biases and heuristics after *Judgment Under Uncertainty*.

Kahneman and Tversky did not claim it is irrational for people to apply the relevant heuristics. They argue on the contrary that the heuristics are quite valuable as a general rule. The drawback is that in certain cases, the use of heuristics leads to systematic and severe errors which were not random and could be described and even predicted.

According to Kahneman (2011), our thinking can be described by two systems, explained by a catalogue of opposing characteristics. System 1 is described as unconscious work by

heuristics and prone to errors. However, System 2 is the conscious works by rule of logic and statistics, and not prone to errors. Biases may be categorised as cognitive biases or emotional biases. Cognitive biases refer to predispositions to thinking and acting in certain ways and can also be regarded as a heuristic or rule of thumb, which may lead to systematic divergence from a standard of good judgement or rationality although there are still some prevailing some controversies as to whether some of these heuristics are in fact irrational or they result in beneficial behaviour or attitudes (Baker and Ricciardi, 2014). An emotional bias on the other hand results in making decisions based on one's feelings instead of facts.

Akerlof and Shiller (2015) in their book *Phishing for Phools*, argue that although the free-market system does a lot of good, it also encourages firms to “phish”<sup>8</sup> for “phools”<sup>9</sup> stating that if we care for the welfare of people, then the invisible hand is usually the problem and not the solution. This invisible hand may punish companies for not taking advantage of the biases like the tendency to show unrealistic optimism or ignoring the fine print. According to Akerlof and Shiller (2015), without due suspicion of complex financial securities being traded, phishing for phools played a significant role in the Great Recession.

The following section describes a list of popular behavioural biases.

### 5.5.1 Overconfidence Bias

The overconfidence bias can be summarized as unjustified faith in one's own intuition, judgements, reasoning and cognitive abilities. It is derived from a vast body experiments and surveys in cognitive psychology where subjects overestimate their own abilities to make predictions. People are not properly calibrated to estimate probabilities therefore events that they think are certain to occur are usually far less than 100 percent certainty of occurrence.

People saying that they are 90% confident that a particular event will transpire, or claiming that a statement is true, are usually only 70% correct (Fuller, 1998). Research prove that overconfidence bias is the cause of market bubbles, litigations, wars and strikes (Moore and Healy, 2008). The overconfidence bias can be placed into two categories – miscalibration and better-than-average effect. According to Hilton (2001), miscalibration can lead to

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<sup>8</sup> Exploiting ignorance and biases of people

<sup>9</sup> Any person who is successfully phished

overestimating or underestimating events. A common way to assess faulty calibration of forecasts is by asking people to make a range prediction, with a 90% conviction that the actual value will be within the specified range.

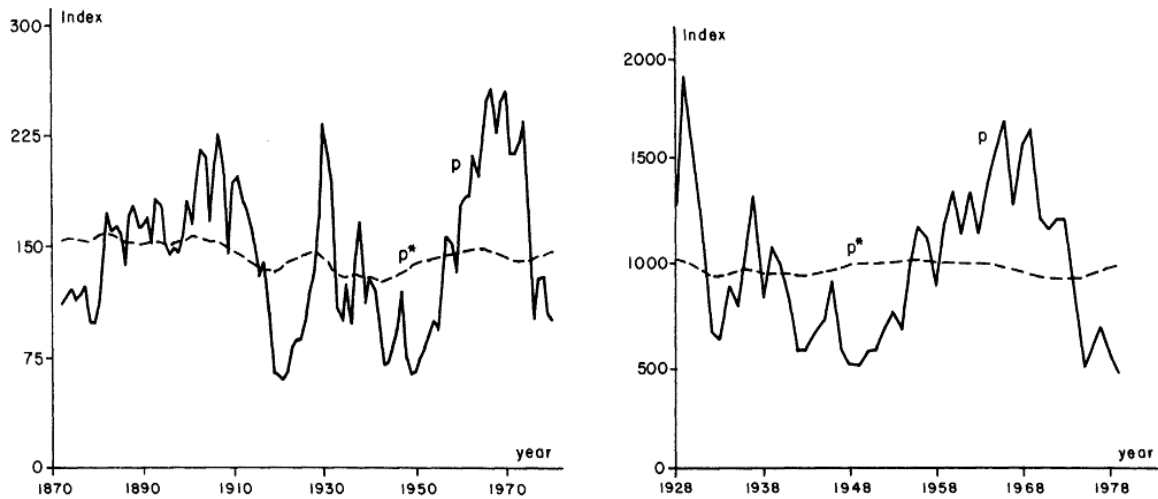
An investment manager for example, asked to make a forecast about the exchange rate of the British Pound/Euro in six months may say that she is 90% confident that the exchange rate will fall within 0.64 and 0.74 pounds. If the manager exhibits proper calibration, the nine out of ten times, the value of the currency should be within the range predicted (“hits”) and thus expect only one out of ten “misses” as a result of predictions falling out of the range. Stephan (1998) observes a strong evidence of miscalibration when he applied this procedure in a multinational bank, with thirty-six foreign exchange traders, with a high rate of misses on foreign exchange rate predictions (71.1%) as well as stock price questions (83.3%) and even in general knowledge questions (78.6%).

When asked about their driving skills, most people consider themselves to be better than the average driver. People tend to show extreme and unrealistic optimism about themselves (Merkle and Weber, 2011, Harris and Hahn, 2011). Such overconfidence is classified as the better-than-average kind of overconfidence. Moore and Healy (2008) describe miscalibration as an extreme belief in one’s precision, and the better-than-average effect as overrating one’s performance relative to the performance of others.

Shiller (1981) in a study on the S&P and the Dow Jones Industrial Average, found that stock prices appeared to be five to thirteen times higher than justified by new information on future dividends providing evidence on miscalibration by investors over the period of the study. Figure 5.3 shows the real S&P index (the solid line p) and the ex-post “rational price (dotted line p) from 1871 to 1979 and the real adjusted Dow Jones Industrial Average (the solid line p) and the ex-post rational price from 1928 to 1979 respectively all detrended by a long-term exponential factor. However, Fama (2016) argues that although he agrees with Shiller (1981), stock prices are made up of two components namely expected cash flows (dividends) and discount rates (expected returns) therefore the variation in prices beyond what is justifiable from the expected cash flows is as a result of the variations in the discount rates as investors may adjust their expected returns in line with new information. There is miscalibration even

among experts and this is usually as a result of a far too tight prediction interval that experts use as a result of overconfidence (Deaves, Lüders and Schröder, 2005; Ben-David, Graham and Harvey, 2010).

**Figure 5.3: S&P Index and the Dow Jones Industrial Average**



**Source:** Shiller (1981: 422)

People tend to showcase overconfidence when difficult questions are posed and under confidence when less difficult ones are posed (Lichtenstein and Fischhoff, 1977) this phenomenon is known as the hard-easy effect. Although the overconfidence bias is exhibited by both genders, men tend to be more overconfident than women (Lundeberg, Fox and Punócohař 1994).

### 5.5.2 Anchoring and Adjustment Bias

Any time a pre-owned car salesperson is negotiating prices with customers, he/she begins with a higher price and then works downwards. The salesperson thus anchors the customer in the higher price so that the customer then accepts that a lower price suggests good value. Anchoring and adjustment are heuristics that involves adjusting from a starting point (Furnham and Boo, 2011, Tamir and Mitchell, 2013).

De Bondt (1993) proposes that anchoring influences people to skew their interval forecasts. To understand this heuristic, one needs to think about a ship which has its anchor dropped therefore

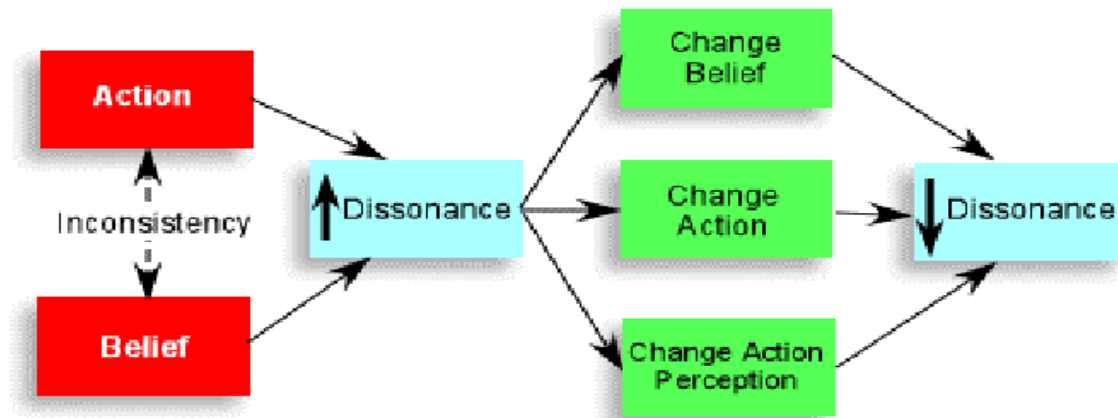
keeping the boat from veering too far off. This is not a problem if the ship is anchored but becomes challenging if one wants to go somewhere. The anchoring heuristic affects calculations that involve a series of operations and numbers and occurs when an operation starts with a number and an adjustment is made relative to that number. Anchoring may be at taking place if the adjustment is too small as this psychological bias forestalls making sufficient adjust from the anchor. The starting point for anchoring may be a recent data like economic growth, inflation or the price of an asset. The anchoring and adjustment bias occurs anytime investors are preoccupied without a reason on a given set of information to which inadequate subsequent modifications are made irrespective of the availability of new information when a rational investor is expected to adjust the starting set of information (Numann, Roberts, Cauvin, 2011, Bokhari and Geltner, 2011).

### **5.5.3 Cognitive Dissonance Bias**

Cognitive dissonance developed by Leon Festinger is based on how people endeavour to attain internal consistency. A person who encounters inconsistency or dissonance is likely to develop psychological discomfort, and is driven to strive to minimise this dissonance as well as actively trying to avoid information and situations that are likely to increase it. Cognitive dissonance is a mental discomfort or stress experienced by a person holding two or more contradictory ideas, beliefs or values concurrently, implements an action that is contrary to one or more ideas, beliefs or values, or encountered new information that contradicts existing ideas, beliefs or values (Festinger, 1962a, Festinger, 1962b).

Academics have distinguished between two different facets of cognitive dissonance that relate to decision making namely, selective perception and selective decision making. The seminal experiment on cognitive dissonance was conducted by Festinger and Carlsmith (1959). In their experiment, all the participants were expected to do what all would concur was a boring undertaking and then to tell another participant (who was in fact a confederate of the conductor of the experiment) that it was exciting. Half of the participants were paid \$1 to co-operate and the other half were paid \$20 (which was quite a bit of money during the 1950s).

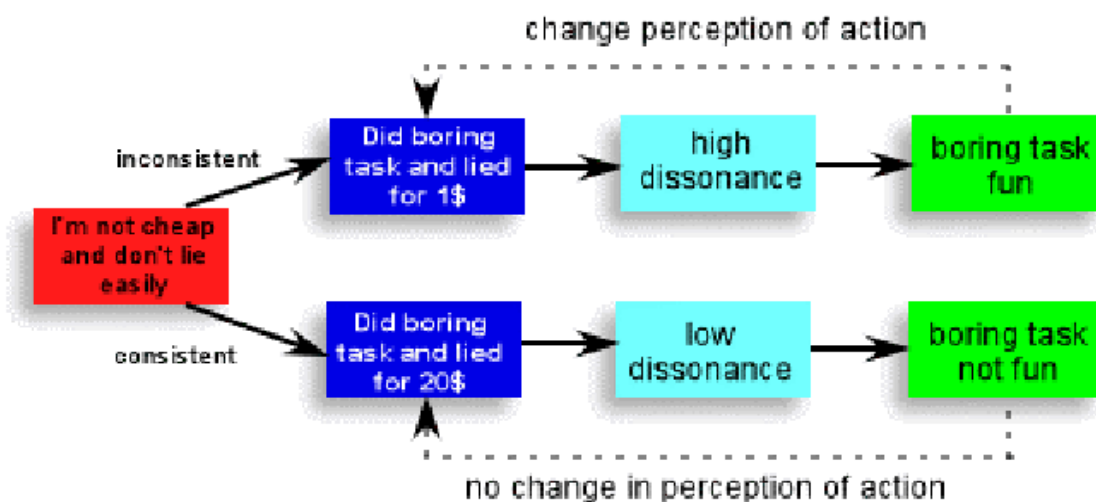
**Figure 5.4: Cognitive Dissonance Theory**



**Source:** Rolla (1998: 2)

Following this, all participants were asked to assess how much they enjoyed the boring task. This latter evaluation served as the dependent measure/experimental criterion. According to behaviourist/reinforcement theory, participants who were given \$20 should enjoy the task more since they would associate the money received with the task. On the other hand, cognitive dissonance theory would predict that participants who received \$1 would feel the most dissonance because they had to complete a boring task and then tell a lie to an experimenter, all for just \$1.

**Figure 5.5: Cognitive Dissonance Theory and the Festinger and Carlsmith (1959) Experiment**



**Source:** R. H. Rolla (1998: 3)

This would create a dissonance between the conviction that they were not evil or stupid, and the action which is that they completed a boring task and then lied for only \$1. Therefore, the cognitive dissonance theory would envisage that the participants in the \$1 group would be more prompted to seek a resolve to their dissonance by reconceptualising/rationalizing their actions. They would establish the belief that the boring task was, actually, fun. It proved to be correct as predicted by Festinger that the participants in the \$1 group would enjoy the task more. Figure 5.5 illustrates the experiment.

#### **5.5.4 Availability Bias**

The availability bias is a rule of thumb, or judgemental heuristic whereby a person assesses the probability of an occurrence by the extent to which an event is easily remembered (Tversky and Kahneman, 1973). People who exhibit this bias identify easily recalled events as being more likely to occur than events that are difficult to imagine or to understand.

Unusual and dramatic events such as shark attacks, homicides or lightning are reported more often in the news than very common and less shocking causes of death such as common diseases (Briñol, Petty and Tormala, 2006). Availability can be as a result of imagination, experience or memory (Lee, O'Brien and Sivaramakrishnan, 2010, Bebbington, 2010, Moradi, Mostafae and Meshk 2013). According to Goetzmann, Kim and Shiller (2016), although historical data points to the fact that the base rate for an extreme, stock market crash in a single day is relatively low, surveys of institutional and individual investors, that have been conducted regularly over 26 years in the United States, indicate that they judge the probability to be far higher. Goetzmann et al. (2016) conclude that this phenomenon is as a result of availability bias as negative market and current market declines made salient by financial press are related to probabilities of higher subjective crashes. Nonmarket-related, rare disasters are also associated with higher subjective crash probabilities.

#### **5.5.5 Representativeness Bias**

Representativeness bias refers to the penchant to placing less emphasis on long-term averages and thereby over-weighting recent events, this phenomenon is referred to as the law of small numbers (Ritter, 2003).

Two fundamental clarifications of representativeness bias affect individual investors namely base-rate neglect and sample-size neglect. With base-rate neglect, investors endeavour to ascertain the possibility of success for example, of an investment in a particular company by placing the business in a familiar classification model that is easy to understand. This investor may classify the company as a value stock and determine the risks and rewards associated with that classification. This approach, however, neglects other factors that are unrelated and could significantly influence the success of this investment. Investors usually adopt this approach because it appears to be a substitute to the meticulous research that is actually needed when valuing an investment. Lacking sensitivity to previous information or disregarding base rate, or a lack of knowledge of regression are some of the factors that result in representativeness bias among investors (Pompian, 2011, Ying Luo, 2013).

On the other hand, sample-size neglect, exists when in judging the probability of a given outcome of an investment, investors fail to correctly take into account the sample size of the particular set of information on which their judgement is based by incorrectly assuming that the small sample size represents the populations this phenomenon is also referred to as the “law of small numbers.”

### **5.5.6 The Affect Heuristic**

The affect heuristic is a mental shortcut people use in making quick and efficient decisions and solving problems. This mental shortcut is influenced by current emotion such as pleasure, fear, surprise, etc. The affect heuristic is therefore a type of heuristic in which in psychological terms, “affect” (emotional response) plays a critical role. This heuristic is a subconscious activity that shortens the process of decision-making and lets people function without the need to go through an extensive amount of information. Furthermore, the affect heuristic has a shorter duration than a mood and occurs involuntarily and rapidly in response to a stimulus. The words "lung cancer" typically invokes an effect of dread, whereas the words "mother's love" typically invokes a sense of affection and comfort. Affect usually comes into play when judging the benefits and risks of something, based on the negative or positive feelings that associated with a stimulus. If the sentiments towards an event are positive, people are more likely to construe the benefits as high and risks low however, if the sentiments towards an event are negative, people are more likely to construe the benefits as low and risks as high (Finucane,



Alhakami, Slovic and Johnson, 2000). For example, people perceive stocks that they identify to be “good” as having low risk and offering higher returns while “bad” stocks are perceived to come with high risk and low returns (Ganzach, 2000). The affect theory predicts that there is a negative correlation between risk and return for unfamiliar stocks and a positive correlation between risk and return for familiar stocks. Riskier stocks were perceived to produce higher returns as predicted by traditional finance models. If a stock is perceived to be safe, investors pay a premium for this perceived safety thereby making it more expensive and depressing expected returns in the process (Kuhnen and Knutson, 2011, Ganzach, 2000). Affect bias ascribes negative and positive images to feelings and occurrences that point out signals for decision making (Slovic, Finucane, Peters, and Macgregor, 2007). Shefrin (2016) posits that, investment professionals on average construe expected return and risk to be negatively correlated, which is contrary to the relationship portrayed in textbook finance. Shefrin (2016) argues that representativeness and affect heuristics are responsible for this phenomenon. Solt and Statman (1989) argue that investors who perceive the shares of good companies as representative of good investments rely on the representativeness bias that a good stock is a stock of a good company. Such associations are referred to as “somatic markers” feelings in the body associated with emotions and strongly influence decision making. Representativeness and affect are in many ways similar, and usually reinforce each other and in this context both biases focus on the “goodness of companies” (Shefrin, 2016).

Baker and Wurgler (2006) identified the extent to which sentiments impact the relationship between characteristics such as size and B/M and realized returns and reported that the size effect is conditional on sentiment therefore in a period of low sentiment, stocks of small companies earn relatively high subsequent returns, however, in a period of high sentiment, the size effect ceases to exist. The conditional sentiment study offers a vehicle to understand how behavioural bias and perceived risk combine to affect realized returns (Shefrin, 2016). In line with classical finance assumptions, investors’ perception that small-cap equities are riskier than large-cap equities on average causes the realized returns of small-cap equities to be greater than that of large-cap equities (Shefrin, 2016). Again, perceptions about the risk-size interaction deepen after periods of negative sentiment which lead to larger size effects during such periods (Shefrin, 2016).

According to Ganzach (2000), financial analysts to a large extent, evaluate stocks in terms of global attitudes toward such stocks and not in according to their risk/return relationships as suggested by traditional finance theories. Analysts' recommendations also have substantial impact on stock prices (Amir et al., 1999). According to Ganzach (2000) this explains some of the "anomalies" observed in studies on market returns particularly Fama and French (1993) and also Fama and French (1996) conclusion that investors are not only compensated for holding high-risk stocks, but also for holding small company stocks, with low sales growth, low P/E ratio, high book-to-market value, and low past returns. All these parameters are however, correlates of low preference, which, according to Ganzach (2000) lead to lower perceived expected returns as well as higher perceived risk resulting in depression in price which is unwarranted. Excessive returns are subsequently realized when this unwarranted depression disappears.

### **5.5.7 The Prospect Theory**

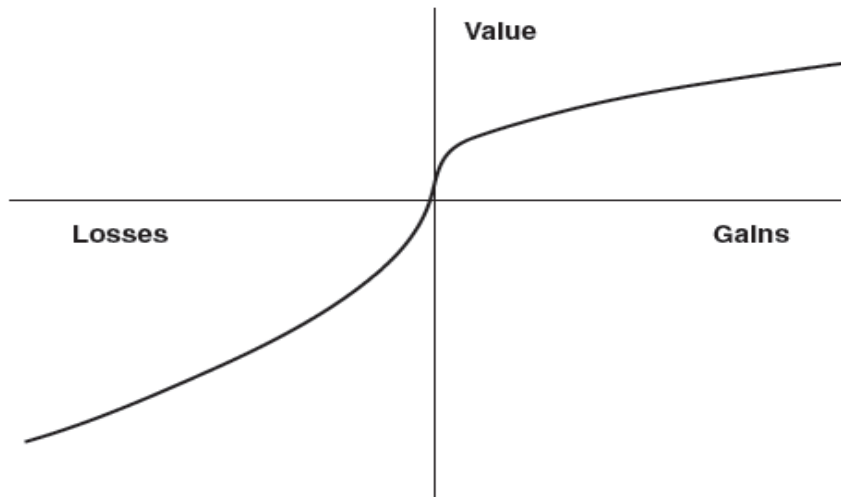
Prospect theory explains how people make decisions on probabilistic choices involving risk, when the outcome probabilities are known. The theory states that people make choices based on the conceivable amount of losses and gains instead of the ultimate outcome, and also, people estimate such losses and gains by applying some particular heuristics.

The theory emerged in 1979 and was expounded in 1992 by Daniel Kahneman and Amos Tversky as a more precise depiction of decision making that bordered on psychology, in comparison with the expected utility theory (Shafir and LeBoeuf, 2002). In their seminal work in behavioural finance, *Prospect Theory: An Analysis of Decision under Risk* by Kahneman and Tversky (1979) used the term prospect originally to refer to lotteries or gambles.

The prospect theory is to behavioural finance what the expected utility theory is to classical finance. In this theory, the assessment of outcomes of a choice is reference-dependent, where reference refers to the existing state of wealth whereas the expected utility theory states that the evaluation of an outcome is reference-independent. The prospect theory argues that people base their decision making on the consequences of the outcome of on their current wealth. The pain one experiences as a result of a loss exceeds a gain of similar magnitude. Figure 5.6

represents a hypothetical value function which was used by Kahneman and Tversky (1979) to show how the value assigned to a gain is far below the value assigned to a loss.

**Figure 5.6: A Hypothetical Value Function**



**Source:** Kahneman and Tversky (1979: 279)

The theory therefore shows that in reality, people simultaneously are risk loving and risk averse as observed when investors buy insurance policies, bonds and mutual funds thereby diversifying and avoiding risks while at the same time, proceeding on to buy single stocks and lotteries, indicating an urge to take on risk. Again, individual investors as well as professional investors sometimes sell winning stocks too early and hold on to declining stocks for far too long due to the fear of a loss proving that losses trigger more severe pain than the pleasure that a gain of similar value brings.

### 5.5.8 Framing

The framing effect refers to situations where different portrayals of the same event bring out different responses (Kahneman and Tversky, 1979). The framing bias leads to the predisposition to react in a different manner to a circumstance depending on how such a situation is presented (Bailey et al., 2011, Chuah and Devlin, 2011). Tversky and Kahneman (1981: 453) posit that, “The frame that a decision maker adopts is controlled partly by the

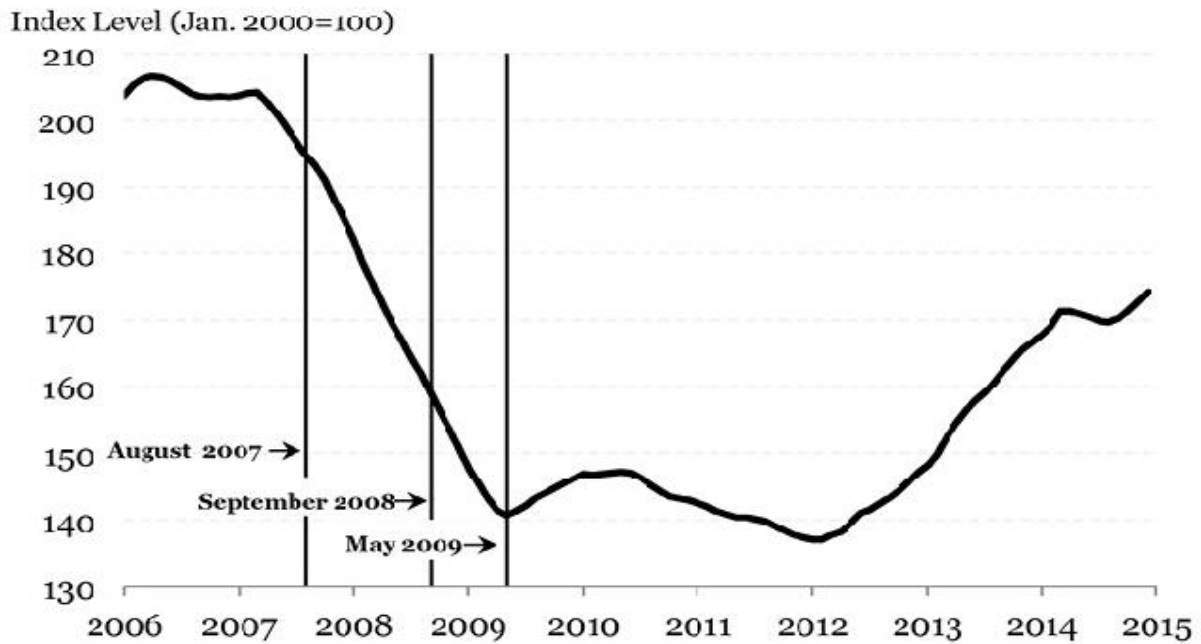
formulation of the problem and partly by the norms, habits, and personal characteristics of the decision maker.”

### **5.5.9 Herding**

There is a common conception that investors have a penchant to flock together, acting like a herd in their trading decisions. This kind of behaviour is usually associated with ‘irrational’ volatility in the market and threatens the stability of financial markets. The inclination to imitate other investors that cause to a group of investors to act in the same way is referred to as herding (Lemieux, 2004, Cipriani and Guarino, 2009). Novice investors are prone to herding and that behaviour influences the price of stocks; this behaviour however does not occur among professional investors (Cont and Bouchaud, 2000). Teh and De Bondt (1997) and Gutierrez and Kelley (2009) also argue that herding can significantly influence the variance of stock returns. On the other contrary, Lakonishok et al. (1991) and Agarwal et al. (2012) argue that even professional investors are also susceptible to herding with the objective of “window-dressing” their portfolio. In South Africa, Sarpong and Sibanda (2014) also found that even professional mutual fund managers exhibit herd behaviour.

According to former Reserve Bank chairman Ben Bernanke, but for the financial crisis, it is not clear whether house prices would have tumbled so far or swiftly since in 2006, house prices had flattened out without declining much initially. When the crisis surfaced, in August 2007, prices of housing were about only 4 percent lower than they were at the start of 2006. Had it not been the panic, the bubble in the housing market might have gradually deflated, as has been anticipated by Federal Reserve’s forecasters had anticipated (Bernanke, 2015). Figure 5.7 shows how the price of housing in 20 major cities in the United States declined only modestly from the beginning of 2006 till August 2007 when the financial crisis began. The decline accelerated throughout the period of the crisis but in May 2009, prices stabilized as the crisis abated and home prices rebounded in early 2012.

**Figure 5.7: Home Prices Fell Sharply After the Financial Crisis**



**Source:** Adopted from S&P/Case-Shiller 20-City Composite Home Price Index, Seasonally Adjusted, Cited in Bernanke (2015: 353)

### **Rational Herding**

There has been an emerging literature on 'rational herding' in financial economics. models in rational herding are developed mainly on one or more of three phenomena namely, payoff externalities models, Principal-agent models and cascade models (Devenow and Welch, 1996). The Payoff externalities models posit that payoffs to an agent taking a particular action rises in the number of other agents taking the same action for example, the rule of driving on the left side of the road. The principal-agent models posit that to gain or preserve reputation in times of imperfectly informed financial markets, managers may choose either to 'ride the herd' thereby proving quality, or 'hide in the herd' thereby avoiding evaluation. Cascades models also posit that later agents, infer information from the behaviour of prior agents and optimally choose to disregard their own information and act in similar manner (Devenow and Welch, 1996).

#### ***Payoff Externalities: Market Liquidity***

In the 19th century, there were roughly 250 stock exchanges in the United States, today, one-tenth of this number remains. This decline may be due to payoff externalities (Devenow and Welch, 1996). With economies of scale or informed traders imposing an externality on

uninformed traders (Admati and Pfleiderer, 1988; Chowdhry and Nanda, 1991), informed and uninformed traders will both gain from transacting in more liquid markets or markets with more depth consequently forcing most traders to transacting in only one market (Devenow and Welch, 1996).

### ***Payoff Externalities: Information Acquisition***

Payoff externalities can also influence the decisions of agents on stocks for which they seek information. In some circumstances, agents find it worthy to pursue further information only when other agents do, thus herding on the acquisition of information or the lack thereof (Devenow and Welch, 1996; Han and Yang, 2013). Brennan (1990) and Hirshleifer et al. (1994) argues that private information reflect in the price of stocks a period after it acquisition, however, this only occurs after a minimum number of investors have also acquired such information. As a Consequence of this, the expected profits from acquiring information is dependent on the assessment of the expected gains of other investors leading to two equilibria. In one equilibrium, no investor purchases such information since the likelihood of information reflecting in the stock price is negligible and vice versa.

### ***Principal-agent/Reputation Models: Investment Decisions***

Principal-agent concerns can also lead to rational herding as the evaluation of managers is usually based on relative performance as opposed to absolute performance (Devenow and Welch, 1996). Pan et al., (2016) provided results from a number of tests to argue that CEO investment cycle, where investment increases over the period of a CEO's tenure while disinvestment decreases causing "cyclical" firm growth in employment and assets. This is caused by agency problems and leads to rising investment quantity and declining investment quality as the CEO, over time wins more control of his board. Morck et al. (1989) also reported that top management dismissals are related to a firm performing poorly relative to its industry, as opposed to industry failures. Baker and Haugen, (2012) argue that portfolio managers may include certain stocks in their portfolio simply because they are easy to explain the inclusion of such stocks to their investment committees. Lütje and Menkhoff, (2003) also report that fund manager, particularly senior managers use rational herd behaviour as a means of adapting to incentives.

These herding models usually reveal that managers prefer to mimic the actions of each other, totally disregarding private information, in order to avoid being exposed to be of low-skill in line with Keynes' remark in the General Theory that "it is better for reputation to fail

conventionally than to succeed unconventionally". Because of this, even the managers who are better than the average prefer to follow the crowd. This works in favour of worse managers as the decision to herd turn out to be a better decision (Devenow and Welch, 1996).

### ***Informational externalities: Cascades***

The most common explanation of rational herding may be cascades, as described in Welch (1992) and Bikhchandani et al. (1992). When actions are publicly visible but not private information and there is a limit to the information of a private agent and actions possible, the basic cascade models may become applicable. The argument is that agents obtain relevant information by observing the previous decisions of other agents, to an extent where it becomes optimal and rational to completely disregard their private information. An investor for example, in possession of the most adverse private information can be motivated to make a purchase regardless if he witnessed three investors making a purchase previously, here, the information from three buys could outweigh the negative private information. Over time, there is very little additional new information to the cascade, investors simply mimic others based on the assumption that such large number of investors cannot be wrong. This however, may lead to erroneous decision on a large scale. Information cascades are usually very brittle, as investors' actions may be based only on public observation and hearsay therefore, any new public information or a more accurate information can alter the behaviour, and the direction of the cascade (Devenow and Welch, 1996; Deng, 2016).

### **5.5.10 Endowment Bias**

The endowment effect which is also referred to as divestiture aversion and connected in the field of social psychology with the mere ownership effect (Beggan, 1992). The endowment bias postulates that people assign more worth to things simply because they own them (Morewedge and Giblin, 2015). This is usually depicted in two ways, in a valuation paradigm and in an exchange paradigm. In terms of valuation, people tend to pay more to hold on to something they own than to acquire one they do not own even in circumstances where a cause for attachment is non-existent, or even if the particular item was only acquired minutes ago. In the exchange paradigm, people when given an asset are hesitant to trade it for another of similar value. For example, participants were reluctant to exchange their Swiss chocolate for a mug of

coffee when first given the Swiss chocolate. However, participants who were first given the mug of coffee were also hesitant to trade it in for a Swiss chocolate (Knetsch, 1989).

The endowment effect is comparable to the Willingness to Accept or Pay (WTAP) behavioural model, a formula used to determine how much a consumer is ready to lose or put up with for different outcomes. Daniel Kahneman, Jack Knetsch & Richard Thaler (Kahneman et al., 1990) provided one of the most popular examples of the endowment effect in finance literature where participants were offered a mug and then given the chance to trade it for an equally valuable alternative (pens). They discovered that the amount that participants demanded as payment for the mug after their ownership had been established i.e. “willingness to accept”, was approximately two times higher than the amount they were prepared to pay to in order to acquire the mug i.e. “willingness to pay”.

Many wealth managers have dealt with clients who are unwilling to sell securities bequeathed to them by previous generations and usually in these situations, investors mention a feeling of disloyalty that is associated with the act of selling inherited securities, tax issues, and the general uncertainty in establishing “the right thing to do,” (Pompian, 2006).

### **5.5.11 Hindsight Bias**

Hindsight bias, also known as creeping determinism or the “knew-it-all-along” effect, is the tendency, after the occurrence of event, to view the particular event as being predictable, despite the nonexistence of any objective basis for predictability (Roese and Vohs, 2012). It is a multidimensional event that may affect the different stages of situations, designs, context, and processes (Pohl, 2007). Hindsight bias can trigger distortions in memory, where recollecting and reconstructing content may result in theoretically false outcomes. Examples of these are evident in the literatures of historians explaining the outcomes of battles, in the judicial systems when trying to attribute culpability and the predictability of accidents and physicians when recalling clinical trials (Fischhoff, 2003).

The hindsight bias was not a novel concept when it appeared in some psychological studies in the 1970s. It had been indirectly defined several times by philosophers, historians, and physicians (Fischhoff, 2003). Baruch Fischhoff attended a conference in 1973 - when he was a psychology graduate student at that time - where Paul Meehl pointed out an observation that



clinicians sometimes overestimate their capability to have foreseen the result of a particular case, claiming they knew it all along. Baruch Fischhoff then discovered an opportunity to explain these observations in psychological research (Fischhoff, 2007).

In the early 1970s, research on heuristics and biases was an important area of investigation in psychology, spearheaded by Amos Tversky and Daniel Kahneman. Among the heuristics studied, two heuristics discovered by Tversky and Kahneman – availability heuristic and the representative heuristic - were of significant importance in developing the hindsight bias (Fischhoff and Beyth, 1975).

In an explanation of these heuristics, Beyth and Fischhoff developed the first experiment that directly tested the hindsight bias. They asked the participants of the experiment to judge the probability of several outcomes of the upcoming visit of US president Richard Nixon to Beijing and Moscow. After president Nixon's return, the participants were again asked to reconstruct or recall the probabilities they had earlier assigned to each of the possible outcomes and their assessments of the probability of each outcome was overestimated or far greater for the events that had actually occurred (Fischhoff and Beyth, 1975). This study is regularly referred to in the definition of the hindsight bias, and perhaps the title of the study, "I knew it would happen", may have led to the hindsight bias being referred to as the "knew it all along" bias.

### **5.5.12 Reputation Mining**

Akerlof and Shiller (2015) introduced the concept of reputation mining which can be described as the ability to take advantage of a good reputation built on a past track record of providing excellent services, to offer substandard services which will still be misconstrued as excellent. Unsuspecting investors therefore pay for these services at the same price as they would pay for a truly excellent service. Akerlof and Shiller (2015) argue that investment banks and ratings agencies had mined their reputations to sell highly complex and risky assets as investment grade to investors who did not understand the complexity of these assets but trusted the AAA rating sanctioned by the ratings agencies.

Michael Lewis (2011), gives an account of reputation mining among ratings agencies Moody's and S&P in the run-up to the financial crisis. In his book *The Big Short*, Lewis (2011) claims the gigantic Wall Street firms such as Goldman Sachs, Bear Stearns, Citigroup, Lehman

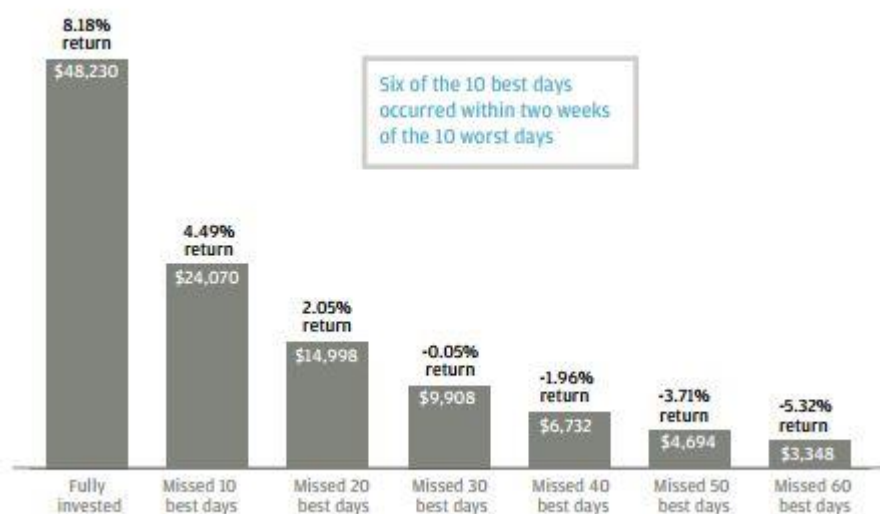
Brothers et al had goals similar to any manufacturing entity - to pay the barest possible minimum for its raw materials (in this case home loans) and charge the maximum possible price for the finished product - mortgage bonds. The price charged for the finished product was fuelled by the ratings given to it by S&P and Moody's using their own models and the intricacies of these so-called models were said to be officially a secret claiming they were simply impossible to game.

### 5.5.13 Regret Aversion Bias

Investors showing regret aversion avoid making any decisive decision since they fear that whatever action they take will turn out less than optimal upon hindsight. This bias aims to prevent the pain of regret that comes with making a poor decision. Even Nobel laureate in economics Harry Markowitz succumbed to this bias when making his retirement decision stating:

“I visualized my grief if the stock market went way up and I wasn't in it—or if it went way down and I was completely in it. My intention was to minimize my future regret, so I split my retirement plan contributions 50/50 between bonds and equities.” (Pompian, 2006:227)

**Figure 5.8: Impact of Being Out of the Market**



**Source:** Roy, Carson and Rizkallah (2016: 35)

The regret aversion is a cognitive bias that leads investors to hang onto losing positions for too long with the aim of avoiding the admittance of errors and realizing losses. Regret aversion also cause investors to be unnecessarily apprehensive of entering markets that have generated losses recently. As study by JP Morgan Asset Management however shows that investors loose out when they stay out of markets that have recently experienced great losses (Roy, Carson and Rizkallah ,2015) .

## **5.6 The Argument for Heuristics**

Kruglanski and Gigerenzer (2011) however argue that in reality, every heuristic studied can be applied both consciously and unconsciously therefore, heuristics cannot be construed to stand in opposition to consciousness. Furthermore, heuristics cannot be pointed out as the general cause of errors since heuristics can lead to more precise inferences when compared to logical or statistical rules.

Wübben and Wangenheim (2008) conducted a study intended to establish the superiority of stochastic customer base analysis models - Pareto/NBD model and the BG/NBD model - over the simple heuristics that companies typically apply. They investigated how many accurate predictions the models made compared to the simple heuristics for an airline, an online CD retailer and an apparel retailer. The outcome showed that the heuristic performed at least as well as the stochastic models.

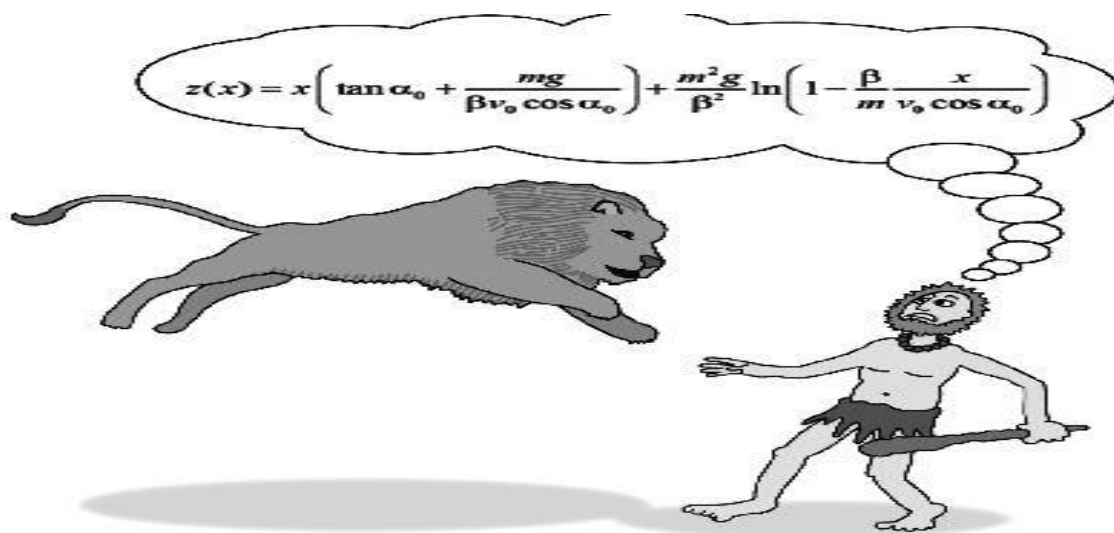
Gigerenzer (2014) therefore argue that heuristics and errors are not associated. The two-system view suggested by Kahneman (2011) overlooks the difference between uncertainty and risk suggesting that whereas statistical methods are vital when faced with known risks, heuristics on the other hand come in handy when faced with uncertainty. Todd and Gigerenzer (2012) therefore propose that instead of spending time knocking heuristics, there is the need to research their ecological rationality; i.e., to investigate in which circumstances heuristics work and in which circumstances they don't.

The Greek term “heuristic” originally meant “serving to find out or discover” and in fields that deal with uncertainty such as artificial intelligence and animal behaviour, heuristics have continuously had a positive connotation (Gigerenzer, 2014:241). The Stanford mathematician Polya (1954) make a distinction between analytical thinking and heuristic, stating that

heuristic thinking is essential in finding a mathematical proof, while analytic thinking is required for checking the processes of a proof.

Emotions are complements to reason more often than they impede it, the interactions between reason and emotions are mostly beneficial. Emotions ward us away from being lost in thought when instant action is crucial, and emotions also reinforce lessons we must learn (Statman, 2014)

**Figure 5.9: Fear Prevents Us from Thinking too Long Before Acting in Dangerous Situations**

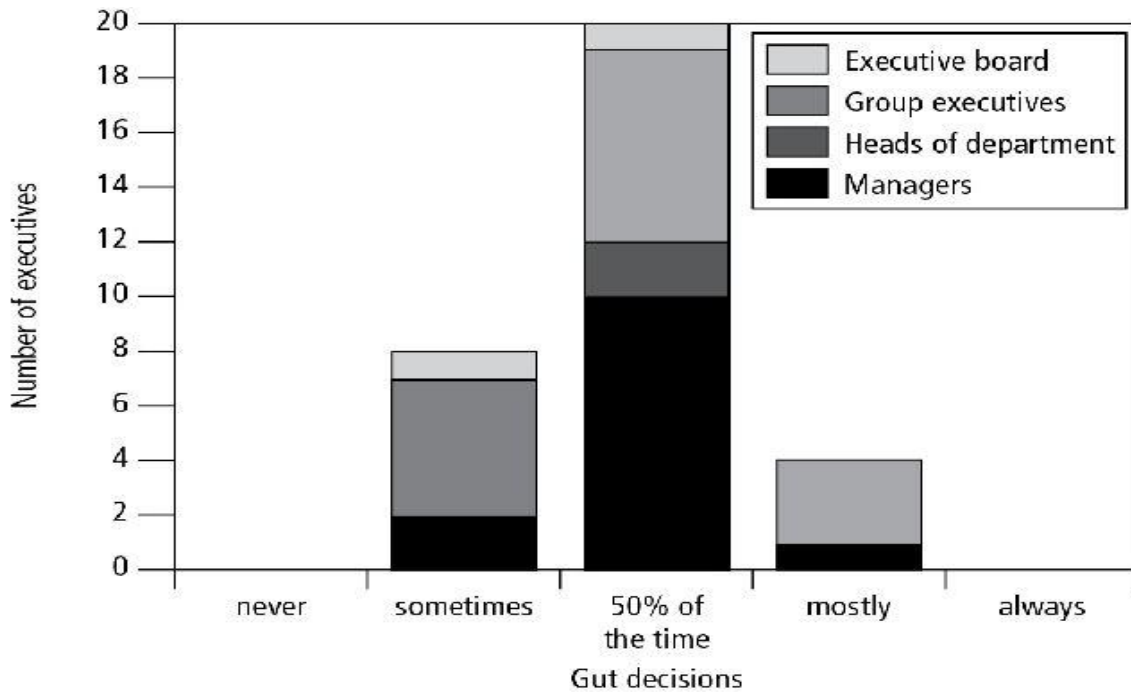


**Source:** Gigerenzer (2014: 66)

Stetson, Fiesta and Eagleman (2007) designed a test of present orientation (the tendency to overly concentrate on the present without taking the future into consideration) by asking participants to read some digital numbers that flashed quickly on a small display. They found that when the participants were relaxed, they could not read the numbers, since they flashed too quickly. However, in a freefall during bungee jump, they could read the numbers. The freefall elicits strong emotion and concentrates all mental resources solely on the present therefore providing an extra mental power that allows people the ability to read numbers that previously were undecipherable. Fear and excitement therefore heighten present awareness, while sharpening instincts and help us survive. Figures 5.10 and 5.11 respectively show how

frequently thirty-two executives from a technology-services provider and fifty top executives from an international car manufacturer make gut decisions based on self-reports.

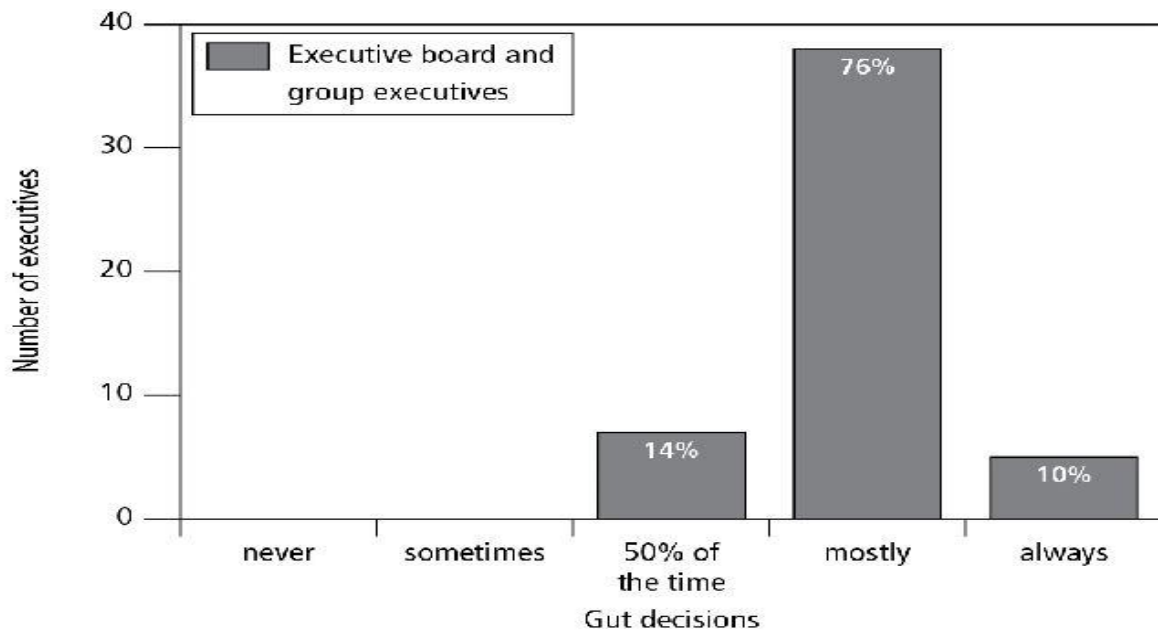
**Figure 5.10: Gut Decisions in an International Technology-Services Provider**



**Source:** Gigerenzer (2014: 99)

According to Gigerenzer (2014), majority of the technology-services provider executives admitted that 50 percent of the time, they rely on gut decisions although few of them would admit publicly to doing so. Furthermore, the relatively higher occurrence of gut decisions among the executives of the car manufacturing company may be due to the fact that these executives were chosen from the top two levels only, instead of choosing from all levels.

**Figure 5.11: Gut Decisions in an International Car Manufacturer**



**Source:** Gigerenzer (2014: 100)

Gigerenzer (2014) points out four misconceptions about intuition namely:

- **The Opposite of Rationality is Intuition:**

This is not so, as intuition can be described as unconscious intelligence that is based on personal experience and can be a smart rule of thumb therefore one requires both intuition and reasoning to be rational.

- **Intuition is Female:**

This has been a long-held view since the Enlightenment. Men are less likely to admit intuition or listen to their gut.

- **Deliberate Thinking is Superior to Intuition:**

Intuition is not inferior to deliberate thinking and vice-versa. Good rules of thumb and intuitions are crucial in an uncertain world whereas logic or statistics is critical for dealing with known risks.

- **Intuition is Grounded in a Complex Weighing of all Evidence Unconsciously:**

This argument has been suggested to explain the reason why decisions based on intuition are often excellent because if an intelligent process is good then it must be based on the bookkeeping process of weighing everything. However, the bookkeeping method is only good in a world of known risk and not in a world of uncertainty. Evidence exist to prove that intuitions are based on smart, simple rules that only take into consideration some of the available information.

Gigerenzer (2014) postulates that Kahneman and followers view laws of logic and probability theory as general norm of rationality and “content-blind” and that heuristics can only be faster but never be more accurate. Although this is true in a world of know risks, in a world of uncertainties, simple heuristics can often do better. The real research question therefore should be aimed towards understanding why and when. The answers known today according to Gigerenzer (2014) are based on the general study of ecological rationality<sup>10</sup> (Todd, Gigerenzer, and the ABC Research Group 2012) and bias-variance dilemma<sup>11</sup> (Gigerenzer and Brighton, 2009).

## **5.7 All Models Are Wrong**

The aphorism *all models are wrong* is attributed to George Box (1976: 792) who famously opined that “Since all models are wrong the scientist cannot obtain a "correct" one by excessive elaboration... Just as the ability to devise simple but evocative models is the signature of the great scientist so overelaboration and overparameterization is often the mark of mediocrity.” It has been recommended that this aphorism be made part of Applied Statistician's Creed (Nester, 1996).

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<sup>10</sup> Exploiting patterns of information within the environment to come out with accurate inferences in a frugal and fast way.

<sup>11</sup> A statistical theory that explains why and when simple rules of thumb can provide more accurate results than more complex methods.

Nobel Prize in economics winners Robert Merton and Myron Scholes who won the prize for developing a new method for determining the value of derivatives, were working partners in the now defunct hedge fund Long-Term Capital Management (LTCM), where they actively applied their asset pricing models. Scholes went ahead to form another hedge fund, Platinum Groove Asset Management (PGAM) in 1999 which went bust in November 2008. Trinsum Group, which also had Scholes' former partner Merton as its chief science officer also was bankrupt in January 2009. This proves that even models developed by Nobel laureates can fail (Chang, 2012). In an article titled *Taleb's Stranded Swan?* structured finance expert Janet Tavakoli (2009) points out how Empirica Kurtosis, a hedge fund started by Nassim Taleb, author of *The Black Swan* posted anaemic returns in 2001 even when Taleb had admitted that the September 11 terrorist attacks were black swan events and the hedge fund was set up purposely to take advantage of such events to produce stellar performance. Empirica Kurtosis was closed in 2005 (Smith, 2016).

Taking this assertion that all models are wrong into consideration, Hand (2014b) proposes that generally, when developing statistical models, one must be mindful that the objective is to gain an understanding, predict, or make a choice on something concerning the real world rather than an abstract mathematical world. Models are not the reality. It is therefore important to admit that although models and theories, be it of classical finance or behavioural finance, are very useful in understanding financial markets, have their flaws since they are just abstractions or simplifications of the real world. Models are never true, however, there is truth in models (Mäki, 2011). We can only understand the world by first simplifying it (Chang, 2014).

Instead of a single specific model, economics entails a collection of models and the field advances by improving the library of models by enhancing the mapping between these models and the real world. Therefore, the diversity of models is the necessary counterpart to the tractability of the real world. Different societal settings necessitate different models therefore economists are unlikely to develop universal general-purpose models and must desist from misconstruing 'a model' as 'the model' and select models as circumstances change with the ability to fluidly shift among different models (Rodrick, 2015).

Ritholtz (2016) argues that as investors we:

- have a limited knowledge about the world around us



- presume we have knowledge about the factors that influence complex systems like financial markets and economies
- misjudge the probabilities of significant random events occurring
- fall prey to false ideas, numerous myths and incorrect “facts”
- do not understand the extent of complexity that exists
- believe we are distant from crowd psychology yet understand it, and
- disregard the possibility of investment styles going in and out of favour

However, investors do not need to have a perfect understanding of the real world in order to be successful. They only need to understand enough in order to achieve whatever goal they set for themselves. To be good enough for any particular task – driving, batting, investing, etc. - demands only a narrow comprehension of a small subset of factors in order to achieve success therefore one does not need to know everything about a particular thing in order to be reasonably successful at the given task (Ritholtz, 2016).

## **5.8 Summary: Let A Hundred Flowers Bloom<sup>12</sup>**

The global financial crisis rekindled the arguments against underlying assumptions of several classical finance theories. A notable alternative to classical finance is behavioural finance which instead of assuming rationality of investors, posits that investors are prone to heuristics which lead them to making suboptimal economic decisions. However, some distinguished behavioural finance academics such as Gerd Gigerenzer and Peter Todd, argue that not all heuristics are inherently detrimental to optimal decision making. Rather, in some cases, heuristics help investors make optimal choices and even more quickly.

Theories in classical finance and economics have led to the introduction of worthwhile innovations in the investment world. The EMH for example, has led to the development of index funds which come with lower fees that in the end benefits investors. The theory of auctions, which draws on abstract game theory (which has an underlying assumption of rationality), provided the principles applied by the Federal Communications Commission in

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<sup>12</sup> The argument to let a hundred flowers bloom was proposed by CHANG, H.-J. 2014. *Economics: the user's guide*, Bloomsbury Publishing USA.

the United States to efficiently apportion the telecommunications spectrum to broadcasters and phone companies and in the process, raising over \$60 billion in revenue for the federal government (Golden Goose Award, 2014). However, the application of game theory principles may not always lead to an optimal outcome and a ‘nudge<sup>13</sup>’ of the participants may become necessary to achieve optimal outcomes. For example, a study by York University (2008) points out that the pharmaceutical industry in the United States spends almost two times as much on advertising compared to research and development. The pharmaceutical industry paid out approximately 24.4% of sales dollar (of US \$235.4 billion) on promotion in 2004, compared to 13.4% for research and development.

There may be situations where individual incentives can diverge from collective goals and sometimes even lead to collective doom, a phenomenon referred to as Darwin’s Wedge which applies to a class of circumstances where, individually rational choices aggregate badly (Frank, 2012). Behavioural finance has created awareness of heuristics that can be detrimental to making optimal economic decisions. There is a need therefore to recognizing that there exist different approaches to economics and finance and this diversity needs to be preserved, or even promoted (Chang, 2014). Since different approaches point out different aspects and give different perspectives, knowing alternative theories, allows for a fuller and more balanced comprehension of the complexities of financial markets.

In the longer run, just as a biological group that has a more diversified gene pool is more adaptable to shocks, a discipline that encompasses an assortment of theoretical approaches can better cope with an evolving world far better than one that is characterized by “intellectual mono-cropping” (Chang, 2014). It will therefore be beneficial to the field of finance to let a “hundred flowers bloom” as different approaches to finance can benefit a lot from learning from each other, making our understanding of the finance world richer.

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<sup>13</sup> A term used to describe propping up individuals to make optimal choices as proposed by THALER, R. H. en Sunstein, CR (2008) Nudge: Improving decisions about health, wealth, and happiness. New Haven: Yale University Press.

# **CHAPTER SIX**

## **THE ASSET MANAGEMENT INDUSTRY**

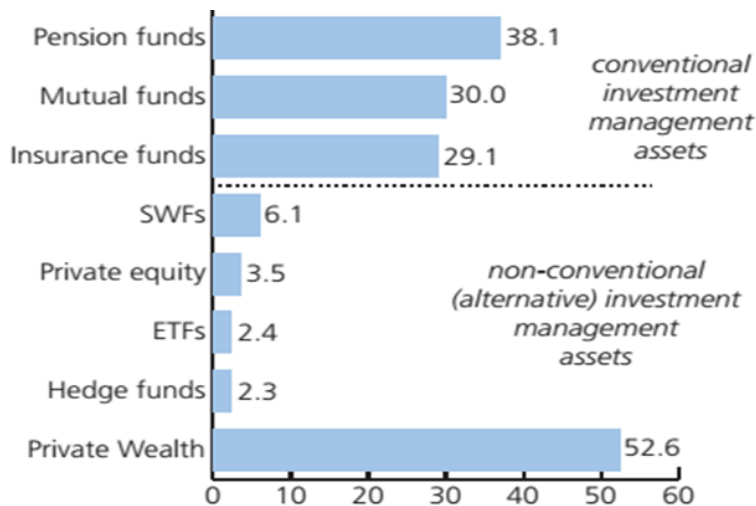
This chapter presents a general overview of the asset management industry. With increasing calls for certain segments of the asset management industry to be classified as Systemically Important Financial Institutions (SIFIs), a move to protect the global financial systems by averting the failure of such SIFIs, or, in the event of a failure, curbing the subsequent adverse effects. The industry has attracted the attention of regulators who seek to avert potential crisis that the industry may pose. The asset management industry therefore plays a significant role in the stability or otherwise of financial markets.

### **6.1 Introduction**

At present, the asset management industry is highly competitive and investment managers compete for clients in an industry that is now highly advanced and matured. There exists a varied universe of firms providing asset management services ranging from independent asset managers to diversified brokerage firms, commercial banks and insurance companies, all providing asset management services as well as other complementary and discrete business activities. Asset managers provide a crucial link between those seeking capital and providers of capital. The asset management industry forms an essential constituent of the global financial services sector and is responsible for the professional management of assets of more than \$68 trillion (Shub, Bartletta, Beardsley, Donnadiou, Fages, Hapelt, Macé, Maguire, Tang, 2014).

The industry has advanced alongside a progressively sophisticated and globalized capital market with investable capital estimated to have grown from \$64 trillion in 2004 to over \$101.1 trillion as at June 2013 (Concannon, 2015). The highly diversified asset management industry can be attributed in part to the variety of clients served by the industry that range from individuals planning for their retirements or big multinational entities that are in charge of billions of dollars in pension liabilities.

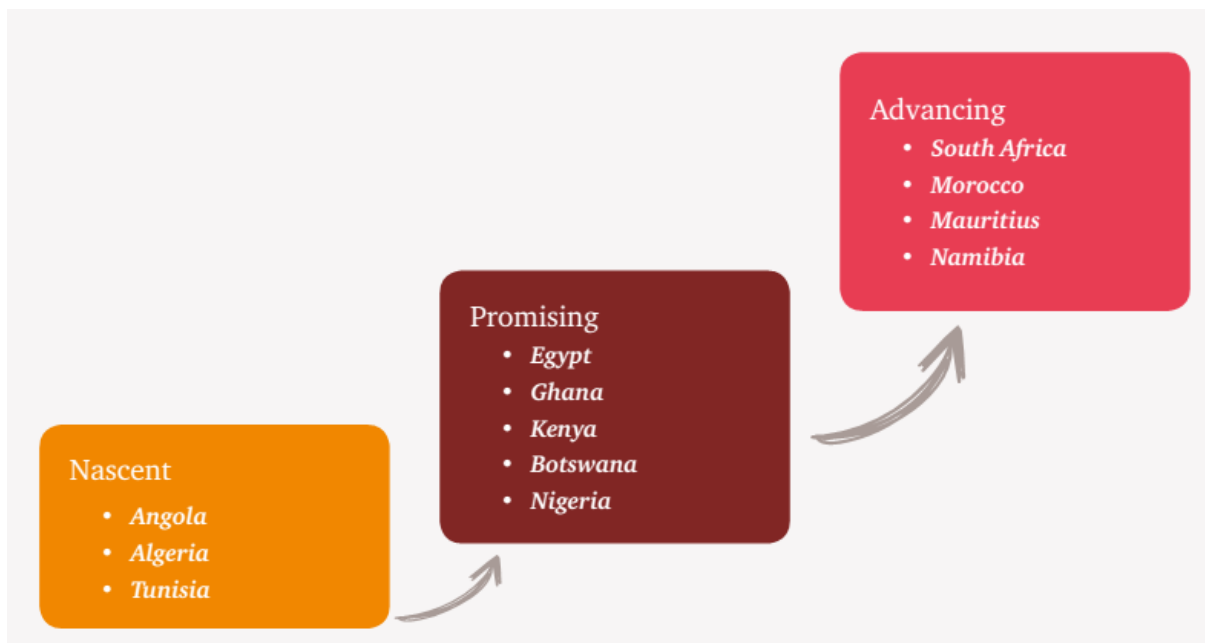
**Figure 6.1: The Global Fund Management Industry**



Source: TheCityUK (2014: 14)

Africa is seen as the final frontier for the asset management industry although the quality of institutions and economic growth mean that the various markets in Africa are at different levels of development.

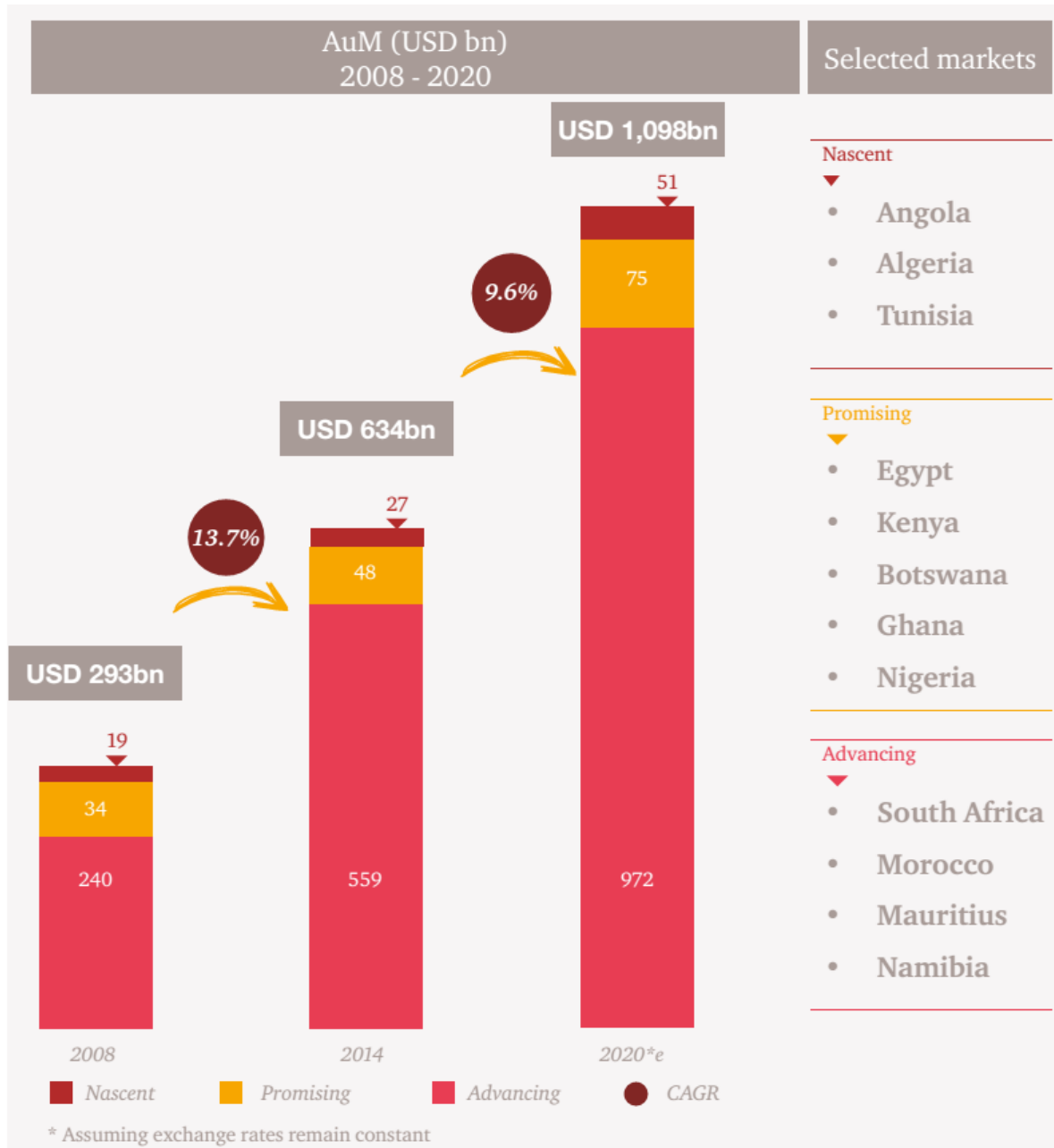
**Figure 6.2: Grouping of Countries**



Source: Adopted from PwC Market Research Centre Analysis, cited in PwC (2015: 6)

PwC (2015) assessed the twelve countries according to relevant indicators in to depict their real investment potential. PwC categorised twelve African countries into three groups namely; nascent markets, promising markets and advancing markets.

**Figure 6.3: Traditional Asset Management in the Three Groups of Countries**



**Source:** Adopted from PwC Market Research Centre analysis based on National Authorities data, cited in PwC (2015: 7)

These countries were categorized to the groups according to their ranking on selected metrics. Some of the metrics used were, the quality of institutions, proportion of AuM in mutual funds relative to GDP, macro indicators such as GDP growth, stock market index and foreign direct investment. Figure 6.2 shows the three categories and the countries that fall in each category and Figure 6.3 shows the AuM for each country and projected AuM for the year 2020.

In South Africa, the total household savings which comprise collective investment portfolios (mutual funds), insurance companies and retirement funds amounted to R 8.1 trillion (\$700 billion) as at December 2014 according to the Association for Savings and Investment South Africa (ASISA) (ASISA, 2015).

## **6.2 An Overview of Portfolio Management**

A portfolio is a combination of assets and portfolio management involves an integrated set of activities carried out in a consistent manner with the objective of creating and maintaining a portfolio that is appropriate in meeting the stated goals of clients (Maginn, Tuttle, McLeavey and Pinto, 2007). The core service provided by asset managers is professional investment portfolio management. Asset managers usually act on behalf of investors, using capital provided by the investors to execute investment strategies as well as assuming a fiduciary role.

Generally, investment strategies are categorized as active or passive even though over time, the techniques and models of portfolio management have persistently changed in line with innovations in financial markets and the demand of investors. Active portfolio managers apply diverse techniques in attempting to outperform their respective benchmarks which are usually represented by market indices such as the S&P 500 or the FTSE/JSE All Share index. The most predominant form of portfolio management however is active management. As at November 2013, approximately 73% of mutual funds in the United States – the world's largest marketplace for asset management – were actively managed (Zoll, 2014). Passive portfolio management involves replicating the returns of a selected market index by holding in the same proportion, the holdings of the market index.

### **6.3 Active versus Passive Portfolio Management**

Active mutual funds' performance has been of immense interest to financial economists for a very long time (Jensen, 1968; Ferson and Schadt, 1996; Carhart, 1997; Kent, Grinblatt, Titman, and Wermers, 1997; Wermers, 2000; Pástor and Stambaugh, 2002; Cohen, Coval and Pástor, 2005; Fama and French 2010; Kacperczyk, Nieuwerburgh and Veldkamp, 2014; Jensen, Fisher and Tkac, 2015; Berk and Van Binsbergen, 2015).

Petajisto (2013) grouped equity mutual funds according to how active their managers are and finds that the most active fund managers are able to outperform their respective benchmarks even after fees. These findings are contrary to the numerous studies on active fund management that found that active managers tend to consistently underperform the market (Jensen, 1968, McDonald, 1974, Sharpe, 1975, Gruber, 1996, Wermers, 2000, Mibiola, 2013).

Apart from a fund manager's skill in spotting investment opportunities, the ability to outperform a benchmark *inter alia*, is also dependent on the returns to scale which also interact with skill: for example, a small fund which is less skilled can outperform a large fund which is more skilled (Pástor et al., 2015).

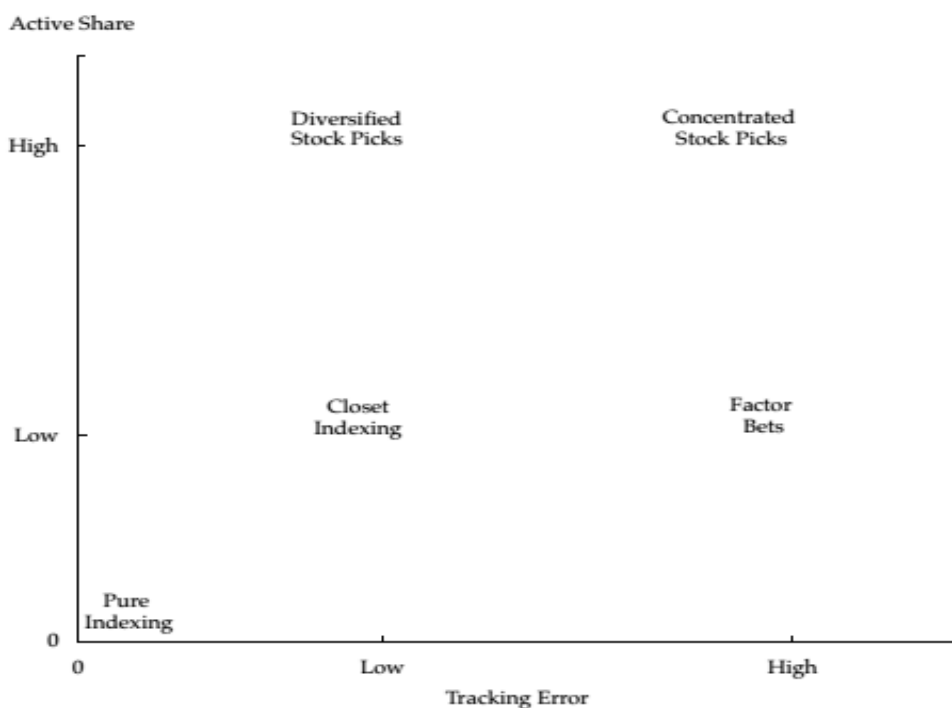
There are two hypotheses on the nature of returns to scale in active management both motivated by liquidity constraints (Pástor et al., 2015). First is a decreasing returns to scale at fund-level i.e. the ability of an active fund to outperform its benchmark decreases as the size of the fund increases (Perold and Solomon, 1991, and Berk and Green, 2004). There is also decreasing returns to scale at the industry level i.e. as the ability of any particular fund to outperform a given benchmark dwindles as the size of the industry of active mutual funds increases (Pástor and Stambaugh, 2012).

Asset prices are affected by large trades by large funds' this will have an impact on the performance of such funds and also, as the number of funds seeking to outperform a given benchmark increases, there is an incremental amount of monies seeking the chance to outperform which leads to prices increases thereby making such a venture elusive. There is increasing amount of evidence that mutual fund trading activities can influence prices on the stock market. Stock market returns are influenced by the aggregate flows into equity mutual funds (Edelen and Warner, 2001). Edelen, Evans, and Kadlec (2007) further posit that another major source of diseconomies of scale for mutual funds can be attributed to trading cost.

Hypothesis on returns to scale at the fund level have been tested in a number of studies with inconclusive findings (Chen, Hong, Huang, and Kubik, 2004; Pollet and Mungo, 2008; Yan, 2008; Ferreira, Keswani, Miguel, Ramos, 2013, a,b;. Reuter and Zitzewitz, 2013).

Cremers and Petajisto (2009) presented a new measure of active portfolio management –Active Share – which depicts the share of portfolio holdings that diverge from the holdings of the benchmark index. The study reports that Active Share forecasts fund performance this implies that funds that have the highest Active Share substantially outperform their benchmarks before and after expenses, and exhibit strong performance persistence as well. Petajisto (2013) further reports that even after fees, funds with the highest Active Share outperformed their benchmarks.

**Figure 6.4: The Different Kinds of Active Share**



**Source:** Adopted from Cremers and Petajisto (2009), cited in Petajisto (2013)

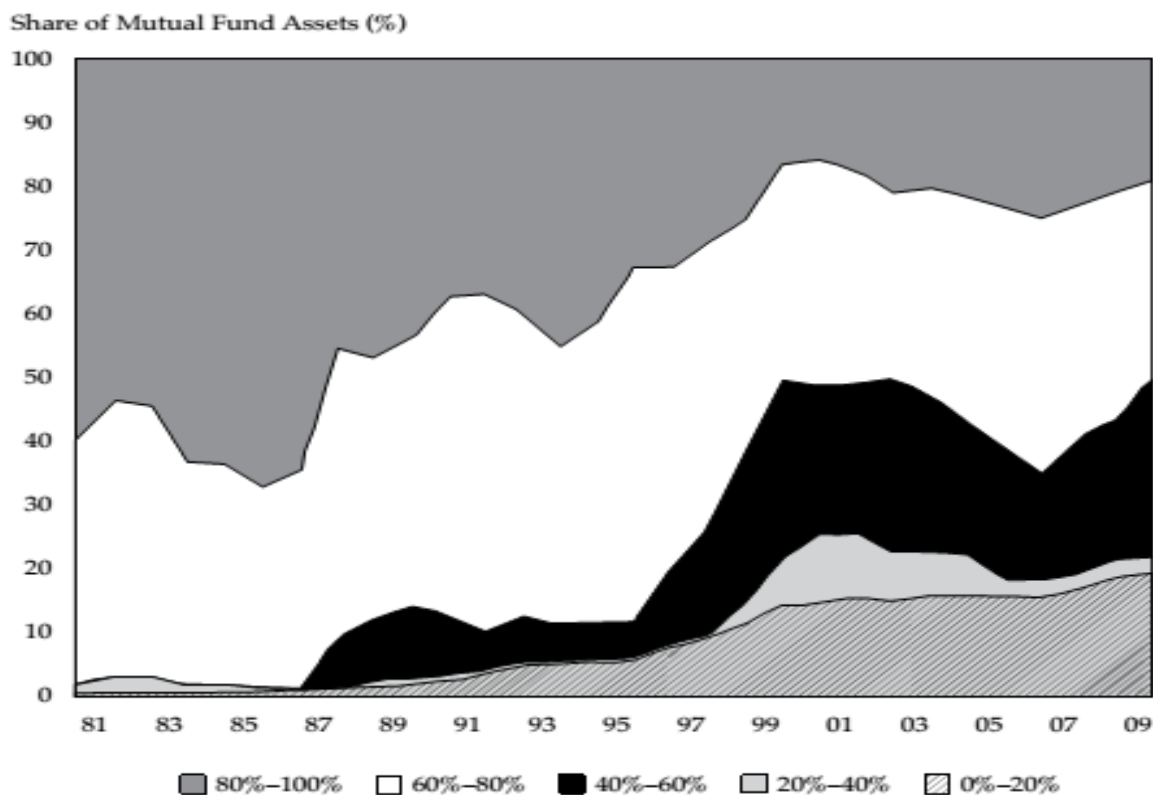
Figure 6.4 illustrates the two aspects of active management and how each can be associated with different styles of active management. Diversified stock pickers display low tracking error and high Active Share, the opposite is true for funds that concentrate on factor bets. Concentrated funds apply both stock selection and factor bets, and therefore score high on each



measure. Closet indexers however score low on each measure. Closet indexers claim to be active managers but are far less involved in any kind of active management.

In the study, Petajisto (2013) distinguishes different kinds of active management explaining that active managers can only add value by differing from the benchmark index either through factor timing (also referred to as tactical asset allocation) which entails time-varying bets on broad factor portfolios such as being overweight in a particular sector of the economy or equity selection which entails active bets on single equities such as choosing just one equity from a given industry.

**Figure 6.5: The Evolution of Active Share in the US (1980 to 2009)**



**Source:** Petajisto (2013: 81)

Figure 6.5 illustrates the portion of assets in United States mutual funds in the five categories of Active Share from 1980–2009. The group of funds at the bottom, that have Active Share less than 20%, are pure index funds which have grown from almost zero in 1980 to around 20% of mutual funds AUM in 2009. The next two category of funds that have Active Share

ranging from 20% and 60%, and are closet indexers and have become even more popular than pure index funds and accounted for about one-third of mutual funds AUM in 2009.

Petajisto (2013) reports that stock selection as depicted by a high Active Share is compensated for in the equity market with the most aggressive stock pickers adding value even after fees for their investors. On the other hand, factor bets, represented by high tracking error on average, did not add value for their investors. Table 6.1 presents the equal-weighted returns for the five types of funds, and the averages across all groups. The figures in parenthesis are the t-statistics.

**Table 6.1: Performance of Active Share**

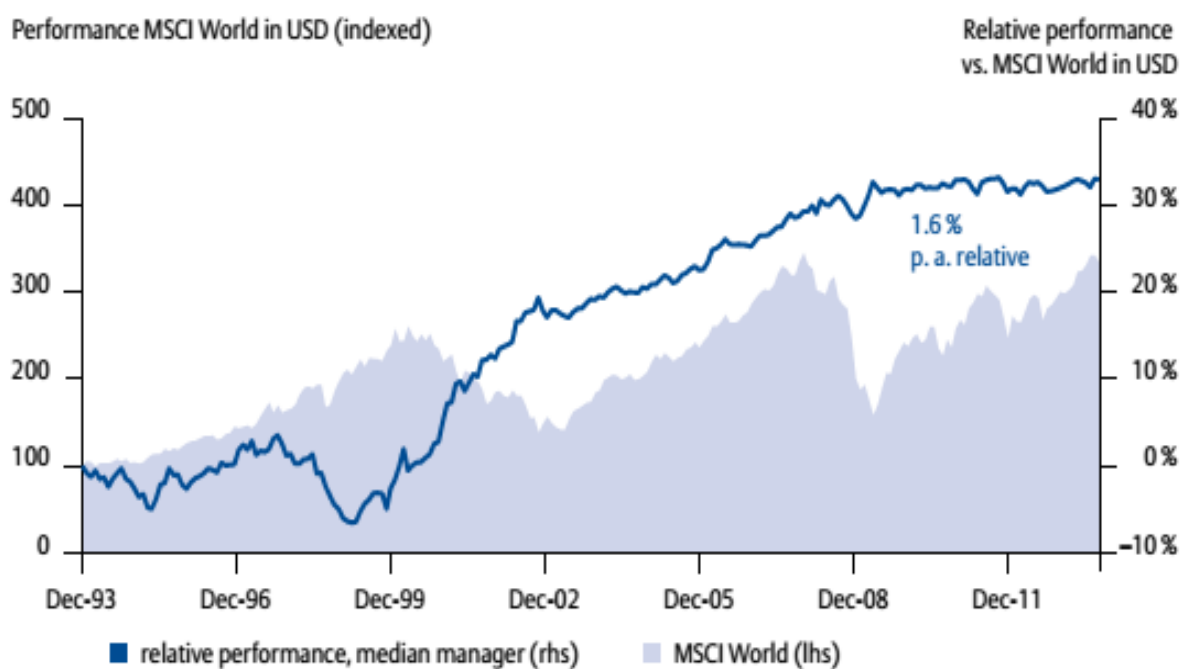
Group	Label	Gross Return		Net Return	
		Benchmark Adjusted	Four-Factor Alpha	Benchmark Adjusted	Four-Factor Alpha
5	Stock pickers	2.61 (3.42)	2.10 (2.72)	1.26 (1.95)	1.39 (2.10)
4	Concentrated	1.64 (0.90)	0.52 (0.40)	-0.25 (-0.17)	-0.89 (-0.72)
3	Factor bets	0.06 (0.06)	-1.02 (-1.47)	-1.28 (-1.31)	-2.19 (-3.01)
2	Moderately active	0.82 (1.63)	0.20 (0.39)	-0.52 (-1.16)	-0.78 (-1.81)
1	Closet indexers	0.44 (1.67)	0.13 (0.51)	-0.91 (-3.38)	-1.07 (-4.46)
All		0.96 (1.70)	0.31 (0.61)	-0.41 (-0.86)	-0.71 (-1.59)
5 - 1	Difference	2.17 (3.31)	1.96 (3.04)	2.17 (3.48)	2.45 (4.00)

**Source:** Petajisto (2013: 84)

However, Frazzini, Friedman and Pomorski (2015) of AQR Capital Management LLC, investigated the Active Share, a measure using the same data set as Cremers and Petajisto (2009) and Petajisto (2013) and concluded that the empirical support for the Active Share is weak and is completely influenced by the strong correlation between the benchmark type and Active Share. (Frazzini et al., 2015) further argue that Active Share rather correlates with the returns of the benchmarks, but cannot predict actual fund returns and conclude that there is no theoretical or empirical justification that Active Share may improve investors' returns.

Rebutting the arguments of Frazzini et al. (2015), Cremers (2015) argues that the AQR paper “falls into a wonderfully creative but altogether different genre, which we label the Wonderland Genre” and should therefore not be interpreted by applying typical academic standards and further arguing that AQR paper is employing a “Sentence First, Verdict Later.” Style and their results cannot be taken at face value, because the information is not shared thereby reversing their main conclusion. In conclusion, Cremers (2015) points out that AQR funds tend to have low Active Shares and little outperformance and hence appearing fairly expensive considering the amount of differentiation offered by the firm.

**Figure 6.6: Performance of Active Managers over the Long-Run**

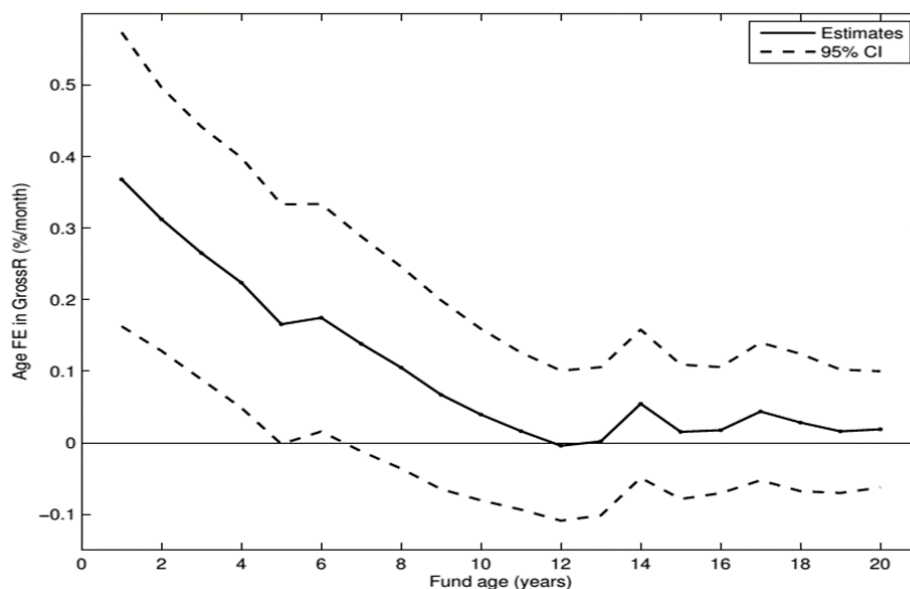


**Source:** Allianz (2014: 5)

According to Allianz Global Investors, the global active equity managers have been able to generate significant value for their clients over the past thirty years, according to Mercer’s GIMD database although recently, there have been a significant slowdown of the pace of outperformance hence calling for the need for more active management (Allianz, 2014). Figure 6.6 shows how over the long-term, the median active fund outperforms the MSCI index and also had a relatively minimal slump during the recent Global Financial Crisis.

Chlanger, Philips and LaBarge (2012) advise investors not use only active share as their sole metric in selecting a portfolio but rather include it in their toolkit in selecting portfolios. Schlanger et al. (2012) conclude that higher active share do not predict outperformance, do not significantly outperform portfolios of lower active shares and had larger dispersion of excess returns. Higher the active-share resulted in higher the fund costs. They also found that funds that had the highest active share were concentrated in small-cap and mid-cap equities.

**Figure 6.7: The Relationship between Fund Age and Performance (March 1993 to December 2011)**



**Source:** Pástor, Stambaugh and Taylor (2015: 35)

Cohen, Leite, Darby and Browder (2014) argue that although active share may assist investors in comparing active managers, it lacks consistency as a measure across different market capitalization, size, benchmarks and mandates. Higher active share comes with a greater level of return dispersion as well as a higher downside risks and strikingly, for large-cap managers, the relationship between excess return and a higher level of active share appears to be largely due to exposures to smaller-cap portfolios (Cohen et al., 2014).

Pástor, Stambaugh and Taylor, (2015) empirically analysed the characteristics of returns to scale in active mutual fund management and reported compelling evidence at the industry level of decreasing returns stating that there is a negative correlation between the active mutual fund industry size and the ability of funds to outperform passive benchmarks. Pástor et al. (2015)

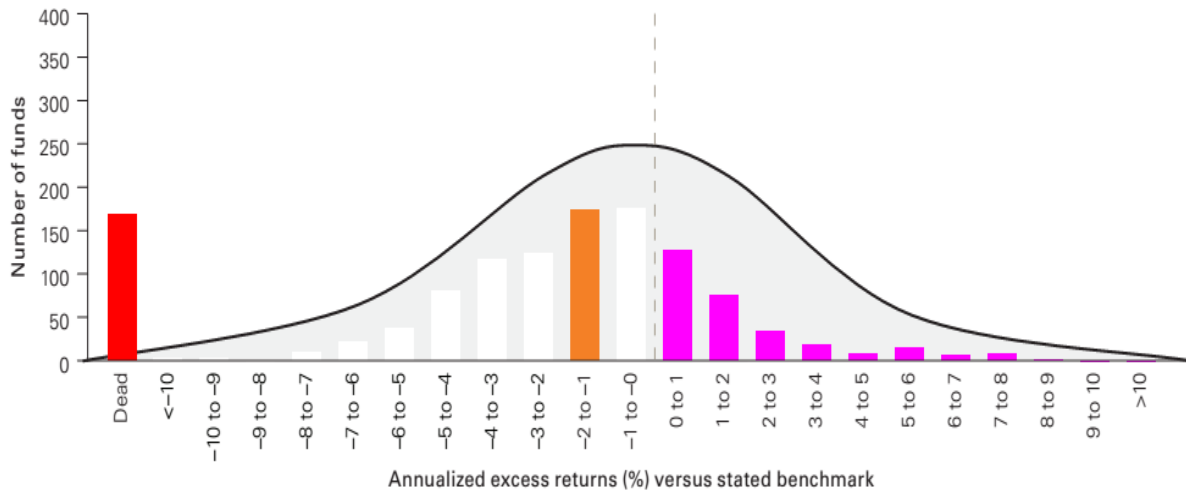
further report that over time, the industry of active fund management has become more skilled with the upward trend in skill coinciding with industry growth and precluding the skill improvement from enhancing fund performance. Their study also reveals a deterioration of performance over the lifetime of a typical fund with the correlation being stronger for funds with relatively higher volatility, turnover and small-cap funds citing decreasing returns to scale at the industry-level as an explanation for this phenomenon. Figure 6.7 illustrate the relationship between performance and fund age. The average fund's performance declines over its lifetime. This result is almost monotonous for funds with that have existed for the past 12 years over the period of the study. According to Pastor et al (2015), the point estimators for the age fixed effects diminish in an approximately linear style from 0.37% every month at age one to 0% at age 12, from this point, they become almost flat therefore, as funds age, their performance diminish.

Philips, Kinniry and Todd (2014) propose combining both active and passive funds in a portfolio as this strategy minimises underperformance, downside risk and dispersion of returns but manage to produce a positive excess returns over the period albeit lower than would have been the case with portfolio made up of only actively managed funds. Figure 6.8 comprises all diversified top quintile U.S. equity funds from 2004 to 2008. Figure 6.9 is made up of the same funds as Figure 6.6, however, it combines each fund in a 50/50 ratio, with a passive index that matches the fund's style of investment. Index returns are reduced by 10 basis points per year to reflect implementation expenses and excess returns are measured according to the stated benchmark of the fund.

The data reflect excess returns from 2009 to 2013 for the 1,205 funds that were in the top quintile from 2004 to 2008.

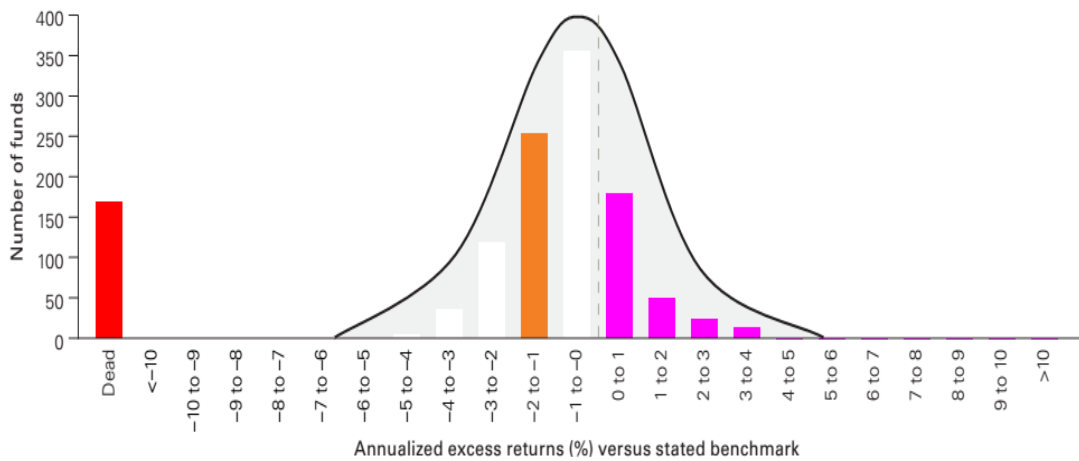
The debate between active and passive management still continues and in recent times it appears the argument for passive management is gaining traction. In the past few years, investors have gravitated towards less expensive and passively managed ETFs and index funds particularly in the United States and poor performance of actively managed funds against their benchmarks has been cited as the reason for this trend (Lamy and Strauts, 2015). Figure 6.10 illustrates the net flow for index and non-index funds in 2014.

**Figure 6.8: Distribution of excess returns for the five years ended 2013 for top quintile funds as of 2008**



**Source:** Philips, Kinniry and Todd (2014: 3)

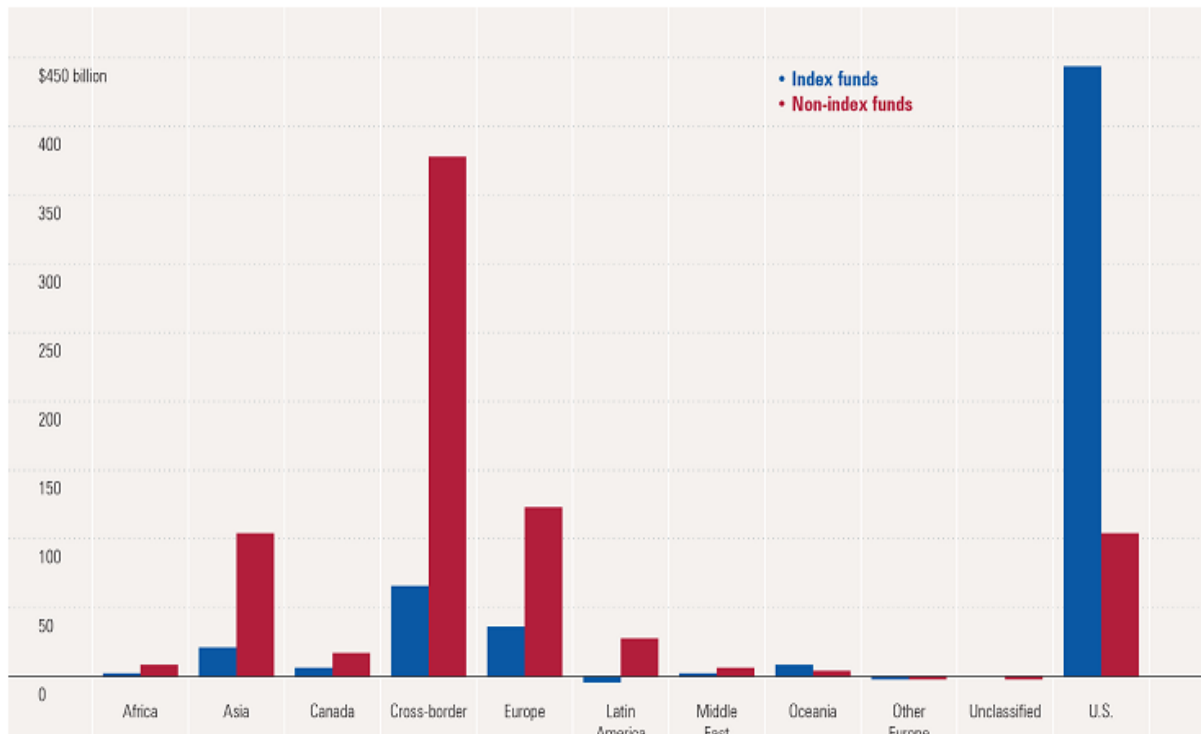
**Figure 6.9: Same distribution but including 50% apportionment to the style benchmark of each fund**



**Source:** Philips, Kinniry and Todd (2014: 3)

As of December 2014, 382 index funds had net assets of \$2.1 trillion while demand for index funds continued to increase, with \$148 billion in net new cash flow. In 2014, among households that owned mutual funds in the United States, 31% had at least one equity index fund (Investment Company Institute, 2015).

**Figure 6.10: Net Flows for Index and Nonindex Funds by Region (2014)**



Source: Lamy and Strauts (2015: 9)

## 6.4 Major Product Segments

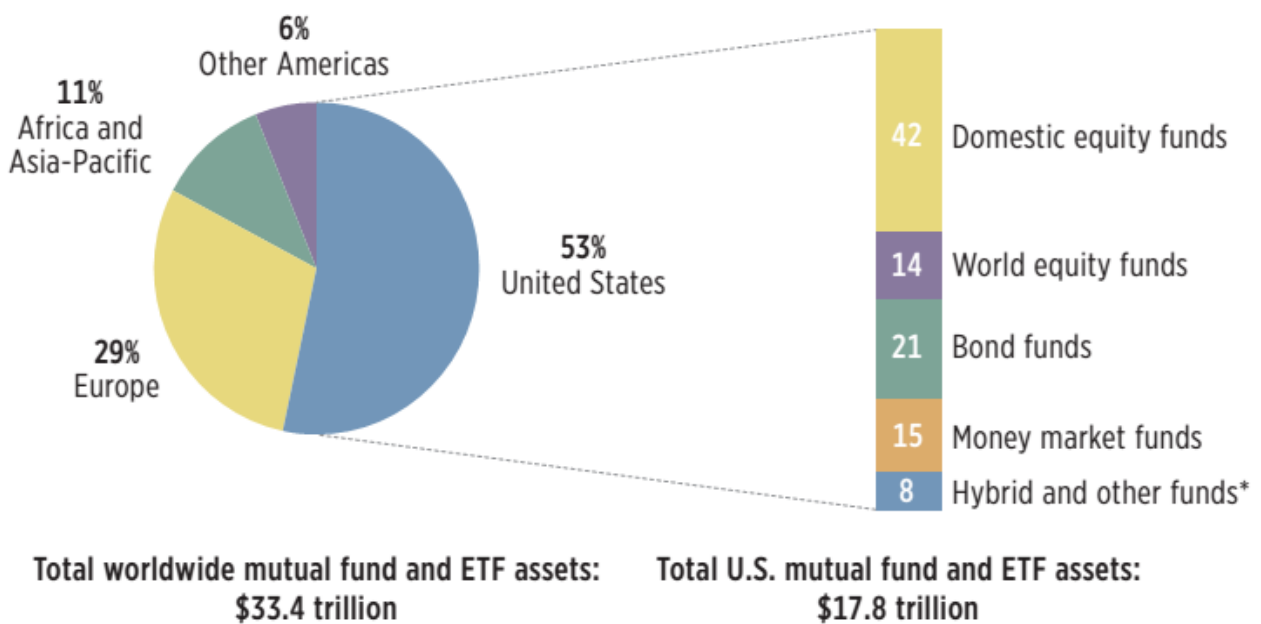
The major product segments in the asset management industry are mutual funds, exchange traded funds separately managed accounts, hedge funds, venture capital, private equity and institutional investors. Institutional investors are mainly made up of pension funds, insurance companies and sovereign wealth funds.

### 6.4.1 Mutual Funds

Mutual funds form part of a large family of financial intermediaries that pool funds from investors to invest in securities. The assets under management of mutual funds worldwide was

\$33.4 trillion as at December 2014 with the United States representing the largest market for mutual funds with a 53% share as at year-end 2014 followed by Europe with 29% (Investment Company Institute, 2015). The mutual fund industry in the United States is dominated by domestic equity funds which make up 42% of industry assets followed by bond funds with 21% of assets. Figure 6.11 illustrates worldwide mutual funds' assets as well as a breakdown of the market share of different categories of fund in the United States.

**Figure 6.11: 2014 Year End Market Share of Mutual Funds and ETFs**



**Source:** Investment Company Institute (2015: 10)

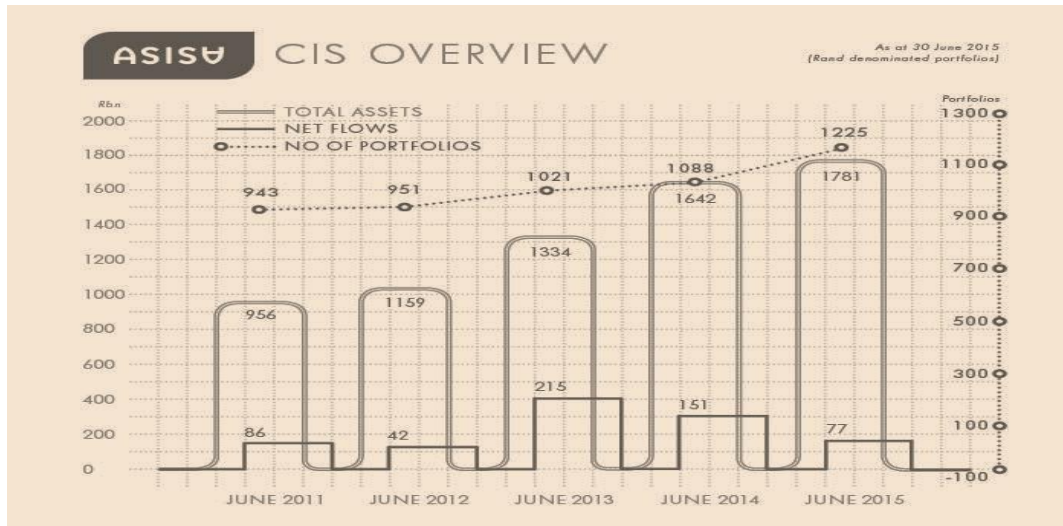
According to ASISA (2015), total assets under management in South Africa as at 30 June 2015 was R1.781 trillion, increasing from R 78.8 billion in June 1998. There were 1225 registered funds as at June 2015. Mutual funds in South Africa had R 77 billion net flow as at June 2015.

The majority of mutual funds (also called Collective Investment Schemes(CIS)) distribution in South Africa is currently through banks and insurance companies, although the emergence of the Retail Distribution Review(RDR) is likely to bring significant changes (PwC, 2015). The market for Independent Financial Advisor (IFA) is expected to considerably shrink, while the Do-It-Yourself (DIY) approach is expected to gain momentum as a result of to increased levels consumer sophistication and internet connectivity (PwC, 2015). The total assets of the 1,171 mutual funds based in South Africa in 2014 worth R 1.7tn (\$147.2bn) have grown at 15.2%



Compound Annual Growth Rate (CAGR) since 2006. During the Global Financial Crisis, the growth slowed but bounced back in 2009 (PwC, 2015). There are 49 registered mutual fund managers in South Africa and many are also registered fund managers in other African countries.

**Figure 6.12: Overview of South African Mutual Fund Industry**

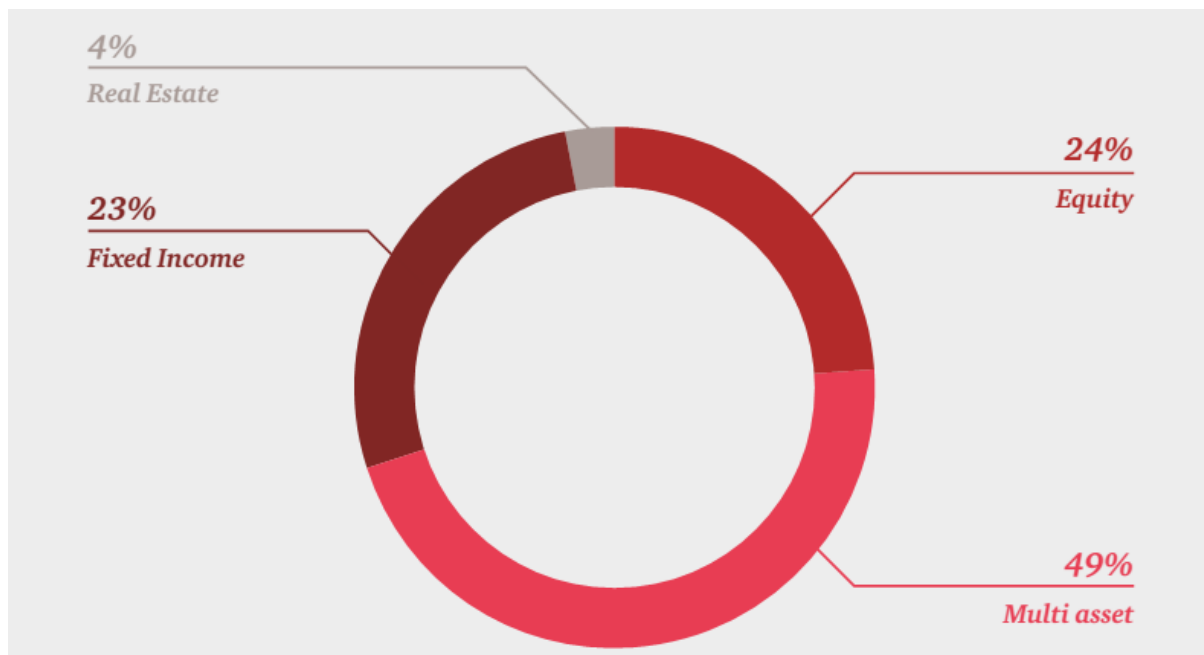


**Source:** ASISA (2015)

The institutional managers market is quite concentrated with the top ten asset managers managing more than half of AuM while the top three are responsible for a quarter of AuM (PwC, 2015). The retail market is however, quite fragmented. The top ten asset managers manage a fifth of AuM. The Financial Services Board (FSB) regulates all South African funds under the terms of the Collective Investment Schemes Control Act, 2002. The FSB permits three different types of CIS: property (CISP), CIS in securities (CISS) and participation bonds (CISPB). The majority of the schemes are however CISS and include feeder funds, money market funds and funds of funds (PwC, 2015). Figure 6.13 shows the asset allocation of CIS in South Africa.

Foreign Collective Investment Schemes (FCIS) are off-shore mutual funds that are also under the regulation of the FSB and approved for distribution in South Africa. The total AuM of these mutual funds amounted to R286 bn (USD 24.7bn) in 2014 with 313 funds. The majority of these funds (53.9%) were based in Luxembourg, with Ireland and Jersey also being popular domiciles (PwC, 2015).

**Figure 6.13: Asset Allocation of CIS (2014)**



**Source: Adopted from ASISA, cited in PwC (2015: 22)**

The managers of the offshore funds have to be approved by the registrar, and the country where these funds are based must have regulatory environments that are at least of similar standing as that of South Africa. Local investors who want to invest in such funds must comply with regulations of the Reserve Bank and use their foreign capital allowance since FCIS funds are denominated in foreign currencies, usually the British Pounds, United States Dollars, Euro and Japanese Yen (PwC, 2015).

## 6.4.2 Exchange Traded Funds (ETFs)

ETFs are designed as open-ended investment vehicles in the same way as mutual fund although investors do not buy ETF shares directly but through stock exchanges. The origins of ETFs can be traced to a computer-based innovation that came around in the 1980s known as “program trading” that allowed investors to trade in shares of major indices with a single trade order (Hill et al., 2015).

**Table 6.2: The Global Exchange Traded Products**

Listing Region	AUM (\$ billions)	Market Share	No. of Products	AUM/Product
United States	\$1,864.3	71%	1,646	1.13
Europe	450.8	17	2,219	0.20
Canada	65.3	2	324	0.20
Latin America	8.5	0	43	0.20
Asia Pacific	186.0	7	694	0.27
Middle East and Africa	45.4	2	377	0.12
Global exchange-traded product industry	2,620.3		5,303	0.49

**Source:** Adopted from BlackRock (2014), cited in Concannon (2015: 61)

Many attribute the creation of the first ETF to State Street Global Advisors in 1993 (State Street Global Advisors, 2013) - the Standard & Poors Depository receipts (SPDR) S& P 500 - designed to track the performance of the S&P 500 with assets of \$6.5 million growing to \$182 billion as at November 2015 (State Street Global Advisors, 2015) making it one of the most extensively traded securities in the world (Concannon, 2015). However, the Toronto Index Participation Shares, launched in 1990 on the Toronto Stock Exchange, is the first ETF and it provided exposure to 35 of the biggest companies in Canada which some preliminary success, but ETF never gained traction and was shut down eventually (Hill, Nadig and Hougan, 2015)

As of October 2013, the global ETF industry had \$2.3 trillion assets and more than 5,000 funds growing from 215 ETF managers on 58 stock exchanges. Although majority of ETFs are passively managed, asset managers have in recent years introduced actively managed ETFs.

- **The Rise of Indexing**

In the 1970s, institutional investors began incorporating modern portfolio theory into their investment products, the concept that investors are better off “holding the market” rather than picking specific stocks also began gaining popularity in part due to Burton Malkiel (1973) in his book *A Random Walk Down Wall Street* and institutions like endowment and pension funds began investing in private portfolios that tracked the S&P 500 (Hill et al., 2015). Well Fargo Investment Advisors structured the first index fund in 1971 for Samsonite Corporation pension fund (Ancell, 2012) and John Bogle (2014) of Vanguard Group started the first index mutual fund in 1975.

- **Exchange-Traded Notes (ETNs)**

Although the term ETF is also used to refer to ETNs, ETNs are not “funds” in the true sense of the word rather, they are unsecured debt obligations of the issuing institution structured as a promise to pay a series of returns that are based on the returns of a given index excluding management fees. Among all exchange traded products, holders of ETNs are exposed to the largest counter party risk because they are unsubordinated and unsecured debt notes and do not carry voting rights as ETNs are not debt securities (Hill et al., 2015).

As at 31 September 2016, there were 71 JSE listed ETFs and ETNs in South Africa. By end of 2014, AUM was R 82.56 billion growing from R 16.4 billion in 2008 (ETF SA, 2016).

### **6.4.3 Hedge Funds**

Similar to mutual funds, the pooling of investments is the core idea behind hedge funds. Investors acquire shares in these funds and the funds proceed to invest the pooled assets on the behalf of the investors. The investors’ stake in the portfolio is represented by the NAV of each share. Hedge funds in this sense, operate in the same way as mutual funds. There are however, significant differences between hedge funds and mutual funds.

Hedge funds are subjected to less stringent transparency requirements than mutual funds. Furthermore, Hedge funds do not advertise to the general public unlike mutual funds and usually have a maximum of 100 investors who are usually high net worth investors. Mutual funds usually make public their investment approach for example, small-cap value orientation, or small-cap momentum orientation, large-cap value orientation, etc., and face the pressure to eschew style drift (the departure from stated investment orientation) whereas hedge fund managers are not obliged to make public their investment strategies. There are also differences in liquidity and compensation structures of hedge funds and mutual funds, whereas hedge funds often implement lock-up periods, i.e., periods within which withdrawal of investments is not allowed and many hedge funds also implement notice of redemption that requires investors to give notices in advance could be weeks or months depending on the fund of the desire to withdraw funds.

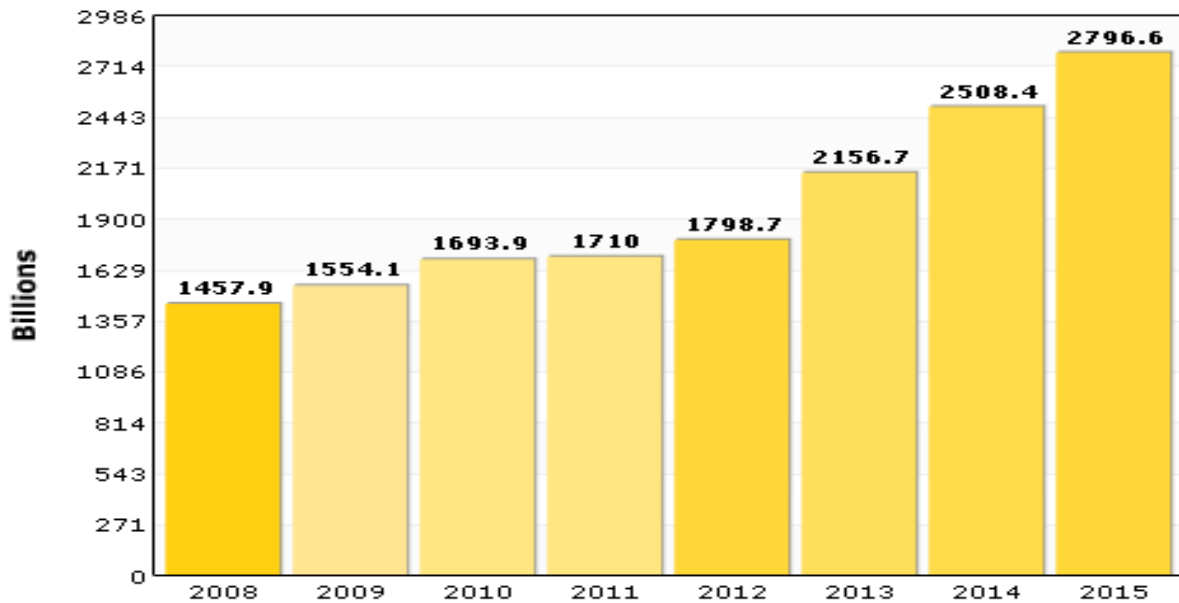
Mutual funds do not usually implement such stringent redemption policies therefore making them more liquid than hedge funds. In terms of remuneration, mutual funds also differ from hedge funds in their fee structure. Mutual funds usually set management fees as fixed percentage of assets under management generally between 0.5% and 1.5% annually for a typical equity fund while hedge funds usually impose a management fee that ranges from 1% to 2% of assets under management and an incentive fee set as a percentage (usually 20%) of any investment profits above a given benchmark (Bodie et al., 2014).

The phrase “hedge fund” was coined by sociologist Alfred W. Jones (Ineichen, 2002, Ubide, 2006) and also credited with the establishment of the first hedge fund in 1949, this however has been disputed (Anson, 2006). Alfred Jones described his fund as "hedged", a term that was generally used on Wall Street to portray risk management of investment as a result of changes in capital markets (Lhabitant, 2011).

Due to heavy losses, several hedge funds collapsed in the period of the recession of 1969–70 as well as the 1973–1974 stock market crash. The industry however gained renewed interest in the late 1980s (Ineichen, 2002). In the 1990s, the number of hedge funds grew substantially, this growth was fuelled by the wealth created during bull market of the 1990s (Ubide, 2006). The renewed interest was as a result of the promise of high returns and the compensation structure adopted by hedge funds that aligned the interest of managers and investors (Nicholas, 2004).

Hedge funds gained worldwide popularity during the first decade of the 21st century and by 2008, the hedge fund industry held \$1.93 trillion in AUM (Herbst-Bayliss, 2011). The financial crisis of 2008 however led many hedge fund managers to constrain withdrawals by leading to a decline in their popularity and AUM (Pessin, 2010). Assets under management of hedge funds have grown from \$1.45 trillion in 2008 to \$2.79 trillion in 2015 (Barclay Hedge, 2016). By February 2011, institutional investors accounted for 61% of worldwide investments in hedge funds (Williamson, 2011). According to Preqin’s 2016 Global Hedge Fund Report, over 5,000 global institutional investors invested in hedge funds. The hedge fund industry attracted \$71.5 billion new capital inflow with 829 funds launched in 2015 and 625 funds closed in 2015 as well. (Preqin, 2015).

**Figure 6.14: Global Hedge Fund Industry: Assets Under Management (AUM)**



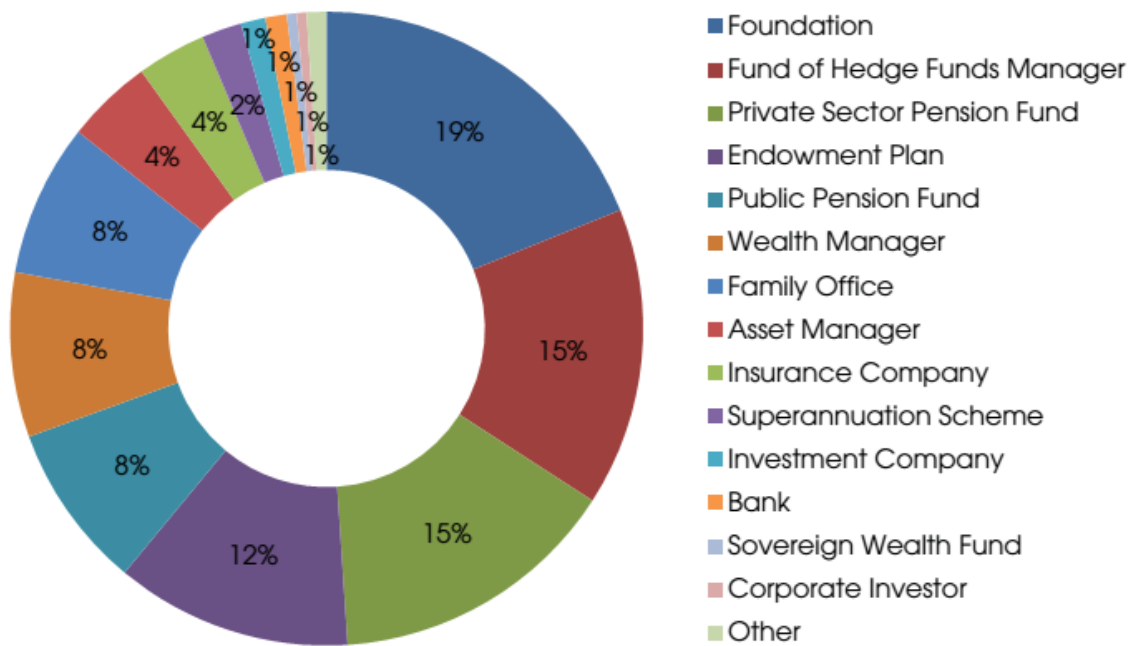
**Source:** Barclay Hedge (2016), “Hedge Fund Industry”

[www.barclayhedge.com/research/indices/ghs/mum/Hedge\\_Fund.html](http://www.barclayhedge.com/research/indices/ghs/mum/Hedge_Fund.html)

More than 4,800 global institutional investors invested with hedge funds in 2014 representing almost 65 percent of the invested capital of the industry. Overall, total assets under management in 2014 increased by \$355 billion (Preqin, 2015). Figure 6.14 illustrates a breakdown of capital invested by institutional investors in hedge funds in 2014.

Regardless of the actions by some public pension funds in the second half of 2014, there was a pervasive over-allocation of funds from the pension funds industry. Public pension plans accounted for about 20 percent of all institutional capital that were invested with hedge funds. When investments from private pensions are factored in, the number almost doubles. Public pension funds dedicated about 7.8 percent on average of their portfolio to hedge funds as shown in Figure 6.15 (Preqin, 2015).

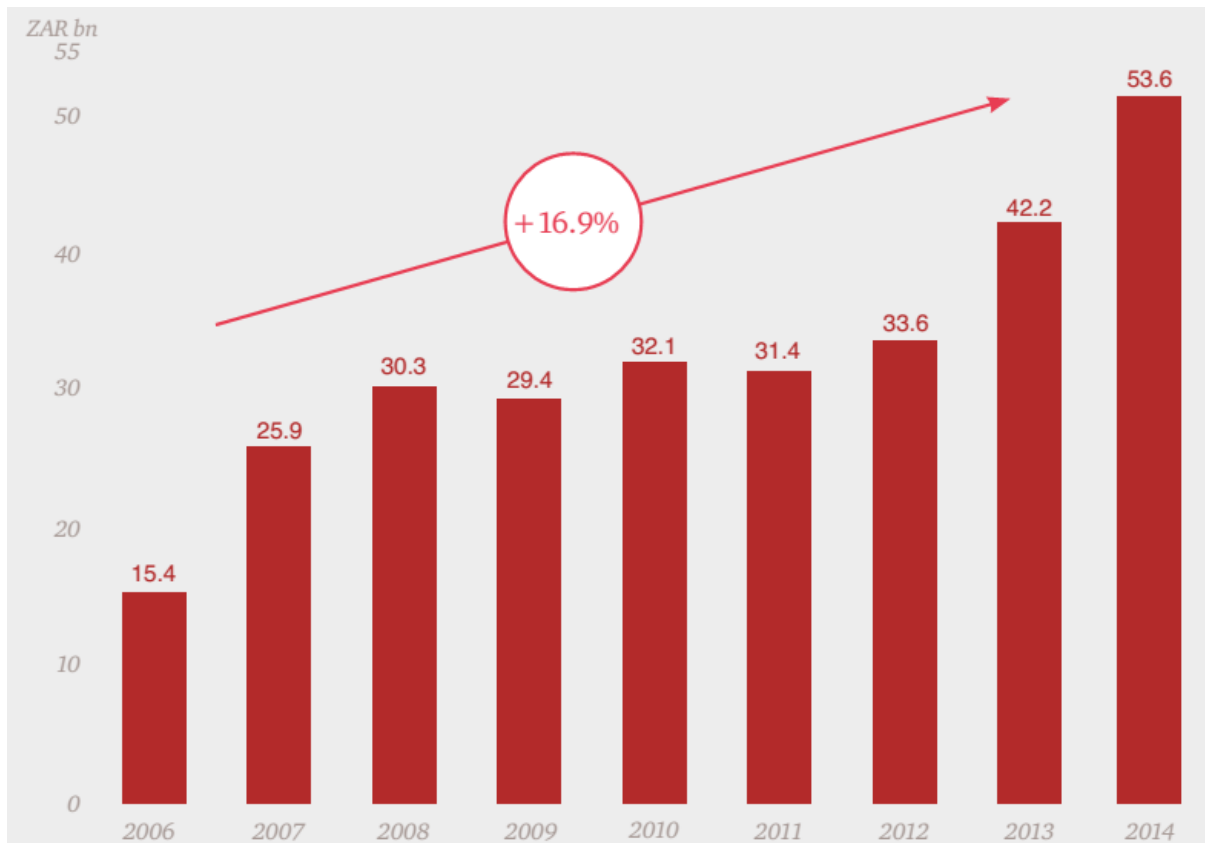
**Figure 6.15: Breakdown of Institutional Investor Capital Invested in Hedge Funds by Investor Type**



**Source:** Preqin (2015: 2)

In South Africa, the financial sector is matured enough to offer hedge funds. Investors in hedge funds in South Africa are mostly funds of funds. From 2006 to 2014, the AuM of South African hedge funds have grown at a CAGR of 16.9% (Figure 6.16) (PwC, 2015). New legislation bringing hedge funds under the regulations of CIS is projected to significantly increase the AuM of hedge funds by making hedge funds which were previously only available to institutional investors, now available to retail investors as well (PwC, 2015).

**Figure 6.16: Evolution of AuM of Hedge Funds in South Africa**



Source: Adopted from Novare Investment, cited in PwC (2015: 24)

#### **6.4.4 Venture Capital (VC) And Private Equity (PE)**

Venture capital (VC) is money that is offered to fund development-stage, emerging as well as emerging growth companies. VC funds provide funding for companies in return, receive equity stakes in the companies. Such companies usually have a business model in the high technology industries or an innovative technology. Usually, venture capital investments take place after a seed funding round which is the initial amount of capital injected into the selected company to finance growth with the objective of generating returns when there is an eventual exit through a sale or an IPO of the particular company. A VC is also another kind of private equity (Bailyn, 2011).

Venture capital, just like equity crowdfunding, angel investing and other seed funding avenues, is appealing to new companies that have short operating history and are not big enough publicly to raise capital in financial markets and are also unable to secure loans from banks or offer debt



instruments. The venture capitalist takes a significant control of the decision-making process and also a significant portion of ownership in exchange for taking on the high risk of investing in a less mature and smaller company.

General George Doriot is credited with creating in 1946, the first institutional venture capital fund, regularising the establishment and helping shape companies into organised business and in the process, setting a standard for the VC industry (Doriot and Gupta, 2004, Ante, 2008, Mason, 2012). However, in a Securities and Exchange Commission (SEC) speech titled *The Future of Securities Regulations*, the general counsel of the SEC Brian Cartwright (2007) pointed out that, venture capital funds “came into their own” in the 1960s when the pivotal funding of Fairchild Semiconductor funded by Venrock Associates in 1959 to develop the first practical and commercially viable integrated circuit. Laurence S. Rockefeller, the fourth of the six children of John D. Rockefeller, founded Venrock in 1969 as a means to permit the other children of Rockefeller to gain exposure to the investments of venture capital (Singh, 2009). Venrock concentrates its investments on start-up and early-stage companies in emerging technologies and information technology. These include: Intel, Apple, StrataCom, DoubleClick, 3Com Corporation, etc. and also has a major venture in the field of nascent nanotechnology, providing the initial funding of Nanosys and the nanotechnology division of Du Pont (Feder, 2004).

By June 2015, the private capital AUM of the PE industry reached \$4.2 trillion (Preqin, 2016). VC and PE managers (general partners, or GPs) operate in a similar manner by raising investor capital from investors who are classified as limited partners (LPs) to acquire, optimize, and eventually sell the acquired companies to make profits. LPs commit the bulk of the capital of a fund. GPs also commit around 1%–5% of the capital of the fund with the objective of aligning the interests of the GP with those of the LP. The lifespan of majority of PE funds is approximately 7–10 years which may be subject to extension, with the first few years spent in acquiring 10 or more target companies with a potential to grow. Unlike most asset managers who trade in public securities, PE and VC funds often adopt a hands-on approach to the companies in their portfolios. They apply a combination of financial engineering, placing their own board and executive members and make significant contributions in the development of the business strategy of the firms in their portfolio. The final stage, which is also known as the

“exit” or “harvesting” phase, occurs when the fund proceeds to profitably dispose of its portfolio of firms through an IPO, a sale to another PE fund or a private sale to a competitor (“strategic buyer”). Table 6.3 shows the top PE managers as at March 2014.

**Table 6.3: Largest PE Managers, Five-Year Fundraising Totals as of March 2014 (\$ bn)**

<b>Manager</b>	<b>AUM</b>
The Carlyle Group	\$30.7
Kohlberg Kravis Roberts	27.2
The Blackstone Group	24.6
Apollo Global Management	22.3
TPG	18.8
CVC Capital Partners	16.6
General Atlantic	16.6
Ares Management	14.1
Clayton Dubilier & Rice	13.5
Advent International	13.2

**Source:** Growth Business, “Ten Biggest Private Equity Firms in the World”, (May 2014)  
<http://www.growthbusiness.co.uk/banking-on-the-cloud-and-saas-rise-in-europe-2401382/>

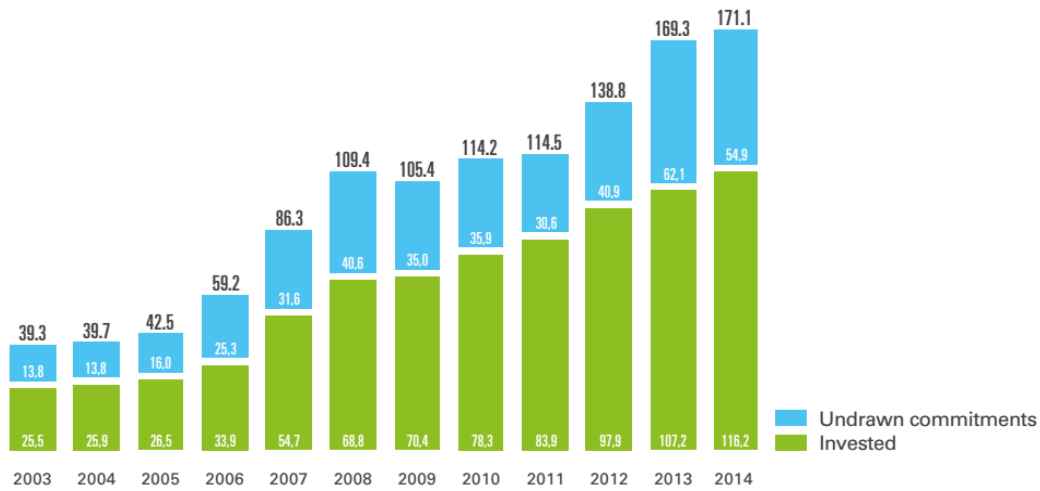
- **The Private Equity and Venture Capital Industry in South Africa**

According to a KPMG and SAVCA (2015) survey, the private equity industry of South Africa had R171.1 billion in funds under management as at December 2014. This figure includes of undrawn commitments of R54.9 billion. This reflects a R1.8 billion increase from R169.3 billion as at 31 December 2013 with a 11.3% compounded annual growth rate of funds under management which excludes undrawn commitments since the survey began in 1999.

The South African PE industry is relatively small when compared to that of the United States and United Kingdom, however, it is locally significant and well established. The KPMG and SAVCA (2015) report that South Africa has an investment activity as a percentage of GDP 0.21 % in 2014 and 0.17 in 2013. The calculation is only in relation to the annual investments by Independents so as to make a direct comparison with the Emerging Markets Private Equity Association information. As a percentage of GDP, South Africa’s PE investment is higher than

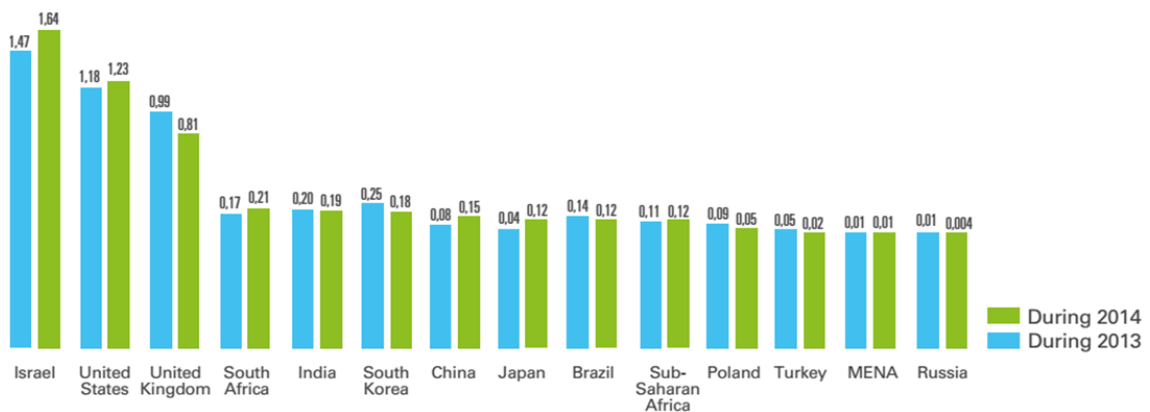
China (0.15), India (0.19%), Brazil (0.12%) and Russia (0.01%). It is still however below that of the United States (1.23), the United Kingdom (0.81%) and Israel (1.64%).

**Figure 6.17: Total funds under management at year end, split by undrawn commitments and investments (Rbn)**



Source: KPMG and SAVCA (2015: 20)

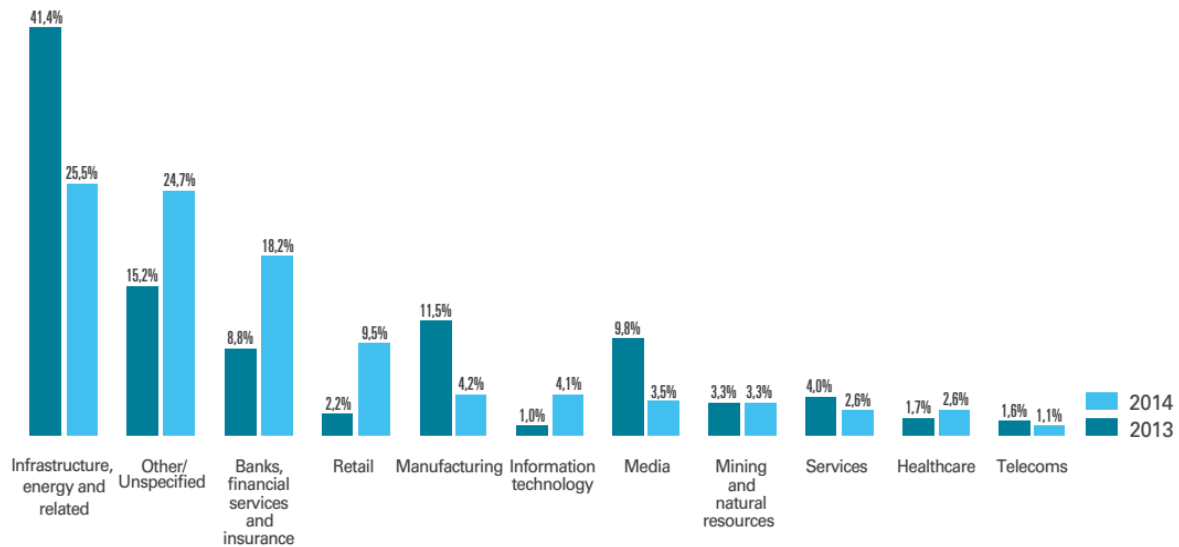
**Figure 6.18: Private Equity annual investment by independents as a percentage of GDP (2013 and 2014)**



Source: KPMG and SAVCA (2015: 25)

In 2014, 25.5% of investments made were in the infrastructure sector, 24.7% and 18.2% in the other sector and in the Banks, financial services and insurance sectors respectively. Figure 6.19 presents investments in the various sectors in 2014.

**Figure 6.19: Investments made during the year, analysed by sector (2013 and 2014)**



Source: KPMG and SAVCA (2015: 35)

PE firms raise revenues through various means:

- **Management fees**

PE firms charge AUM-based fees that is between 1% and 2% calculated on the committed capital which sometimes may step down a number of years into the period of investment of a fund or, calculated based on the net invested capital.

- **Investment income:**

These are the gains that are generated on capital contributed by the GP to the fund.

- **Transaction and monitoring fees**

Fees paid to the GP by the companies in the portfolio for the various structuring and corporate services. In most cases, a percentage of this fee goes to the LPs as an offset to management fees.

- **Incentive Fees (Carried interest)**

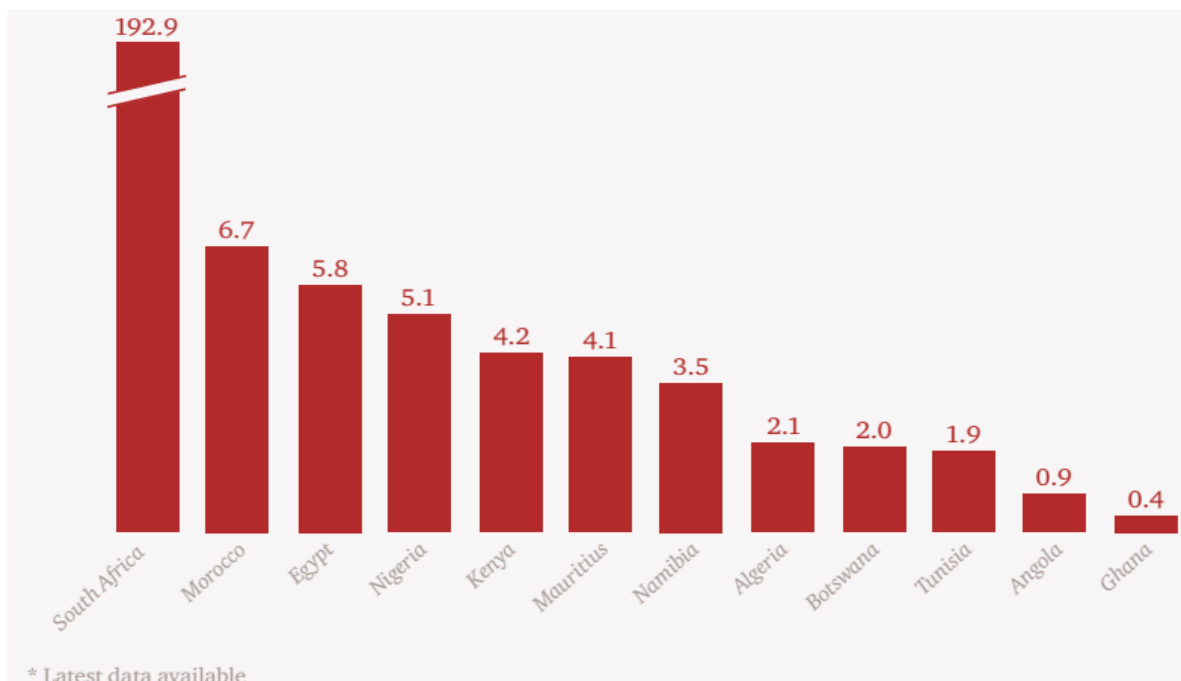
This represents the share of the GP’s gains which is usually 20%, on the sales of portfolio companies. Distribution of the proceeds from the sales is subject to certain “distribution waterfall” terms. In a European-style distribution waterfall, the GPs receive their fees only after the LPs have received distributions that is equivalent to their committed capital in addition to a hurdle or preferred return that is usually between 5%–8%. In some instances, a GP “catch-

up” may where as long as the GP provides the LP with the preferred return, the GP claims all the profits or a majority of the profits up until the profit split which was agreed upon, as prescribed by the carried interest is reached. After the payment of the preferred return to LPs as well as the GP catch-up, the remaining distribution follows the normal split of 80/20 carried interest allocation. In some distribution waterfall structures where the calculation of carried interest is on a deal-by-deal basis, it is necessary to take into consideration the scenario where there will be a “clawback” clause in the case of a negative performance by the fund.

### 6.4.5 Insurance Companies

By the end of 2013, insurers worldwide held over \$13 trillion in AUM, the United States represents the largest market with more than \$5.5 trillion (Concannon, 2015). Many insurance companies operate an in-house portfolio management team that takes responsibility for the management of general account assets (assets made available for the payment of claims and benefits). Other insurers however, outsource their portfolio management duties to third-party investors, sometimes via separately branded subsidiaries (Concannon, 2015).

**Figure 6.20: Total Assets of Insurance Undertakings per Country\* (\$bn)**



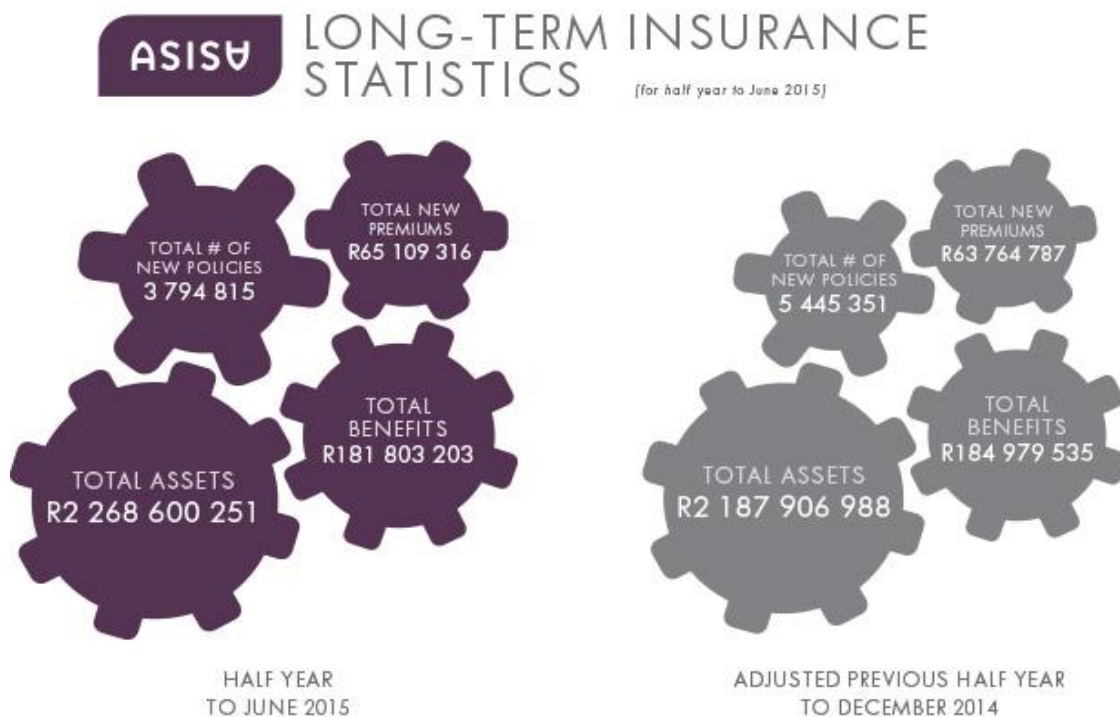
**Source:** Adopted from PwC Market Research Centre analysis based on National Authorities data, cited in PwC (2015: 10)

Insurance companies are progressively outsourcing some of their portfolio management duties relating to general account portfolios to unaffiliated managers. They mainly outsource managing of complex alternative asset classes. In the United States, for example, the trend is especially striking: The percentage of outsourced AUM over the past four years ending 2013 increased by 54% to over \$2.8 trillion (Diamond, 2014).

In Africa, the industry is growing rapidly. Africa however, has a low average penetration rate of about 3.5% of GDP in terms of premiums collected, with the exception of South Africa which is over 15% (PwC, 2015). Serious growth of the insurance industry in other African countries only began recently as a result of lack of financial awareness among consumers as well as the religious beliefs of some countries in North Africa (PwC, 2015). Figure 6.20 shows the total AuM of selected African countries.

In South Africa, the long-term insurance industry had a total asset of R2.2 trillion with a total liability of R2.1 trillion as at 31 December 2014 (figure 6.21) whereas the short-term insurance industry had R119 billion in assets and R 61 billion in liabilities (ASISA, 2015, SAIA, 2015).

**Figure 6.21: Long-Term Insurance Statistics (South Africa)**



Source: ASISA (2015)

## 6.4.6 Pension Funds

A pension fund, in some countries also called a superannuation fund, is any fund, plan or scheme that provides income for retirement. Pension funds major investors in both listed and private companies as they generally have substantial amounts of money to invest.

By the end of 2013, worldwide pension assets reached \$32 trillion by the end of 2013. The United States is the largest marketplace for pension in the world, making up over 58% of global pension assets (Tower Watson, 2014). Table 6.4 illustrates, pension assets held by thirteen different countries

**Table 6.4: Global Pension Assets**

Market	Total Assets (USD billion)	Total Assets (USD billion)	Growth rate (USD)
	Year end 2003	Year end 2013e	10-year CAGR
<b>Australia</b>	<b>424</b>	<b>1,565</b>	<b>14.0%</b>
<b>Brazil</b>	<b>83</b>	<b>284</b>	<b>13.1%</b>
<b>Canada</b>	<b>636</b>	<b>1,451</b>	<b>8.6%</b>
<b>France</b>	<b>139</b>	<b>169</b>	<b>2.0%</b>
<b>Germany</b>	<b>229</b>	<b>509</b>	<b>8.3%</b>
<b>Hong Kong</b>	<b>37</b>	<b>114</b>	<b>12.1%</b>
<b>Ireland</b>	<b>64</b>	<b>130</b>	<b>7.4%</b>
<b>Japan</b>	<b>2,906</b>	<b>3,236</b>	<b>1.1%</b>
<b>Netherlands</b>	<b>614</b>	<b>1,359</b>	<b>8.3%</b>
<b>South Africa</b>	<b>100</b>	<b>236</b>	<b>9.0%</b>
<b>Switzerland</b>	<b>355</b>	<b>786</b>	<b>8.3%</b>
<b>UK</b>	<b>1,261</b>	<b>3,263</b>	<b>10.0%</b>
<b>US</b>	<b>9,942</b>	<b>18,878</b>	<b>6.6%</b>
<b>Total (USD)</b>	<b>16,787</b>	<b>31,980</b>	<b>6.7%</b>

**Source:** Tower Watson, “Global Pensions Asset Study -2014” (February 2014),

<https://www.towerswatson.com/en-US/Insights/IC-Types/Survey-Research-Results/2014/02/Global-Pensions-Asset-Study-2014>

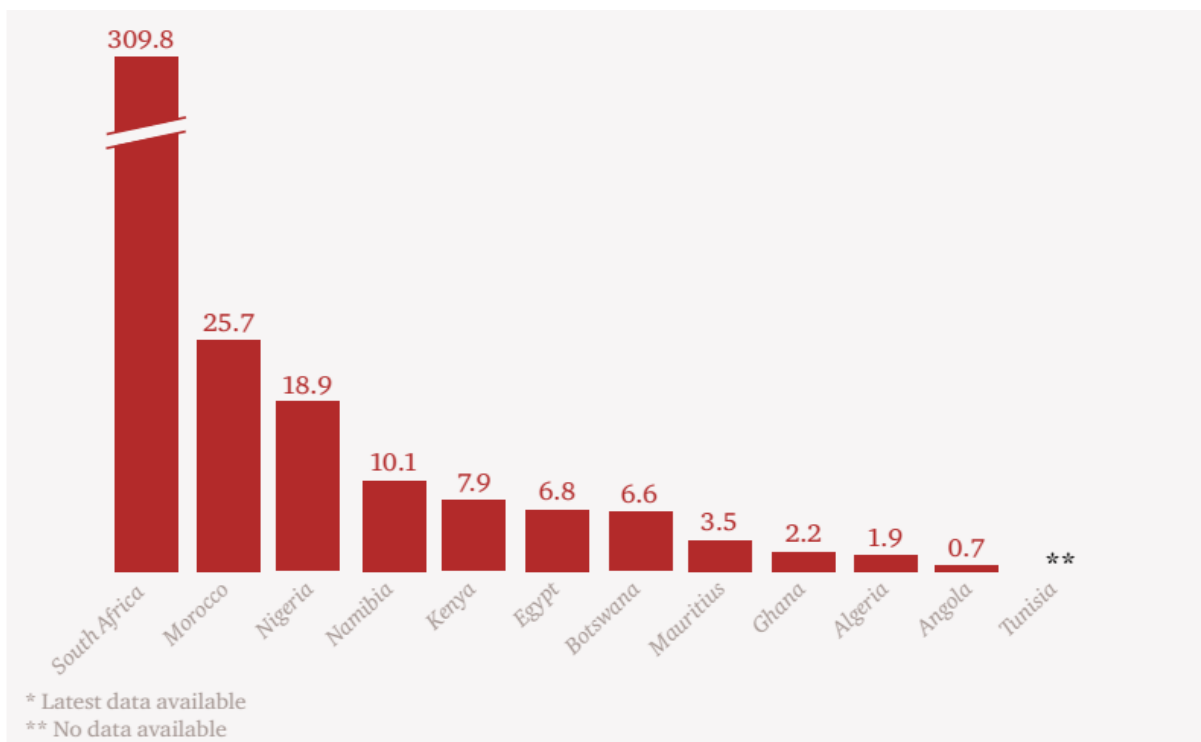
The pension fund sector in some African countries grew steadily from 2006 to 2014 (Figure 6.22) and this growth expected to continue. As the economies of these country mature, pensions are expected to become more significant part of their respective financial sector, though many African countries still have essentially no private pension schemes (PwC, 2015).

A pension plan may be either defined benefit (DB) or a defined contribution plan.

- **Defined Benefit (DB) Pension Plan**

A DB pension plan is a kind of pension plan that has a sponsor or employer making a commitment to make monthly payments upon retirement according to a formula that is based on the age of the employee, earnings history and period of service and is not directly dependent on investment returns of amounts contributed over the years by both the employer and employee (Goldhaber and Grout, 2016). A DB plan is termed 'defined' because the formula for the benefit determination is defined and also known in advance.

**Figure 6.22: Total Pension Fund Assets in Selected African Countries\* (\$Bn)**



**Source:** Adopted from PwC Market Research Centre analysis based on National Authorities data, cited in PwC (2015: 9)



DB plans are dogged with many operational challenges ranging from accounting, actuarial, liquidity, and regulatory challenges and have wide variations in sophistication and asset allocation. The outlook in the long-term for the DB pension plans is negative as many sponsors of pension plans are steering clear of the risk, complexity and expenses involved managing DB plans. DB plan sponsors are increasingly closing plans to their new employees as well as freezing benefits for participants (Concannon, 2015, Keele and Alpert, 2015).

- **Defined Contribution Pension Plan**

In a defined contribution (DC) plan, the employee, employer or both make regular contributions and individual accounts are established for the members with benefits based on the amounts that are credited to these accounts in addition to any earnings on investment that accrue to the amounts in the account. Unlike a DB plan, in a DC plan, only the contributions by the employer are guaranteed, and not the future benefits. The future benefits in a defined contribution plan, fluctuate in line with investment earnings (Sialm et al., 2015). DC plans are the dominant form of retirement plans in the United States and Australia and they are now gaining substantial momentum in Japan, the Netherlands and Canada (Tower Watson, 2014).

#### **6.4.7 Sovereign Wealth Funds (SWFs)**

SWFs are state-owned investment funds that are commonly funded by the revenues from export of commodities or from foreign exchange reserves. The assets of SWF doubled to more than \$1 trillion from 2000 to about \$7 trillion in 2015 (The City UK, 2015). SWFs, unlike DB pension plans, normally do not manage specific liability obligations, and have a long-term investment horizon as well as allocations to alternative investments that is considered above average. Majority of the assets in SWFs are clustered in resource-rich economies in the Middle East and Asia. Table 6.5 lists the top 10 SWFs.

The SWF phenomenon is spreading throughout all the emerging regions and not just Asia and the Middle East, but also Latin America and Africa as well. Currently, there are 114 known sovereign wealth funds in operating worldwide according to ESADEgeo Sovereign Wealth Funds Ranking 2015 (ESADEgeo, 2015).

**Table 6.5: Top 10 Global Sovereign Wealth Funds (AUM)**

<b>Top 10 Global Sovereign Wealth Funds (AUM)</b>			
No.	Country	Sovereign Wealth Fund	AUM (US\$ bn)
1	Norway	Government Pension Fund Global	869.0
2	China	China Investment Corporation	652.7
3	UAE	Abu Dhabi Investment Authority	589.0
4	China	State Administration of Foreign Exchange (Investment portfolio only)	456.0
5	Kuwait	Kuwait Investment Authority (“KIA”)	386.1
6	Singapore	GIC Private Limited	315.0
7	Qatar	Qatar Investment Authority	304.4
8	Saudi Arabia	Saudi Arabian Monetary Agency (investment portfolio only)	210.0
9	Singapore	Temasek Holdings	177.2
10	UAE	Investment Corporation of Dubai	159.8

**Source:** Barbary et al. (2014: 8)

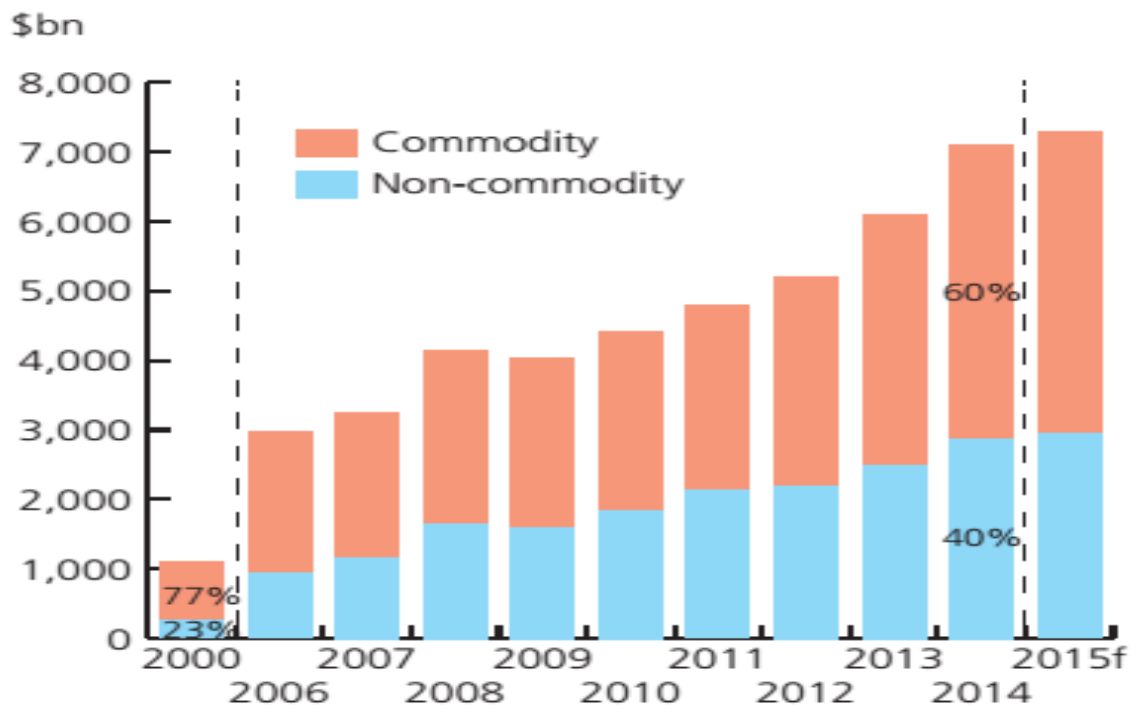
Investments by SWFs continue to be concentrated, the major funds account for majority of transactions. The conventional receiving sectors of real estate and financial services, attracted new capital. Investments in real estate well exemplifies specifically the paradox many institutional investors in the sector face i.e., the funds grow in average size therefore making them more competitive. Conversely, this increase in size also presents a difficulty in efficiently investing ever larger amounts of capital (KPMG, 2014).

SWFs that are funded by export of commodities, mainly oil exports, account for about 60% of the overall assets of SWFs. Non-commodity SWFs are mainly funded by the transfer of assets from government budget surpluses, official foreign exchange reserves, pension reserves and privatisation revenue make up the remaining 40%. Non-commodity SWFs however, are likely to take over a growing percentage of the market in coming years (The City UK, 2015).

It is possible that flows into certain funds could turn negative. The Growth of assets in SWFs is closely related to the price of oil, this is because about 60% of SWF assets are from commodity exports. Major oil producing economies pumped their reserves of foreign exchange

into funds with the aim of stabilizing their economies as well as paying for pensions. The decline in oil prices from the second half of 2014 led to a shortfall in cash for some of these countries and if low oil prices persist for a long period, these oil exporting countries may channel monies from their SWFs for the stabilisation of their economies as well as financing budget shortfalls.

**Figure 6.23: SWF Assets under Management**



**Source:** TheCityUK (2015: 18)

Slowing growth in China’s GDP may possibly constrain the growth in assets. Transfer of assets from foreign exchange reserves as well as budget surpluses and revenues from privatization are the source of funds for non-commodity SWFs. The growth in official foreign exchange reserves particularly in a some of Asian countries, shave led to their monetary authorities to conclude that their foreign reserves exceed their immediate needs. The global foreign exchange reserves were about \$11.8 trillion as at 2014 year-end and around a quarter of these reserves-\$2.8 trillion - were held in SWFs (TheCityUK, 2015).

The share of Non-commodity SWFs of global SWFs assets has improved over the past decade, with the 41% share as at 2014 year-end is expected to increase further in subsequent years.

Regardless of the economic slowdown, a number of Asian countries, notably China, have increasingly accumulated foreign exchange reserves. About a decade ago, central banks in Asia had accumulated a third of the official currency reserves and by 2014 year-end, had accumulated around two-thirds of official reserves. The growth is mainly as a result of current account surpluses. Germany and China currently hold the biggest current account surpluses in the world, far ahead of the oil-exporting countries as well as other developed countries (TheCityUK, 2015).

At the end of 2014, China had a total of about around \$4 trillion in foreign exchange reserves, that is over one-third of the global reserves. Japan's is also 11% of the global total with Saudi Arabia and Switzerland with around 6% and 5% respectively (TheCityUK, 2015).

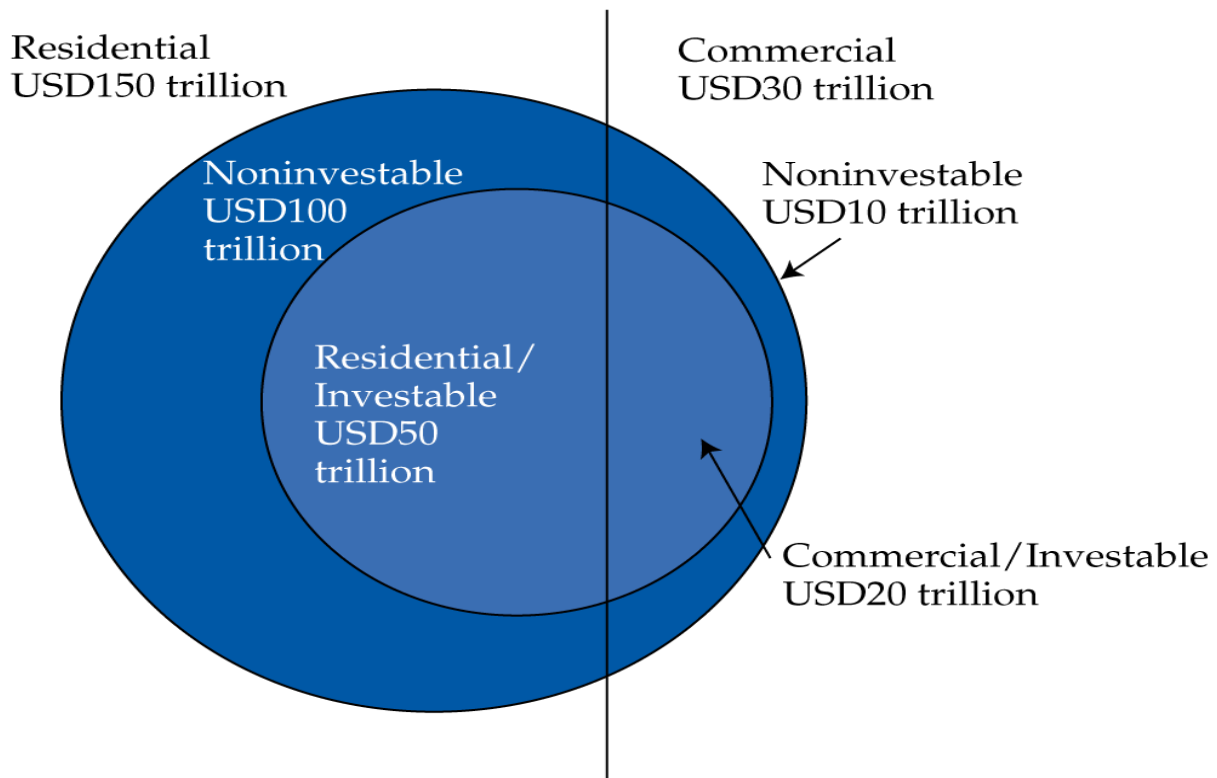
### **6.4.8 Real Estate**

Among all alternative asset classes, the most ubiquitous is the private real estate debt which accounts for approximately half of all the global alternative assets investments are made directly and indirectly in assets such as land, office properties and family housing (Hewitt EnnisKnupp, 2014).

Investing directly and indirectly in assets such as land, urban office properties, single-family and housing, multifamily housing have for a long time, been a mainstay for investors. Real estate assets generally have featured low correlations with fixed income and equities and are considered as long-term assets with relatively stable cash flows that are usually positively correlated with inflation.

As an asset class, real estate forms a significant role in portfolios of all kinds of investors and usually display unique investment characteristics when compared to the conventional assets, like as stocks and bonds, especially over long time periods. Investments in real estate offer the benefits of diversifying the portfolio of an investor portfolio for asset class allocations as well as geographic allocations. As at 2013 year-end, the global real estate industry had \$1150 trillion in residential properties with \$50 trillion in investable residential properties and \$100 trillion in non-investable residential properties. The commercial real estate sector was valued at \$30 trillion with \$20 trillion in investable properties, and \$10 trillion in non-investable properties (Figure 6.24).

**Figure 6.24: The Value of the World's Real Estate as at Year end 2013**



**Source:** Based on data from Savills Research, cited in Younus (2015: 6)

Peter Westerheide (2006) conducted a study in 2006 aimed at examining real estate investment trusts (REITs) and securities with REIT characteristics in eight countries, which included Japan, the United States and Australia and concluded that, real estate securities appear to be representative of an asset class that is distinct from stocks and bonds in most countries. They appear in the long run to mirror the performance of actual real estate investments and offer further portfolio diversification opportunity. Table 6.6 gives a breakdown of investment markets in selected countries as a percentage of the global investment market, the commercial real estate market of the selected countries as a percentage of the global commercial real estate market, GDP and population as a percentage of the global GDP and population respectively.

Comparing REITs with bonds and stocks, whereby a single share or in the case of bonds, a minimum number of units can be acquired, real estate assets are generally expensive. Real estate investors seldom pay entirely in cash for the property. In most cases, a greater percentage of the acquisition price is financed by some kind of debt or financial instrument such as mortgage loan with the property itself used as a collateral.

**Table 6.6: Geographical Breakdown of Investment Markets, GDP, and Population**

	<b>MSCI ACWI IM Index<sup>14</sup></b>	<b>Commercial Real Estate Market Size<sup>15</sup></b>	<b>GDP<sup>3</sup></b>	<b>Population<sup>3</sup></b>
United States	52.4%	36.7%	22.2%	4.4%
Japan	7.5	11.6	6.5	1.8
United Kingdom	7.2	9.8	3.5	0.9
France	3.1	6.2	3.7	0.9
Canada	3.4	4.8	2.4	0.5
Germany	3.0	7.2	4.9	1.1
Other	23.4	23.7	56.7	90.4

**Source:** Based on data from MSCI, Investment Property Databank (IPD), the World Bank, and the Population Reference Bureau, cited in Younus (2015: 7)

The portion of the acquisition price that is financed by debt is called leverage while the amount which the investor finances by himself is the equity. In most cases however, the investor may not have all the cash to acquire a large real estate like office buildings. In such situations, the formation of a collective investment scheme becomes necessary to pool equity together. Investments in real estate generally can be made directly, through unlisted real estate vehicles

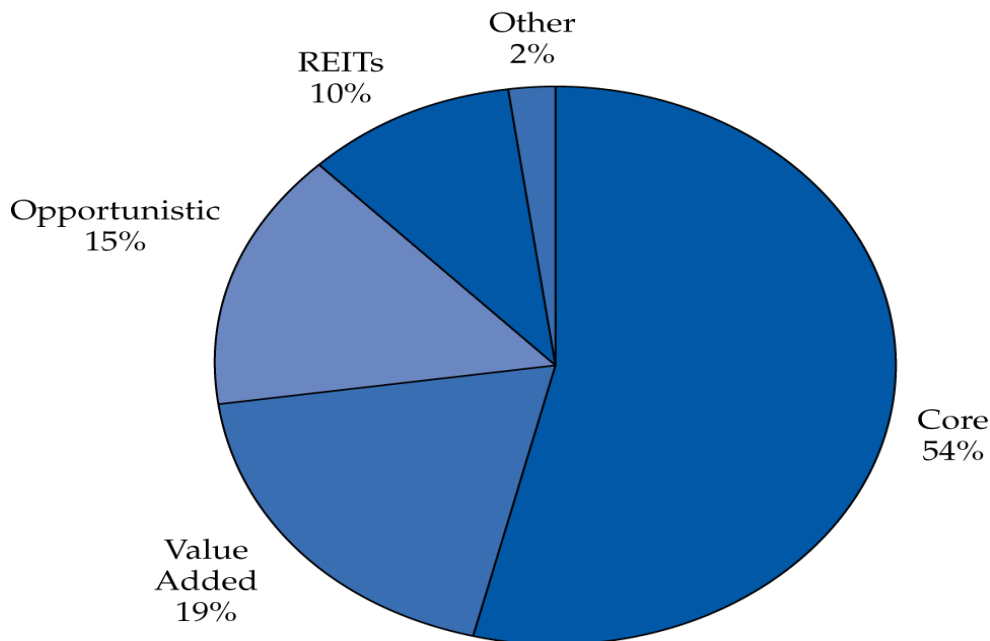
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<sup>14</sup> Data are as of February 2015

<sup>15</sup> Data are as of 2013

such as open-ended and close-ended funds or through listed real estate instruments like REITS, REOCS or PropCos i.e. real estate operating companies.

**Figure 6.25: Allocations to Real Estate Investment Styles**



**Source:** Based on data from IPD and MSCI, cited in Younus (2015: 17)

Real estate investments are also an important class of alternative funds in South Africa. There are two categories of Real Estate Investment Trusts (REITs) in South Africa namely, company and trust. Majority of South African REITs invest a greater percentage of their assets in South Africa, but they are allowed to invest in the continent as a whole and globally. Currently, 32 REITs are listed on the JSE, with R 350bn (\$28.9bn) in market capitalisation (PwC, 2015).

## 6.5 Systemically Important Financial Institutions (SIFIs)

Financial crises are now a recognisable part of the economic cycle, even though they rarely repeat themselves in an exact manner. In the 1980s there was the crisis in Latin America; then Russia and South-East Asia in the late 1990s; then the housing and banking crisis in 2007-08 in the United States. Now, there is an increasing concern that the asset-management industry may be the next locus of financial crisis (The Economist, 2014).

A SIFI is an insurance company, bank, or any other financial institution whose collapse may cause a financial crisis. The unfolding of the global financial crisis has moved the international community to safeguard the financial systems by averting the failure of SIFIs, or, in the event of one failing, limiting the devastating effects of its failure. The Financial Stability Board in November 2011, published a catalogue of global systemically important financial institutions (G-SIFIs). (FSB, 2011). The Basel Committee on Banking Supervision further introduced new regulations - Basel III - that also targets specifically the SIFIs. The regulations focus mainly on increasing bank capital requirements and also to introduce surcharges on capital for systemically important banks (BCBS, 2011). Some economists however, have warned that the tighter capital regulation, which is based primarily on risk-weighted assets, might further affect the stability of the financial systems negatively (Slovik, 2012, Allen, Chan, Milne and Thomas, 2012).

According to the Economist, the asset management industry manages \$87 trillion, which makes it three-quarters the size of banks with the biggest fund manager, - BlackRock - running \$4.4 trillion of assets, which is more than any bank boasts on its balance-sheet (The Economist, 2014). After the financial crisis, tight regulatory measures have been implemented on banks, among other regulations, is a requirement that banks hold more capital and possess sufficient liquidity to deal with short-term pressures.

The asset management industry has run into crisis in the past for example, the collapse of Long-Term Capital Management in 1998, led to a rescue by the Federal Reserve. Furthermore, the failure of two hedge funds managed by Bear Stearns led to its collapse in 2008. On September 16, 2008, The Reserve Primary Fund on September 16, 2008 “broke the buck” (imposing loss on investors) when the fund’s net asset value (NAV) plunged to 97 cents per share. In the history of investing, this was one of the first times that a retail money market fund had ever failed to maintain a NAV of \$1 per share sending shockwaves through the industry which prompted the Fed to offer a backstop yet again.

There is a fear among regulators that herding among fund managers may trigger a general sell-off, similar to that experienced in 2008 with mortgage securities. The asset management industry is now becoming more concentrated, due to the persistent growth of passive funds which track an index. Regulators are now faced with the complex task of anticipating future



crises, which may not be similar to crises of the past meaning they may have to regulate segments of the industry which in the past have not been a source of problems.

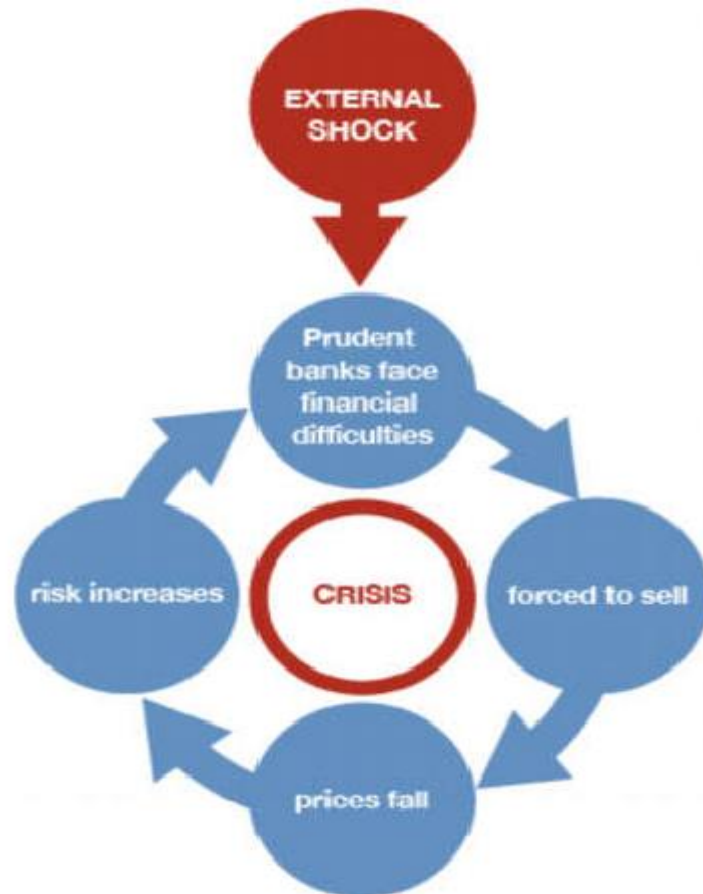
Another issue of concern is that regulatory bodies may be stuck in a game of whack-a-mole where hammering risk down in one section may lead to it popping up somewhere else. For example, some of the problems that regulators worry about, like the illiquidity of the market for corporate-bonds, are as a result of the regulations that have been imposed since the crisis. If they now turn their attention to funds or the fund managers, they might just cause another problem somewhere else (The Economist, 2014).

Danielsson and Zigrand (2015b) however argue that systemic risk is an inescapable part of any market economy. Systemic risk cannot be entirely eliminated, the agenda for policy makers and researchers should therefore be focused on creating a more robust financial system that is less disposed to catastrophic crises and provides economic and societal benefits. The recent crisis has revealed the flaw in assuming that as long as each segment of the financial system is secured, then the whole system must also be safe. This assumption comes with the possibility of regulatory bodies committing a ‘fallacy of composition’ suggested by Milton Friedman (1980):

“The great mistake everyone makes is to confuse what is true for the individual with what is true for society as a whole. This is the most fascinating thing about economics. In a way, economics is the most trivial subject in the world, and yet it is so hard for people to understand. Why? I believe a major reason is because almost any interesting economic problem has the following characteristic: what is true for the individual is the opposite of what is true for everybody together.”

Figure 6.26 illustrates how regulating all banks to be prudently run can lead to systemic risk if it triggers a sale of risky assets in reaction to an external shock forcing a downward spiral of the price of assets forcing more disposals which further depress prices culminating in a crisis.

**Figure 6.26: How Individual Prudence Results in Systemic Crisis**



**Source:** Danielsson and Zigrand (2015b), “A proposed research and policy agenda for systemic risk”, <http://voxeu.org/article/systemic-risk-research-and-policy-agenda>

According to Danielsson and Zigrand (2015b), attempting to minimise risks associated with any single institution and curtailing the natural volatility of financial markets in the short term causes a ‘Great Moderation’ (a façade of a state of permanent stability). However, this illusion of stability is by itself, the source of accumulation of hidden systemic imbalances resulting in the validation of Hyman Minsky's assertion that ‘stability is destabilising’ (Minsky, 1982). Danielsson and Zigrand (2015a) further suggest that designating asset managers as systemically important financial institutions would be impulsive and most likely ill-conceived since the motivation for such a step emanates from inappropriately applying the macro-prudential thought from banking, instead of the underlying externalities that may lead asset managers to be part of a systemic risk. They further argue that regulatory bodies are silent on the important

question of what the SIFI designation in practice should mean, despite the inherent connection between identification and remedy.

In the banking world, there is a vast body of policy and academic literature on how banks can contribute to systemic risk, this facilitates sophisticated discussions on the reasons for the regulating banks, and then how the regulations should be. In the asset management industry on the other hand, such formal analysis is almost non-existent and most ensuing SIFI discussion seems to be based on only anecdotal examples and often only referring to Long-Term Capital Management as opposed to hard analysis. With the exception of a very few, discussions are normally silent on why in the first place, asset management is systemic, as if this issue was self-evident. There is therefore no basis to believe that generally, the kind of systemic risk that banks create is the same as the systemic risk posed by asset managers (Danielsson and Zigrand, 2015a).

## **6.6 The Future of The Asset Management Industry<sup>16</sup>**

The Global financial crisis that occurred between 2008 and 2009 affected millions of people, but only caused a temporary set-back in the long-term growth trajectory of the asset management industry. The global assets under management (AuM) at year end 2014 totalled \$63.9 trillion by 2020, projected to grow to around \$101.7 trillion amounting to a nearly 6% compound growth rate. This prediction is based on an examination of the correlation between AuM and several economic factors over a thirteen-year period that includes two financial crises i.e. the Dotcom crash of the late 1990s and the great depression of 2008-2009. There is a strong correlation between overall AuM growth and nominal gross domestic product (GDP), especially that relating to the fund management industry. Growth in one region can influence the AuM in another region as economies have become increasingly dependent on each other as such, the effect of the growth in strong regions such as the United States is factored into the forecast for 2020 assuming a nominal global GDP growth of 5.15% between 2012 and 2020. The assets of pension fund are projected to grow at 6.6% a year to reach about to \$57 trillion

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<sup>16</sup> Unless otherwise indicated, the information on The Future of Asset Management was obtained from PWC. 2014. Asset Management 2020: A Brave New World. Available: <https://www.pwc.com/gx/en/asset-management/publications/pdfs/pwc-asset-management-2020-a-brave-new-world-final.pdf> [Accessed 01 November 2015].

by 2020 rising from \$21.3 trillion as at 2004 to \$33.9 trillion in 2012. Majority of Defined Benefit (DB) schemes will be phased out but DB scheme will still persist for the remainder of this half-century and will still represent a significant proportion of AuM.

**Table 6.7: Global AuM (USD Trillion)**

Products	2004	2007	2012	2020 (estimated)
<b>Global AuM</b>	<b>37.3</b>	<b>59.4</b>	<b>63.9</b>	<b>101.7</b>
of which mutual funds	16.1	25.4	27.0	41.2
<i>of which active investments</i>	15.1	23.3	23.6	30.8
<i>of which passive investments</i>	1.0	2.0	3.4	10.5
of which mandates	18.7	28.8	30.4	47.5
<i>of which active investments</i>	17.6	26.5	26.6	35.3
<i>of which passive investments</i>	1.2	2.3	3.9	12.2
of which alternatives	2.5	5.3	6.4	13.0

**Source:** Adopted from PwC analysis. Past data based on Hedge Fund Research, ICI, Prequin, Towers Watson and The City UK, cited in PwC (2014, 8)

**Table 6.8: Client AuM USD Trillion**

Clients	2004	2007	2012	2020
Pension funds	21.3	29.4	33.9	56.5
Insurance companies	17.7	21.2	24.1	35.1
Sovereign Wealth Funds (SWF)	1.4	3.3	5.2	8.9
HNWI	37.9	50.1	52.4	76.9
Mass affluent	42.1	55.8	59.5	100.4

**Source:** PwC (2014: 9)

The increase in AuM of pension schemes in general though will be mainly from Defined Contribution (DC) schemes created in prosperous and fast-growing countries and by 2020 and will be the preferred model for savings for retirement, the DB schemes will form a far smaller albeit significant pool of assets. As countries, both developed and developing try to include more savers in retirement schemes, total assets managed by pension funds will experience significant growth with the strongest growth coming from Asia Pacific and Latin America with above 9% growth rate each. North America and Europe however will have above \$30 trillion and \$14 trillion respectively in AuM making up the largest pool of funds in 2020.

A growing middle-class is projected to fuel the growth in mutual funds at a rate of 5.7% per annum with mandates growing at 5.7% mainly through institutional investors like pension funds and Sovereign Wealth Funds (SWF) as well as high net-worth clients.

- **Game changers projected to redefine the industry**

In 2020, the asset management industry will operate in a significantly changed environment. The six Game changers that will redefine the industry are:

1. **Asset Management will play a Pivotal Role:** The insurance and banking industries have long overshadowed the asset management industry this will however change in 2020 as the asset management industry will emerge to take centre stage.
2. **Regional and Global Platforms projected to Dominate and Redraw Distribution:** South Asian, North Asia, Europe and Latin America will develop distinct regional blocks of fund distribution allowing pan-regional sale of products as well as developing trade and regulatory links with each other and in the process transforming the views of asset managers on distribution channels.
3. **Transformation of Fee Models:** The fee models of most asset managers currently embed management and distribution fees in some form or shape that are misaligned with the objectives of the investors.
4. **Proliferation of Passively Managed Funds and ETFs as Alternative investments become Mainstream:** Growth in traditional active management will decline but still remain a core of the asset management industry while passive management and

alternative strategies will grow rapidly reducing the overall share of active management and traditional assets under management.

5. Emergence of New Class of Global Managers: A new class of managers will emerge from both traditional funds and alternative funds with platforms that are highly streamlined, stronger and trusted brands and targeted customer solutions.

6. Asset Management in the 21st Century: Although it is a virtual business, the asset management industry operates in a comparatively low-tech infrastructure. It is projected that by 2020, technology will be very essential in driving the engagement of customers, data mining for clients and potential clients' information, with operational efficiency, regulatory and tax reporting also becoming critical issues. Cyber risk will also pose a significant risk for the industry, together with market, operational and performance risk.

## **6.7 Summary**

The asset management industry continues to play a significant role in financial markets as well as in the lives of individuals all over the world. Apart from efficient allocation of capital, the industry is responsible for diversity of activities ranging from providing adequate retirement during old age through retirement funds, indemnifying clients in times of losses or accidents through long-term and short-term insurance as well as creating and protecting wealth through mutual funds, hedge funds and sovereign wealth funds. The industry therefore remains a very crucial in various respects and recently have been the subject of consideration as a systemically important financial institution (SIFI).

The following chapter presents methodologies that study the behaviour of financial markets and the activities of a segment of the asset management industry – the mutual fund industry - that regulators and academics are increasingly debating their role as a SIFI.

## **CHAPTER SEVEN**

### **THE JOHANNESBURG STOCK EXCHANGE (JSE)**

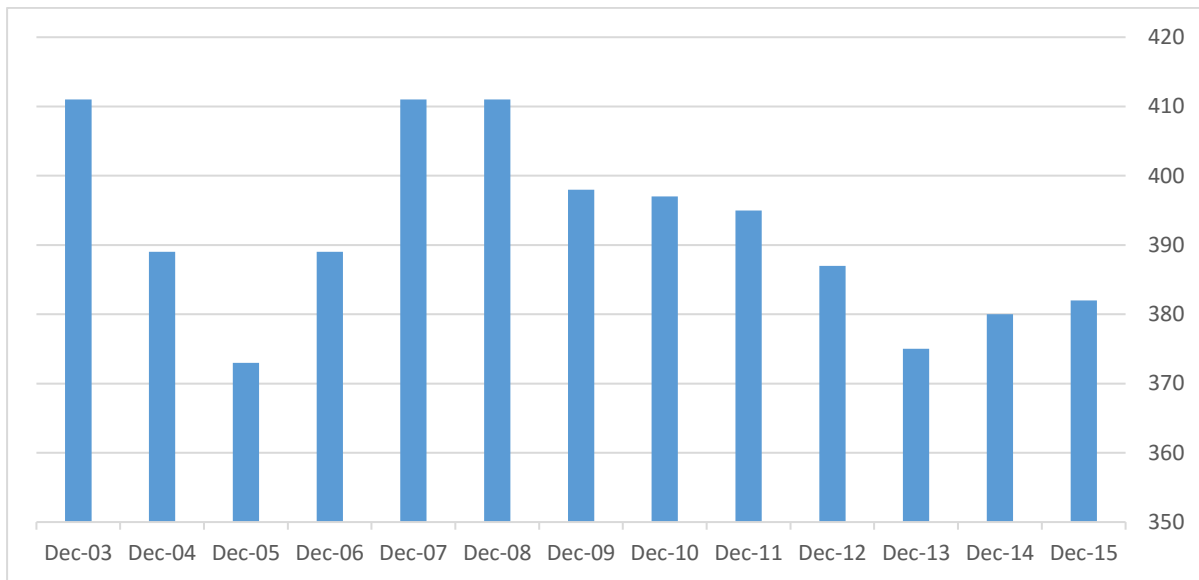
This chapter discusses the Johannesburg Stock exchange, the stock exchange selected for this study. The JSE is the 19<sup>th</sup> largest stock exchange in the world by market capitalization, it is the largest and the first stock exchange in Africa established in 1887 during the first gold rush in South African with 383 listed companies and \$ 997.17 billion in market capitalization as at June 2016 (JSE, 2013b, WFE, 2016). In 1947, The Stock Exchange Control Act was passed to govern the activities of the stock exchange.

#### **7.1 Introduction**

The JSE became a member of the World Federation of Exchanges (WFE) in 1963 and a founding member of the African Stock Exchanges Association (ASEA) established in 1993. The Securities Services Act was passed in 2004 and replaced The Stock Exchanges Control Act and the Financial Markets Control Act. In the same year, The Social Responsibility Index (SRI) was established in May, aimed at measuring the policies of companies, performance as well as reporting relating to the three fundamentals of the ‘triple bottom line’ namely, economic, environmental and social sustainability (JSE, 2013b).

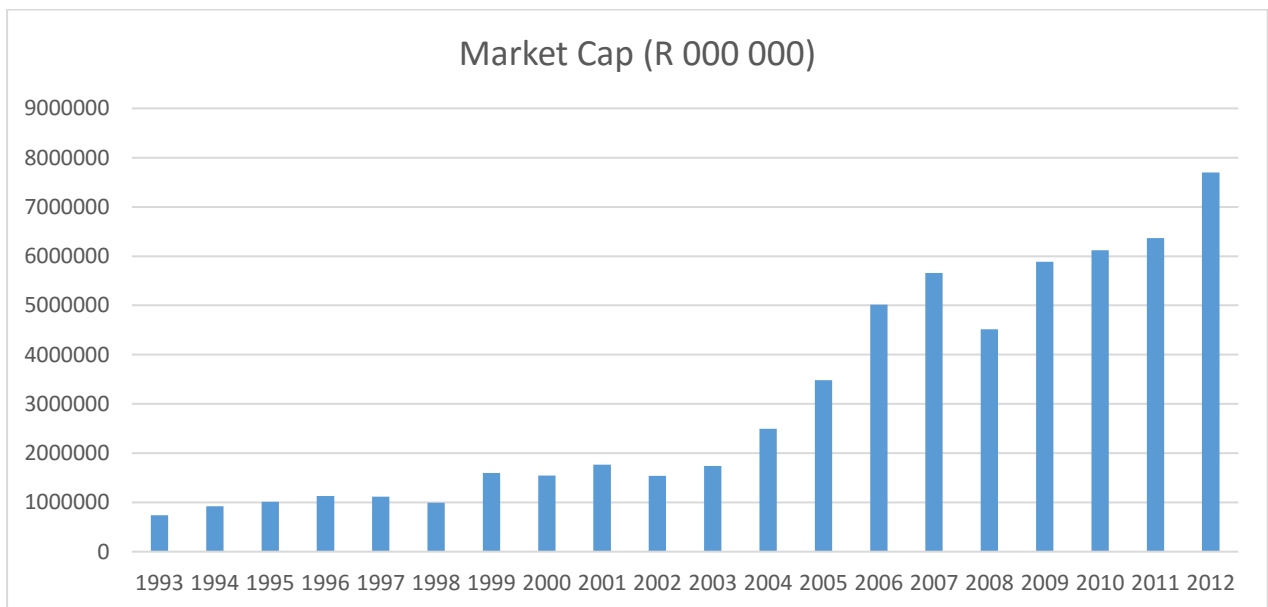
The JSE sets and enforces requirements for listing, membership requirements and trading rules. The Financial Services Board (FSB) oversees the JSE in the execution of its regulatory duties. Significant changes in the regulatory environment are however expected in future, as South Africa seeks to establish a twin peaks model of oversight where the South African Reserve Bank (SARB) will take on the supervisory role while the FSB carries out regulations on market conduct regulation (ASEA, 2016). South Africa is ranked number one in terms of securities exchange regulations out of 144 countries according to the World Economic Forum’s 2014-2015 Global Competitive Index Survey making it the fifth consecutive year the JSE has remained number one in the survey, also ranked number three in the ability to raise capital through the local equity market, number three again in terms of the effectiveness of corporate boards and number two in protecting the rights of minority shareholders (ASEA, 2016).

**Figure 7.1: JSE Number of Listed Companies**



Source: Based on data from World Federation of Exchanges (2016)

**Figure 7.2: Market Capitalization of the JSE**

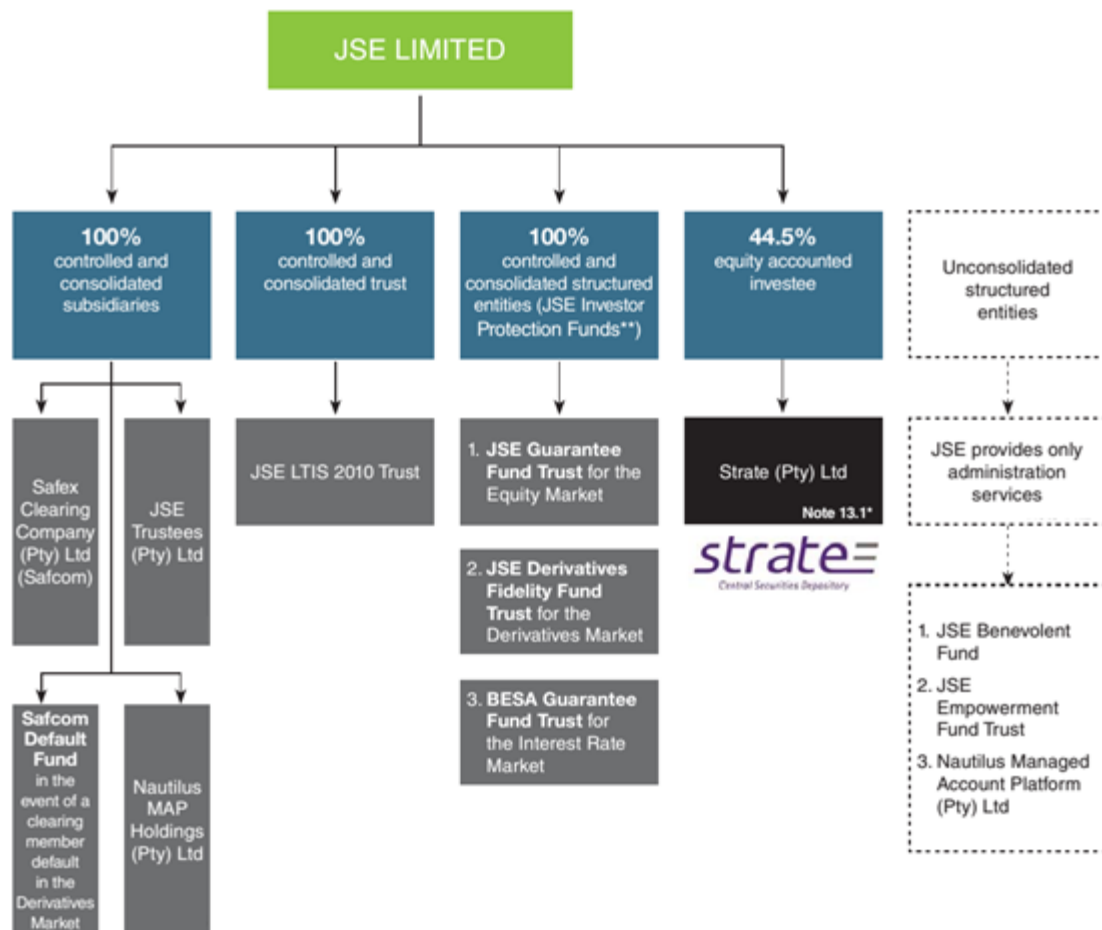


Source: Base on data from World Federation of Exchanges (2013)



Currently the JSE is the only operating stock exchange in South Africa although the ZAR X Stock Exchange has been granted an operation licence by the FSB (BizNews, 2016). Since inception, the JSE has witnessed major changes relating to location, ownership, management, systems of trading, and regulations.

**Figure 7.3: JSE Group Structure**



**Source:** JSE (2013a: 2)

The JSE witnessed significant changes in 1995 after the political changes that occurred in South Africa. Notable among such changes was the elimination of financial sanctions (Jefferis & Okeahalam, 2000). During the same year, a number of amendments to the legislation governing the stock exchange were made which resulted in the deregulation of the JSE (JSE, 2013b). In 1999, The Insider Trading Act was passed in line with the recommendations of the King Task Group on Corporate Governance, and the first ETF tracking the top 40 shares on the JSE – Satrix 40 - was listed on the JSE in 2000 (JSE, 2013). On September 2000, the JSE relocated

to its current location in Sandton, Gauteng. In 2001, An agreement between the London Stock Exchange (LSE) and the JSE allowed cross-trading between the two exchanging, resulting in the JET system being replaced with that of the LSE (JSE, 2013b).

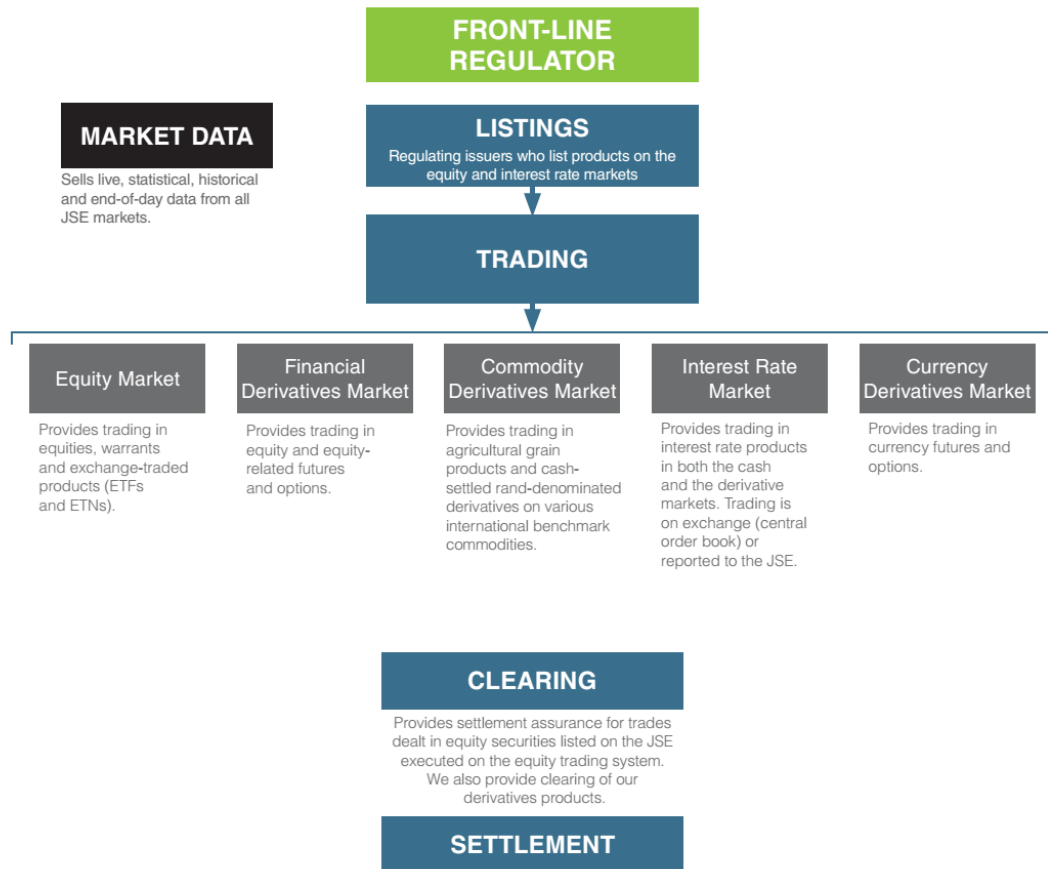
## **7.2 JSE Sens**

In August 1997, a real-time Stock Exchange News Service (Sens) was launched to enhance investor confidence and market transparency. Initially, companies listed on the JSE could opt to use the Sens services for a trial period of two months. However, from 15 October, the JSE listing requirements made it mandatory for companies to publicize on the Sens all their corporate information as well as all price-sensitive information before reaching out to any other news outlet (JSE, 2013).

## **7.3 JSE Strate**

In 2002, the Strate was launched and the JSE has experienced zero “failed trade record” since its inception (JSE, 2013). Strate Ltd is an accredited Central Securities Depository (CSD) for settlement of financial instruments electronically in South Africa. The purpose of Strate is to minimise risk while ensuring the efficiency of South African financial markets as well as improving their profiles as an investment destination (JSE, 2013).

**Figure 7.4: JSE Business Model**

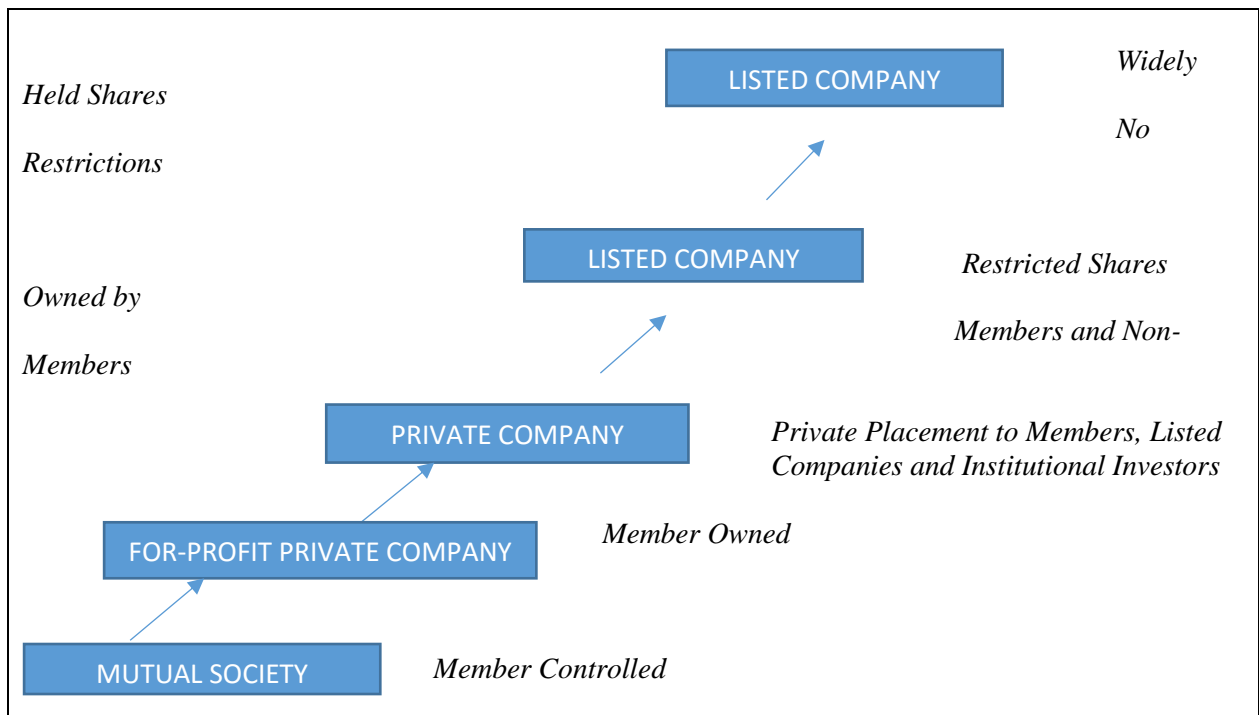


Source: JSE (2013a: 3)

## 7.4 Demutualization

The JSE on July 2005, made some structural changes through a process of demutualisation. Before this date, the exchange was mutually owned therefore it was used, owned and exclusively ran by member firms, who made decisions by voting on a one-member-one-vote basis (Mongalo and Mateele, 2009). An Initial Public Offer (IPO) was made and the JSE became listed on itself. Demutualisation allows a maximization of potential market capitalization and value for shareholders (Serifsoy, 2008).

**Figure 7.4: The Process of Demutualization**



**Source:** Aggarwal (2006)

## 7.5 JSE Tradelect

The JSE Tradelect is an electronic trading system which operates under a license from the LSE. The system was designed purposely to meet the requirements of the JSE. In April 2007, the JSE Tradelect replaced the JSE SETS, which was also a replacement for the JSE JET in May 2002 (JSE, 2013).

## 7.6 JSE Clear

The JSE Clear is a JSE-owned derivative central counterparty (CCP), a system for risk management that enables the clearing, settlement and recording of transactions. On 1 February 2016, the European Securities and Markets Authority (ESMA), announced that JSE Clear, has been acknowledged as “equivalent” to CCPs in the European Union. The JSE Clear was also among the first to be granted Qualifying Central Counterparty (QCCP) by the International Organization of Securities Commission (IOSCO) (Mntambo, 2016).

## 7.7 The JSE and Market Efficiency

Academics and investment professionals continue to debate the economic underlying the pricing of financial assets. This debate is mainly centred on efficient market hypothesis which argues that the market prices of financial securities fully incorporate all available information. The robustness or otherwise of the efficient market hypothesis is of immense practical relevance. This for example will imply that the study of patterns and trends of time series of asset prices will not permit the correct prediction of future performance of asset prices, therefore, the activities of technical analysts have no value to investors. Again, the activities of fundamental analysts cannot also be expected produce any consistent superior investment performance. The depth of this argument becomes even clearer given the importance of the two categories of analysts in the traditional style of portfolio management.

Numerous studies have been conducted on the JSE with regards to its efficiency with inconclusive results. Strebel (1977) argues that at best, the EMH applies to 50% of shares traded on the JSE. These are shares with a trading volume of at least 250 000 and the other 50% of shares have very low volumes making their market risk volume-dependent, rendering invalid, the ex-post CAPM as a framework of market equilibrium therefore rendering the general test of market efficiency useless. Furthermore, the existence of longer runs, marketability and higher returns, at low volumes point out that the assumption of competitive market necessary for the EMH breaks down (Strebel, 1977). Gilbertson and Roux (1977) conducted an evaluation of the evidence for and against market efficiency on the JSE and also conclude that the evidence supports market efficiency.

Hadassin (1976) provided evidence against the EMH applying the Von Neumann serial correlation and runs tests to analyses the number of upward price variations and downward price variations occurring in succession before the occurrence of opposite price variation or no variation, to ascertain whether share returns of 30 listed companies on the JSE exhibited random walk. The study reported correlation between future and historical price variations and concluded that the JSE does not exhibit random walk and is not efficient (Hadassin 1976). This study however used a short sample period (January 1971–December 1973) and could be affected by a bias of time-period as the evidence may only reflect the economic situation existing at that time period. Another study tested for independence in price movements, applying run tests and serial correlation tests (Roux and Gilbertson, 1978). Both tests reported

that variations in prices may not entirely be independent. These dependencies were however small and inconsistent, and therefore may not permit continuously profitable trades by investors (Roux and Gilberston 1978).

Doyle and Chen (2013) applied the overlapping serial test (OST) to test for efficiency on the JSE ALSI, and concluded that from the period of January 1996 to June 2012, the index was characterized by non-randomness for a two-day window length and exhibited randomness for the remainder of the window lengths.

Many studies that provide evidence in favour of the EMH used linear dependencies tests in stock returns, overlooking the prospect of non-linear dependencies (Lim, 2007). Studies that test returns for dependencies on the JSE mostly investigated linear serial dependence (Noakes and Rajaratnam, 2014). Recently however, Kruger et al. (2012) tested for nonlinear dependence in price movements on the JSE over the period January 2002 to December 2009. The study tested 109 stocks using various full period tests as well as episodic tests, and reported linear and nonlinear dependence in stock returns although such dependence was not observed regularly or consistently over time. This study concluded that the JSE was generally efficient with short periods of inefficiency over the sample period (Kruger et al. 2012). Mangani (2007) tested the properties of distribution of the JSE from February 1973 to April 2002, using the weekly closing prices and reported that returns on the JSE were non-linearly dependent and therefore can be forecasted over time. Kruger et al. (2012) however argue that Mangani (2007) only applied one of the several nonlinear dependency tests available and had a small sample size.

Jefferis and Smith (2005), applying a time varying generalised autoregressive conditional heteroskedasticity (GARCH) as a test of evolving efficiency (TEE), tested the JSE Actuaries ALSI for changing efficiency over time and concluded that over the period of January 1990 to June 2001, the JSE was constant weak form efficiency with no sign of changing efficiency. Bonga-Bonga (2012) also concluded that the JSE was weak form efficient over the period of March 1995 to December 2009 using a time varying GARCH model on weekly prices.

Variance ratio tests (VRT) have also been applied to test for a proof of random walk. The advantage of applying the VRT is that it can be applied even when the price time series are not normally distributed (Jefferis and Smith 2004). Smith et al. (2002) applied multiple variance ratio tests to investigate whether the JSE ALSI exhibits a random walk. Using weekly stock

price data from January 1990 to August 1998, and concluded that the JSE ALSI follows a random walk. Over the period of April 1996 to March 2001, in a similar study but including a time-varying GARCH, Jefferis and Smith (2004) concluded that the JSE indices made up of a mostly large cap shares, were weak form efficient. The smaller cap indices were mostly inefficient with tests of evolving efficiency showing no signs that these smaller indices were becoming efficient.

Noakes and Rajaratnam (2014) tested for market efficiency on the JSE using the overlapping serial test to assess the efficiency of large mid and small cap indices on the JSE using index level as well as individual company level data over a stable period as well as a period that includes the global financial crisis. The study concludes that share prices of small cap companies are characterized by high degree of non-random movements. Mid cap stocks also exhibit inefficiencies albeit to a much lesser extent while large cap stocks displayed higher degree of efficiency

## **7.7 Spillover Effects of International Financial Markets on The JSE**

A vast body of studies have shown that over time, there are co-movements among international financial markets (Kim et al., 2015, Li and Giles, 2015, Rejeb and Arfaoui, 2016, Kim, 2015, Mensi et al., 2016). The recent financial crisis again points out how no market is totally immune to the effects of spill-overs from other international markets. Collins and Biekpe (2003) find evidence that the JSE experienced contagion effect during the Asian financial crisis. Using an aggregate-shock (AS) model, Heymans and Da Camara (2013) confirm spill-over effects on returns and volatility of the London, Hang Seng, New York, Paris and Frankfurt equity markets on the JSE. The study further confirms the returns on the JSE All share index are directly affected by contagion of the economic region where these crises emanate. Heymans and Da Camara (2013), however conclude that in recent times, South Africa has progressed in protecting JSE against financial crises.

Sui and Sun (2016) examined the relationships among interest differentials, foreign exchange rates, local stock returns of Brazil, Russia, India, China, and South Africa (BRICS) and U.S.

S&P 500 returns and discovered that foreign exchange rates have significant spill-over effects on to stock returns in the short-run, although not vice versa. Shocks from the S&P 500 significantly influence equity markets in South Africa, Brazil and China. The study also confirms that during the recent financial crisis of 2007-2009, there was a strong spill-over effects between stock returns and exchange rates.

## **7.8 Summary**

The JSE is the 19<sup>th</sup> largest stock exchange in the world by market capitalization, it is the largest and the first stock exchange in Africa. South Africa is ranked number one in terms of securities exchange regulations according to the World Economic Forum's 2014-2015 Global Competitive Index Survey and also number two in protecting the rights of minority shareholders as well as number three in the ability to raise capital through the local equity market and number three again in terms of the effectiveness of corporate boards (African Securities Exchanges Association, 2016).



# CHAPTER EIGHT

## DATA AND METHODOLOGY

### 8.1 Introduction

This chapter discusses the data selected for the study and the methodology the study adopts in investigating the low volatility anomaly as well as testing for non-linearity and chaos on the JSE. Once the existence of chaos or otherwise is established on the JSE, it also sets out to investigate how the FMH describes the behaviour of the JSE.

### 8.2 Data

The data for this study were obtained from the database of McGregor BFA, based in Johannesburg, South Africa. McGregor is a prominent provider of stock exchange and accounting data to firms and researchers. McGregor has standardised financial data dating from 1972, and has information for all companies and industries on the JSE. Data on the components of the selected FTSE/JSE indices were obtained from the JSE. This study investigates the existence of the low-volatility anomaly on the JSE over the period June 1995 to December 2014.

Daily price data from June 1995 to December 2014 of the indices selected for the study is well above the 2500 simulated data observation, below which Feder (1988) posits that such observations become questionable. As at December 2014, the FTSE/JSE All Share index had a total market capitalisation of R 9.9 trillion, the FTSE/JSE Top 40 had a market capitalisation of R 8.3 trillion and the FTSE/JSE Small Cap index had a market capitalisation of R 307 billion. Table 8.1 presents the market capitalisation of the selected indices.

**Table 8.1: Market Capitalization of the Selected FTSE/JSE Indices**

<b>INDEX</b>	<b>MARKET CAPITALIZATION</b>	<b>DATE</b>
FTSE/JSE TOP 40	R 8,283,699 MILLION	12 DECEMBER 2014
FTSE/JSE ALL SHARE	R 9,899,880 MILLION	12 DECEMBER 2014
FTSE/JSE SMALL CAP	R 306,991 MILLION	12 DECEMBER 2014

Source: McGregor BFA (2015)

The indices investigated are the daily returns of the FTSE/JSE All Share (J203), which represents 99% of the full market capitalisation of all eligible shares listed on the main board of the JSE; FTSE/JSE Top 40 (J200), which represents the largest 40 companies on the JSE ranked by market capitalisation; and FTSE/JSE Small Cap (J202), which consists of all the remaining companies after the selection of the top 40 and mid cap companies. The study takes 8 cycles of sub-samples from a large sample of  $n = 4840$ , with  $n = 2420$  in the second cycle with 2 sub-samples, and so on until 20 sub-samples of  $n = 242$ .

The study obtains data on quarterly mutual fund portfolio holdings from the database of Profile Data from January 2004 to December 2014. Profile Data carries out research and provides financial data including data on mutual funds holdings which are only available on a quarterly basis. Data on the components of the selected indices is obtained from the JSE Ltd. The study covers the population of all domestic equity mutual funds registered with the Association for Savings and Investment South Africa (ASISA). Excluded from the population are fund of funds to avoid double counting.

ASISA defines domestic equity funds as funds that have at least 80% of the market value of the portfolios invested in equities with capital appreciation as the primary goal. The study does not include fund of funds as this will amount to double counting. Unclassified funds are also excluded from this study because they do not make up a significant proportion of the universe of equity funds and do not have a specific benchmark against which performance among the group can be measured. Table 8.2 presents the total assets under management of the various domestic funds in South Africa. As at September 2016, equity funds had R 368.5 billion assets under management. General equity funds were the largest fund in this category of funds with R 322.5 billion assets under management making up approximately 87.5% of assets under management. Multi asset funds are the largest category of domestic funds with R900 billion in assets under management as at September 2016. During this period, the total assets under management of the mutual fund industry in South African was R 1.8 trillion.

**Table 8.2: Total Domestic Funds AUM**

	30/09/2016		30/06/2016		31/03/2016		31/12/2015	
	Rm	%	Rm	%	Rm	%	Rm	%
<b>EQUITY FUNDS</b>								
General funds	322,506	18	315,232	18	317,984	19	301,459	18
Large Cap funds	23,003	1	21,116	1	18,539	1	17,576	1
Mid & Small Cap funds	6,952	0	6,790	0	6,798	0	6,783	0
Unclassified funds	1,057	0	1,186	0	1,123	0	1,125	0
Resources & Basic Industries funds	3,763	0	3,497	0	3,223	0	2,571	0
Industrial funds	7,672	0	8,067	0	8,278	0	8,702	1
Financial funds	3,563	0	3,703	0	3,910	0	3,194	0
<b>SUB TOTAL</b>	<b>368,517</b>	<b>21</b>	<b>359,591</b>	<b>21</b>	<b>359,854</b>	<b>21</b>	<b>341,409</b>	<b>21</b>
<b>MULTI ASSET FUNDS</b>								
Target Date funds	2,333	0	2,096	0	1,985	0	2,097	0
Low Equity funds	236,365	13	235,878	14	230,927	14	229,490	14
Medium Equity funds	51,221	3	49,706	3	48,466	3	50,933	3
High Equity funds	428,666	24	419,653	24	414,338	24	396,823	24
Flexible funds	59,270	3	54,278	3	50,533	3	55,391	3
Income funds	122,032	7	125,658	7	126,376	7	119,813	7
<b>SUB TOTAL</b>	<b>899,887</b>	<b>51</b>	<b>887,270</b>	<b>51</b>	<b>872,624</b>	<b>51</b>	<b>854,546</b>	<b>52</b>
<b>REAL ESTATE FUNDS</b>								
General funds	69,964	4	68,102	4	69,644	4	65,667	4
<b>SUB TOTAL</b>	<b>69,964</b>	<b>4</b>	<b>68,102</b>	<b>4</b>	<b>69,644</b>	<b>4</b>	<b>65,667</b>	<b>4</b>
<b>INTEREST BEARING FUNDS</b>								
Variable Term funds	51,235	3	52,989	3	49,700	3	48,979	3
Short Term funds	95,131	5	94,148	5	88,250	5	87,413	5
<b>SUB TOTAL</b>	<b>146,366</b>	<b>8</b>	<b>147,137</b>	<b>8</b>	<b>137,950</b>	<b>8</b>	<b>136,392</b>	<b>8</b>
<b>TOTAL (excluding Money Market)</b>	<b>1,484,734</b>	<b>84</b>	<b>1,462,100</b>	<b>84</b>	<b>1,440,072</b>	<b>84</b>	<b>1,398,013</b>	<b>84</b>
Money Market funds	293,263	16	275,618	16	267,473	16	259,853	16
<b>TOTAL (Including Money Market)</b>	<b>1,777,997</b>	<b>100</b>	<b>1,737,718</b>	<b>100</b>	<b>1,707,545</b>	<b>100</b>	<b>1,657,867</b>	<b>100</b>

**Source: ASISA**

ASISA represents the majority of South Africa's mutual fund management companies, asset managers, and life insurance companies. According to ASISA, the total assets under management in South Africa as at 30 June 2015 was R1.781 trillion, and the total number of registered funds as at June 2015 was 1225. Mutual funds in South Africa had R 77 billion net flow as at June 2015. This study will use Eviews to analyse the data.

## 8.3 Statistical Analysis Techniques

This section discusses the various statistical techniques the study used. The study compares the mean, standard deviation, maximum and minimum daily returns of the selected indices. The study further tests for skewness and kurtosis to test the distribution of the time series of the selected indices. The Anderson-Darling test is also used to test the normality of distribution.

### 8.3.1 Risk-Adjusted Returns

The study compares the annualised returns of the FTSE/JSE Top 40 to the annualised returns of the FTSE/JSE Small Cap index over the period June 1995 to December 2014. To test for the existence of the low volatility anomaly on the JSE, the study adopts the well-publicised risk-adjusted returns measure, the Sharpe ratio. The Sharpe ratio measures the excess return or the risk premium per unit of deviation (risk) in a security developed by Nobel laureate economist William F. Sharpe (Sharpe, 1966). The Sharpe ratio is given as:

$$S_a = \frac{E(R_a - R_b)}{\sigma_a} \quad [1]$$

Where  $R_a$  is the return of the asset,  $R_b$  is the return on the benchmark asset (the risk-free rate) which in this study is the South Africa 10-Year Bond Yield and  $\sigma_a$  is the standard deviation of the returns of the asset. The Sharpe ratio describes how well the return of a security compensates an investor for a given level of risk taken. A portfolio with a higher Sharpe ratio offers a better return for the same level of risk or the same return for a lower risk.

The study further compares the P/E ratios, dividend yields and earnings yields of the FTSE/JSE Top 40 and the FTSE/JSE Small Cap index to ascertain whether there are any differences in these metrics. This approach is referred to as the method of comparables. In using this method, the study would be able to reach a conclusion on the similarity or otherwise of the selected indices. For example, if both indices possess similar profit margins, risk and prospects for growth, an index with a P/E of 20 will be construed to be relatively undervalued compared to the index with a P/E of 30 (Pinto et al., 2015).

### 8.3.2 The BDS Test<sup>17</sup>

This study applies the BDS test for independence as explained by Brock, Dechert, Scheinkman and LeBaron (1996) which is a portmanteau test for time-based dependence in a time series and also applied to test for deviations from independence be it chaos, non-linear dependence or linear dependence. The test can also be used on a series of estimated residuals to determine if such residuals are independent and identically distributed (*iid*).

One can for example, test the series of residuals from an ARMA model to determine whether there exists any dependence that is non-linear after fitting the linear ARMA model. The aim behind such a test is simple. To proceed with this test, we select a distance,  $\epsilon$ , then select a pair of points. If the series are in fact *iid*, then for any given pair of points, the probability that the distance between such points being equal to or less than epsilon will remain constant. This this probability is denoted by  $c_1(\epsilon)$ .

Sets that consist of multiple pairs of points can also be considered. These sets of pairs can be chosen by moving orderly through the consecutive observations of the sample. Therefore, given observations  $s$ , and  $t$  of a series  $X$ , a set of pairs of the form:

$$\{\{X_s, X_t\}, \{X_{s+t}, X_{t+1}\}, \{X_{t+2}, X_{s+2}\}, \dots, \{X_{s+m-1}, X_{t+m-1}\}\} \quad [2]$$

can be constructed, with  $m$  being the number of consecutive points that are used in the set, or the *embedding dimension*. The joint probability of every set of points in the set that satisfies the epsilon condition is denoted by the probability  $c_m(\epsilon)$ .

Under the assumption of independence, the BDS test further by notes that this probability is the product of the probabilities for each individual pair. Therefore, if the series are independent,

$$c_m(\epsilon) = c_1^m(\epsilon) \quad [3]$$

$c_1(\epsilon)$  or  $c_m(\epsilon)$  are not directly observable but can only be estimated from the sample thus, this relationship does not to hold perfectly, but only with some error therefore, the larger the error, the less probable it is that the error is as a result of random sample variation. The BDS test gives a formal basis for evaluating the size of this error.

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<sup>17</sup> As described in IHS GLOBAL INC 2013. EViews User Guide. Irvine, California: IHS Global Inc

In estimating the probability for any given dimension, one simply goes through all conceivable sets of that length drawn from the sample while counting the sets that satisfy the  $\epsilon$  condition. The estimate of the probability is provided by dividing the ratio of the number of sets that satisfy the condition, by the total number of sets. This condition, in a series  $X$  with  $n$  sample of observations can be stated as:

$$c_{m,n}(\epsilon) = \frac{2}{(n-m+1)(n-m)} \sum_{s=1}^{n-m+1} \sum_{t=s+1}^{n-m+1} \prod_{j=0}^{m-1} I_{\epsilon}(X_{s+j}, X_{t+j}) \quad [4]$$

Where  $I_{\epsilon}$  is the indicator function:

$$I_{\epsilon}(x, y) = \begin{cases} 1 & \text{if } |x - y| \leq \epsilon \\ 0 & \text{otherwise} \end{cases} \quad [5]$$

$c_{m,n}$  are also called *correlation integrals*. These sample estimates of the probabilities can be used to estimate a test statistic for independence:

$$b_{m,n}(\epsilon) = c_{m,n}(\epsilon) - c_{1,n-m+1}(\epsilon)^m \quad [6]$$

The last observation is eliminated by the second term so that it is based on the same number of terms as the first statistic. This statistic is expected to be close to zero under the assumption of independence. Brock et al. show it as:

$$(\sqrt{n-m+1}) \frac{b_{m,n}(\epsilon)}{\sigma_{m,n}(\epsilon)} \rightarrow N(0,1) \quad [7]$$

Where

$$\sigma_{m,n}^2(\epsilon) = 4(k^m + 2 \sum_{j=1}^{m-1} k^{m-j} c_1^{2j} + (m-1)^2 c_1^{2m} - m^2 k c_1^{2m-2}) \quad [8]$$

and  $c_1$  can be calculated using  $c_{1,n}$ . The probability of any triplet of points lying within  $\epsilon$  of each other is denoted by  $k$ , which is estimated by counting the number of sets that satisfies the sample condition:

$$k_n(\epsilon) = \frac{2}{n(n-1)(n-2)} \sum_{t=1}^n \sum_{s=t+1}^n \sum_{r=s+1}^n \quad [9]$$

$$(I_{\epsilon}(X_t, X_s)I_{\epsilon}(X_s, X_r) + I_{\epsilon}(X_t, X_r)I_{\epsilon}(X_r, X_s) + I_{\epsilon}(X_s, X_t)I_{\epsilon}(X_t, X_r))$$

To apply the FMH to describe the low volatility anomaly on the JSE, the study first tests for chaos on the stock exchange by using the BDS test to test for correlation integral - the main concept behind the BDS test (Zivot, 2006) to measures how frequent temporal patterns are repeated in a given time series. The BDS test is designed to spot non-linear dependence (Oppong et al., 1999).

One advantage of the BDS test is that it requires no distributional assumptions on the series to be tested.

### 8.3.3 The Rescaled Range Analysis (The Hurst Exponent)

To establish the fractal nature of the selected indices, the study applies the rescaled range analysis. In proposing the FMH, Peters (1994) applied a modified rescaled range (R/S) procedure, which was pioneered by Hurst (1951). Peters (1994) and Howe, Martin and Wood (1997) review the steps for computing the R/S analysis. First, the index series of the JSE is converted into logarithmic returns,  $S_t$ , at period  $t$  of the JSE index series.

Using raw daily price data in stock markets has many limitations because prices are generally non-stationary (Mehta, 1995) and therefore interfere with estimating the  $H$  exponent. The series is therefore converted into logarithmic rates of returns to overcome the problem.

In line with Peters (1994), the study divides the period into  $A$  contiguous sub-periods with a length of  $n$ , so that  $A \times n = N$ , with  $N$  being the length of the series  $N_t$ . The study labels each sub-period  $I_a$  where  $a = 1, 2, 3, \dots, A$ . The study further labels each element in  $I_a$  is categorised  $N_{k,a}$  where  $k = 1, 2, 3, \dots, n$ . The average value,  $e_a$  for each  $I_a$  of length  $n$  is defined as:

$$e_a = \left(\frac{1}{n}\right) \times \sum_{k=1}^n N_{k,a} \quad [10]$$

The range  $R_{I_a}$  is given as the maximum minus the minimum value  $X_{k,a}$ , within every sub-period  $I_a$  given as:

$$R_{I_a} = \max(X_{k,a}) - \min(X_{k,a}), \text{ where } 1 \leq k \leq n, 1 \leq a \leq A,$$

[11]

with

$$X_{k,a} = \sum_{i=1}^k (N_{i,a} - e_a), k = 1, 2, 3, \dots, n,$$

[12]

being the time series of the accumulated divergence from the mean for each sub-period. Each range  $R_{I_a}$  is divided by the sample standard deviation  $S_{I_a}$  that corresponds to it to normalise the range. The standard deviation is given as:

$$S_{I_a} = \left[ \left( \frac{1}{n} \right) \times \sum_{k=1}^n (N_{k,a} - e_a)^2 \right]^{0.5}$$

[13]

The mean  $R/S$  values for length  $n$  is given as:

$$(R/S)_n = \left( \frac{1}{A} \right) \times \sum_{a=1}^A (R_{I_a} / S_{I_a})$$

[14]

Finally, an OLS regression is applied with  $\log(R/S)$  as the dependent variable and  $\log(n)$  being the independent variable. The Hurst exponent,  $H$ , is obtained from the slope coefficient of the regression. An  $H$  of 0.5 denotes the series under investigation exhibits characteristics in line with the random walk theory. An  $H$  greater than 0.5 denotes persistence while an  $H$  lower than 0.5 denotes anti-persistence. According to Peters (1991), the Hurst exponent describes the probability of two consecutive events occurring therefore an  $H$  of 0.6 implies a 60% probability that if the last move was negative, the next move will also be negative.

Once  $H$  is computed, the autocorrelation within the time series is computed as:

$$CN = 2^{(2h-1)} - 1$$

[15]

According to Peters (1994), the  $CN$  represents the percentage of movements in the time series that can be explained by historical information. A  $CN = 0$  signifies randomness in the time



series under consideration pointing to a weak-form efficient market where historical information cannot be relied on to outperform the market.

### 8.3.4 The Variance Ratio Test

To test the statistical significance of the estimated Hurst Exponent, the study applies the variance ratio test (VRT) to check if the whether the Null-hypothesis of  $H = 0.5$  can be rejected (Steffen et al., 2014). The VRT has also been applied to test for evidence of a random walk. The advantage of applying the VRT is that it can be applied even when the price time series are not normally distributed (Jefferis and Smith 2004). Lo and MacKinlay (1988) developed this test statistic and more details see can be found in Lo and MacKinlay (2001).

Given that the time series  $\{Y_t\} = (Y_0, Y_1, Y_2, \dots, Y_n)$  satisfies

$$\Delta Y_t = \mu + \epsilon_t \quad [16]$$

With  $\mu$  being a random drift parameter. The key characteristics of a random walk to test are  $E(\epsilon_t \epsilon_{t-j}) = 0$  for any positive  $j$  and  $E(\epsilon_t) = 0$  for all  $t$ .

#### The Basic Test

Two test statistics were developed by Lo and MacKinlay (1988) for properties of random walk applicable under different sets of assumptions of null hypothesis about  $\epsilon_t$ :

Lo and MacKinlay (1988) first assume the  $\epsilon_t$  are *iid*. Gaussian with variance  $\sigma^2$  although the assumption of normality is not strictly necessary. Lo and MacKinlay (1988) refer to this as the homoscedastic random walk hypothesis, also referred to as the *iid* null.

Lo and MacKinlay (1988) alternatively describe a heteroskedastic random walk hypothesis with the assumption of *iid*. weakened and allow for rather general forms of dependence and conditional heteroskedasticity. A hypothesis which is sometimes referred to as the martingale null, because it provides a set of sufficient but not necessary, conditions for  $\epsilon_t$  to be a martingale difference sequence (*m.d.s.*).

The estimators for the mean of first difference and the scaled variance of the  $q$ -th difference can be defined as:

$$\hat{\mu} = \frac{1}{T} \sum_{t=1}^T (Y_t - Y_{t-1})$$

$$\hat{\sigma}^2(q) = \frac{1}{Tq} \sum_{t=1}^T (Y_t - Y_{t-q} - q\hat{\mu})^2 \quad [17]$$

and the variance ratio:

$$VR(q) = \frac{\hat{\sigma}^2(q)}{\hat{\sigma}^2(1)} \quad [18]$$

Lo and MacKinlay (1988) suggest that the variance estimators may be adjusted for bias by replacing  $T$  in Equation 18 with in the drift case or the no-drift case.

Lo and MacKinlay (1988) show that the variance ratio z-statistic:

$$z(q) = (VR(q) - 1) \cdot [\hat{s}^2(q)]^{-1/2} \quad [19]$$

is asymptotically  $N(0,1)$  for suitable choice of estimator  $\hat{s}^2(q)$ .

Under the hypothesis of *iid.*, the estimator is given as:

$$\hat{s}^2(q) = \frac{2(2q - 1)(q - 1)}{3qT} \quad [20]$$

under the assumption of *m.d.s.* however, we use the kernel estimator,

$$\hat{s}^2(q) = \sum_{j=1}^{q-1} \left( \frac{2(q-j)}{q} \right)^2 \cdot \hat{\delta}_j \quad [21]$$

Where

$$\hat{\delta}_j = \left\{ \sum_{t=j+1}^T (y_{t-j} - \hat{\mu})^2 (y_t - \hat{\mu})^2 \right\} / \left\{ \sum_{t=j+1}^T (y_{t-j} - \hat{\mu})^2 \right\}^2$$

[22]

The approach by Lo and MacKinlay (1988) uses an overlapping variance ratio test, which examines the predictability of a given time series by comparing the variances of the log difference of the series calculated over different intervals. The statistic tests whether the equation

$$\frac{Var(z(t) - z(t - \tau))}{\tau Var(z(t) - z(t - 1))} = 1$$

[23]

can be accepted or not. Therefore, if we hypothesize that our selected price series are in fact stationary, then, over time, the variances of the series will not increase. However, if the series contain unit roots and therefore non-stationary, the estimated variances for each series will increase over time. The variances of subsets of the price series that are differently sampled will then be compared over time to determine what happens with the obtained ratios of the variance (see equation 16). The variances of the price series are calculated at  $\Delta t$  time periods. If we sample every  $k \times \Delta t$  periods, it is expected that the variance be  $k\sigma^2$  under a random walk, therefore, equation 16 holds.

### **Joint VRT**

Because the variance ratio constraint holds for every difference  $q > 1$ , the statistic is commonly evaluated at several selected values of  $q$ . Chow and Denning (1993) proposed a conservative test statistic which analyzes the absolute maximum value for a group of multiple variance ratio statistics to control the size of the joint test. Using  $m$  variance ratio statistics,  $T$  degrees of freedom and parameter  $m$ , the probability for the Studentized Maximum Modulus (SMM) distribution bounds from above, the  $p$ -value for the Chow-Denning statistic. In line with Chow and Denning (1993), the study approximates this bound applying the asymptotic ( $T = \infty$ ) SMM distribution.

### **Wild Bootstrap**

Kim (2006) provides a wild bootstrap methodology to enhance the properties of small sample of variance ratio tests. this method involves estimating the individual as well as the joint variance ratio test statistics on samples generated by weighting the original data by variance 1 and mean 0 random variables, and applying the outcome to create bootstrap distributions of the

test statistics. The  $p$ -values are directly calculated from the fraction of replications that fall outside the range defined by the statistic calculated.

In summary, equation 16:

- is equal to 1 if the price series follows a random walk,
- is (strictly) less than 1 under mean reversion (stationarity),
- and is (strictly) larger than 1 under mean aversion (trending up- or downwards).

### **8.3.5 Analysis of Portfolio Holdings**

Baker et al. (2011) argue that two of the reasons for the low-volatility anomaly are the structure of managers' remuneration and agency problems that cause fund managers to include high volatility stocks in their portfolios. This study obtains information from quarterly mutual funds holdings from the January 2004 to December 2014. This period is selected because it is the only period for which data was obtained on the complete mutual fund holdings. For the other periods, quarterly mutual fund holdings below 1% are aggregated together and presented as holdings less than 1%. The study analyses the quarterly holding of funds to ascertain the percentage of portfolio allocation to companies in the FTSE/JSE Top 40 and the FTSE/JSE Small Cap. This is to confirm whether South African fund managers contribute to the low-volatility anomaly on the JSE. The analysis of portfolio holdings of South African equity funds covers a relatively shorter period of January 2004 to December 2014 a period that can be described as turbulent due to the Global Financial Crisis and this may have a possible influence the portfolio holding of these funds.

### **8.3.6 Analysts Coverage**

The study compares the number of analysts covering stocks in the FTSE/JSE Top 40 and the FTSE/JSE Small Cap indices using data from McGregor BFA. As of 31<sup>st</sup> December 2015, the FTSE/JSE Top 40 includes the 43 largest companies with common stock listed on the JSE.

### **8.3.7 Frequency of Publication**

Using data from McGregor BFA, the study counts the number of publications for companies in the FTSE/JSE Top 40 and the FTSE/JSE Small Cap over the previous one year from 1<sup>st</sup> January 2015 to 31<sup>st</sup> December 2015. A broad definition of publications is used. This according to McGregor BFA, includes news from sources such as newspapers, online publications and journals as well as JSE issued news and historical company news as they relating to a company.

### **8.3.8 Normalized Volume of Trade**

In order to compare the volume of trade between the FTSE/JSE Top 40 and the FTSE/JSE Small Cap, the study normalizes the volume of trade for both indices by dividing the total volume of trade for each index for the year ended 31 December 2002 to 31 December 2014 by the total free float stocks in the index in line with Rangelova et al. (2015). The study applies this normalized measure of volume of trade to work out an average monthly number for each index.

## **8.4 Summary**

This chapter discussed the data and methodology applied to achieve the five objectives of the study. Data for the study is obtained from Profile Data, the JSE and BFA McGregor. The study applies the Sharpe ratio to investigate the low volatility anomaly on the JSE, the first objective of the study. The BDS test is also applied to determine whether the time series of the selected indices are *iid*, this is the second objective of the study. The study also applies the rescaled range analysis to investigate the fractal nature of the selected indices to achieve the third objective of the study. The study further investigates factors that contribute to the low volatility anomaly on the JSE as well as ascertaining whether the FMH explains this anomaly.

## CHAPTER NINE

### DATA ANALYSIS AND INTERPRETATION

This chapter presents the findings of the study and provides interpretations to the findings.

#### 9.1 Results and Discussion

Table 9.1 shows the statistical properties of the data used in the study. The FTSE/JSE Small Cap index had the highest daily mean return and lowest standard deviation over the period of the study. The FTSE/JSE Top 40 recorded the lowest negative return as well as the highest positive daily return over the period of the study.

The kurtosis values for the indices selected are all larger than 3, which is the value for normal distribution signifying that all the series of the indices have fat tails compared to a normal distribution and leptokurtic in line with the FMH. The returns of the indices therefore have frequent extremely large deviations from the mean with the FTSE/JSE Small Cap exhibiting the highest leptokurtosis. The series of all the indices are also negatively skewed, again with the FTSE/JSE Small Cap displaying the highest (in absolute terms) of negative skewness.

**Table 9.1: Summary Statistics for FTSE/JSE Indices**

STATISTIC	FTSE/JSE All Share	FTSE/JSE Top 40	FTSE/JSE Small
<i>N</i>	4840	4840	4840
Mean	0.000209	0.000203	0.000212
Standard deviation	0.005393	0.005934	0.002919
Skewness	-0.477473	-0.403190	-1.769811
Kurtosis	9.284673	9.290103	17.63013
Minimum	-0.055112	-0.062047	-0.033932
Maximum	0.032238	0.036685	0.017227
<i>p</i> – value*	0.000000	0.000000	0.000000
Anderson-Darling	44.56388	41.43948	81.56400
<i>p</i> -value for $A^2$ Test	0.0000	0.0000	0.0000

\*Significant at 0.01 level

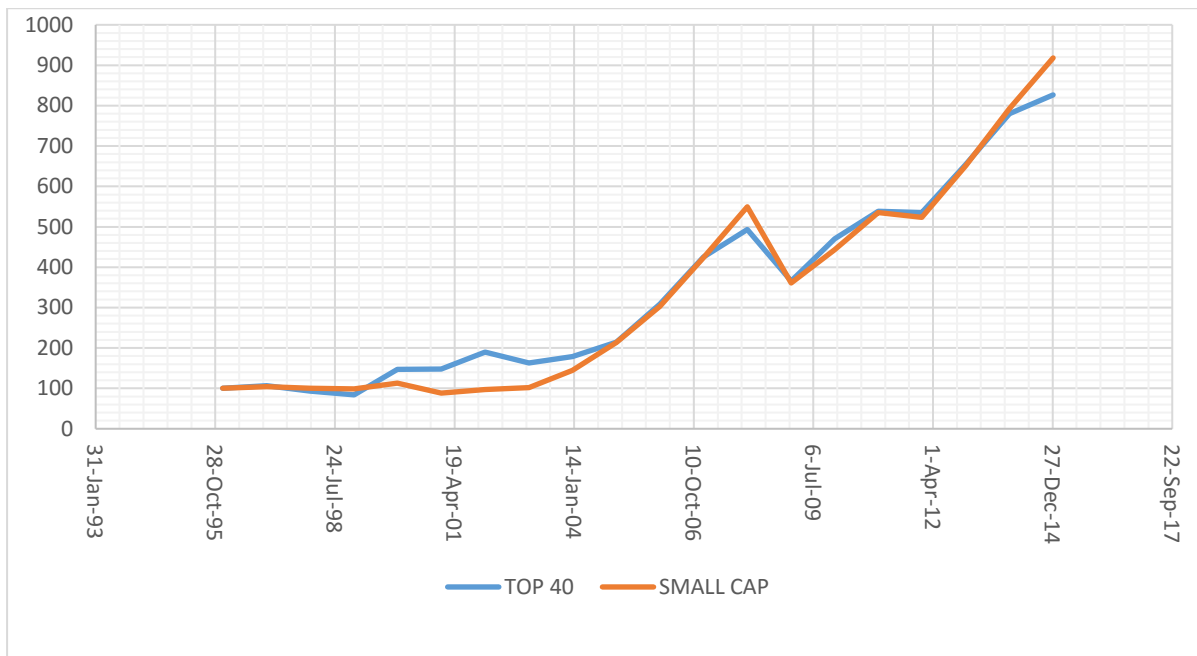
The Anderson-Darling test also rejects the null hypothesis of normality at the 0.01 significance level. The implications of these findings are that the series of indices considered in this study show significant and frequent deviations from the mean, and therefore applying statistical models that do not take fatter tails into consideration will underestimate the likelihood of very good or very bad outcomes.

## **9.2 FTSE/JSE Small Cap Outperforms FTSE/JSE Top 40 Index**

The first research objective of the study is to investigate the existence of the low volatility anomaly on the JSE. Contrary to the fundamental concept in classical finance that risk is compensated by expected returns, the study confirms the existence of low-volatility anomaly on the JSE. The FTSE/JSE Small Cap index is less risky and outperforms the FTSE/JSE Top 40 on a risk-adjusted basis. Over the period June 1995 to December 2014, the FTSE/JSE Small Cap index outperformed the FTSE/JSE Top 40 by 0.6% per annum. Although the absolute outperformance of the FTSE/JSE Small Cap index is not phenomenal, its outperformance of the FTSE/JSE Top 40 on a risk adjusted basis is phenomenal with a Sharpe ratio of 9.93 to 3.88. Figure 8.1 illustrates the growth of R100 over the period of the study. Table 9.2 illustrates the absolute and risk-adjusted performance of the two indices.

The findings of this study are in line with Jensen et al. (1972), Haugen and Heins (1972), Blitz and Van Vliet (2007) and Li et al. (2016) who confirmed the existence of the low-volatility anomaly in the markets they investigated.

**Figure 9.1: Growth of R 100 (June 1995 - December 2014)**



**Source:** McGregor BFA (2015)

**Table 9.2: Summary Statistics – Performance (June 1995 - December 2014)**

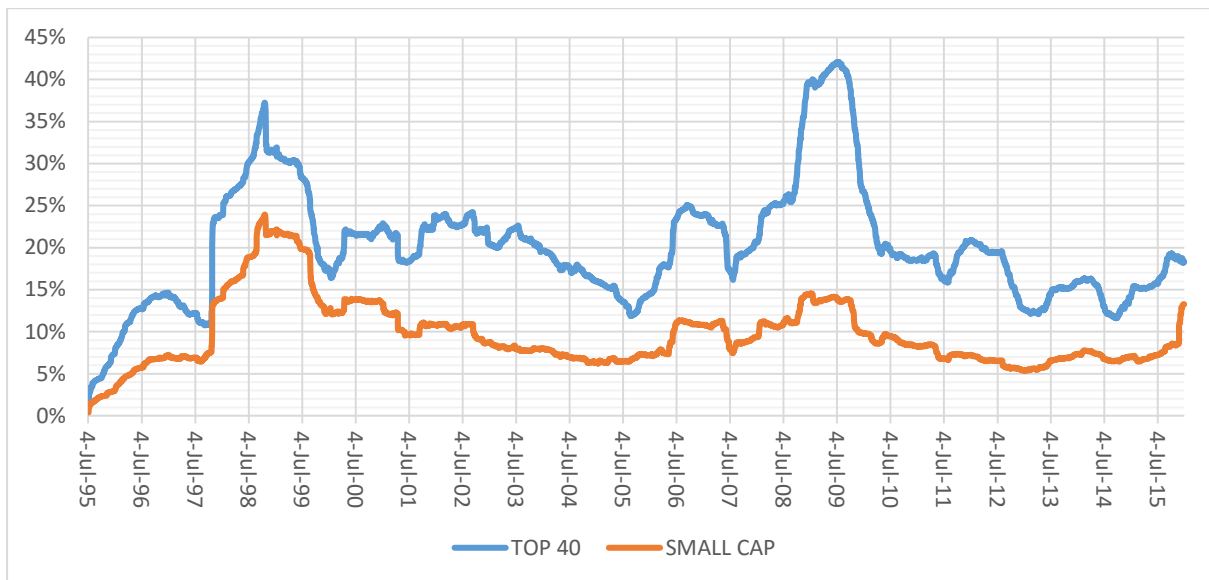
	<b>Top 40</b>	<b>Small-Cap</b>
<b>Annualised</b>	11.7%	12.3%
<b>Minimum</b>	-25.93%	-34.34%
<b>Maximum</b>	74.92%	47.85%
<b>Sharpe Ratio</b>	3.88	9.93

**Source:** Author

Figure 9.2 shows the volatility for measures for the FTSE/JSE Top 40 and the FTSE/JSE Small Cap index. As predicted by the FMH, the small cap index which has an  $H$  of 0.68 has experienced a relatively lower volatility compared to the top 40 index.



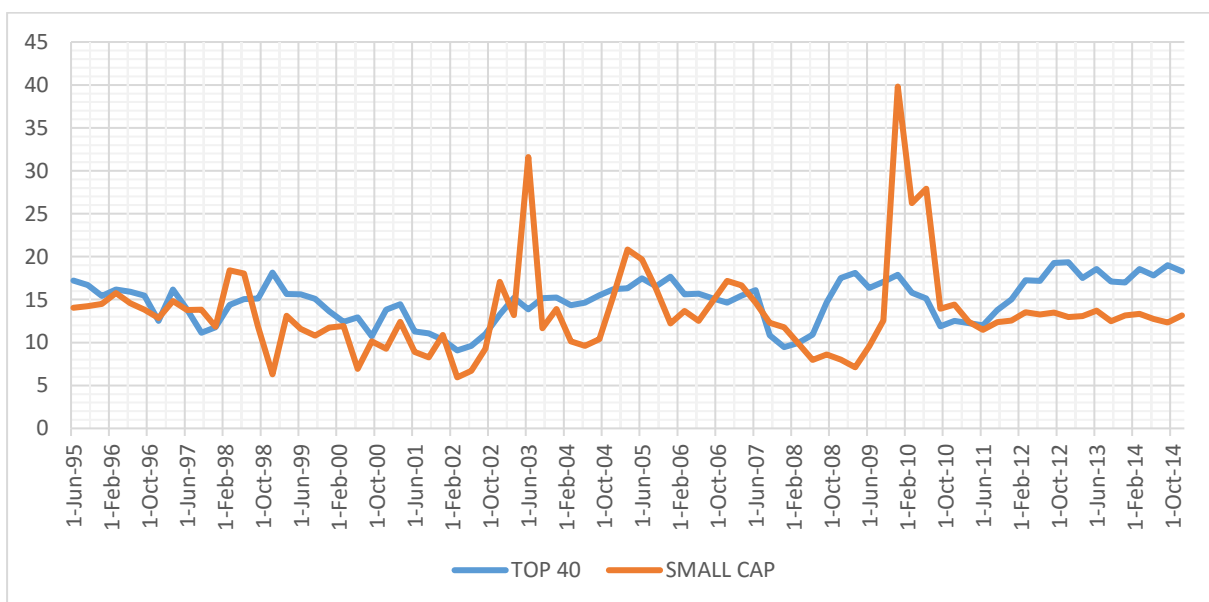
**Figure 9.2: Volatility (June 1995 - December 2014)**



**Source:** McGregor BFA (2015)

Furthermore, over the period of the study, the P/E ratio of the FTSE/JSE Top 40 was higher than the P/E ratio of the FTSE/JSE Small Cap. Figure 9.3 and table 9.3 present the P/E ratios of both indices.

**Figure 9.3: P/E Ratio (June 1995 - December 2014)**



**Source:** McGregor BFA (2015)

**Table 9.3: Summary Statistics - P/E Ratio (June 1995 - December 2014)**

	<b>Top 40</b>	<b>Small-Cap</b>
<b>Average</b>	14.86	13.47
<b>Median</b>	9.08	5.94
<b>Minimum</b>	19.81	12.87
<b>Maximum</b>	15.2	39.81

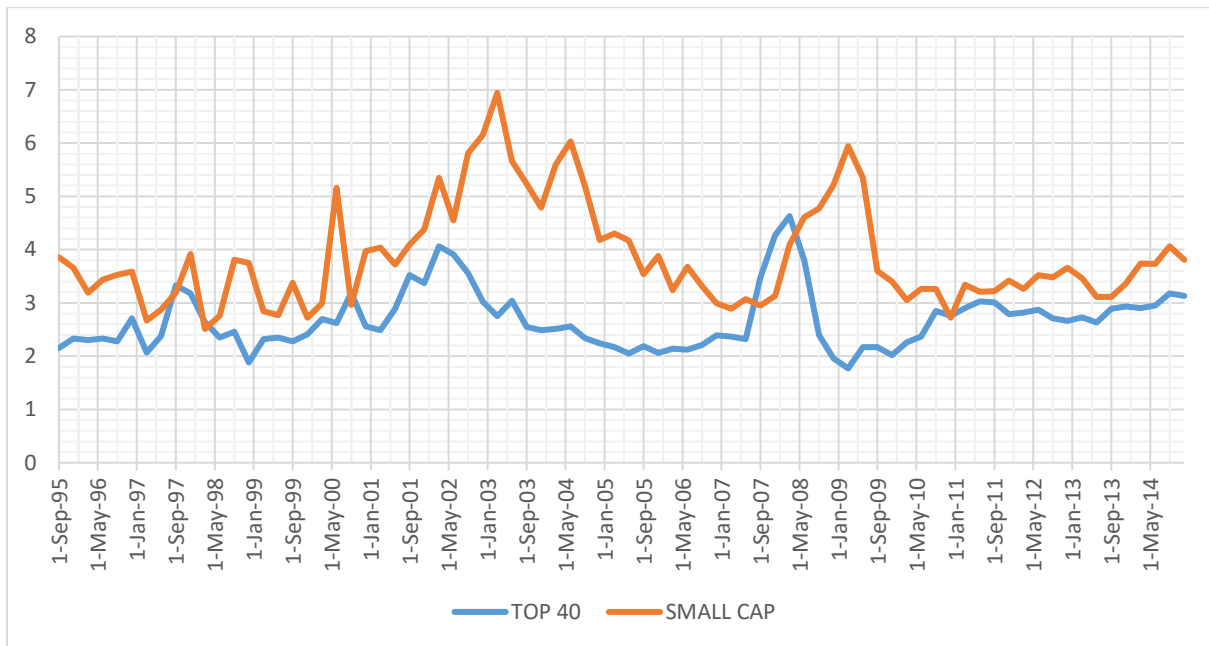
**Source:** McGregor BFA (2015)

The theory regarding price multiples like the P/E ratio is that one cannot evaluate the price of a stock in isolation. The evaluation must be done in relation to what it can buy in terms of net assets, earnings, or some other evaluation of value. By dividing the price of a stock by a per share measure of value gives the price to buy a unit of value in whatever means of measuring the value. A P/E of 30 for example, means it takes 30 units of currency say R 30, to buy a unit of earnings (for example, R 1 of earnings). Comparison among stocks can then be done through such scaling of price per share by value per share. A stock with a P/E of 25 is therefore more expensive than a similar stock with a P/E of 20 even if they both sell for the same price. In using this method of comparables, an analyst would conclude that if the shares are closely similar, for example, if they possess similar profit margins, risk and prospects for growth, the stock with the P/E of 20 is relatively undervalued compared to the stock with a P/E of 30 (Pinto et al., 2015).

The law of one price, is the economic rationale behind the method of comparables. This is the principle that assets that are identical should sell at the same price. The method of comparables is possibly the most widely applied technique for analysts who report valuation judgments based on price multiples. The use of multiples in valuing assets is sometimes seen mainly as a kind of relative-valuation method (Pinto et al., 2015). A higher Sharpe ratio together with a lower P/E ratio therefore implies that the FTSE/JSE Small Cap index is not only outperforms the FTSE/JSE Top 40 index but also relatively less expensive or undervalued. The dividend yields as well as the earnings yield of the FTSE/JSE Top 40 was lower than the FTSE/JSE

Small Cap over the period of the study. Figure 9.4 and Table 9.4 presents the dividend yields for both indices over the period. Figure 9.5 and Table 9.5 present the earnings yield of the two indices.

**Figure 9.4: Dividend Yield (June 1995 - December 2014)**



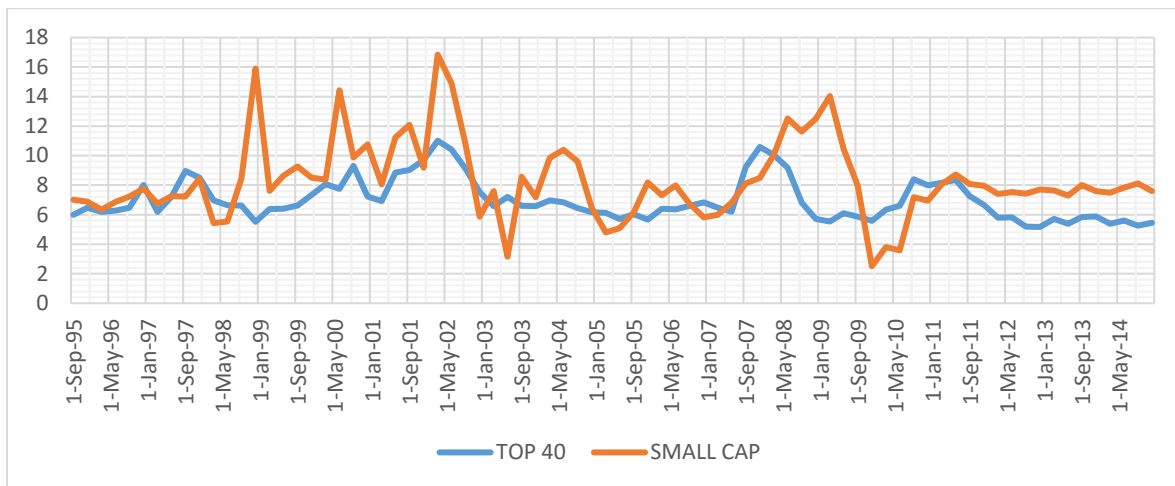
Source: McGregor BFA (2015)

**Table 9.4: Summary Statistics - Dividend Yield (June 1995 - December 2014)**

	Top 40	Small-Cap
<b>Average</b>	2.68	3.86
<b>Median</b>	2.56	3.60
<b>Minimum</b>	1.77	2.51
<b>Maximum</b>	2.56	6.94

Source: McGregor BFA (2015)

**Figure 9.5: Earnings Yield (June 1995 - December 2014)**



Source: McGregor BFA (2015)

**Table 9.5: Summary Statistics - Earnings Yield (June 1995 - December 2014)**

	Top 40	Small-Cap
<b>Average</b>	6.98	8.28
<b>Median</b>	6.59	7.81
<b>Minimum</b>	5.17	2.51
<b>Maximum</b>	11.01	16.84

Source: McGregor BFA (2015)

The findings of this study are in line with the assertion that small cap companies are less explored or totally ignored by many analysts and a large population of investors, and therefore the market for small stocks tend to be inefficient compared to their large cap counterparts, leading to prices deviating from fair values (Fundamental Index 2008; Foley 2014; Credit Suisse 2014). Kuppore (2013) argues that small cap markets require less efficiency, otherwise this market that historically has created jobs, brought about break-through technologies while rewarding investors with price escalation will seize up for good.

## 9.2 BDS Test

The second objective of the study is to determine whether the times series of equity prices on the JSE are independently and identically distributed (*iid*) and the BDS test is applied to achieve this objective. EViews version 8 was used for the BDS test. The results for the BDS test on the three indices are presented in tables 9.2, 9.3 and 9.4. All BDS test statistics are presented at the 0.01 significance level. The BDS test is a powerful statistical tool for differentiating non-linear stochastic systems or deterministic chaos from random independent and identically distributed systems.

**Table 9.6: BDS Test for FTSE/JSE Top 40 (June 1995 – December 2014)**

Dimension	BDS Statistic	Std. Error	z-Statistic	Prob
2	0.020296	0.001263	16.06869	0.0000
3	0.043829	0.002005	21.86348	0.0000
4	0.061754	0.002384	25.90133	0.0000
5	0.071797	0.002482	28.92776	0.0000
6	0.076036	0.002391	31.80620	0.0000
7	0.076134	0.002188	34.79629	0.0000
8	0.073571	0.001931	38.09098	0.0000
9	0.069521	0.001660	41.88956	0.0000
10	0.064655	0.001397	46.29486	0.0000

**Table 9.7: BDS Test for FTSE/JSE All Share (June 1995 – December 2014)**

Dimension	BDS Statistic	Std. Error	z-Statistic	Prob
2	0.020446	0.001272	16.07334	0.0000
3	0.044719	0.002019	22.15165	0.0000
4	0.063110	0.002401	26.28666	0.0000

5	0.073500	0.002499	29.40969	0.0000
6	0.077907	0.002407	32.36510	0.0000
7	0.078095	0.002203	35.44835	0.0000
8	0.075613	0.001945	38.88169	0.0000
9	0.071584	0.001671	42.84050	0.0000
10	0.066711	0.001406	47.44444	0.0000

**Table 9.8: BDS Test for FTSE/JSE Small Cap**

<b>Dimension</b>	<b>BDS Statistic</b>	<b>Std. Error</b>	<b>z-Statistic</b>	<b>Prob</b>
2	0.024080	0.001291	18.64708	0.0000
3	0.045668	0.002046	22.31723	0.0000
4	0.061074	0.002430	25.13436	0.0000
5	0.068026	0.002526	26.93400	0.0000
6	0.070060	0.002429	28.84341	0.0000
7	0.068195	0.002220	30.72152	0.0000
8	0.064567	0.001957	33.00075	0.0000
9	0.059558	0.001679	35.47940	0.0000
10	0.054089	0.001411	38.34702	0.0000

The series are examined up to 10 dimensions in line with Oppong, Mulholland and Fox (1999) and Bhattacharya and Sensarma (2006). The z—statistic is given as the BDS test divided by the standard error and is the final step that is used to test the null hypothesis. The null hypothesis of *iid* is not accepted if the z-statistic is greater than 2.58 at 0.01 level of significance.

Given that the z-statistics tables 9.6, 9.7 and 9.8 are all greater than 2.58 for all the ten dimensions for the indices selected and *p*-values of 0.0000, the study concludes that the times series of returns for all the three indices do not exhibit randomness at 0.01 significance level.

### 9.3 Rescaled Range Analysis (Hurst Exponent)

The third objective of the study is to establish the fractal characteristics of the JSE by applying the rescale range analysis (Hurst exponent). Hypothetically, the  $H$  suggests some trading strategies, for example,  $H$  greater than 0.5 signifies persistence in the time series, and an  $H$  less than 5 signifies reversion to the mean, and  $H = 0.5$  signifies randomness in the time series, therefore the more divergent the  $H$ , the less efficient the market is. Tables 9.9 and 9.10 present the outcome of the R/S analysis of the FTSE/JSE indices selected for the study.

The FTSE/JSE Top 40 and the FTSE/JSE All Share exhibit slight reversion to the mean with an  $H$  of 0.461 and 0.4634, respectively. The correlation coefficients are -0.0526 and -0.0495 for the FTSE/JSE Top 40 and the FTSE/JSE All Share, respectively, implying that only 5.26% of the movements in the time series of the FTSE/JSE Top 40 are dependent on historical data and 4.95% for the FTSE/JSE All Share index. The FTSE/JSE Small Cap, however, displays significant persistence with an  $H$  of 0.6790 and a correlation coefficient of 0.2817, implying that 28.17% of movements in this index are dependent on historical information.

**Table 9. 9. Average R/S for Each Value of n**

<b><i>N</i></b>	<b>FTSE/JSE Top 40</b>	<b>FTSE/JSE Small Cap</b>	<b>FTSE/JSE All Share</b>
4840	69.63505	190.7382	73.78643
2420	53.53300766	138.1191622	56.1917233
1613	52.50887127	103.6487477	53.50605385
1210	42.71046899	82.26782126	44.12135614
968	34.4884864	63.74142505	35.87497224
605	28.48231733	44.88302406	29.2172694
484	25.71719924	41.59856064	27.10216567
242	18.36267392	28.20862672	19.21426979

**Table 9.10. Hypothesis Test for  $H$** 

	<b>FTSE/JSE Top 40</b>	<b>FTSE/JSE Small Cap</b>	<b>FTSE/JSE All Share</b>
$C = \exp(b_0)$	0.179338	-0.193979	0.189598
$H = b_1$	0.460994	0.679026	0.463352
$CN$	-0.052637863	0.281693572	-0.049535852
$R^2$	0.973949	0.987767	0.980835
$SE(C)$	0.093843	0.030850	0.080617
$SE(H)$	0.030779	0.030850	0.026442
$T\text{-test}(C)^*$	1.911052	-2.062362	2.351825
$T\text{-test}(H)^*$	14.97736	22.01089	17.52357
$Prob(C)$	0.1046	0.0848	0.0569
$Prob(H)$	0.0000	0.0000	0.0000

\*significant at 1% level

Given that the FTSE/JSE All Share is a free-float market weighted index, the time series of its returns will be significantly influenced by the large caps companies and therefore the  $H$  for the series will be similar to that of the FTSE/JSE Top 40 as can be seen from table 9.10.

A high  $H$  according to Peters (1991), implies less risk, clearer trend and less noise and therefore the FTSE/JSE Small Cap index can be construed to be less risky than the FTSE/JSE All Share and FTSE/JSE Top 40 contrary to the popular notion that small cap indices and stocks are riskier. Jefferis and Smith (2005), Van Heerden, Rodrigues, Hockly, Lambert, Taljard and Phiri (2013) and Phiri (2015) conclude that the JSE is weak form efficient. The efficient market hypothesis in its pure form does not accept only *iid* observations and does not necessarily entail independence over time, asserting that “if returns are random then the market is efficient. The converse may not be true, however.” (Peters, 1991:18). The study corroborates the conclusions of Smith (2008), that the JSE does not exhibit a random walk over the period of June 1995 to December 2014.



## **9.4 FTSE/JSE Top 40 More Volatile than FTSE/JSE Small Cap Index**

### **9.5 Variance Ratio Test**

To test for the statistical significance of the estimated Hurst Exponent for the three indices, the study applies the Variance Ratio Test developed by Lo and MacKinlay (1988) to the Null-hypothesis of  $H = 0.5$ . Multiple values ( $k$ ) can be tested for various sampling periods (usually  $k = 2, 4, 8, 16, 32, \dots$ ), this allows us to observe the intervals at which a price series may be mean reverting or trending. This study chose the interval of  $k = 2, 4, 8, 16, 32, 64, 128$ .

The study computes the basic Lo and MacKinlay variance ratio test which assumes heteroskedastic increases to the random walk. The estimations also provide for a non-zero innovation mean and bias correct the variance estimates. The study also applies the original Lo and MacKinlay test that is based on the innovations from the original data.

For the three indices, the study takes the log difference of each price series over the period of the study. Three tests are conducted for each index. The first round of tests is illustrated in Tables 9.11, 9.12 and 9.13. The test probabilities are computed using the default Asymptotic normal results (Lo and MacKinlay 1988).

The first part of Table 9.11 illustrates the overall results of the test for the FTSE/JSE All Share Index. Since the study specifies more than one test period, are two sets of test results are presented. The “Joint Tests” presents the tests of the joint null hypothesis for all the periods, and the “Individual Tests” represent the variance ratio tests for individual periods. Here, the Chow-Denning maximum statistic of 4.401947 is associated with the period 2 individual test. The approximate  $p$  value of 0.0001 is obtained using the studentized maximum modulus with infinite degrees of freedom so that we strongly reject the null of a random walk.

**Table 9.11: Variance Ratio Test for FTSE/JSE All Share Index**

**Null Hypothesis: Log of FTSE/JSE All Share Index is a random walk**

Sample: June 30 1995 to 31 December 2014

Included Observations: 4872 (after adjustments)

Standard error estimates assume no heteroskedasticity

Use biased variance estimates

Lags: 2 4 8 16 32 64 128

Joint Tests	Value	df	Probability
Max  z  (at period 2)*	4.401947	4872	0.0001
Wald (Chi-Square)	39.43581	7	0.0000

**Individual Tests**

Period	Variance Ratio	Standard Error	z-Statistic	Probability
2	1.063065	0.014327	4.401947	0.0000
4	1.088623	0.026803	3.306468	0.0009
8	1.021741	0.042379	0.513016	0.6079
16	1.028573	0.063062	0.453087	0.6505
32	1.050171	0.091385	0.549007	0.5830
64	1.031304	0.130793	0.239340	0.8108
128	0.992763	0.186066	-0.038895	0.9690

\*Probability approximation using studentized maximum modulus with parameter value 7 and infinite degrees of freedom

However, the individual tests for periods 8,16,32,64 and 128 are all greater than 0.05 and therefore at these periods, the null hypothesis cannot be rejected. This is in line with the FMH which argues that the more divergent the  $H$  from 0.5, the less efficient the market and vice versa. The FTSE/JSE All Share index with an  $H$  of 0.46 can therefore be construed to be fairly efficient.

**Table 9.12: Variance Ratio Test for FTSE/JSE Top 40 Index**

**Null Hypothesis: Log of FTSE/JSE Top 40 Index is a random walk**

Sample: June 30 1995 to 31 December 2014

Included Observations: 4872 (after adjustments)

Standard error estimates assume no heteroskedasticity

Use biased variance estimates

Lags: 2 4 8 16 32 64 128

Joint Tests	Value	df	Probability
Max  z  (at period 2)*	3.338213	4872	0.0059
Wald (Chi-Square)	36.22743	7	0.0000

**Individual Tests**

Period	Variance Ratio	Standard Error	z-Statistic	Probability
2	1.047826	0.014327	3.338213	0.0008
4	1.054685	0.026803	2.040268	0.0413
8	0.961102	0.042379	-0.917867	0.3587
16	0.937219	0.063062	-0.995539	0.3195
32	0.931303	0.091385	-0.751733	0.4522
64	0.919195	0.130793	-0.617814	0.5367
128	0.906084	0.186066	-0.504743	0.6137

\*Probability approximation using studentized maximum modulus with parameter value 7 and infinite degrees of freedom

The first part of Table 9.12 illustrates the overall results of the test for the FTSE/JSE Top 40 Index. Again, the study specifies more than one test period, and therefore two sets of test results are presented. The Chow-Denning maximum statistic of 3.338213 is associated with the period 2 individual test. The approximate *p* value of 0.0059 is obtained using the studentized maximum modulus with infinite degrees of freedom so that we reject the null of a random walk.

However, the individual tests for periods 8,16,32,64 and 128 are all greater than 0.05 and therefore at these periods, the null hypothesis cannot be rejected. This is in line with the FMH

which argues that the more divergent the  $H$  from 0.5, the less efficient the market and vice versa. The FTSE/JSE Top 40 index, with an  $H$  of 0.46 can also be construed to be fairly efficient.

**Table 9.13: Variance Ratio Test for FTSE/JSE Small Cap Index**

**Null Hypothesis: Log of FTSE/JSE Small Cap Index is a random walk**

Sample: June 30 1995 to 31 December 2014

Included Observations: 4872 (after adjustments)

Standard error estimates assume no heteroskedasticity

Use biased variance estimates

Lags: 2 4 8 16 32 64 128

Joint Tests	Value	df	Probability
Max  z  (at period 32)*	26.15458	4872	0.0000
Wald (Chi-Square)	806.0579	7	0.0000

**Individual Tests**

Period	Variance Ratio	Standard Error	z-Statistic	Probability
2	1.243349	0.014327	16.98570	0.0000
4	1.565328	0.026803	21.09212	0.0000
8	1.988815	0.042379	23.33268	0.0000
16	2.645518	0.063062	26.09369	0.0000
32	3.390147	0.091385	26.15458	0.0000
64	3.747656	0.130793	21.00775	0.0000
128	3.667735	0.186066	14.33755	0.0000

\*Probability approximation using studentized maximum modulus with parameter value 7 and infinite degrees of freedom

The first part of Table 9.13 illustrates the overall results of the test for the FTSE/JSE Small Cap index. Just as the other two indices, the study specifies more than one test period, and therefore two sets of test results are presented. The Chow-Denning maximum statistic of 26.15458 is associated with the period 32 individual test. The approximate  $p$  value of 0.0000

is obtained using the studentized maximum modulus with infinite degrees of freedom so that we strongly reject the null of a random walk.

Unlike the previous two indices tested, the null hypothesis is also strongly rejected for the individual tests. This is also in line with the FMH which argues that the more divergent the  $H$  from 0.5, the less efficient the market vice versa. The FTSE/JSE Small Cap 40 index, with an  $H$  of 0.68 can therefore be construed to be the least efficient among the indices selected for this study.

The findings of this study are in line with Smith et al. (2002) who applied multiple variance ratio tests to investigate whether the JSE ALSI exhibits a random walk from January 1990 to August 1998, and concluded that the index indeed follows a random walk. Again, Noakes and Rajaratnam (2014) tested for market efficiency on the JSE using the overlapping serial test to investigate the efficiency of large, mid and small cap indices on the JSE over a stable period as well as a period that includes the global financial crisis. The study also concluded that the stock prices of small cap companies are characterized by high degree of non-random movements. Mid cap stocks also exhibit inefficiencies albeit to a much lesser extent with large cap stocks displaying higher levels of efficiency.

Appendix C1 presents the variance test ratios for the selected indices by computing probabilities using a wild bootstrap Kim (2006) with a two-point error distribution, a 1000 replications and a Knuth random generator. The null hypothesis of random walk is only weakly rejected for the FTSE/JSE All Share with a probability of 0.0480 while the null could not be rejected for the FTSE/JSE Top 40 with a probability of 0.1470 whereas the null hypothesis is strongly rejected for the FTSE/JSE Small Cap with a probability of 0.0000.

Appendix C2 presents the variance test ratios for the selected indices by computing probabilities using a wild bootstrap Kim (2006) with a Rademacher error distribution, a 1000 replications and a L'Ecuyer random generator. The null hypothesis of random walk is again only weakly rejected for the FTSE/JSE All Share with a probability of 0.0360 while the null could not be rejected for the FTSE/JSE Top 40 with a probability of 0.1440 and again the null hypothesis is strongly rejected for the FTSE/JSE Small Cap with a probability of 0.0000.

## **9.6 Factors That May Contribute to The Low Volatility Anomaly on the JSE**

The fifth objective of the study is to ascertain the factors that may contribute to the low volatility anomaly on the JSE. The following section presents four factors that may contribute to this anomaly.

### **9.6.1 Publication Frequency is Lower for Small Caps**

The FMH argues that different investors interpret information differently and it is this difference in the interpretation of information that creates liquidity for the proper functioning of the market. Information distribution is therefore asymmetric. A symmetric distribution and assimilation of information into asset prices would lead to investors interpreting and reacting to information in the same way therefore creating crashes and explained by the FMH in times of crises when all market participants with differing time horizons seek to exit the market leading to a liquidity dry-up and subsequently, a market crash.

This section presents the distribution of information on the JSE. The study investigates how often stocks are reviewed or receive published reports. Again, the study used the data from BFA McGregor to count the number of publications for companies in the FTSE/JSE Top 40 and the FTSE/JSE Small Cap over the previous one year from 1<sup>st</sup> January 2015 to 31<sup>st</sup> December 2015. We used a broad definition of publications, which according to McGregor BFA includes news from sources such as newspapers, online publications and journals as well as JSE issued news and historical company news as they relating to a company. The results are reported in Table 9.11. The study finds a substantial difference in the frequency of publications for the constituents of the two indices. On average, there were 85 updates for the stocks in the FTSE/JSE Top 40 whereas stocks on the FTSE/JSE Small Cap received 33 of such publications with a ratio of 2.6 to 1. Barry and Brown (1984) find that stocks for which there is little information available tend to yield higher returns. Peress (2014) concludes that the media contributes to stock market efficiency as it improves the information dissemination among investors and the incorporation of such information into stock prices.

The5) re is an asymmetric distribution of information among the Top 40 companies and Small Cap companies. The relative lack of information is part of the reason for the persistent inefficiency in the FTSE/JSE Small Cap. This persistent inefficiency leads to more uncertainty around pricing and earnings estimates for such companies and therefore creating opportunities for the generation of alpha by skilled stock-pickers.

**Table 9.14: Number of Publications**

	<b>Top 40</b>	<b>Small-Cap</b>
<b>Average</b>	85	33
<b>Median</b>	54	30
<b>Minimum</b>	12	6
<b>Maximum</b>	893	116

**Source:** McGregor BFA (2016)

Given that large cap stocks receive more publications than small cap stocks, large cap stocks are more susceptible to overreaction by market participants who herd into (out) of these stock whenever there is favourable (unfavourable) news. This is part of the reason for the high volatility of the FTSE/JSE Top 40 relative to the small cap index.

Information remains primal for market efficiency. Given that the FTSE/JSE Top 40 receives relatively higher information, the assimilation of information into prices of equities on this index ensures efficiency evident in the weak rejection of the null hypothesis of random walk using the the basic Lo and MacKinlay and the non-rejection of the null for the two subsequent tests when the study applied a two-point error distribution, a 1000 replications and a Knuth random generator as well as a Rademacher error distribution, a 1000 replications and a L'Ecuyer random generator.

The findings of this study corroborate the assertions of McLean and Pontiff (2016) who argue that mispricing may exist in financial markets and investors learn about these mispricings from publications. Financial markets can therefore not be construed to incorporate all relevant

information since factor models purely reflect risk-return trade-offs and should not be affected by the publications.

## 9.6.2 The Number of Analysts Covering Small-Cap Equities is Smaller Than for Large-Cap

Asymmetric distribution of information does not only affect investors but also analyst, as more analysts tend to cover the Top 40 companies than the Small Cap companies. The study compares the number of analysts covering stocks in the FTSE/JSE Top 40 and the FTSE/JSE Small Cap indices. As of 31<sup>st</sup> December 2015, the FTSE/JSE Top 40 includes the 43 largest companies with common stock listed on the JSE. In that period, the market capitalization of companies in the FTSE/JSE Top ranged from R 1.77 trillion to R 16.96 billion, with a median of R 95.96 billion and an average market capitalisation of R 215.97 billion.

As of 31<sup>st</sup> December 2015, the FTSE/JSE Small Cap index included the smallest 61 companies listed on the JSE. During that period, the market capitalisation of stocks in the FTSE/JSE Small Cap index ranged from R 9.45 billion to R 2.14 billion with a median of R 4.84 billion and an average market capitalisation of R 5.01 billion. The study used data from BFA McGregor to count the number of analysts tracking each stock in the respective index, as shown in Table 9.12. The median count of analysts covering FTSE/JSE Top 40 stocks was seven compared to two for FTSE/JSE Small Cap stocks. Some stocks in the FTSE/JSE Small Cap, had no sell-side analyst coverage at all. In contrast, Shoprite, Woolworths Holdings, Naspers, and Vodacom, were the most widely covered stock in the S&P 500, followed by 11 analysts which is almost two times the number of analysts covering Lewis Group and Mpact Ltd the most widely covered in the FTSE/JSE Small Cap, covered by 6 analysts.

**Table 9.15: Analyst Coverage**

	<b>Top 40</b>	<b>Small-Cap</b>
<b>Average</b>	6	2
<b>Median</b>	7	2
<b>Minimum</b>	1	0
<b>Maximum</b>	11	6

**Source:** McGregor BFA (2016)



The differences in analyst coverage is corroborated by Bhushan (1989) who concludes that some company characteristics have influence on the demand and supply of analyst services and names firm characteristics such as the structure of ownership, size of firm, number of lines of business, variability of returns and the correlation between market return and firm return as factors that influence the demand and supply of analyst service.

Again, given that there is a larger number of analysts that cover large cap stocks relative to small cap stocks, and the higher number of publications received by the top 40 index relative to the small cap index, any mispricing in large cap stocks are quickly arbitrated away while mispricing in small cap stocks persist. However, the relative informational efficiency of the top 40 index also leads to higher volatility. Fischer Black, posits that financial markets become progressively volatile as they become more efficient. This is as a result of market participants reacting in the same manner anytime unanticipated new information is available, therefore, causing larger swings in market prices. Efficiency and volatility according to Fisher, are not alternatives but complements. Consequently, given the volatility of expectations of market participants, prices are not as volatile as they should be (Black, 1995).

### **9.6.3 General Equity Funds Gravitate to Large Caps**

Over the period of January 2004 to December 2014 for which quarterly fund holdings was obtained, the study finds that components of the FTSE/JSE Top 40 make up a significant percentage of holding of general equity funds. This implies that greater research time is dedicated to just the largest 40 companies listed on the JSE. Possibly, the relatively larger analyst coverage and publications make it easy for fund managers to identify such stock. The noteworthiness of the stocks coupled with the agency problems and nature of managers' compensation (Baker et al., 2011) may explain why general equity funds dedicate significantly large proportion of their portfolios to the stocks in the FTSE/JSE Top 40 stocks although the JSE had 164 companies listed on the JSE as at 31<sup>st</sup> December 2015.

**Table 9.16: Percentage of Fund Holdings (January 2004 – December 2014)**

	<b>Top 40</b>	<b>Small-Cap</b>
<b>Average</b>	67.76%	3.12%
<b>Minimum</b>	44.66%	0.00%
<b>Maximum</b>	86.44%	12.54%

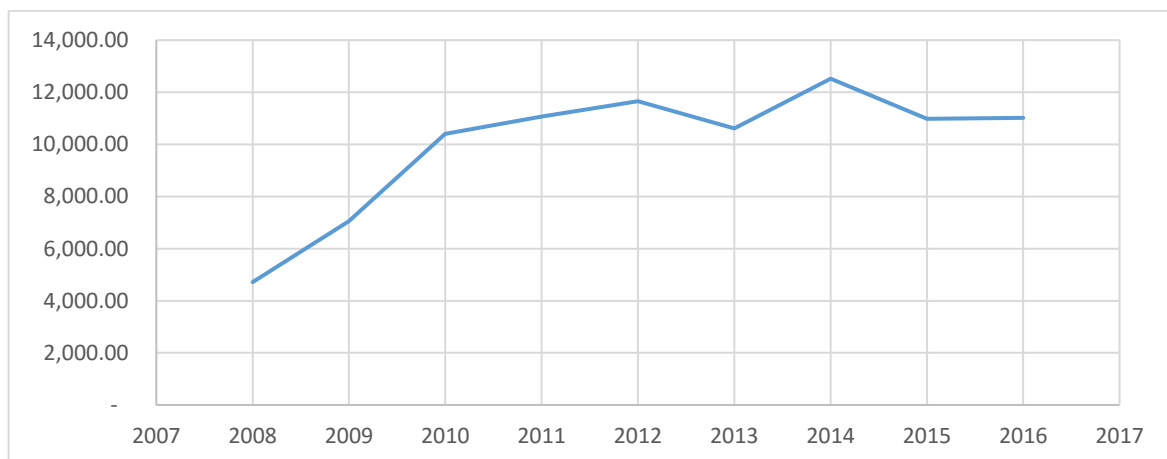
The study finds that large managers gravitate towards large cap stocks and dedicate a disproportionately smaller percentage of their portfolios to small cap equities. Such disproportionate holdings may be as a result of analysts' and professional managers' ability to conveniently defend the inclusion of such stocks to clients. Also, their payment structure may encourage inclusion of such stocks in their portfolios as argued by Baker and Haugen (2012). Given that institutional managers account for a very high participation rate on the JSE, accounting for 40% of shareholding and the largest shareholders on the JSE being government employees through the Government Employees Pension Fund (GEPF) (Ambrosi, 2014), a high demand for the FTSE/JSE Top 40 shares by institutional investors can therefore drive up prices as well as volatility while suppressing returns.

Arbel and Strebels (1982) and Arbel and Strebels (1983) found that companies that were relatively ignored or least researched by security analysts showed better performance relative to those intensively researched with the average annual return (dividends included), for the most ignored group of stocks on the S&P 500 being about 18% and 7% for the group that received relatively higher attention. The neglected group also showed persistent higher risk-adjusted returns which did not disappear even after factoring beta coefficients as a measure of market risk. Barber and Odean (2008) argue that individual investors are net purchasers of attention-grabbing shares. These are shares in the news, shares with high abnormal volume of trade and shares with one-day returns that are extreme. Share purchases that are attention-driven are due to the difficulty investors face when searching the thousands of shares that they can potentially purchase. On the JSE, it appears that professional fund managers also make attention driven purchases as they disproportionately hold shares in the FTSE/JSE Top 40, which also happens to be the index that receives greater attention.

Given the influence of asset managers on the JSE, they may be construed to be Systemically Important Financial Institutions (SIFIs) as herding among these managers may trigger a general sell-off, similar to the one experienced in 2008 with mortgage securities.

Furthermore, as at 31 March 2016, there were seven ETFs and 6 index funds that tracked the FTSE/JSE Top 40 whereas no ETFs or index funds are dedicated to the FTSE/JSE Small Cap index. Total AUM for these funds increased from R 4.70 billion in 2008 to R 11.00 billion by 31 March 2016 (ETF SA, 2016). The growth of ETFs dedicated to the FTSE/JSE Top 40 increases demand pressure on the index relative to the FTSE/JSE Small Cap therefore driving up its price and volatility while repressing returns. As concluded by Bolla et al. (2016), ETFs are still in their development stages in South Africa and therefore the large cap companies will be the most affected by risk commonalities.

**Figure 9.6 JSE Top 40 ETFs AUM January 2008 – March 2016 (R Million)**



**Source:** (ETF SA, 2016)

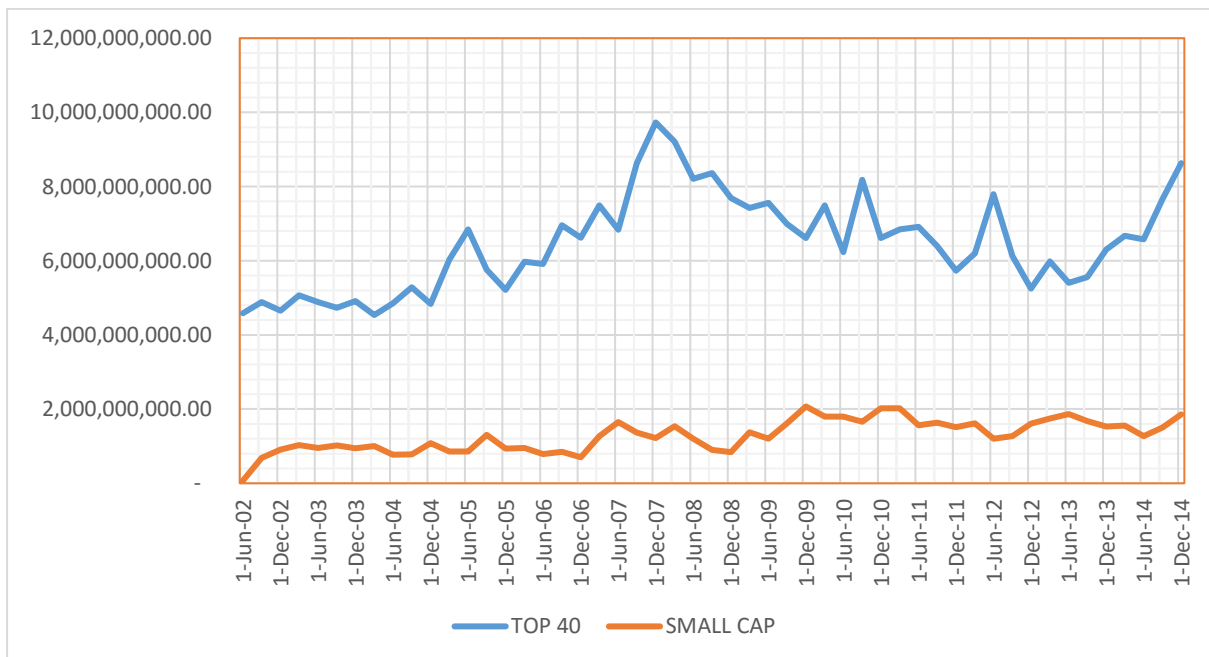
The asset management industry is poised to becoming more concentrated, as a result of the persistent growth of passive funds in South Africa. Regulators in future may face the complex task of forecasting and preparing for future crises, which might not be similar to previous crises and may have to regulate certain segments of the industry which previously had not been a source of problems.

## 9.6.4 Small Cap Index Exhibit Less Liquidity Than Large Cap Index

Classical finance theories assume that there are no frictions in financial markets and therefore perfectly liquid, dismissing the question of market liquidity as a friction or adding transaction cost to the fundamental value to account for market liquidity. Market liquidity is typically included as transaction cost. The FMH however emphasizes the impact of liquidity and investment horizons on asset prices.

Comparing the normalised volume of trade and bid-ask spread as a percentage of closing price, the FTSE/Small Cap index is less liquid compared to the FTSE/JSE Top 40, the theoretical insight offered by the Amihud and Mendelson (1986) on this phenomenon is that in equilibrium, securities with less liquidity are allocated to investors with longer investment horizons this is what they describe as the clientele effect. The longer horizons palliate the extra costs in bid-ask spreads on less liquid securities. Possibly, the high cost of transaction associated with the small cap index deters speculators from participating in this market giving way for long term investors.

**Figure 9.7: Volume of Trade from June 2002 – December 2014 (Absolute Values)**

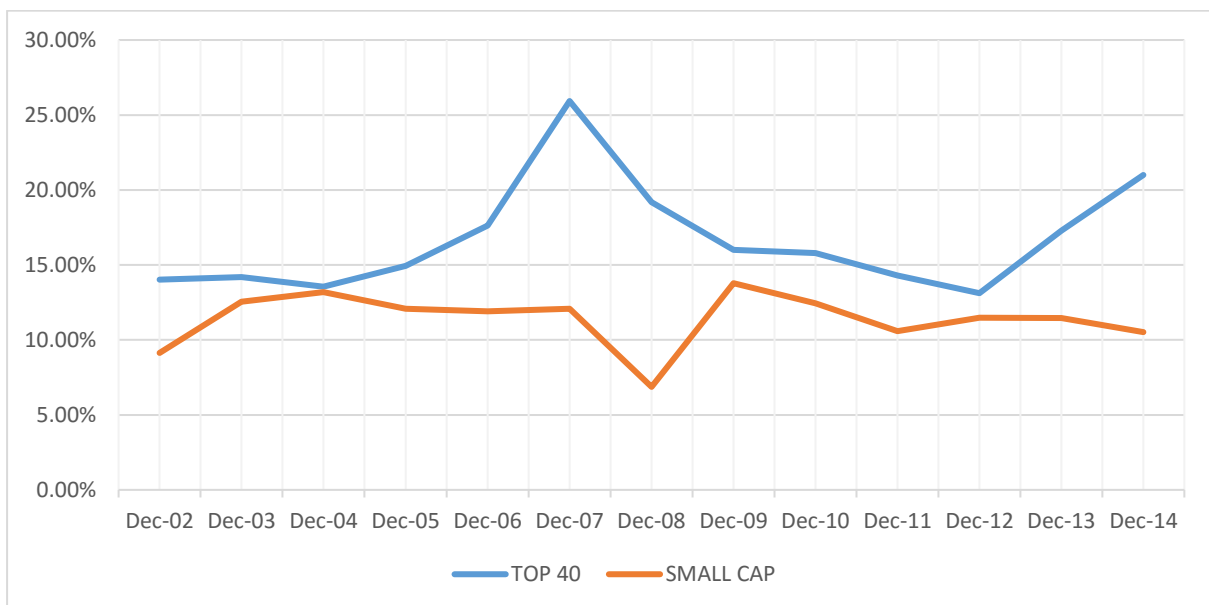


Source: McGregor BFA (2015)

Furthermore, the standard deviation of the normalised volume of trade of 3.62% for the FTSE/JSE Top 40 is almost twice as large as that of the FTSE/JSE Small Cap index. This implies that investors of small cap stocks are twice as likely to hold onto their stocks as those of the top 40 companies corroborating the assertions of Amihud and Mandelson (1986) that less liquid investments attract long-term investors.

The study normalizes the volume of trade for both indices by dividing the total volume of trade for each index for the year ended 31 December 2002 to 31 December 2014 by the total free float stocks in the index in line with Ranguelova et al. (2015). The longer investment horizons also explain why the FTSE/JSE Small Cap is less volatile as there is minimal reaction to short-term price changes. Long-term investors may hold onto small cap stocks with the hope that such companies over time, will grow into large cap stocks and are therefore less prone to reacting to short-term price changes. The concentration of a greater percentage of portfolio holding by fund managers to top 40 companies as well as the dedication of ETFs to top 40 companies provide a relatively higher liquidity for the top 40 index.

**Figure 9.8: Normalised Volume of Trade from December 2002 – December 2014**



**Source:** Author

**Table 9.17: Normalised Volume of Trade**

	<b>Top 40</b>	<b>Small-Cap</b>
<b>Average</b>	16.69%	11.39%
<b>Median</b>	15.80%	11.91%
<b>Minimum</b>	13.12%	6.87%
<b>Maximum</b>	25.93%	13.78%
<b>Standard Deviation</b>	3.62%	1.82%

Strebel (1977) posits that at best, the EMH is applicable to half of the stocks traded on the JSE. These are stocks with a trading volume of at least 250 000 and the other half have very low volumes making their market risk volume-dependent, and thereby invalidating, the ex-post CAPM as a framework of market equilibrium which in turn makes the general test of market efficiency useless.

**Table 9.18: Bid-Ask Spread as a Percentage of Closing Price**

	<b>Top 40</b>	<b>Small-Cap</b>
<b>Average</b>	0.18%	1.74%
<b>Median</b>	0.13%	0.85%
<b>Minimum</b>	0.01%	0.01%
<b>Maximum</b>	0.60%	15.80%

The FMH postulates that asset prices are a reflection of technical trading of short-term nature and long-term fundamental valuation. Short-term price changes therefore are likely to exhibit more volatility or noise than long-term-trades. Furthermore, short-term trends are likely as a result of herd behaviour because short-term trends have no relationship with long-term economic trends (Peters, 1994).

The expected returns of an asset can be affected in many ways by market liquidity, or lack of liquidity. There is a transaction cost to each trade if markets are not fully liquid, therefore, the required return on the transaction must increase in a way to compensate traders for this friction. Illiquid investments should therefore provide higher expected returns (Adler, 2012). Ibbotson, Diermeier, and Siegel (1984), Amihud and Mendelson (1986) and Amihud, Mendelson, and Pedersen (2012) argued that the “marketability” (this includes liquidity) of an asset affects its expected return and the bid–ask spread as a proxy for liquidity to conclude theoretically that (1) such transaction costs must be priced and (2) investors who have long time horizons should hold illiquid assets in order to benefit from the assets’ higher expected returns.

The FTSE/JSE Top 40, with an  $H$  of 0.46 signifies a more efficient market according to the FMH and signifies randomness in the time series whereas the FTSE/JSE Small Cap with an  $H$  of 0.68 represents a less efficient the market. The availability of information and information efficiency coupled with high liquidity and low bid-ask spreads (another characteristic of an efficient market) however come with attendant problems. Market participants tend to overreact to information and therefore a highly liquid financial market with increasing availability of information tends to experience high volatility and underperformance as market participants drive prices up beyond what the fundamentals may dictate and in the process suppressing returns. As Chang (2012) argues, a highly efficient market can also be problematic. Innovations do not simply make financial markets highly efficient but also efficient in generating short-term profits to the detriment of long-term growth. As experienced in the 2008 global financial crisis, new financial innovations caused financial systems as well as the overall economy to be more unstable. Furthermore, high liquidity of assets, lead market participants to respond too quickly to change, making it tough for ‘real-sector’ companies to hold on to the ‘patient capital’ required for long-term development. It is in line with this argument that economist James Tobin, the 1981 Noble laureate proposes a need to “throw some sand in the wheels of our excessively efficient international money markets” (Tobin, 1978: 4).

### **9.6.5 Can Portfolio Managers Exploit This Anomaly?**

A major argument against the exploitability of the low volatility anomaly on the JSE is that asset managers hold huge amounts of money whereas small cap companies have very small market capitalisation making it impractical to exploit this anomaly. Secondly, the low liquidity

of the small cap index coupled with high bid-ask spread makes it relatively costly to exploit this anomaly. This argument was raised at the 2017 Southern African Finance Association Conference (Ward, 2017). However, at as 31<sup>st</sup> December 2015, the FTSE/JSE Small Cap index had a total of 64 listed companies with a gross market capitalization of R 320 billion, an average free float of 65% and a net market capitalization of R 215 billion. Over this same period, the total AuM of domestic general equity funds was R 301 billion (ASISA, 2016) whereas the number of domestic general equity funds was 272 excluding fund of funds with 94 funds having an average AuM of over R 1 billion and 48 funds with average AuM of over R 3 billion. The size of the FTSE/JSE Small Cap index is therefore significantly large and therefore economically viable to be considered for the exploitation of this anomaly. With regards to liquidity, Ibbotson, Diermeier, and Siegel (1984), Amihud and Mendelson (1986) and Amihud, Mendelson, and Pedersen (2012) suggest that investors who have long time horizons should hold illiquid assets in order to benefit from the assets' higher expected returns. Given the relatively high risk-adjusted returns of the FTSE/JSE Small Cap index, domestic general equity fund managers may benefit in the long term from increasing their portfolio holdings in small cap companies.

## **9.7 The FMH and the Low Volatility Anomaly**

This study has established that the low volatility exists on the JSE, the time series of the selected JSE indices are not *iid*, and, the FTSE/JSE Small Cap exhibits significant persistence ( $H= 0.68$ ) and non-randomness (applying the VRT), whereas the FTSE/JSE Top 40 can be construed to be relatively efficient with its  $H = 0.46$  and the the null hypothesis of random walk cannot be rejected using the VRT. In this section, the study proceeds to explain the low volatility anomaly on the JSE using the fundamentals of the FMH.

Peters (1994) following up on his earlier criticism of the EMH, proposed the FMH. The main statistical tool for the FMH is the re-scaled range analysis where the Hurst exponent is used to determine the fractal nature of a given time series. Whereas the EMH offers no explanation for the low volatility anomaly on the JSE, the FMH appears to provide reasons for this anomaly. Small cap stocks are construed to be riskier and therefore should provide higher returns to compensate for the higher risk. Investors are assumed to be rational and therefore will not hold assets with higher risks but relatively lower returns. The FMH on the other hand posits that



assets with higher Hurst exponents are less risky and less efficient than assets with lower Hurst exponents. On the JSE, this is evident in the fact that the FTSE/JSE Small Cap index with the higher Hurst exponent is less risky and less efficient relative to the FTSE/JSE Top 40.

The FMH is built on three main fundamentals namely the impact of information, time horizon and liquidity. Information is interpreted differently by investors with different time horizons according to the FMH whereas the EMH assumes information is interpreted the same way by rational investors. The availability bias corroborates the assertion of the FMH that different investors interpret the same information differently. The relatively minimal availability of information on the FTSE/JSE Small Cap index companies means investors are less familiar with such companies and trade less in their stocks therefore these stocks are relatively illiquid and also relatively less volatile. The low demand for these stocks also ensures that their prices remain below what traditional asset pricing models may suggest and therefore tend to produce relatively higher risk-adjusted returns.

In line with the affect heuristic, given the familiarity of companies in the FTSE/JSE Top 40 as a result of larger analyst coverage and publications, investors perceive these companies as low risk whereas the FTSE/JSE Small Cap index as a result of the minimal analyst coverage and publications are misconstrued to be high risk. Furthermore, given the traditionally accepted assertion of risk-reward trade-off backed by models and theories propounded by highly influential finance academics, there is a general perception of risk-reward trade-off in the world of investment and finance. The 2013 Economics Nobel Prize winner and father of modern finance – Eugene Fama – and other laureates such as Harry Markowitz, Robert Merton, and Myron Scholes are stalwarts in the development of modern finance, the works of these scholars are taught in both undergraduate and graduate finance curriculums in South Africa although their works were conducted on markets mainly in the United States and to some extent, Western Europe. Financial analysts as well as professional investors may therefore evaluate stocks in terms of global attitudes toward such stocks and universal finance models while neglecting their actual risk/return relationships in the local financial market. This phenomenon provides some insight into the low volatility anomaly reported on the JSE. Furthermore, the availability and interpretation of information is affected by investors' biases and therefore asymmetric.

Liquidity, another fundamental of the FMH also may also provide another reason for the low volatility anomaly on the JSE. Given the different levels of information availability between

the FTSE/JSE Top 40 and the FTSE/JSE Small Cap Index, investors may trade more FTSE/JSE Top 40 stocks than the FTSE/JSE Small Cap stocks. Frequent trading provides liquidity on the FTSE/JSE index relative to the Small Cap index therefore making it relatively more efficient.

Finally, the third fundamental of time horizon is influenced by the first two fundamentals. As investors react to new information, they keep trading frequently to such new information. Given that the top 40 companies receive more coverage and publications, there is a higher availability of information which attract more traders frequent trading and consequently more short term traders than the small cap companies which receive relatively less coverage and publications.

Risk is a fundamental factor in every investment strategy therefore a suitable evaluation of risk that is based on empirical evidence instead of theoretical postulations will offer practitioners a more comprehensive knowledge of risk in the markets in which they operate. Furthermore, with fractal statistics, it becomes possible to expand risk management models and offer alternative analysis of financial markets that differs from the neoclassical assumptions of rationality, equilibrium, the mathematical hypotheses of continuity and symmetry and efficient markets. Fractal science and Chaos Theory provides a description of the fractal characteristics and messiness of financial markets and again, offer sufficient prospects and the statistical tools necessary to analyse it. These tools will be of benefit to finance theories as they provide more realistic models and assumptions of the behaviour of financial markets.

## **9.8 Summary**

The EMH fails to explain the low volatility anomaly on the JSE. However, the FMH offers an explanation for this low volatility anomaly. All selected indices for this study exhibit fat tails in line with the FMH whereas the EMH postulates that financial markets exhibit normal distribution. Further, the more efficient FTSE/JSE Top 40 index with an  $H$  of 0.46 exhibits more volatility, more liquidity and less returns relative to the FTSE/JSE Small Cap Index. Again, while the EMH offers no explanation for this phenomenon, the FMH provides explanation for this phenomenon. Emphasizing liquidity, and different investment horizons/holding periods, the less liquid small cap index attracts longer term investors and therefore are not as susceptible to short-term price variations thus exhibiting less volatility than

the large cap index. The relatively high availability of information on large cap companies compared to small cap companies and the inclination of institutional managers to dedicating a greater percentage of their portfolios to top 40 companies creates a huge demand for these stocks therefore driving up prices while suppressing returns.

The FTSE/JSE Top 40 is relatively highly researched and information readily available on the companies that make up the index. As equity asset managers gravitate towards large cap companies, a Darwin's wedge is created whereby rational decision by individual managers to overweight top 40 shares aggregate badly, pushing up the price and volatility of the index relative to the FTSE/JSE Small Cap Index which receives less news and analyst coverage and therefore exploitable inefficiencies persisting among components of this index. According to Ranguelova et al., (2015), small-cap equities provide more attractive opportunities for alpha by investing in "under the radar" equities that talented stock pickers discover therefore investors who focus on small and mid-cap equities benefit from the "structural alpha" that exists in this segment by taking advantage of lingering inefficiencies like the quality of information. For example, fewer analysts' coverage and less frequent publication of research reports on small cap stocks, as well as the limited volume and, from a playing field that is less crowded relative to that of large cap equities.

Again, the concentration of equity ETFs on the FTSE/JSE Top 40 creates additional demand for components of the index disregarding individual company fundamentals. The proliferation of index funds is as a result of active managers persistently underperforming the market. However, as investors rationally switch to funds that track the index, the aggregate is an increase in demand for all the companies in the index increasing the price and volatility.

The EMH does not offer any explanation for the phenomenon of low risk assets offering higher risk adjusted returns than high risk asset. This phenomenon is therefore referred to as the low volatility anomaly. Applying the principles of FMH however, this phenomenon is not as anomalous as reported but rather a consequence of the availability or otherwise of information. The FMH encompasses rather than debunk the EMH to some extent in that, investors can only trade on availability of information therefore less known assets receive less coverage and therefore little information on which investors trade. Classical economics, which provided the bedrock for classical finance even lay emphasis on the asymmetries between different social

classes in terms of the differences in political power, economic property and access to knowledge and information (Kurz, 2016). Availability of information therefore differs among investor classes and companies. Investors who hold assets for which information is not readily available happen to trade less as there is seldom new information on which to trade or adjust expectations and discount rates - the reason for excess volatility in financial markets as Fama (2016) argues) - and therefore tend to be long term investors.

Coupled with the lack of information is the relative illiquidity which repels a class of investors with a given horizon – short-term – as these investors will require a quick exit at minimal cost. Lack of information and illiquidity therefore leads to the domination of illiquid small stocks by long-term investors who are in the long-run compensated for their patience. Under the assumption of investor rationality, investors will hold less liquid stocks only if they are compensated for taking on such illiquidity risk – illiquidity premium. Readily available information on the other hand attracts lots of investors with different time horizons who take opposite sides of each trade thereby providing high liquidity on which efficient markets function. The readily available information in an efficient market however leads to rational investors constantly adjusting their expectations and discount rates therefore creating high volatility with the potential of suppressing returns as forecasting expected returns is not an exact science and fraught with miscalculations to which investors constantly recalibrate. The high volatility and subsequent underperformance can therefore be attributed to the cost of liquidity or a liquidity discount.

**Figure 9.9: A Summary of FMH**



**Source:** Author

Another major difference between the FMH and the EMH is on the concept of bubbles and crashes. Whereas such crashes are not explained by the EMH, the FMH posit that in times of panic, there is a disproportionate shift to short term horizon leaving insufficient investors to take the opposite side of a trade therefore drying up liquidity which further exacerbates the panic forcing fire sale of assets and consequently a crash. In periods of novel developments or discoveries, the excitement and availability of information generates into irrational exuberance where investors over-estimate expected returns which kick starts rapid appreciation of asset price and attracts more investor seeking to make a quick profit thereby feeding into the rapid price acceleration. New investors disregard the sustainability of such rapid price acceleration, and only buy with the intention to sell at an even higher price. As the rapid acceleration ceases, followed by a decline in prices, panic ensues and a rush to dispose of such assets is stifled by the lack of buyers creating illiquidity which further drives down prices leading to a bust.

Theoretical physicist and 1965 Physics Nobel Laureate Richard Feynman is reported to have said that “It doesn't matter how beautiful your theory is, it doesn't matter how smart you are. If it doesn't agree with experiment, it's wrong.” (Zichichi, 2016). The assertion that risk is

compensated by returns may sound intuitive and logical in markets where participants are assumed to be rational, however, empirical evidence reports otherwise. Whereas the EMH does not explain the low volatility anomaly, the FMH provides an explanation for this phenomenon. Paul Wooley, a senior fellow at the London School of Economics and Political Science opines that it is long overdue for professional investors to ditch the EMH as the basis of most strategies of asset management, arguing that the EMH does not address the “three perversities of investing” namely, short-termism, momentum, and risk-return inversion (Larrabee, 2013). Furthermore, on 15 July 2015, the Financial Stability Board, which is made up of financial regulators from major countries/regions, agreed to exempt the asset management industry from systemic risk regulation a focus rather on market liquidity (Walter, 2015). Evidence from the JSE proves that information, liquidity and time horizon are the major factors that drive financial market efficiency and changes in these variables are the cause of inefficiencies and crashes.

In an interview with the CFO Magazine, William Sharpe points out that, “If there is a reward for bearing risk, it almost has to be that. Otherwise, the world makes no sense at all...Will a new theory come along eventually and blow out the lights? Undoubtedly there will be one. I haven't the foggiest idea about what it will be or what area it will be in. If I did, I would be working on it.” (Sharpe, 2000).

# **CHAPTER TEN**

## **SUMMARY, CONTRIBUTION, RECOMMENDATIONS AND CONCLUSION**

This chapter discusses the study, its contributions to literature, recommendations and finally a conclusion.

### **10.1 Main Outline of the Study**

The recent Global Financial Crisis has rekindled debate on market efficiency and the validity of the underlying assumptions of classical finance particularly investor rationality and the market efficiency. Peters (1991) proposed the FMH as an alternative to the EMH. The fractal markets hypothesis (FMH), is centred on empirically observed features of the financial markets and posits that financial markets consist of heterogeneous investors who react to information according to their investment horizon. What may be considered a negative information and a sell signal for investors with short-term horizon might be a buy signal for investors with long-term horizon and vice versa. The existence of adequate number of buyers and sellers ensure that markets are efficiently cleared ensuring a smooth functioning of the market. The FMH therefore argues that adequate liquidity ensures market efficiency. A uniform representation of investors with differing horizons means the supply and demand are met, markets work efficiently and remain stable. On the other hand, when an investment horizon becomes dominant, buy and sell orders are not cleared efficiently which can lead to the occurrence of extreme events. FMH proposes that critical events are connected to one investment horizon becoming dominant.

The phenomenon of less risky stocks outperforming riskier stocks have also attracted numerous studies recently after it was discovered by Jensen, Black and Scholes (1972) and Haugen and Heins (1972). This is contrary to what is expected according to traditional finance theories. This study applies the FMH to offer an explanation to the low volatility anomaly. The study first investigates and confirms the existence of chaos on the JSE applying the BDS test and also the re-scaled range analysis. Further, the study investigates the flow of information among the selected indices as well as the liquidity of the indices. The study finds that the efficiency of

the FTSE/JSE Top 40 index consequently leads to relatively higher volatility whereas the less efficient FTSE/JSE Small Cap is less volatile since information is relatively not readily available for companies on the index with regard to news coverage, publications and analyst coverage. The study concludes that, the JSE does not exhibit random walk. The study further finds that information distribution on the JSE is not symmetric as the FTSE/JSE Top 40 companies receive more publications and coverage than FTSE/JSE Small Cap companies. Equity managers also commit a greater percentage of their portfolios to the Top 40 companies and the FTSE/JSE Top 40 index is riskier and offers less returns relative to the FTSE/JSE Small Cap index therefore confirming the low volatility anomaly on the JSE.

## **10.2 Summary of Literature Reviewed**

The study reviewed theoretical and empirical and literature from extant studies on classical finance in chapter 3, behavioural finance in chapter 3, Chaos Theory and the Fractal Market Hypothesis (FMH) in chapter 4 and the asset management industry in chapter 5. A framework for the theories of traditional finance, behavioural finance and the FMH was established to provide the background to this study.

### **10.2.1 Classical Finance**

This chapter begins with a discussion of literature on the historical background of classical finance theories and explores the fundamental theories of classical finance that have been advanced over the years and how such theories have become very influential both in academia in the finance industry. Among other classical finance theories, the chapter discusses the efficient market hypothesis, the modern portfolio theory, capital asset pricing model, mean variance theory multifactor pricing models and the arbitrage pricing theory. The chapter further points to empirical evidence accumulated over time that points out the inadequacy of the existing classical finance theories to explain major financial crises that have dogged financial markets and delivers the background to the rise of behavioral finance as an alternative approach.



## **10.2.2 Chaos Theory and Fractal Market Hypothesis**

Chapter 3 presents an alternative theory on the behaviour of financial markets which provides a different hypothesis on the behaviour of financial markets. Velasquez (2009) argues Chaos Theory and Fractal Science better explain financial phenomenon and the “messiness” of financial markets. The FMH developed by Peters (1991) is based on Chaos Theory and offers a robust theoretical contribution that provides an explanation of the turbulence, discontinuity, and non-periodicity that characterize capital markets. The FMH describes a financial market as a place where investors meet to find buyers or sellers of securities. To permit investors with different time horizons to efficiently trade, it is essential to ensure sufficient liquidity in the market. A liquid market guarantees that there will be no crash or panic if demand and supply are imbalanced. The major function of financial markets is to provide stability, in the form of a liquid environment, to facilitate trading activities. This stability comes in the form of investors with differing time horizons, differing information sets, and different concepts of fair price. A shift in time horizons leading to one dominant horizon leads to market instability and crashes.

## **10.2.3 Financial Crises**

Chapter 4 discusses the causes of financial crises and details a selected history of financial crises from the Tulip mania to the recent Global Financial Crisis.

## **10.2.4 Behavioural Finance**

Chapter 5 discusses behavioural finance and its development over the years and the alternative theories it offers in explaining financial market behaviour. Behavioural finance can be simply defined as applying principles of psychology to finance and is based on the assumption of ‘normal people’ instead of ‘rational people’ in classical finance and promulgates behavioural portfolio theory and behavioural asset pricing instead of mean-variance portfolio theory and CAPM and other classical finance models which suggest that expected returns are only determined by risk (Statman, 2014). The chapter also discusses the works of behaviourists as Gerd Gigerenzer who argue certain behavioural biases or heuristics are not necessarily detrimental to rational decision making as proposed by many behaviourists.

### **10.2.5 The Asset Management Industry**

With an increasing call for certain segments of the asset management industry to be classified as Systemically Important Financial Institutions (SIFIs), a move to protect the global financial systems by averting the failure of such SIFIs, or, in the event of a failure, curbing the subsequent adverse effects, the industry has become the centre of attention for regulators both nationally and internationally. Chapter 5 presents a general overview of the asset management industry, the development of the industry over the years, recent trends as well as expected future trends of the industry.

### **10.3 The Johannesburg Stock Exchange**

Chapter 7 gives an overview of the JSE from its history to the various innovations that has taken place at the stock exchange since its establishment. The chapter further discusses the spillover effects of international markets on the JSE.

### **10.4 Data and Research Methodology**

Chapter 8 discusses the data selected for the study and the methodologies adopted. The study obtains data from the JSE Ltd, McGregor BFA and Profile Data. The study applies the Sharpe ratio to test for the low volatility anomaly on the JSE. The study then applies the BDS test as well as the re-scaled range analysis to investigate chaos on the JSE. The study proceeds to investigate the availability of information for companies in the selected indices, the liquidity as well as the extent to which fund managers dedicate portions of their portfolios to the selected indices.

### **10.5 Summary of Findings and Interpretation**

The first objective of the study is to investigate the existence of the low volatility anomaly on the JSE and selects three indices, the FTSE/JSE All Share, FTSE/JSE Top 40 and the FTSE/JSE Small Cap. The low volatility anomaly was discovered from both an academic and an applied investment source (Marmer, 2015). From the academic source, the anomaly was discovered through the empirical testing of the capital asset pricing model (CAPM) by academics who found that “high-beta securities had significantly negative intercepts and low-beta securities had significantly positive intercepts, contrary to the predictions of the traditional form of the model.” (Jensen, Black and Scholes, 1972: 44). From the applied investment perspective,

Haugen and Heins (1972) reported that monthly returns of stocks with lower variances over the long run, outperform stock portfolios with higher variance. Baker et al. (2011) grouped the top 1000 stocks by market capitalization tracked by the CRSP using trailing volatility and beta into five quintiles and reported that stocks with the lowest volatility also had the highest returns and concluded that over the long-term, low-risk portfolios outperforming high-risk portfolios. Blitz and Van Vliet (2007), Baker and Haugen (2012) and Frazzini and Pedersen (2014) significantly contributed to the literature on the low volatility effect and documented similar results in global equity markets, as well as distinguishing and disentangling a volatility effect different from the classic value, size and momentum effects, and offering possible explanations for this effect. The first evidence of the low volatility anomaly on the JSE was reported by Rensburq and Robertson (2003), who found that there is a negative correlation between a stock's beta and its return. Strugnell et al. (2011) also confirmed the existence of the low volatility anomaly on the JSE applying a more refined estimate of beta. Khuzwayo (2011) also reported that low beta portfolios outperformed both high beta portfolios and the ALSI during periods of overall market underperformance in the market

Applying the risk-adjusted measure of Sharpe ratio, the study confirms that the FTSE/JSE Small Cap index outperforms the FTSE/JSE Top 40 on a risk-adjusted basis thereby confirming the low volatility anomaly on the JSE. This has significant implications for asset managers in South Africa as the make portfolio selection decisions. The traditional approach to portfolio selection based on classical finance models may not be applicable in the South African context and may therefore have to include other nontraditional approaches such as the FMH in their portfolio selection processes.

The study applies the BDS test on the selected indices to investigate the existence of chaos in the selected indices this is also to determine whether the times series of the selected indices are independently and identically distributed (*iid*). This was the second objective of this study. Evidence of long-run persistence in the share returns will mean that future returns are influenced by past returns at least in the long term (Bendel, Smith & Hamman, 1996) which will then mean there will be a need for further investigations into the behaviour of stock price time series in modern economies. According to Peters (1996,6), financial markets exhibit non-linear dynamic systems characterised by positive feedback and fractals, and therefore “what happened yesterday influences what happens today”. This study applied the BDS test, a

portmanteau test for time-based dependence in a time series for independence as explained by Brock, Dechert, Scheinkman and LeBaron (1996) which can also be used to test for a variety of deviations from independence be it chaos, non-linear dependence or linear dependence. The BDS test can also be applied on a series of estimated residuals to investigate whether such residuals are independent and identically distributed (*iid*).

In this study, the selected series are examined up to 10 dimensions in line with Opong, Mulholland and Fox (1999) and Bhattacharya and Sensarma (2006). The  $z$ -statistic is given as the BDS test divided by the standard error and is the final step that is used to test the null hypothesis. The  $z$ -statistics were all greater than 2.58 for all the ten dimensions for the indices selected and  $p$ -values of 0.0000, the study therefore concluded that the times series of returns for all the three indices do not exhibit randomness at 0.01 significance level.

The third objective of this study was to establish the fractal nature of the selected indices on the JSE. The study applied the rescaled range analysis. In proposing the FMH, Peters (1994) used a modified rescaled range (R/S) analysis, pioneered by Hurst (1951). Peters (1994) and Howe, Martin and Wood (1997) reviewed the steps for computing the R/S analysis. First, the index series of the JSE is converted into logarithmic returns,  $S_t$ , at time period  $t$  of the JSE index series. The study concluded that with an  $H$  of 0.461 and 0.463, respectively and correlation coefficients of -0.0526 and -0.0495 for the FTSE/JSE Top 40 and the FTSE/JSE All Share are more efficient than the FTSE/JSE Small Cap Index which has an  $H$  of 0.679 and a correlation coefficient of 0.2817. The correlation coefficients of -0.0526, -0.0495, and 0.2817 imply that 5.26%, 4.95% and 28.17% of the movements in the time series of the FTSE/JSE Top 40, FTSE/JSE All Share and the FTSE/JSE Small Cap respectively are dependent on historical data. Since risk is a major factor to consider in any investment strategy, a proper evaluation of risk based on empirical evidence as opposed to theoretical postulations will offer investment practitioners a comprehensive understanding of risk in the particular markets in which they operate. Again, with fractal statistics, it becomes possible to further enhance financial risk models and offer alternative arguments of financial markets different from the classical assumptions of perfect markets, equilibrium, rationality and the mathematical hypotheses of symmetry. Fractal science and Chaos Theory provide a more accurate narrative of the messiness and the fractal characteristic of capital markets and sufficient perspective together with the mathematical tools necessary to analyse it. These tools

will be of benefit to finance practitioners as they offer more appropriate and realistic assumptions and models of the behaviour of financial markets.

The fourth objective of the study is to ascertain the factors that contribute to the low volatility anomaly on the JSE. Several explanations have been given to the low risk anomaly. Among the explanations given are agency problems, the types of manager compensation and overconfidence bias (Fischhoff, Slovic, and Lichtenstein 1977; Alpert and Raiffa 1982, Baker and Haugen, 2012). This study concludes that the frequency of publication, the number of analysts' coverage, managers' propensity to hold Top 40 stocks and liquidity may be some of the factors that contribute to the low volatility anomaly on the JSE. The more coverage and exposure given to the Top 40 companies attracts more investors and consequently more trade volume and volatility relative to the companies in the Small Cap index. Large companies are also, according to traditional asset pricing models, assumed to be less risky.

The findings of this study is corroborated by Shefrin (2016) who posits that on average, investment professionals construe expected return and risk to be negatively correlated, contrary to what is described in textbook finance. Shefrin (2016) argues that the affect heuristic and representativeness are responsible for this phenomenon. The findings of this study are in line with Solt and Statman (1989) who reported that investors who assume the shares of good companies to be representative of good investments depend on the representativeness bias that a good stock is a stock of a good company. In line with classical finance assumptions, investors' perception that small-cap equities are riskier than large-cap equities on average causes the realized returns of small-cap equities to be greater than that of large-cap equities (Shefrin, 2016). Again, perceptions about the risk-size interaction deepen after periods of negative sentiment which lead to larger size effects during such periods (Shefrin, 2016).

The study concludes that the FMH provides an explanation for the low volatility anomaly on the JSE (fifth objective). In line with the FMH, lack of information and the illiquidity of the FTSE/JSE Small Cap attracts long-term investors who become the dominant class of investors on the index and are compensated for taking on the risk of illiquidity in the form of illiquidity premium and low volatility. The highly liquid FTSE/JSE Top 40 coupled with the relatively high availability of information on the other hand attracts different classes of investors with differing horizons who take opposite sides of each trade as different classes of investors interpret the same set of information differently. The high liquidity and information leads to

high volatility as investors continually adjust their holding in line with the emergence of new information. The high volatility and subsequent underperformance of the FTSE/JSE Top 40 therefore is a cost of efficiency and liquidity (liquidity discount).

## **10.6 Contribution**

The low volatility anomaly is one of the major anomalies that put the fundamental assumption in classical finance of market efficiency into question. After the Global Financial Crises, renewed critiques of these assumptions have sprung back into the spotlight with increasing number of studies prying into the flaws of these fundamental assumptions. From the behaviourist quarters, the argument against these fundamental classical finance assumptions is that market participants are fraught with several behavioural biases that inhibit optimal decision making and therefore cannot be construed to make rational choices all the time with the aim of maximizing satisfaction. Several centuries of the history of financial crises point to repeated patterns of irrational exuberance in times of booms that create bubbles and subsequent bursts with devastating consequences reaffirming the behavioral biases of markets participants that lead to sub-optimal decision making.

Proponents of the FMH, offering an alternative to the EMH argue that financial markets exhibit fractal nature that is why financial crises keep recurring at frequencies beyond what theories of traditional/classical finance proposes. Benoit Mandelbrot, argues that the “very heart of finance fractal”. Applying the principles of chaos theory, Edgar Peters argues that the FMH offers a better alternative to the EMH. Central to the FMH are investor heterogeneity, whereby different investors with differing investment horizons take opposite sides of a trade to ensure the smooth functioning of financial markets; again, the path of the market is determined by past events therefore exhibiting deterministic order which makes short-term predictions possible and also argue that distribution of returns of financial assets are not normally distributed but exhibit fat tails.

Studies on the FMH generally concentrate on market crashes. This study applies the FMH to offer an explanation to a phenomenon other than a market crash - the low volatility anomaly - on the JSE. Among the explanations given for the low volatility anomaly are the behavioural

bias of overconfidence, agency problems and the type of manager compensation. This study contributes to the literature on the low volatility anomaly and the FMH literature by offering a synthesis of the FMH and the low volatility anomaly. There is no known synthesis of this anomaly and the FMH either in South Africa or internationally.

In this novel study, the findings point to the conclusion that the bedrock of the FMH – information, liquidity and time horizon - plays a major role in creating the low volatility anomaly on the JSE. The relative informational efficiency of the FTSE/JSE Top 40 index to the FTSE/JSE Small Cap index means information is readily available and immediately assimilated into prices of stocks that make up the top 40 index. The quick assimilation of such information creates excess volatility on this index as market participants are continually reacting to information as they become available. As argued by Fischer Black, market participants react in the same way to new information (Black, 1995), therefore creating excessive swings in the time series of the FTSE/JSE Top 40 index. Volatility therefore is a concomitant of efficiency on the FTSE/JSE Top 40 and therefore a cost of efficiency (liquidity discount). The less efficient FTSE/JSE Small Cap index on the other hand has less analyst coverage and publications and therefore relatively little information available for market participants to react to and therefore exhibit less volatility. The lack of information and illiquidity dissuades short-term investors therefore this index is dominated by one class of investors with a given horizon (long-term).

These investors are compensated for holding such illiquidity risk with an illiquidity premium in the form of low volatility and relatively higher returns. The availability of information also attracts institutional investors who tend to dedicate a significant proportion of their portfolios to the top 40 companies. Herding on the JSE as reported by Sarpong and Sibanda (2014) and the growth of ETFs concentrated on the FTSE/JSE Top 40 attract relatively and significantly larger volumes of trade, and liquidity albeit at a cost of relatively higher volatility. In line with Tobin (1978), this study infers that the illiquidity of the FTSE/JSE Small Cap index serves as the “sand” in the wheels of an otherwise excessively efficient financial market that attracts, in the words of Chang (2012) “patient capital” of long-term investors (Amihud and Mendelson, 1986) that weathers short-term volatility and turn out to provide superior risk adjusted returns. High liquidity on the other hand attracts “impatient capital” which constantly reacts to new

information and consequently adjusting discount rates as expectations are adjusted in line with new information.

### **10.7 Limitations of the Study**

The analysis of portfolio holdings of South African equity funds covered a relatively shorter period of December 2008 to December 2012. This period can be described as a period of turbulence as a result of the Global Financial Crisis and this may have a possible influence the portfolio holding of these funds.

### **10.8 Recommendations for Further Studies**

Further studies could focus on investigating the low volatility anomaly among the stocks on the JSE and further measure the exact value of the illiquidity premium to determine whether the low volatility premium is solely as a result of the illiquidity premium or otherwise. Again, with the recent proliferation of ETFs and index funds, future studies could focus on investigating the extent to which such funds increase volatility on the JSE.



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# APPENDIXES

## APPENDIX A: RESULT OF LINEAR REGRESSION OF LOG N AND LOG R/S

<b>ALL SHARE</b>		
<b>LOG N</b>	<b>LOG R/S</b>	<b>SLOPE</b>
3.684845	1.867977	0.463352057
3.383815	1.749672	
3.207634	1.728403	<b>AUTOCORRELATION</b>
3.082785	1.644649	-0.049535852
2.985875	1.554792	
2.781755	1.46564	
2.684845	1.433004	
2.383815	1.283624	
<b>TOP 40</b>		
<b>LOG N</b>	<b>LOG R/S</b>	<b>SLOPE</b>
3.684845	1.842828	0.460993959
3.383815	1.728622	
3.207634	1.720233	<b>AUTOCORRELATION</b>
3.082785	1.630534	-0.052637863
2.985875	1.537674	
2.781755	1.454575	
2.684845	1.410224	
2.383815	1.263936	
<b>SMALL CAP</b>		
<b>LOG N</b>	<b>LOG R/S</b>	<b>SLOPE</b>
3.684845	2.280438	0.679025691
3.383815	2.140254	
3.207634	2.015564	<b>AUTOCORRELATION</b>
3.082785	1.91523	0.281693572
2.985875	1.804422	
2.781755	1.652082	
2.684845	1.619078	
2.383815	1.450382	

### APPENDIX B: R/S VALUES FOR ALL SUB SAMPLES

ALL SHARE					TOP 40					SMALL CAP				
n	ST DEV	MAX – MIN	R/S	LOG R/S	n	ST DEV	MAX – MIN	R/S	LOG R/S	n	ST DEV	MAX - MIN	R/S	LOG R/S
4840	0.0053925	0.3978948	73.7864305	1.8679765	4840	0.002918	0.556662	190.738196	2.280438	4840	0.005933	0.413146	69.635054	1.842828
2420	0.0051986	0.2834876	54.5314570	1.7366471	2420	0.003275	0.428759	130.930872	2.117042	2420	0.005762	0.303806	52.725641	1.722022
2420	0.0055796	0.3227895	57.8519896	1.7623183	2420	0.002512	0.364959	145.307452	2.162288	2420	0.006099	0.331427	54.340374	1.735123
1613	0.0054215	0.2887256	53.2553927	1.7263636	1613	0.003717	0.309486	83.261101	1.920442	1613	0.006023	0.313837	52.108335	1.716907
1613	0.0051052	0.2830258	55.4388876	1.7438145	1613	0.002432	0.350253	144.028537	2.158449	1613	0.005584	0.302158	54.108139	1.733263
1613	0.0056361	0.2920851	51.8238812	1.7145299	1613	0.002398	0.200601	83.656605	1.922500	1613	0.006175	0.316824	51.310139	1.710203
1210	0.0055018	0.2683413	48.7736630	1.6881854	1210	0.003949	0.249867	63.276024	1.801239	1210	0.006165	0.285934	46.377784	1.666310
1210	0.0048764	0.2506922	51.4090228	1.7110393	1210	0.002412	0.235417	97.588900	1.989400	1210	0.005328	0.270926	50.848449	1.706278
1210	0.0067420	0.3318372	49.2197585	1.6921395	1210	0.002982	0.364359	122.199737	2.087070	1210	0.007346	0.339884	46.268318	1.665284
1210	0.0040998	0.1110338	27.0829802	1.4326965	1210	0.001930	0.088809	46.006624	1.662820	1210	0.004520	0.123619	27.347324	1.436915
968	0.0054959	0.2497274	45.4392509	1.6574312	968	0.003989	0.257810	64.631356	1.810443	968	0.006202	0.250463	40.387359	1.606245
968	0.0053513	0.2052827	38.3611762	1.5838919	968	0.002982	0.172588	57.882648	1.762548	968	0.005813	0.227801	39.186015	1.593131
968	0.0046492	0.1194366	25.6897840	1.4097605	968	0.002231	0.104731	46.942549	1.671567	968	0.005106	0.123564	24.199807	1.383812
968	0.0070174	0.2822579	40.2223625	1.6044676	968	0.003010	0.298692	99.232803	1.996655	968	0.007651	0.305020	39.867454	1.600618
968	0.0039437	0.1169786	29.6622876	1.4722046	968	0.001843	0.092169	50.017770	1.699124	968	0.004359	0.125556	28.801797	1.459420
605	0.0043143	0.1229574	28.5002061	1.4548480	605	0.002746	0.108202	39.402609	1.595525	605	0.004993	0.142780	28.597642	1.456330
605	0.0064746	0.2588460	39.9784451	1.6018259	605	0.004860	0.240708	49.525216	1.694826	605	0.007147	0.263352	36.847068	1.566403
605	0.0052941	0.1844669	34.8441750	1.5421302	605	0.002766	0.100117	36.201640	1.558728	605	0.005718	0.196788	34.413215	1.536725
605	0.0044225	0.1567023	35.4329502	1.5494073	605	0.001944	0.097503	50.153757	1.700303	605	0.004911	0.166851	33.976960	1.531185
605	0.0051039	0.1201853	23.5477100	1.3719487	605	0.002599	0.113270	43.586294	1.639350	605	0.005550	0.122492	22.071010	1.343822
605	0.0080465	0.2740678	34.0603709	1.5322494	605	0.003283	0.242867	73.978970	1.869108	605	0.008776	0.297888	33.944275	1.530767
605	0.0046456	0.0829325	17.8519202	1.2516849	605	0.002027	0.073320	36.170195	1.558351	605	0.005142	0.094077	18.295484	1.262344
605	0.0034676	0.0676965	19.5223779	1.2905327	605	0.001824	0.054817	30.045512	1.477780	605	0.003796	0.074834	19.712885	1.294750
484	0.0028919	0.0984486	34.0429441	1.5320271	484	0.001749	0.113995	65.174859	1.814080	484	0.003458	0.098143	28.379391	1.453003
484	0.0072110	0.2342712	32.4882047	1.5117257	484	0.005358	0.243391	45.427205	1.657316	484	0.008056	0.233557	28.990108	1.462250

484	0.0051465	0.1639777	31.8621358	1.5032749	484	0.003323	0.130817	39.365244	1.595113	484	0.005567	0.174479	31.342110	1.496128
484	0.0055415	0.2260034	40.7839233	1.6104890	484	0.002581	0.069533	26.943618	1.430456	484	0.006040	0.245512	40.649137	1.609051
484	0.0041634	0.1076754	25.8622603	1.4126665	484	0.001884	0.079011	41.946082	1.622691	484	0.004625	0.109921	23.764678	1.375932
484	0.0050882	0.0947395	18.6196163	1.2699707	484	0.002530	0.097901	38.694780	1.587652	484	0.005544	0.097021	17.499438	1.243024
484	0.0081582	0.2385828	29.2444117	1.4660429	484	0.003432	0.191927	55.923059	1.747591	484	0.008885	0.261110	29.386872	1.468153
484	0.0056302	0.1035413	18.3903333	1.2645896	484	0.002481	0.087178	35.141627	1.545822	484	0.006155	0.108583	17.640457	1.246510
484	0.0042865	0.0844934	19.7116611	1.2947232	484	0.001770	0.072323	40.858631	1.611284	484	0.004781	0.092380	19.321856	1.286049
484	0.0035674	0.0714060	20.0161661	1.3013809	484	0.001909	0.050614	26.510502	1.423418	484	0.003891	0.078596	20.197946	1.305307
242	0.0029407	0.0580807	19.7506103	1.2955805	242	0.001581	0.073929	46.747334	1.669757	242	0.003551	0.057227	16.113776	1.207197
242	0.0028323	0.0515373	18.1965086	1.2599881	242	0.001899	0.059480	31.329850	1.495958	242	0.003351	0.055151	16.457386	1.216361
242	0.0069271	0.1813053	26.1732330	1.4178574	242	0.004866	0.196389	40.358023	1.605930	242	0.007845	0.194578	24.801812	1.394483
242	0.0074833	0.2078417	27.7740440	1.4436391	242	0.005787	0.211651	36.575105	1.563186	242	0.008262	0.199180	24.107543	1.382153
242	0.0055223	0.1645281	29.7931821	1.4741169	242	0.003761	0.135365	35.990409	1.556187	242	0.006013	0.175145	29.128148	1.464313
242	0.0047409	0.0768728	16.2148545	1.2099131	242	0.002817	0.062048	22.027845	1.342972	242	0.005082	0.081732	16.083000	1.206367
242	0.0057818	0.1604602	27.7525211	1.4433024	242	0.002850	0.067596	23.717819	1.375075	242	0.006275	0.176533	28.134392	1.449238
242	0.0052318	0.1044761	19.9696274	1.3003700	242	0.002279	0.045734	20.066204	1.302465	242	0.005732	0.110459	19.270597	1.284895
242	0.0045208	0.0737210	16.3071162	1.2123772	242	0.002016	0.050688	25.141075	1.400384	242	0.005005	0.077592	15.501646	1.190378
242	0.0037707	0.0743714	19.7234325	1.2949825	242	0.001737	0.065367	37.629866	1.575533	242	0.004210	0.077318	18.366903	1.264036
242	0.0041625	0.0771310	18.5300827	1.2678774	242	0.002092	0.043753	20.916857	1.320496	242	0.004552	0.081243	17.845919	1.251539
242	0.0058687	0.0919579	15.6691700	1.1950460	242	0.002898	0.091348	31.518543	1.498566	242	0.006383	0.092873	14.549943	1.162861
242	0.0060011	0.1090205	18.1666638	1.2592752	242	0.003100	0.098789	31.864967	1.503313	242	0.006529	0.114460	17.532285	1.243839
242	0.0098375	0.1870536	19.0143923	1.2790824	242	0.003702	0.090237	24.373617	1.386920	242	0.010718	0.203952	19.028976	1.279415
242	0.0064420	0.0895998	13.9087078	1.1432868	242	0.002693	0.076846	28.532931	1.455346	242	0.007038	0.094052	13.363327	1.125915
242	0.0046721	0.0701171	15.0076342	1.1763122	242	0.002246	0.054052	24.063185	1.381353	242	0.005114	0.074196	14.508619	1.161626
242	0.0051598	0.0652270	12.6414330	1.1017963	242	0.001983	0.045342	22.859828	1.359073	242	0.005747	0.071863	12.503739	1.097040
242	0.0031723	0.0484491	15.2724674	1.1839092	242	0.001503	0.031706	21.100377	1.324290	242	0.003553	0.056782	15.980517	1.203591
242	0.0038730	0.0581168	15.0056835	1.1762558	242	0.001929	0.039669	20.566036	1.313151	242	0.004231	0.060461	14.290721	1.155054
242	0.0032326	0.0627583	19.4140312	1.2881157	242	0.001885	0.035432	18.792664	1.273988	242	0.003519	0.069262	19.684227	1.294118

## APPENDIX C

### EXPONENTIAL RANDOM WALK; ORIGINAL DATA; WILD BOOTSTRAP; BOOTSTRAP DISTRIBUTION TWO-POINT;

**Null Hypothesis: Log of FTSE/JSE All Share Index is a random walk**

Sample: June 30 1995 to 31 December 2014

Included Observations: 4872 (after adjustments)

Standard error estimates assume no heteroskedasticity

Use biased variance estimates

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Lags: 2 4 8 16 32 64 128

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Test probabilities computed using wild bootstrap: dist = two point, reps=1000, rng = kn, seed=335508759

Joint Tests	Value	df	Probability
Max  z  (at period 2)*	4.401947	4872	0.0480
Wald (Chi-Square)	39.43581	7	0.0310

#### Individual Tests

Period	Variance Ratio	Standard Error	z-Statistic	Probability
2	1.063065	0.014327	4.401947	0.0190
4	1.088623	0.026803	3.306468	0.0610
8	1.021741	0.042379	0.513016	0.7700
16	1.028573	0.063062	0.453087	0.7810
32	1.050171	0.091385	0.549007	0.7320
64	1.031304	0.130793	0.239340	0.8660
128	0.992763	0.186066	-0.038895	0.9760

**Null Hypothesis: Log of FTSE/JSE Top 40 Index is a random walk**

Sample: June 30 1995 to 31 December 2014

Included Observations: 4872 (after adjustments)

Standard error estimates assume no heteroskedasticity

Use biased variance estimates

Lags: 2 4 8 16 32 64 128

Test probabilities computed using wild bootstrap: dist = two point, reps=1000, rng = kn, seed=1410272969

<b>Joint Tests</b>	<b>Value</b>	<b>df</b>	<b>Probability</b>
Max  z  (at period 2)*	3.338213	4872	0.1470
Wald (Chi-Square)	36.22743	7	0.0310

**Individual Tests**

<b>Period</b>	<b>Variance Ratio</b>	<b>Standard Error</b>	<b>z-Statistic</b>	<b>Probability</b>
2	1.047826	0.014327	3.338213	0.0790
4	1.054685	0.026803	2.040268	0.2520
8	0.961102	0.042379	-0.917867	0.5990
16	0.937219	0.063062	-0.995539	0.5400
32	0.931303	0.091385	-0.751733	0.6170
64	0.919195	0.130793	-0.617814	0.6500
128	0.906084	0.186066	-0.504743	0.6810



**Null Hypothesis: Log of FTSE/JSE Small Cap Index is a random walk**

Sample: June 30 1995 to 31 December 2014

Included Observations: 4872 (after adjustments)

Standard error estimates assume no heteroskedasticity

Use biased variance estimates

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Lags: 2 4 8 16 32 64 128

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Test probabilities computed using wild bootstrap: dist = two point, reps=1000, rng = kn, seed=885052725

Joint Tests	Value	df	Probability
Max  z  (at period 32)*	26.15458	4872	0.0000
Wald (Chi-Square)	806.0579	7	0.0000

**Individual Tests**

Period	Variance Ratio	Standard Error	z-Statistic	Probability
2	1.243349	0.014327	16.98570	0.0000
4	1.565328	0.026803	21.09212	0.0000
8	1.988815	0.042379	23.33268	0.0000
16	2.645518	0.063062	26.09369	0.0000
32	3.390147	0.091385	26.15458	0.0000
64	3.747656	0.130793	21.00775	0.0000
128	3.667735	0.186066	14.33755	0.0000

**EXPONENTIAL RANDOM WALK; ORIGINAL DATA; WILD BOOTSTRAP;  
BOOTSTRAP DISTRIBUTION TWO-POINT;**

**Null Hypothesis: Log of FTSE/JSE All Share Index is a random walk**

Sample: June 30 1995 to 31 December 2014

Included Observations: 4872 (after adjustments)

Standard error estimates assume no heteroskedasticity

Use biased variance estimates

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Lags: 2 4 8 16 32 64 128

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Test probabilities computed using wild bootstrap: dist = rademacher, reps=1000, rng = le, seed=2068825208

Joint Tests	Value	df	Probability
Max  z  (at period 32)*	4.401947	4872	0.0360
Wald (Chi-Square)	39.43581	7	0.0310

**Individual Tests**

Period	Variance Ratio	Standard Error	z-Statistic	Probability
2	1.063065	0.014327	4.401947	0.0170
4	1.088623	0.026803	3.306468	0.0640
8	1.021741	0.042379	0.513016	0.7580
16	1.028573	0.063062	0.453087	0.7670
32	1.050171	0.091385	0.549007	0.7110
64	1.031304	0.130793	0.239340	0.8380
128	0.992763	0.186066	-0.038895	0.9810

**Null Hypothesis: Log of FTSE/JSE Top 40 Index is a random walk**

Sample: June 30 1995 to 31 December 2014

Included Observations: 4872 (after adjustments)

Standard error estimates assume no heteroskedasticity

Use biased variance estimates

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Lags: 2 4 8 16 32 64 128

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Test probabilities computed using wild bootstrap: dist = rademacher, reps=1000, rng = 1e, seed=896000583

Joint Tests	Value	df	Probability
Max  z  (at period 32)*	3.338213	4872	0.1440
Wald (Chi-Square)	36.22743	7	0.0280

**Individual Tests**

Period	Variance Ratio	Standard Error	z-Statistic	Probability
2	1.047826	0.014327	3.338213	0.0700
4	1.054685	0.026803	2.040268	0.2690
8	0.961102	0.042379	-0.917867	0.5960
16	0.937219	0.063062	-0.995539	0.5440
32	0.931303	0.091385	-0.751733	0.6230
64	0.919195	0.130793	-0.617814	0.6800
128	0.906084	0.186066	-0.504743	0.7170

**Null Hypothesis: Log of FTSE/JSE Small Cap Index is a random walk**

Sample: June 30 1995 to 31 December 2014

Included Observations: 4872 (after adjustments)

Standard error estimates assume no heteroskedasticity

Use biased variance estimates

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Lags: 2 4 8 16 32 64 128

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Test probabilities computed using wild bootstrap: dist = rademacher, reps=1000, rng = 1e, seed=995946675

Joint Tests	Value	df	Probability
Max  z  (at period 32)*	26.15458	4872	0.0000
Wald (Chi-Square)	806.0579	7	0.0000

**Individual Tests**

Period	Variance Ratio	Standard Error	z-Statistic	Probability
2	1.243349	0.014327	16.98570	0.0000
4	1.565328	0.026803	21.09212	0.0000
8	1.988815	0.042379	23.33268	0.0000
16	2.645518	0.063062	26.09369	0.0000
32	3.390147	0.091385	26.15458	0.0000
64	3.747656	0.130793	21.00775	0.0000
128	3.667735	0.186066	14.33755	0.0000

## APPENDIX D: SOUTH AFRICAN COLLECTIVE INVESTMENTS INDUSTRY

	TOTAL ASSETS								SALES							
	30/09/2015		30/06/2015		31/03/2015		31/12/2014		30/09/2015		30/06/2015		31/03/2015		31/12/2014	
	Rm	%	Rm	%	Rm	%	Rm	%	Rm	%	Rm	%	Rm	%	Rm	%
<b>SOUTH AFRICAN FUNDS</b>																
Equity	339,896	21	356,740	22	361,256	23	335,155	22	31,134	5	23,368	5	55,236	14	35,768	7
Multi Asset	803,133	50	788,634	49	778,926	49	754,869	49	122,811	21	84,276	19	104,254	26	86,178	17
Real Estate	67,850	4	64,764	4	67,756	4	57,592	4	8,122	1	7,871	2	10,710	3	7,254	1
Interest Bearing	406,578	25	391,723	24	394,086	25	389,922	25	418,949	72	336,210	74	237,140	58	390,810	75
<b>SUB TOTAL</b>	<b>1,617,457</b>	<b>100</b>	<b>1,601,861</b>	<b>100</b>	<b>1,602,024</b>	<b>100</b>	<b>1,537,538</b>	<b>100</b>	<b>581,015</b>	<b>100</b>	<b>451,724</b>	<b>100</b>	<b>407,340</b>	<b>100</b>	<b>520,010</b>	<b>100</b>
<b>WORLD WIDE FUNDS</b>																
Equity	1,968	6	1,773	6	745	3	713	3	353	14	1,057	35	294	19	385	16
Multi Asset	31,541	94	30,039	94	28,748	97	27,597	97	2,241	86	2,004	65	1,214	81	2,017	84
<b>SUB TOTAL</b>	<b>33,509</b>	<b>100</b>	<b>31,812</b>	<b>100</b>	<b>29,493</b>	<b>100</b>	<b>28,311</b>	<b>100</b>	<b>2,594</b>	<b>100</b>	<b>3,061</b>	<b>100</b>	<b>1,508</b>	<b>100</b>	<b>2,402</b>	<b>100</b>
<b>REGIONAL FUNDS</b>																
Equity	10,093	56	10,502	57	10,605	54	8,389	46	736	80	833	69	1,202	70	792	67
Multi Asset	5,939	33	6,272	34	7,494	38	8,468	46	14	1	232	19	300	18	232	20
Real Estate	367	2	380	2	342	2	316	2	27	3	47	4	45	3	74	6
Interest Bearing	1,582	9	1,344	7	1,227	6	1,244	7	143	16	101	8	167	10	81	7
<b>SUB TOTAL</b>	<b>17,981</b>	<b>100</b>	<b>18,497</b>	<b>100</b>	<b>19,667</b>	<b>100</b>	<b>18,417</b>	<b>100</b>	<b>920</b>	<b>100</b>	<b>1,213</b>	<b>100</b>	<b>1,715</b>	<b>100</b>	<b>1,180</b>	<b>100</b>
<b>GLOBAL FUNDS</b>																

Equity	74,404	56	73,572	57	70,465	57	60,426	55	10,410	58	7,637	56	13,662	69	6,247	53
Multi Asset	50,748	38	48,271	37	45,906	37	44,284	40	5,222	29	4,940	36	4,804	24	4,953	42
Real Estate	6,975	5	5,470	4	5,567	5	4,438	4	1,258	7	849	6	1,340	7	489	4
Interest Bearing	1,844	1	1,506	1	1,447	1	1,381	1	1,116	6	136	1	94	0	77	1
<b>SUB TOTAL</b>	<b>133,970</b>	<b>100</b>	<b>128,818</b>	<b>100</b>	<b>123,384</b>	<b>100</b>	<b>110,530</b>	<b>100</b>	<b>18,006</b>	<b>100</b>	<b>13,561</b>	<b>100</b>	<b>19,899</b>	<b>100</b>	<b>11,765</b>	<b>100</b>

	REPURCHASES								NET INFLOW								ANNUAL	
	30/09/2015		30/06/2015		31/03/2015		31/12/2014		30/09/2015		30/06/2015		31/03/2015		31/12/2014		AS AT 30/09/2015	
	Rm	%	Rm	%	Rm	%	Rm	%	Rm	%	Rm	%	Rm	%	Rm	%	Rm	%
<b>SOUTH AFRICAN FUNDS</b>																		
Equity	30,728	6	22,178	5	46,440	12	21,151	4	406	1	1,190	8	8,797	91	14,617	40	25,009	25
Multi Asset	101,222	19	70,827	16	99,910	25	61,328	13	21,589	54	13,448	87	4,344	45	24,849	68	64,231	63
Real Estate	7,359	1	6,396	1	7,657	2	6,634	1	762	2	1,475	10	3,053	32	620	2	5,910	6
Interest Bearing	401,921	74	336,877	77	243,655	61	394,101	82	17,028	43	-668	-4	-6,515	-67	-3,291	-9	6,554	6
<b>SUB TOTAL</b>	<b>541,230</b>	<b>100</b>	<b>436,279</b>	<b>100</b>	<b>397,662</b>	<b>100</b>	<b>483,215</b>	<b>100</b>	<b>39,785</b>	<b>100</b>	<b>15,445</b>	<b>100</b>	<b>9,678</b>	<b>100</b>	<b>36,795</b>	<b>100</b>	<b>101,704</b>	<b>100</b>
<b>WORLD WIDE FUNDS</b>																		
Equity	108	6	25	1	8	1	9	1	244	37	1,032	92	286	187	375	56	1,938	74
Multi Asset	1,817	94	1,917	99	1,347	99	1,724	99	424	63	88	8	-133	-87	293	44	672	26
<b>SUB TOTAL</b>	<b>1,925</b>	<b>100</b>	<b>1,941</b>	<b>100</b>	<b>1,355</b>	<b>100</b>	<b>1,734</b>	<b>100</b>	<b>668</b>	<b>100</b>	<b>1,120</b>	<b>100</b>	<b>153</b>	<b>100</b>	<b>669</b>	<b>100</b>	<b>2,610</b>	<b>100</b>
<b>REGIONAL FUNDS</b>																		
Equity	255	31	175	14	130	9	323	16	481	458	658	-3,165	1,072	438	469	-55	2,680	-513
Multi Asset	427	52	1,012	82	1,125	77	1,677	83	-413	-394	-781	3,755	-825	-337	-1,445	170	-3,463	664
Real Estate	44	5	15	1	30	2	7	0	-17	-16	32	-155	16	6	68	-8	98	-19
Interest Bearing	88	11	31	3	185	13	24	1	54	52	70	-335	-18	-7	57	-7	163	-31
<b>SUB TOTAL</b>	<b>815</b>	<b>100</b>	<b>1,234</b>	<b>100</b>	<b>1,470</b>	<b>100</b>	<b>2,031</b>	<b>100</b>	<b>105</b>	<b>100</b>	<b>-21</b>	<b>100</b>	<b>245</b>	<b>100</b>	<b>-851</b>	<b>100</b>	<b>-522</b>	<b>100</b>

GLOBAL FUNDS																			
Equity	8,877	63	5,386	60	7,689	56	4,778	46	1,533	39	2,251	49	5,973	95	1,469	104	11,226	69	
Multi Asset	4,324	31	2,968	33	5,277	39	5,134	50	1,056	27	2,197	48	-45	-1	1,136	80	4,344	27	
Real Estate	641	5	545	6	582	4	355	3	77	2	75	2	102	2	-80	-6	173	1	
Interest Bearing	208	1	58	1	65	0	86	1	918	23	80	2	52	1	-24	-2	1,026	6	
<b>SUB TOTAL</b>	<b>14,050</b>	<b>100</b>	<b>8,957</b>	<b>100</b>	<b>13,612</b>	<b>100</b>	<b>10,353</b>	<b>100</b>	<b>3,956</b>	<b>100</b>	<b>4,605</b>	<b>100</b>	<b>6,287</b>	<b>100</b>	<b>1,412</b>	<b>100</b>	<b>16,260</b>	<b>100</b>	
<b>TOTAL</b>	<b>558,020</b>	<b>100</b>	<b>448,410</b>	<b>100</b>	<b>414,098</b>	<b>100</b>	<b>497,331</b>	<b>100</b>	<b>44,514</b>	<b>100</b>	<b>21,149</b>	<b>100</b>	<b>16,363</b>	<b>100</b>	<b>38,025</b>	<b>100</b>	<b>120,053</b>	<b>100</b>	

	NO OF ACCOUNTS								NO OF FUNDS								
	30/09/2015		30/06/2015		31/03/2015		31/12/2014		30/09/2015		30/06/2015		31/03/2015		31/12/2014		
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	
SOUTH AFRICAN FUNDS																	
Equity	926918	35	1034956	36	900912	35	1030009	37	268	25	256	25	258	25	248	25	
Multi Asset	840854	32	898920	31	803516	31	837942	30	613	57	590	57	587	57	568	57	
Real Estate	69303	3	65927	2	61043	2	57373	2	49	5	46	4	44	4	42	4	
Interest Bearing	830184	31	868528	30	830031	32	890103	32	141	13	142	14	139	14	135	14	
<b>SUB TOTAL</b>	<b>2667259</b>	<b>100</b>	<b>2868331</b>	<b>100</b>	<b>2595502</b>	<b>100</b>	<b>2815427</b>	<b>100</b>	<b>1071</b>	<b>100</b>	<b>1034</b>	<b>100</b>	<b>1028</b>	<b>100</b>	<b>993</b>	<b>100</b>	
WORLD WIDE FUNDS																	
Equity	30	0	19	0	15	0	7	0	5	8	3	5	2	4	4	8	



Multi Asset	14881	100	14684	100	14098	100	13973	100	58	92	55	95	52	96	47	92
<b>SUB TOTAL</b>	<b>14911</b>	<b>100</b>	<b>14703</b>	<b>100</b>	<b>14113</b>	<b>100</b>	<b>13980</b>	<b>100</b>	<b>63</b>	<b>100</b>	<b>58</b>	<b>100</b>	<b>54</b>	<b>100</b>	<b>51</b>	<b>100</b>
<b>REGIONAL FUNDS</b>																
Equity	5113	81	7110	83	5173	82	6804	83	17	63	17	65	17	65	16	64
Multi Asset	126	2	135	2	140	2	143	2	1	4	1	4	1	4	1	4
Real Estate	66	1	124	1	58	1	102	1	2	7	1	4	1	4	1	4
Interest Bearing	1008	16	1222	14	922	15	1138	14	7	26	7	27	7	27	7	28
<b>SUB TOTAL</b>	<b>6313</b>	<b>100</b>	<b>8591</b>	<b>100</b>	<b>6293</b>	<b>100</b>	<b>8187</b>	<b>100</b>	<b>27</b>	<b>100</b>	<b>26</b>	<b>100</b>	<b>26</b>	<b>100</b>	<b>25</b>	<b>100</b>
<b>GLOBAL FUNDS</b>																
Equity	106416	73	117860	74	102684	73	119517	74	43	38	41	38	41	40	41	40
Multi Asset	33027	23	34131	21	33341	24	35339	22	49	43	47	44	45	44	44	43
Real Estate	66	0	124	0	58	0	102	0	11	10	10	9	8	8	8	8
Interest Bearing	1409	1	1494	1	1622	1	1872	1	10	9	9	8	9	9	9	9
<b>SUB TOTAL</b>	<b>145661</b>	<b>100</b>	<b>159673</b>	<b>100</b>	<b>141587</b>	<b>100</b>	<b>161054</b>	<b>100</b>	<b>113</b>	<b>100</b>	<b>107</b>	<b>100</b>	<b>103</b>	<b>100</b>	<b>102</b>	<b>100</b>
<b>TOTAL</b>	<b>2834144</b>	<b>100</b>	<b>3051298</b>	<b>100</b>	<b>2757495</b>	<b>100</b>	<b>2998648</b>	<b>100</b>	<b>1274</b>	<b>100</b>	<b>1225</b>	<b>100</b>	<b>1211</b>	<b>100</b>	<b>1171</b>	<b>100</b>

**Appendix E: Market value of assets under administration as at 30 September 2015**

ASSET TYPE	DISCRETIONARY	RETIREMENT ANNUITIES AND PRESERVATION FUNDS	CONTRIBUTING PENSION AND PROVIDENT FUNDS	RETIREMENT INCOME	ENDOWMENTS and VOLUNTARY PURCHASE ANNUITIES	TOTAL
Local collective investment schemes	390,923,627,457	201,103,490,752	7,412,363,934	283,755,059,741	83,438,258,182	966,632,800,067
Tied Agents (insurance linked)	82,336,913,079	26,159,252,040	2,899,259,221	52,954,110,966	18,610,750,225	182,960,285,531
Tied Agents (bank linked)	49,407,030,114	5,769,915,516	0	10,949,617,932	5,719,400,236	71,845,963,798
Tied Other	4,797,633,621	1,353,039,005	0	1,664,002,283	1,781,480,913	9,596,155,822
Independent financial advisor	242,305,313,370	147,155,405,716	3,052,585,403	203,753,931,703	55,849,527,666	652,116,763,858
Direct Clients	12,076,737,273	20,665,878,475	1,460,519,311	14,433,396,857	1,477,099,142	50,113,631,058
Pensions	0	0	0	0	0	0
Offshore funds/investments	30,075,112,968	691,129,118	0	2,926,972,616	16,563,857,753	50,257,072,455
Tied Agents (insurance linked)	108,347,773	0	0	0	919,701,483	1,028,049,255
Tied Agents (bank linked)	46,658,910	3,605,543	0	3,659,929	12,798,133	66,722,514
Tied Other	0	0	0	0	0	0
Independent financial advisor	26,435,515,935	679,774,773	0	2,920,240,028	15,069,678,417	45,105,209,152
Direct Clients	3,484,590,351	7,748,802	0	3,072,659	561,679,721	4,057,091,533
Pensions	0	0	0	0	0	0
Local Life funds	1,397,510,449	6,377,311,758	0	12,865,630,514	9,125,009,783	29,765,462,504
Smoothed bonus life funds	153,163	3,404,028,294	0	6,046,093,872	2,864,481,234	12,314,756,564
Performance linked life funds	1,397,357,286	2,973,283,464	0	6,819,536,642	6,260,528,549	17,450,705,940
Call accounts	354,630,860	99,581,690	0	93,499,032	105,453,811	653,165,394
Other	7,793,535,597	6,562,285,910	1,501,633,584	11,261,051,763	4,147,054,903	31,265,561,757
Assets under administration	1,547,743,198	3,900,140,327	1,486,034,175	7,605,279,961	2,045,373,202	16,584,570,863
Managed assets	6,245,792,400	2,662,145,583	15,599,409	3,655,771,801	2,101,681,701	14,680,990,894

Total Sum of Assets	430,544,417,332	214,833,799,228	8,913,997,519	310,902,213,666	113,379,634,432	1,078,574,062,176
( B ) Packaged / risk profiled solutions	15,745,007,235	7,198,465,198	373,800,811	15,716,558,539	875,582,255	39,909,414,038
( C ) Number of accounts	562,151	408,133	12,931	335,708	103,527	1,422,450
( D ) Inflows / outflows for the quarter	5,271,509,655	2,183,086,040	0	1,945,629,414	379,592,921	9,779,818,030
TRANSACTION TYPE	DISCRETIONARY	RETIREMENT ANNUITIES AND PRESERVATION FUNDS	CONTRIBUTING PENSION AND PROVIDENT FUNDS	RETIREMENT INCOME	ENDOWMENTS and VOLUNTARY PURCHASE ANNUITIES	TOTAL
New business	32,478,575,399	15,650,486,292	446,209,066	15,402,317,596	5,559,639,431	69,537,227,784
<u>Lump sums</u>	30,741,167,081	14,463,477,570	401,268,129	15,389,505,647	5,112,667,788	66,108,086,215
Tied Agents (insurance linked)	5,494,110,631	2,389,432,046	200,771,940	3,221,638,085	912,035,674	12,217,988,376
Tied Agents (bank linked)	4,481,212,992	503,539,543	0	796,226,587	532,252,236	6,313,231,358
Tied Other	713,670,178	167,473,287	0	565,025,827	305,177,647	1,751,346,939
Independent financial advisor	18,298,152,115	10,069,135,923	115,738,330	10,146,669,804	3,220,053,254	41,849,749,426
Direct Clients	764,997,954	1,333,896,771	84,757,859	659,945,343	143,148,978	2,986,746,905
Pensions	989,023,211	0	0	0	0	989,023,211
<u>Recurring</u>	1,737,408,318	1,187,008,722	44,940,937	12,811,949	446,971,643	3,429,141,569
Tied Agents (insurance linked)	253,693,740	122,935,862	0	0	148,385,459	525,015,061
Tied Agents (bank linked)	97,567,023	53,783,426	0	0	1,066,908	152,417,356
Tied Other	139,249,658	10,100,756	0	0	0	149,350,415
Independent financial advisor	1,194,307,122	870,095,547	14,203,998	12,811,949	280,471,471	2,371,890,087
Direct Clients	52,590,775	130,093,131	30,736,940	0	17,047,805	230,468,650
Pensions	0	0	0	0	0	0
Withdrawals	24,675,803,123	9,128,890,103	308,387,732	29,918,940,627	-17,051,826,078	46,980,195,506
Regular payments (income)	2,252,574,565	5,100,924	0	16,266,326,587	-4,876,443,736	13,647,558,340
<u>Lump sums</u>	22,423,228,558	9,123,789,179	308,387,732	13,652,614,040	-12,175,382,342	33,332,637,166
Tied Agents (insurance linked)	4,614,969,138	1,159,463,138	50,150,412	1,956,932,654	-3,329,317,509	4,452,197,834

Tied Agents (bank linked)	1,227,239,640	135,686,548	0	66,409,888	14,566,583	1,443,902,660
Tied Other	768,554,264	228,712,279	0	1,099,058,080	-1,234,718,396	861,606,227
Independent financial advisor	14,975,293,784	6,595,002,347	175,412,079	10,259,251,184	-7,732,123,561	24,272,835,833
Direct Clients	812,415,412	1,004,924,866	82,825,241	270,962,233	98,392,871	2,269,520,623
Pensions	24,756,320	0	0	0	7,817,670	32,573,989
Net new business	7,802,772,276	6,521,596,189	137,821,334	-14,516,623,031	22,611,465,509	22,557,032,278
New business emanating from income (distributions) reinvested	3,470,583,920	1,622,477,751	85,024,311	2,216,700,887	241,397,682	7,636,184,550



