Application of Fundamental Indexation for South African Equities

A Research Project presented to the

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Masters in Commerce (M.Com) in Finance

By

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Declaration

Except for assistance which is duly acknowledged, and references which are specifically indicated in the text and bibliography, I, Joswil Scott Engel, declare that this research project is wholly my own work and not being in part or in its entirety submitted at any other university for degree purposes.

Joswil Scott Engel

January 2014

Dedication

Dedicated to my family and parents, Mr. J.A. Engel and Mrs. A.P. Engel

Acknowledgements

Firstly, I would like to send my deepest condolences to the family and friends of my first supervisor, the late Prof. Chris Visser. I first met Prof. Chris Visser as a student in his Investment Management class, where I was first introduced to the subject Investments. I am grateful for Prof. Chris Visser contribution, who advised me on selecting a topic within the field of indexing. Due to the difficulties surrounding his condition, I approached Prof. Heng-Hsing Hsieh for supervision.

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I am solely responsible for any errors.

Abstract

Recent literature suggests that fundamental attributes are better proxies for index construction in contrast to market capitalisation-weighted methods. Arnott, Hsu and Moore (2005) argue that high-priced shares will have the tendency to realise lower risk-adjusted returns, thus a cap-weighted index that places more weight in high-priced shares will experience lower risk-adjusted returns. Hsu and Campolo (2006) find that fundamental indices outperform their cap-weighted counterparts, not due to firm's fundamental attributes being truer indicators of their share fair values, but merely because the indices are non-price weighted. They argue that cap-weighted indices are price sensitive and therefore experience a performance drag whilst fundamental indices are price-insensitive. The performance drag of price-sensitive indices is considered too be caused by noise variables within share prices due to investor overreaction and overvaluation of growth shares and undervaluation of value shares.

The JSE All Share Index (ALSI) is dominated by few large-cap stocks. The primary objectives of this research are to determine whether indices constructed from fundamental attributes of ALSI constituents outperform indices weighted by market capitalisations; and whether the performance of fundamental indices could be explained by size and value risk factors. The examination period is 1st January 2000 to 31st December 2009. The JSE ALSI constituent's fundamental attributes; book values, dividends, earnings and sales together with their market values are extracted from DataStream International. Indices are subsequently constructed according to share's market values and the four aforementioned fundamental attributes as well as a composite metric. The composite metric is a combination of all four fundamental attributes. Fundamental indices are found to be more mean-variance efficient than cap-weighted indices, whilst displaying moderate value bias and minor size bias. Fundamental indices exhibit lower risk-adjusted returns when rebalanced less frequently, except for sales-weighted indices which justly capture undervalued shares that mean revert throughout the year. Fundamental indexation is therefore, adjudged to be superior to cap-weighted methods and only relatively affected by value effect.

Key words: fundamental indexation, efficient market hypothesis (EMH), asset pricing, investor overreaction, value effect, size effect, asset allocation, rebalancing.

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Chapter 1 :   INTRODUCTION

1.1   Background

The intention of an index is to track the performance of a broad capital market, where the index comprises of the most influential securities within that market. Indices are constructed by summing a single share of each constituent within the exchange, divisible by the number of constituents. There are numerous weighting methods for indices. Indices can be weighted by constituent's share price, market capitalisations or be equally-weighted. Indices can also represent a sector or asset class within an exchange. The benefit indices provide is that it affords investors the inexpensive option of investing in a diversified passive investment that tracks the market index's performance. Another benefit of indices is that they act as proxies for broad risk factors that influence multiple asset returns. The factors influencing an asset's return can now be separated by the influence of market macro risk factors and by individual firm-specific components.

Indices generally reflect a specific segment of the market and its constituents historical share price changes for a particular period. Indices also, provide useful benchmarks as a point of reference for investors to match their fund performances against. According to Laing (2009), as indices represent the aggregate market movement; this would lead one to innocuously assume that roughly half of active funds outperform the market index and that the other half underperforms the index. However, Fox and Krige (2013) point out that the standard active fund manager does not outperform the JSE ALSI market within the period 1997 to 2011.

Globally, much academic literature has shown that most asset managers have struggled to outperform financial market indices resembling their actively-managed portfolios. Indexation has since become a viable diversified investment option for investors who seek exposure within their portfolio at lower administration costs. Indexing products like exchange traded funds (ETF) have grown in popularity in international markets like Europe and America. However, in contrast to international market trends, in South Africa investment in indices only accounts for about 5% of assets managed within unit trusts, life assurance and retirement portfolios (Beere and Netto-Jonker, 2009). According to Cameron (2010) as at March 2010, a mere R30

billion was invested in exchange traded funds in relation to the R783 billion invested in active collective funds.

Beere and Netto-Jonker (2009) note that though South African investors are reluctant to invest in indices, support for indexation has grown over recent years. Cameron (2010) highlights that, due to popularity, many professional active fund management institutions such as; ABSA, Investec, Old Mutual and RMB have all introduced passive collective schemes under subsidiary boutiques. It is therefore evident that the supply for indexation options and initiatives for investors are growing.

Almost all Indices within the FTSE/JSE Index series is constructed and rebalanced according to their constituent's market capitalisations. Examples of such indices are; JSE ALSI index, JSE Top 40 index, JSE Mid Cap index, JSE Industrial 25 index and the JSE Financial 15 index. A constituent's market capitalisation is commonly regarded as an indication of their firm's worth. Therefore, a firm's size or strength may be greatly influenced by its market price. Indices and portfolios based on market values are therefore considered to be price-sensitive. As markets are driven by demand and supply, market forces occasionally bid up firm share prices, which thereby increases the firm's market capitalisation. This in turn raises a constituent's weighting within cap-weighted indices.

The use of share market values derives from modern portfolio theory (MPT) of Markowitz (1952, 1959) and capital asset pricing model (CAPM) of Sharpe (1964). Markowitz (1959) found that portfolio construction would be dependent on two considerations, the highest anticipated return a portfolio could offer and the lowest expected risk an investor would bear for investing in that portfolio. From a set of mean-variance portfolio combinations, the portfolio with the asset allocation that produced the highest expected return with the lowest expected risk would be considered the optimal combination to invest in. Sharpe (1964) considered Markowitz's (1959) intuition and contemplated what the repercussions would be if all investors saw the optimal mean-variance portfolio as the best combination to invest in. Since all investors are assumed to be utility maxi-misers, all investors would be homogenous towards the optimal mean-variance portfolio, termed the market portfolio. When all investors invest in accordance with the optimal mean-variance combination, their actions would result in the optimal mean-variance combination to

be a reflection of the market. With this intuition, Sharpe (1964) identified that shares are priced in proportion to their contribution to the market portfolio and that investors should invest accordingly and therefore, follow the market portfolio.

These insights have been challenged by certain academics such as Banz (1981), Kahneman and Tversky (1979, 1982) and De Brondt and Thaler (1985, 1987) on the premise that anomalies exist that produce recurrent risk-adjusted returns in excess of the market. Other academics such as Malkiel (2005) remain adamant that the market cannot be outperformed on a consistent basis, and that evidence of unsuccessful active asset managers suggest that investing according to the market is the safest advantageous investment policy to follow.

A recent alternative to cap-weighted methods is the use of firm fundamental attributes as proposed by Arnott, Hsu and Moore (2005). Firm fundamental attributes are accounting measures such as; company's book values, gross revenues and total employment which is used by many analysts to determine the stability and strength of a firm. Arnott *et al* (2005) is of the view that fundamental indices realise a higher mean-variance in relation to cap-weighted indices. Their belief behind fundamental indices superior performance is on the premise that cap-weighted indices are affected by irrational investor behaviour partaking in noise trading. Noise trading promotes security miss-pricings within markets, which results in certain shares to be overvalued and others to be undervalued.

Another possibility for the superior mean-variance of fundamental indices, offered by Arnott *et al* (2005) is that fundamental indices are exposed to different risk factors at different propensities than cap-weighted indices. However, Arnott *et al* (2005) acknowledge that their evidence was not conclusive but consider their notion to be conceivable as a cause behind fundamental indices higher risk-adjusted returns. They also argue, that fundamental indices should significantly outperform cap-weighted indices in all markets developed and less developed throughout different time periods. Recent literature by Hsu and Campollo (2006) has displayed evidence of fundamental indexation potential superiority over cap-weighted methods in markets of 23 different countries.

The JSE limited (formally known as Johannesburg Securities Exchange) is seen as an emerging market but has undergone many reforms that have improved trading on the JSE. In 2002, the JSE became more modern by adopting London Stock Exchange SETS trading platform. In the same year the JSE launched the FTSE/JSE Africa index series which assisted investors investing in indices. Within the FTSE/JSE Index series, the first index to be based on firm fundamental attributes was the FTSE/JSE RAFI 40 index launched in September 2007. The FTSE/JSE RAFI 40 index composition is based on constituents; book value or net asset value, total sales, gross dividends and free cash flow. Index composition is reached by each company being attributed with a fundamental value that is derived by taking the average weight of each fundamental measure.

Figure 1.1   Cumulative FTSE/JSE RAFI 40 Total Return Index versus FTSE/JSE
              Top 40 Total Return Index within the period July 2004 to July 2012.
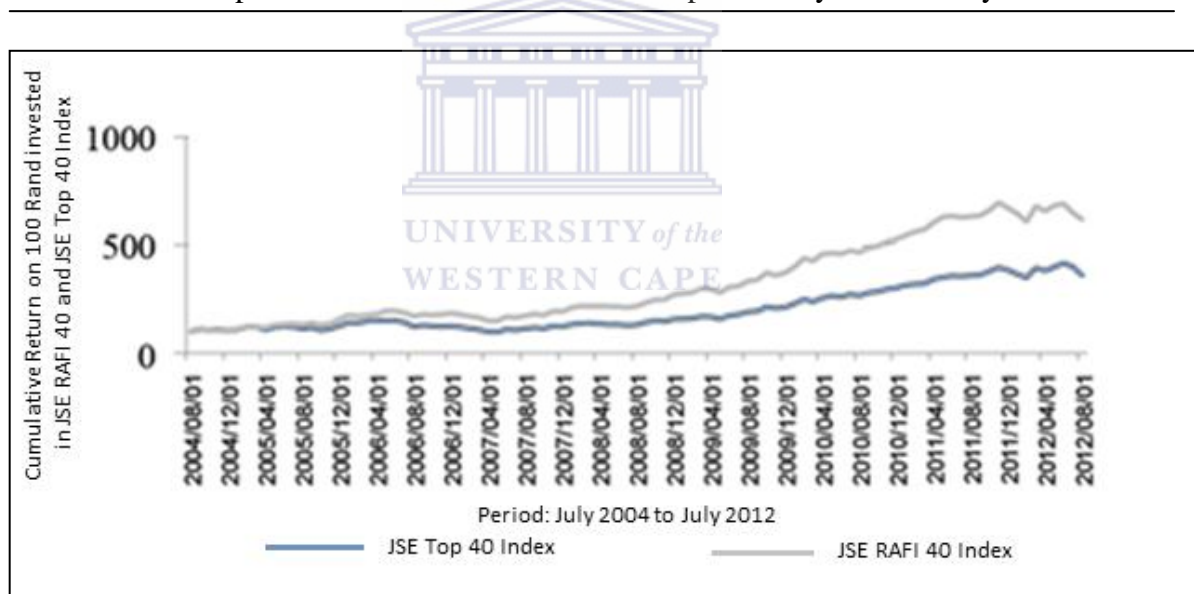
Source: *I-Net Bridge/* JSE.

The above Figure 1.1 illustrates that from July 2004 to July 2012, the FTSE/JSE RAFI 40 index outperformed the FTSE/JSE Top 40 index by 4.8% total returns. This evidence provides encouragement that fundamental indices could outperform cap-weighted indices on a risk-adjusted basis within emerging markets, as presumed by Arnott *et al* (2005).

1.2   Research Motivation and Objectives

Indexation has recently risen as a viable means for investing in diversified portfolios at lower costs. According to Laing's (2009) opinion, modern indexing techniques have the potential to outperform around 80% of funds invested with professional fund managers in South Africa. The rise in indexation popularity stems from findings that many fund managers underperform the market.

Arnott *et al* (2005) show that investors can do better than merely investing in indices, by investing in fundamental indices, where evidence suggests that fundamental indexation outperforms standard cap-weighted indices on a risk-adjusted basis. Due to the increase in support for indexation, fundamental indices may become significant investment vehicles utilised by investors within the South African market. Therefore, it is important to assess the practicality of fundamental indexation on the JSE.

The underlying purpose of this study is to determine whether fundamentally-weighted indices represent a unique investment style that are more mean-variance than cap-weighted indices within the JSE context. The basis for Arnott *et al* (2005) argument is that firm fundamental attributes are price insensitive measures in contrast to firm market-caps. In time, growth share's market values have been argued to be overstated in comparison to their true fair values. Constituent share prices are in part affected by investors' perceptions and behaviour but, Arnott *et al* (2005) assume that firm fundamental attributes are not sensitive or are only partially affected by investor perceptions. For their argument to stand, the various fundamental attributes that they employ should not display similar behaviours or characteristics as cap-weighted indices. Furthermore, it is obligatory to ascertain whether firm fundamental attributes are in fact price insensitive attributes as argued by Arnott *et al* (2005).

Fundamental indexation has also been criticised as being predefined active portfolios that benefit from size and value tilts within their indices compositions. Size effect occurs when smaller market-cap shares generate noticeably higher risk-adjusted returns than larger market-cap shares. This is considered to be caused by small-cap shares holding a higher distress risk. Since fundamental indices are constructed alternate to firm market values, fundamental indices constituent base will inherently consist of smaller market-cap shares. Value effect is evident when shares identified by

their firm's financials such as, low price-earnings ratios or strong book-to-market metrics, realise repeated returns in excess of the market on a risk-adjusted basis. Asness (2006) argues that evidence of fundamental indexation is not a new phenomenon as value strategies have already documented abnormal returns achieved with the use of company fundamental attributes. In addition, this research will further evaluate the influence value and size risk factors have on the performances of fundamental indices.

According to Arnott *et al* (2005) with market volatility, cap-weighted indices over value growth shares and therefore experience a lag in performance. Cap-weighted indices are in essence price-weighted and therefore hugely affected by price fluctuations during an investment's holding period. To curb overemphasis of growth shares within index's compositions, rebalancing strategies are implemented to ensure the index's chosen risk profiles are maintained. The FTSE/JSE indices are typically rebalanced quarterly. However, with time, index constituent's share prices tend to fluctuate thereby distorting their index's weighting schemes to be becoming more cap-weighted. When fundamental index's asset allocations has been set, the rebalancing frequency employed plays a pivotal role in ensuring that growth shares remain adequately weighted. It is the intention of this study to review the effect less frequent rebalancing frequencies have on the performances of fundamental indices and cap-weighted indices, and whether a cap-drag exists for indices constructed from JSE ALSI index constituents.

1.3   Scope of the Study

The population sample utilised in this study is the constituents from the FTSE/JSE ALSI index within the period under review from 1st January 2000 to 31st December 2009. The monthly data employed includes the total return index, month-end closing prices, number of shares outstanding, book values, earnings, dividends and gross sales of the sample shares within the examination period. Additional data required, is JSE ALSI index returns and South African 3-month treasury yield returns for the same period. The JSE ALSI index is adopted as this study's market proxy whilst the South African 3-month treasury yield is utilised as this study's risk-free proxy. All data are sourced and downloaded from DataStream International's database.

1.4   Overview

Following the introductory chapter, chapter 2 reviews the theoretical foundations from which fundamental indexation stems from. The initial theory for the utilisation of accounting figures for security analysis is presented after which modern portfolio theory, capital market theories, efficient market hypotheses (EMH), critique of CAPM, behavioural finance, market anomalies, passive versus active management are discussed as to how they contribute to the development of fundamental indexation which shall be discussed in the last part.

After fundamental indexation was recognized by Arnott *et al* (2005), advocates and opponents augmented in debate of its merits. In chapter 3, the advantages of fundamental indexation are reviewed as well as literature supporting and criticising fundamental indexation. Chapter 4 identifies the research problem, research purposes and research questions of this study. The research sample is discussed and potential biases are highlighted. The study's primary research questions are to evaluate fundamental indices and cap-weighted indices mean-variance efficiency, to analyse the extent fundamental indices performance are attributable to size and value risk factors and to observe the effect less frequent rebalancing strategies have on fundamental indices performances.

In chapters 5 to 7, the test results are presented with the main findings analysed in order to answer the three primary research questions identified. The penultimate chapter 8 concludes the findings of this study and recommends further research within the field of fundamental indexation.

1.5   Expected Contribution

The JSE is relatively new to index investment products in comparison to other developed markets. The index product offering gained much needed impetus in 2000 when the first ETF, the SATRIX 40 was launched, and after a decade, as at July 2010 there were only 23 different ETFS listed on the JSE (Cameron, 2010). To the author's knowledge, little literature exists on fundamental indexation on the JSE, besides Ferreira and Krige (2011) who test fundamental indexation using JSE constituents.

Therefore, the findings of this research will contribute to the body of literature in fundamental indexation on JSE as an emerging stock market.

The share price, determined by demand and supply is considered by investors to be the primary indicator of a firm's worth. The research conducted by Ferreira and Krige (2011) was limited to testing the practicality of fundamental indexation on JSE. They compared the performance of JSE ALSI index to the performances of four fundamental indices constructed from the entire JSE ALSI index constituent base. To further research in this area this study conducts performance attribution analysis on fundamental indices to determine whether fundamental indexation could be considered as a new investment style on the JSE.

The composite measure calculation method adopted in this study is also dissimilar to other fundamental indexation research methods. Therefore, this contrasting calculation method is a new contribution within the fundamental indexation field.

The aim of this study is also, not only to relate fundamental indices mean-variance efficiency to cap-weighted indices, but also to evaluate the likelihood that firm fundamental attributes are more appropriate measures for identifying undervalued securities of all sizes. This will thereby support advocates of fundamental indices, that fundamental measures are better indicators of valuable companies.

In addition, this study also evaluates the performance of various rebalancing strategies on fundamental indices consisting of JSE ALSI constituents. To the author's knowledge, no literature currently exists regarding the sources of performances and analysis of rebalancing strategies for fundamental indices within the South African context.

This study's results attempt to provide insight on the benefits of fundamental indexation on the JSE, as a viable investment strategy which asset managers could follow. These research findings are also endeavoured to provide new insights to fund managers regarding; fundamental indices risk-adjusted performances within different business cycles, the signifying capabilities of different accounting metrics which could be utilised, the optimal rebalancing frequency to pursue and the influence value and size risk factors have on fundamental index's performances.

Chapter 2 :   THEORETICAL FRAMEWORK

2.1   Introduction

In portfolio construction, the dilemma all investors face is which assets to select, how to diversify investment between different asset classes and when to rebalance and alter the portfolio's constituents. The objective for any investor is also to produce excess returns in relation to their portfolio's benchmark. Investors could partake in active portfolio management or invest passively tracking the market index.

According to *Modern Portfolio Theory*, a rational utility maximising investor should invest according to the market portfolio, found when the capital market is in equilibrium. The equilibrium condition occurs consistently as the operational efficiency of the market corrects any asset mispricing that transpires. The percentage of the market portfolio allocated to a single share is recognised as the firm's market capitalisation. Therefore, those shares that command a higher market capitalisation are usually higher priced. The market portfolio is understood to be the only combination of all markets' assets that produces the highest expected return with the lowest possible expected variance. Therefore, those shares that command a higher asset price are perceived to be worth more than other shares. The formation of the market portfolio inadvertently adjudges the worth of a company by allocating a higher portion to certain shares and less to others.

As the market portfolio is considered to be the most efficient asset combination that produces the highest expected return with minimal expected variance, any deviation from the market portfolio is expected to produce sub-optimal performance. Deviations from the market portfolio could result in either higher expected return at a substantially higher expected variance, or a lower expected return at a lower expected variance. Notwithstanding, the possible loss an investor may experience from deviating from the market portfolio, transaction costs to invest otherwise also has a profound effect on the return achievable by any investor.

Advocates of passive management argue that the transaction costs involved for exploiting share mispricing prevent investors from realising satisfactory gains from

attempting to exploit arbitrage opportunities. They furthermore argue that, no investor can consistently outperform the market and therefore, should not attempt to invest in any strategy other than tracking the market portfolio. However, tracking all global market's assets is virtually impossible. Therefore, advocates of passive investing refer to an exchanges market's index as an ideal proxy to pursue. Their argument is based on the finding that active investors struggle to beat their market index on a consistent basis.

In light of Modern Portfolio Theory's notions and the arguments of passive investment advocates, Arnott *et al* (2005) show that indices constructed according to share fundamental measures yield returns in excess of the market index. Their indices not only produce higher returns but achieve this feet with similar risk profiles as there counterpart market capitalisation-weighted indices.

According to modern portfolio theory, the market portfolio is understood to be the only combination that produces the best risk-adjusted performance. In contrast Arnott *et al* (2005) show that this is in fact not true. Their finding contravenes the theoretical justification for the establishment of the market portfolio. Their finding also contravenes passive investment arguments, as the fundamental indices outperform the market index on a regular basis. Their fundamental indices are also infrequently rebalanced and as such; do not suffer from exorbitant transaction costs.

The following chapter outlines the development of Modern Portfolio Theory (MPT) established by Markowitz (1959), the conception of the market portfolio by Sharpe (1964) and the Efficient Market Hypothesis (EMH) by Fama (1970) which is crucial to the market portfolio's existence.

Criticisms by Roll (1977, 1978) regarding the theoretical justifications for the market portfolio as well as critique of MPT, with alternative prospect theory offered by Kahneman and Tversky (1979) are presented. Criticisms of EMH justified by investor overreaction hypothesis by De Brondt and Thaler (1985, 1987) are also discussed.

Lastly, the debate between active and passive portfolio management is reviewed with an alternative to cap-weighted indexation; fundamental indexation by Arnott, Hsu and Moore (2005) is presented.

2.2   Security Analysis According to Fundamental Values

The use of accounting/fundamental factors can arguably originate from security analysis principles of Graham and Dodd (1934). After the devastation of the stock market crash in 1929; they were driven to show that investing could be safe, if the correct businesses that exhibited certain key factors were targeted for investment. Graham and Dodd (1934) did however; consider the dilemma all investors face when attempting to outperform the market. They were of the view that the only way an investor can outperform the market is by investing in securities with excellent growth prospects. The problem however, was how to identify these shares.

Graham and Dodd (1934) suggest that investors value a share separate from the market's valuation. This independent view from the market was called the share's "*intrinsic value*". Though the method for finding a share's precise intrinsic value was never explained, there were some insights provided as to what aspects to look for in finding excellent shares. These insights are regarded as screens.

Graham and Dodd (1934) propose that investors focus on the value of a company's tangible assets such as; earnings, dividends, stability and financial strength.   They also, assert that investors should invest in a share as if they were buying into a piece of ownership of that company. Graham and Dodd (1934) also, distinguish between two types of investors, those that are risk-averse and those that are risk-seeking. The risk-averse investor was advised to object from investing in small companies, and rather select and invest in firms that display book values that were closely related to their market values which also exhibit strong earnings ratios. The risk-seeking investor was advised to invest in companies of all sizes, to invest in companies that pay dividends and to invest in companies that have a price less than 120% its company's book value ratio. Ultimately, Graham and Dodd (1934) argue that investors should look for stable companies with good growth prospects, and invest on the premise that they will gain long term favourable dividends and appreciation in the shares' market values.

Graham and Dodd (1934) value investing beliefs focus on finding companies whose shares are undervalued by its market price. Their notion was that investors investing in companies with sound business principles will prosper as long as investors

diversify their portfolios. Investors that are confident in their investment decisions and not driven by market opinion are also likely to outperform the market.

2.3   Capital Market Theories

2.3.1   Mean-variance Framework

Modern portfolio theory was established by Markowitz (1959) incorporating the success of his earlier research on mean-variance framework (1952). Markowitz (1952) research on portfolio theory considered how an optimizing investor would behave in uncertain scenarios. The consideration of uncertainty is imperative, because if investors knew the payoffs of specific assets they would invest solely in those assets that produce the highest returns. Since investors cannot tell with certainty what an asset's price is likely to be in the future, they must diversify their portfolios to reduce the chances of experiencing severe losses. Therefore, the presence of certainty governs investor rational behaviour. It is presumed that in uncertain times, rational investors would act agreeing to "probability beliefs" where no independent possibilities are identified.

At the time of Markowitz (1952) research, shares were analysed in isolation. Investors preferred shares that offered favourable returns and diversification was done in an attempt to negate major loss. Markowitz (1952) agreed that investors should be concerned with a share's future expected value. However, a share is also a part of a basket of securities that as a whole form a portfolio. Markowitz (1952) deliberated the practicality of having many securities if an individual security presented the highest expected future value. Since investors did not behave in this conduct, they were obviously concerned with more than just expected future returns. Investors were also concerned with the risks involved in investing, and not just the risk of a single share, but the risk that the whole portfolio endangers in relation to its expected return.

Markowitz (1952) envisioned variance as a measurement of volatility or risk. To support his beliefs, he considered the use of covariance between shares within a portfolio as a measurement of that portfolio's risk. Different mean-variance combinations were created, offering portfolios with different risk-return combinations. The multiple mean-variance portfolios belonged to an efficient set of

portfolios known as the efficient frontier. In accordance with an investor's risk tolerance, an investor would choose a specific portfolio with a mean-variance combination that realises the highest expected return relative to their chosen risk preference. The optimal mean-variance combination will be found along the efficient frontier. As many investors would likely be risk averse, the investors' choice of portfolio mix would be based on the investors' viewpoint, that the chosen mix of assets satisfies their desired expected utility function.

Figure 2.1 Markowitz's Efficient Frontier
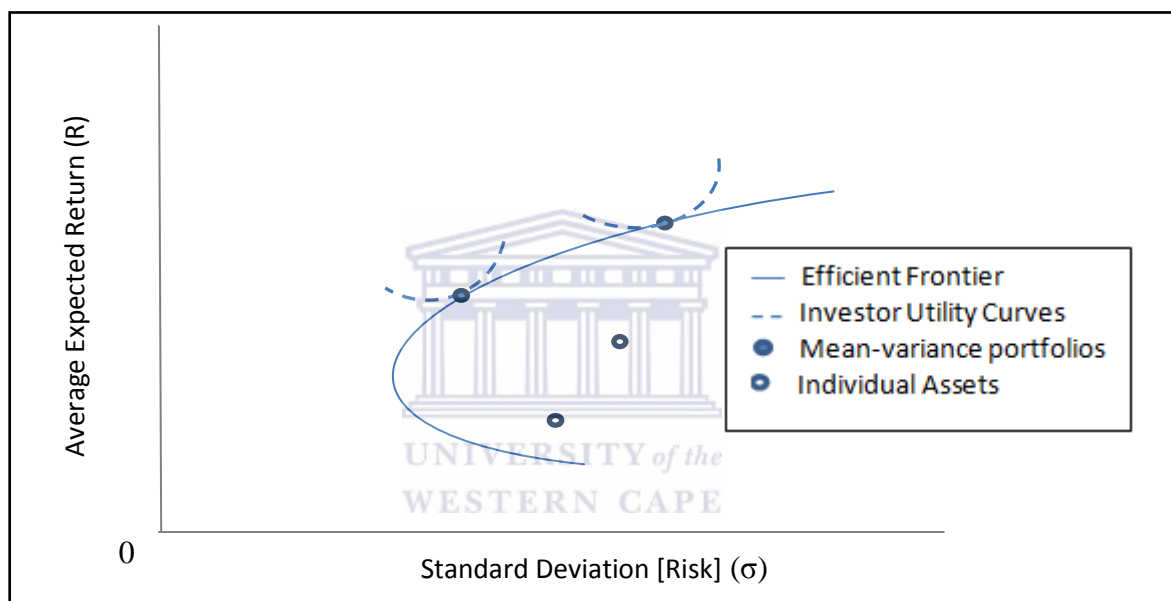
Kahneman, and Tversky (1979), believe investors base their decisions regarding portfolio compositions on expected utility theory. That a rational investor would only invest in those assets that either increases the portfolios expected return maintaining the portfolio's volatility or, opt for portfolio with lower risk variation without significantly diminishing the portfolio's expected return.

The assumptions for Markowitz (1952) mean-variance theory are:

- Investors choose between different assets based on their expected risk and return, determined by the asset's variance and mean.
- All investors are concerned with utility wealth maximisation and invest within identical time horizons.

- All investors are in agreement with regard to investment decisions concerning all assets, variances and means.

- Monetary assets must be arbitrarily interchangeable in exchange.

Markowitz (1952) noticed that diversification would diminish risk but not remove it. With use of mathematics and diversification, Markowitz (1952) found that a portfolio's volatility could be dramatically reduced without altering the portfolio's expected return. Markowitz (1952) recognised that a solitary share's risk was not significant, but rather how the share's risk contributed to the variance of the entire portfolio.

Investors are presumed to be utility maximisation conscious and therefore, will leave investments that offer a certain expected return with high volatility for a similar investment offering the same expected return but with lower risk. Similarly, investors would leave investments that offer a low return, at a given level of risk, for similar investments offering a higher expected return but with similar risk. A portfolio's expected return formula can be seen in Equation 2.1 and a portfolio's risk can be seen in Equation 2.2.

$$E(R_p) = \big(w_i * E(R_i)\big) + \big(w_j * E(R_j)\big) \qquad (2.1)$$

$$\sigma_{p^2} = (w_i^2 \sigma_i^2) + \big(w_j^2 \sigma_j^2\big) + \big(2w_i w_j \sigma_i \sigma_i \rho_{ij}\big) \qquad (2.2)$$

The variables w_i and w_j are the asset's weights in portfolio P. The variables σ_i and σ_j are the asset's standard deviations in portfolio P. The ρ_{ij} variable is the portfolio's correlation coefficient between assets, i and j historical return distributions in portfolio P.

A portfolio's expected return is calculated as being the weighted average of all shares expected return's, within the portfolio. The portfolio's risk is derived by determining the standard deviation of all portfolio share historical returns. A portfolio's risk profile is greatly influenced by the correlation between its asset's returns. Combinations of uncorrelated assets generally result in a lower portfolio standard deviation whilst combination of highly correlated assets usually results in a higher portfolio standard deviation. Therefore, an investor would only diversify his portfolio by incorporating

assets that are uncorrelated with each other whilst increasing the portfolio's expected return.

For mean-variance theory to be optimal, certain conditions must be met. The investor's utility function must be stipulated. The return distributions of assets must also be stipulated. An optimum portfolio found by an investor, is specifically related to return distributions within a single period. The correlations and covariance between all portfolios' assets must be estimated within a single period. The single period restraint has caused mean-variance theory to be notionally questioned, as investor's investment problems are truly multi-period problems.

2.3.2 Liquidity Preference Theory towards Separation Theorem

Liquidity preference theory is concerned with how much funds an investor would invest within financial assets. Liquidity preference, also considers the amount an investor allocates between cash (liquid low risk investments) and the alternative, financial assets.

Considering Liquidity preference theory, Tobin (1958) illustrated in uncertain periods that the portfolio's allocation decision essentially has two parts. The first part being, how the investor allocates funds among risky assets, and the second part involving how much the investor considers investing within the combination of risky assets to investment with safe assets. The described dilemma the investor faces is known as the separation theory. The separation theorem is based on investor utility preference towards expected return and risk.

Tobin (1958) utilised mean-variance theory to depict opportunity lines illustrating combinations of safe assets to risky assets, as seen in Figure 2.2. Investor utility functions were found to be tangent to the opportunity lines. Similar to Markowitz (1952), Tobin (1958) recognised standard deviation as a measurement of portfolio risk. The standard deviation measure described the portfolio's volatility for earning possible rates of returns. Investors who wish to earn higher rates of return will have to accept higher levels of volatility. Investors who prefer lower expected volatility will have to accept lower expected rates of return.

Figure 2.2 Tobin's Combination of Safe and Risky Assets Opportunity Lines
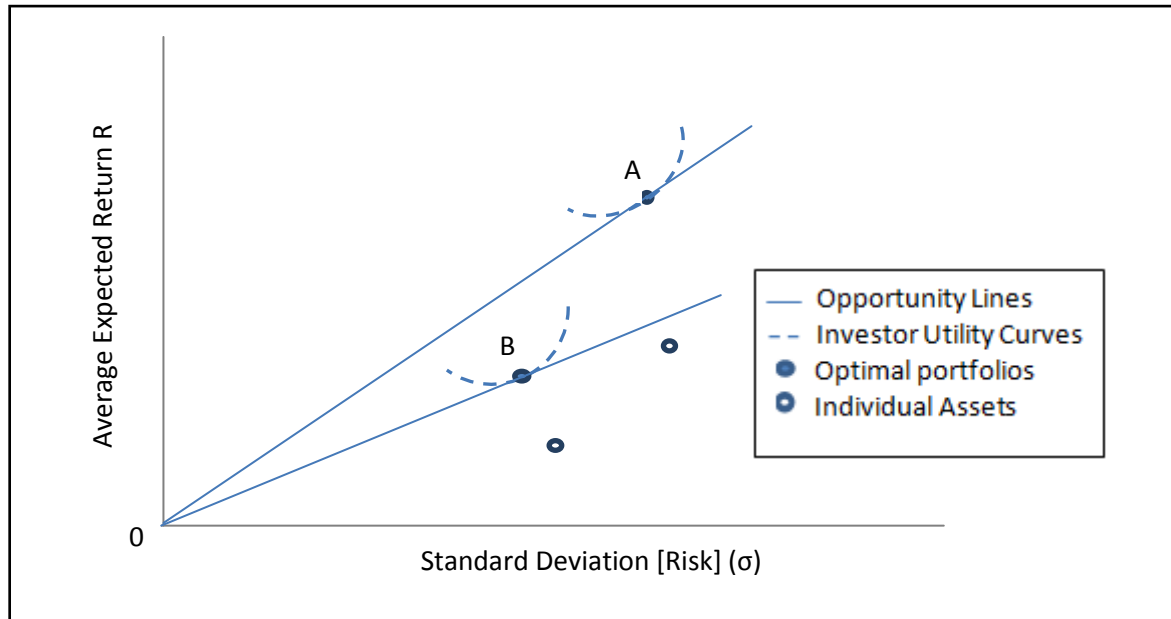
Investor utility curves are representative of an investor's preference towards expected return and risk. In Figure 2.2, the utility curve A on the top opportunity line represents a high fraction of investment in risky assets to safe assets. The utility curve B in Figure 2.2, on the below opportunity line represents a high proportion of investment with safe assets in relation to investment in risky financial assets.

Investors are considered to prefer utility curve A's return at utility curve B's risk. It is assumed investors always prefer a higher expected return. Investors who choose a higher expected return at a higher risk are seen as risk-lovers, whereas investors who choose a lower expected return at a lower risk are viewed as risk averters. Therefore, the proportion an investor holds between cash and financial assets determines an investor preference towards risk. The risk-averse investor is seen as the diversifier between the other two alternatives.

2.3.3 Modern Portfolio Theory

After Markowitz (1952) derived mean-variance portfolio theory, his next focus was to develop a critical line algorithm for finding the mean-variance optimal portfolio along the efficient frontier. Markowitz (1959) recognised separation theorem of Tobin (1958), as a means for finding the mean-variance optimal portfolio.

Separation theorem is concerned with allocation between risky assets and safe assets. If an investor has access to safe assets, then the decision of the optimal portfolio of risky assets is seen as independent and unambiguous to the investor's preference for expected risk and return. To find the mean-variance optimal portfolio is in essence a two-fund separation theorem.

Tobin's (1958) findings facilitated Markowitz (1959) discovery of the Capital Allocation line (CAL). Markowitz (1959) utilised the two-fund separation theory to produce the capital allocation line which is a combination between riskless and risky assets. In Figure 2.3, different allocations of riskless assets with Markowitz's (1952) efficient set of portfolios produce different expected risk return combinations that have each their own CAL. The CAL combination between riskless assets and set of risky assets that touches the efficient frontier was seen as the optimal combination and denoted as the Capital Market Line (CML), in Figure 2.3. The CML is consequently the topmost achievable CAL that offers a portfolio with the best risk return prospects for any investor. As identified in Figure 2.3, the CML is a straight line stemming from the risk free asset's return, touching the efficient frontier, thereby identifying the mean-variance optimal portfolio. The mean-variance optimal portfolio is found tangent between the CML and Markowitz's (1952) efficient frontier of risky assets.

Figure 2.3 Markowitz Mean-variance Efficient Optimal Portfolio
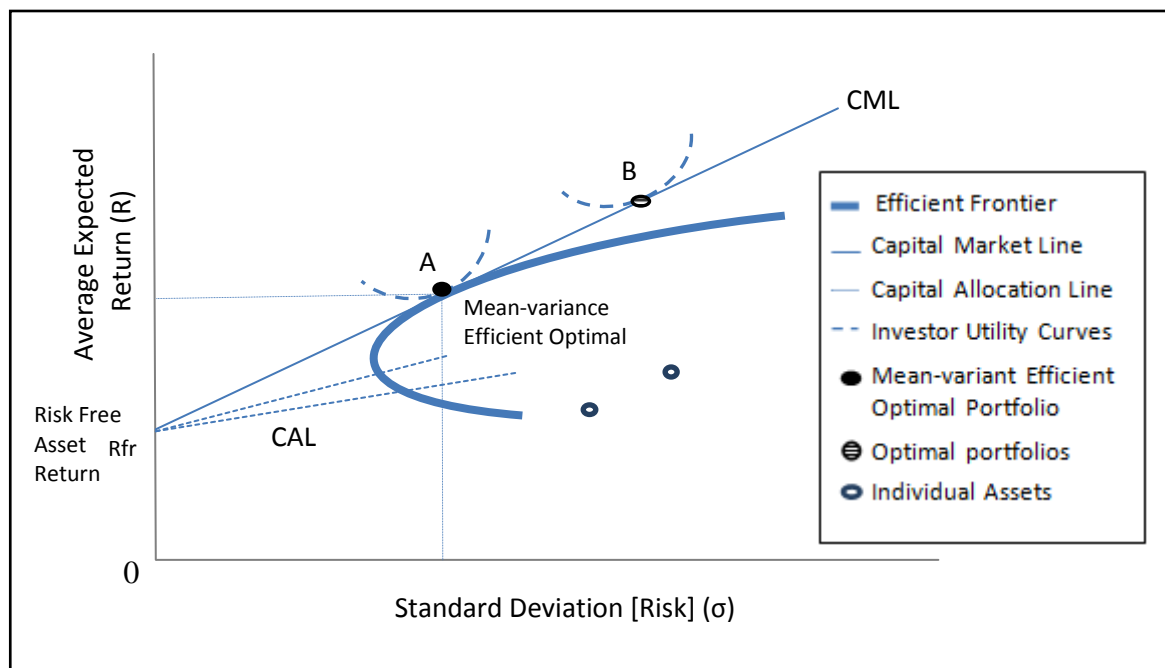
Each investor will have a utility curve according to their risk preference. The investor utility curves along the CML are considered optimal portfolios in their allocations between risky assets and riskless assets, as shown in Figure 2.3. The mean-variance efficient optimal portfolio is a thoroughly diversified portfolio that offers investors maximum expected return minus riskless return in ratio to the portfolios standard deviation or risk. The mean-variance efficient optimal portfolio is commonly regarded as the 'market portfolio'.

The mean-variance portfolio can be illustrated by the following Equation 2.3:

$$E(R_p) = R_f + \sigma_p^2 * \left(\frac{E(R_M) - R_f}{\sigma_M^2} \right) \tag{2.3}$$

The portfolio's expected return is shown as $E(R_p)$. The market's expected return is shown as $E(R_m)$. The return for the risk free asset is denoted as R_f. The portfolio's variance is denoted as σ_p^2. The variance of the market's portfolio is depicted as σ_M^2.

According to Markowitz (1959) a rational utility maximising investor within an uncertain single period should choose the mean-variance efficient optimal portfolio.

2.3.4 Capital Asset Pricing Model
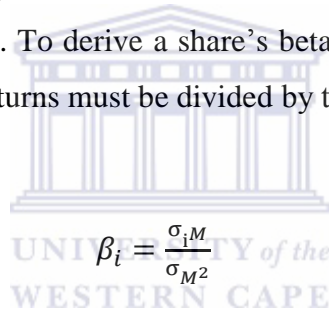
After the development of modern portfolio theory, issues arose on the input demands and computational complexity for finding the mean-variance optimal portfolio. Sharpe (1963) produced the 'diagonal model' that eased the computational burden of Markowitz (1952) mean-variance model. The major assumption of the diagonal model, as similar to Markowitz (1959) portfolio theory, is that an asset's return is commonly influenced by its relationship with a central underlying factor. Sharpe (1963) uses Markowitz (1959) CAL or 'critical line method', to derive the parameters necessary for his diagonal model, as depicted below in Equation 2.4.

$$R_i = \alpha_i + \beta_i I + \varepsilon_i \tag{2.4}$$

The shares expected return in Figure 2.4, is denoted as Ri. In Figure 2.4, the α_i and β_i variables are parameters and ε_i is a random measure estimated to be zero. The factor I in Figure 2.4 is seen as an index or an entire security exchange market, which significantly influences the returns of all shares.

Further developments by Sharpe (1964) and contributions from Linter (1965) and Mossin (1966) saw the creation of the Capital Asset Pricing Model (CAPM). When markets are in equilibrium, the CAPM is seen as a tool for calculating shares equilibrium rates of return. The CAPM was built on the assumption that shares within markets move together more than often. Therefore, only a small number of factors hugely influence the cross-sectional variation in returns. After establishing the linear relationship for the combination of shares, Sharpe (1964) considered an individual share's relationship to a group of risky assets. Sharpe (1964) termed this relationship a security's 'systematic risk'.

The portion of share's risk shared by all assets in the market is known as its unsystematic risk. Since the unsystematic risk can be diversified away, investors expect to attain excess return for accepting a share's systematic risk. A share's systematic risk is identified by its covariance with its market risk, and is known as the share's 'beta' coefficient (βi). To derive a share's beta coefficient, the share's return covariance with the market returns must be divided by the market return's variance, as depicted in Equation 2.5.

$$\beta_i = \frac{\sigma_{iM}}{\sigma_{M^2}}$$
(2.5)

With further extensions on Sharpe's (1963) diagonal model and independent contributions from Linter (1965) and Mossin (1966), the CAPM can now be seen below in Equation 2.6 as simplified 'single index' model:

$$E(R_i) = R_f + \beta_i\big(E(R_M) - R_f\big)$$
(2.6)

A portfolio's or share's expected return is illustrated as, $E(R_i)$. When the market is in equilibrium, the expected return is derived by adding the risk-free asset (R_f) with the market risk premium $\big(E(R_M) - R_f\big)$ sensitive to the investments systematic risk beta (β_i).

The Equation 2.6 is also denoted as the securities market line (SML). The SML, as proposed by Mossin (1966), aids investors to find the equilibrium price for their portfolio at the point when assets are exchanged within the market. Therefore, when the market is in equilibrium, the expected price of any asset is controlled by its

systematic risk. Those assets with a higher systematic risk would produce higher beta coefficients and therefore, be forecasted to generate higher returns to reimburse investors for undertaking the additional risk.

Figure 2.4 The Security Market Line
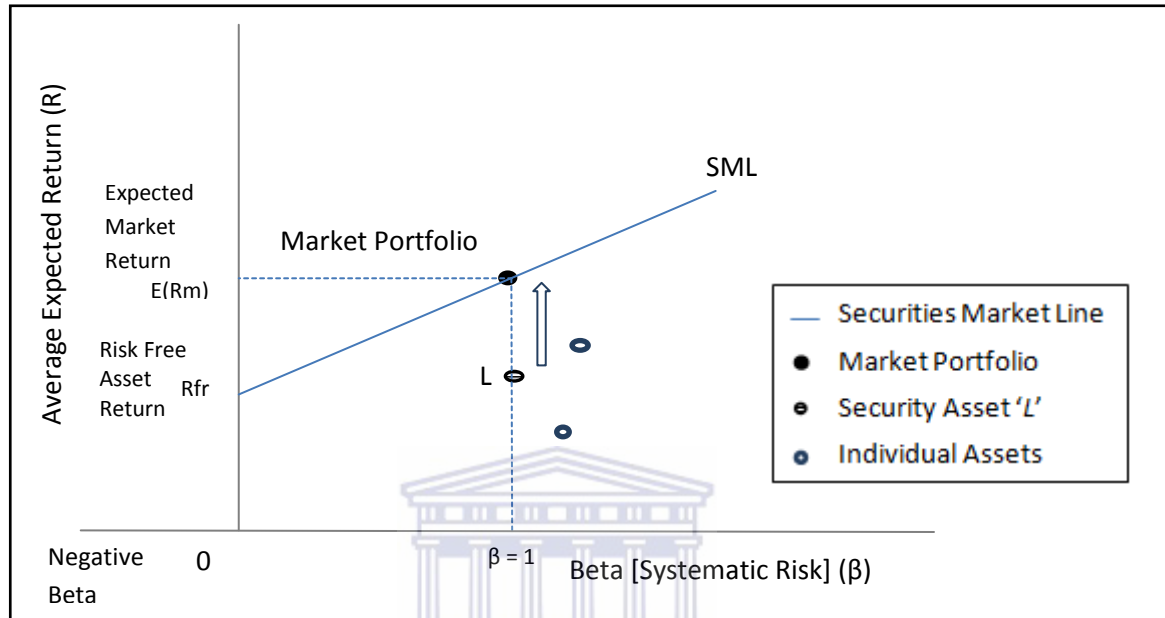
The expected asset returns, as identified by the SML in Figure 2.4 are governed by the assumption that the capital market must be in equilibrium. Hence, any asset offering returns not plotted on the SML will be incorrectly valued in comparison to the asset's relative systematic risk. Assets found to be above the SML are perceived to be undervalued whilst assets, like security asset 'L' that are plotted below the SML in Figure 2.4, are deemed to be overvalued. Security asset 'L' is seen as overvalued because its price is too high in comparison to the market. Security asset 'L' offers investors low expected return in relation to its expected systematic risk. As a result, investors will reduce their holdings in security 'L' thereby lowering the demand for the asset. This in turn reduces the price of security asset 'L'. When the price declines, investors would perceive the asset as a favourable holding and demand will increase to a point that the asset will converge back onto the SML, as illustrated in Figure 2.4. Due to market forces and investor trading behaviour; any asset not plotted on the SML will always submerge back onto the SML as the market recaptures an equilibrium state.

2.3.5 CAPM Theory of Market Equilibrium

The accuracy of CAPM relies on markets to be in equilibrium. Sharpe (1964) asserts that when markets are in equilibrium the CAPM determines the price of capital assets.

Sharpe (1964) considers investor preference within Markowitz's (1959) MPT. An uncertain investor is faced with possible investment options whilst considering the probability distributions of all assets. In making the investment decision, the investor will consider the investment's expected return and risk. The investor is assumed to be risk-averse and will choose the portfolio that offers the highest expected return with the lowest possible risk. According to Markowitz (1959) the portfolio that maximises a rational investor's utility function is the mean-variance efficient optimal portfolio.

Sharpe (1964) acknowledges that if an optimal portfolio was identified within a market, all rational investors intuitively should choose this optimal portfolio. In a market where interest rates for borrowing are the same for all investors and all investors are homogenous in their expectations. All investors will opt for the mean-variance efficient optimal portfolio; thereby making their investment preference resulting in the market to come into equilibrium. Sharpe (1964) termed the identified optimal portfolio preferred by all rational investors as the "Market portfolio".

For the capital market to be in equilibrium the following assumptions must be met:

- Short sales are allowed
- There is a risk free rate for lending and borrowing money. The rate is the same for lending and borrowing and investors have any amount of credit.
- There are no transaction costs in the buying and selling of capital assets.
- There are no income or capital gains taxes.
- The market consists of all assets. (No assets are exclusively private property).

Since all investors are homogenous and choose the market portfolio. Each investor will hold the same allocation of funds between assets. Their investment preference towards the market portfolio is collectively a representation of the 'market'. Therefore the optimal combination of Tobin risk –free asset and Markowitz mean-variance efficient portfolio is in fact an actual reflection of the market itself.

It is with this insight that Sharpe (1964) realises the CAPM. CAPM derives an asset's price specifically to the asset's expected risk and return when the market is in equilibrium. The CAPM's expected return-beta relationship is graphically illustrated by the SML. The market portfolio is found along the SML. The SML represents the equilibrium relation between all assets or the portfolios' expected return and systematic risk.

If a single security was not included in the market portfolio, that single security's price will drop, making the security severely undervalued. Once investors realise the asset is undervalued, the security will be bid up to a point that the asset is once again included in the market portfolio.

The security behaviour discussed above is the result of auto-correlations within efficient markets. Fama (1991) asserts that accurate asset pricing models cannot exist without operating within an efficient market. Therefore, tests on asset pricing models inadvertently tests the efficiency of markets they are applied.

2.4   Market Efficiency and Critique of Capital Market Theory

2.4.1   Efficient Market Hypothesis

Samuelson (1965) was the pioneer to debate the efficiency of markets, but concentrated on the concept of martingale instead of arguing on the theory that asset returns follows a random walk. Samuelson (1965) accredits the unpredictable trends in asset fluctuations to the immediate incorporation of fresh information that instantaneously adjusts asset prices in an unbiased manner. When competition is fair within the market, all information must be accessible to all investors preventing no blockades to trade. When all assumptions are met and information is available to all in an unbiased manner, the market is seen to be near flawless efficient.

Fama (1965b) recognises that security prices follow a 'random walk'. From this assertion Fama (1970) shows that successive asset price changes are independent, where the covariance between current securities returns and future returns are mutually independent. The implication is that returns are serially uncorrelated, and that current asset price changes are independent from prior price changes.

Following the realisation that security prices follow a random walk, Fama (1970) considers a '*fair game*' analogy. In a '*fair game*', an investor has the opportunity to either win or lose in a game of chance with regard to investing in a certain asset. In a '*fair game*' situation an asset prices reflect all current information and that changes in asset's prices are a result of new information. On the proposition that new information and the quality of this information are expected to be revealed indiscriminately, this would imply that future and current asset prices move randomly.

From the aforementioned concepts, Fama (1970) establishes the different forms of market efficiency according to his '*Efficient Market Hypothesis*'. Three forms of market efficiency are identified; the weak, semi-strong and the strong form efficient market. The *Efficient Market Hypothesis* states that an operationally efficient market in the 'weak form' disallows rational investors to seek out excess market return, because all security prices will incorporate all past and available trading information in an unbiased manner. Trading information such as share's historical return patterns and trading volume.

A semi-strong efficient market is considered when all security prices reflect publicly known information regarding all firms' future prospects. Publicly available information is any public announcements of listed company's financial positions and performances. In a strong form efficient market, all security prices reflect historical trading trends, publicized company future prospects and all companies inside information are not accessible to the public.

Investors utilise all available information to trade on the market. According to Fama (1970) asset returns are random in nature and unpredictable for investors to arbitrage from. Fama (1970) hypothesises that each form of market efficiency rules out investor's attempts to outperform the market. The market therefore behaves in a manner that makes investors trading schemes obsolete that no investor may achieve excess asset returns on a consistent basis. This is in fact why the market is seen as efficient, as arbitrage opportunities are quickly nullified after such anomalies are discovered.

2.4.2   Critique of Capital Market Theory

The derivation of the Market Portfolio in capital market theory is unfortunately based on unrealistic assumptions. According to CAPM, the market portfolio is a compilation of all assets; therefore the market portfolio would include all developed markets and emerging market's assets, real estate and bonds in unison. It is on these assumptions with which *Roll*'s *Critique* argues against the capital market theory's market portfolio.

Roll (1977) criticises the foundations of CAPM and the nature of the market portfolio. He argues that no definite test of the CAPM has been evident thus far. Roll's (1977) argument is based on the requirements for ascertaining the market portfolio, and the likelihood of never observing the market portfolio. According to Sharpe (1964) the market portfolio consists of all assets worldwide, all assets like shares, bonds and real estate from all markets developed and emerging. However, it is virtually impossible to hold all markets' assets at once. Therefore, Roll (1977) contends that the market portfolio is unobservable and hence un-testable.

Rolls (1977) second argument that CAPM is un-testable is on the deliberation that many researchers test CAPM by use of a proxy for the market like the SP 500 index. The issue with using a market proxy is that, the market proxy might be mean-variance efficient when the real market portfolio is not. Conversely, the market proxy might be mean-variance inefficient at a point when the true market portfolio is efficient. This implies that CAPM tests using a market proxy are biased since the market proxy chosen is not an accurate reflection of the true market portfolio.

Similar assertions are found by Hansen and Richard (1987), with regards to criticisms of the testing of CAPM. CAPM infers a conditional linear factor model, but does not imply an unconditional model. Therefore, when CAPM fails asset's pricing tests within conditional boundaries; the CAPM may be better suited in finding an asset's mean and variance in unconditional terms. CAPM implies and is dependent on all investors' information sets being identical. However, it is unlikely that all investor information sets will be observable. Therefore, the conditions for CAPM to exist restrain it from ever being accurately tested.

2.4.3   Misspecification of CAPM

Following *Roll's Critique*, Roll (1978) identifies an important criticism of CAPM that realises the Joint-Hypothesis problem whenever EMH or capital market theory is tested. CAPM states that each asset's expected return is related to its beta coefficient, where any anticipated residuals revert back to zero. The importance of beta is that it determines the portion of an asset's risk and return that is associated with the market, where the excess expected return is seen to be uncorrelated with the market. CAPM assumes that investors have homogenous expectations with different risk appetites. In reality, all investors do not obtain the same level of information, where some investors may have superior information in their possession and therefore, have different expectations in relation to other investors.

Roll (1978) identifies that if the use of a market proxy is bias in attempting to test CAPM's practicality, then the beta and SML derived from such a market proxy would inherently be biased as well. Roll (1978) asserts that deriving an assets beta from a market proxy would be significantly different if the asset's beta was obtained from the true market portfolio. Therefore, the decision whether an asset's expected excess return is above or below the SML is greatly affected by the choice of market proxy. The use of a market proxy inherently results in a misspecification of an asset's beta coefficient and relation to the market's SML.

2.5   Behavioural Finance

The traditional premise in economics is that asset prices are determined by rational investors. There are however two issues with this belief. Firstly, if the aggregate of rational investors sets an asset price, there would still be curiosity as to what an individual investor's behaviour is towards investing in that asset. Secondly, supporters of this rational investor theory have struggled to define the principles regarding the exact theory, though the argument is instinctively attractive.

According to Thaler (1999), rational investors are interested in practical assessment of assets and not in the expressive characteristics they hold. Rational investors are also naturally risk averse, at no time are they confused by conscious errors. Rational investors also exhibit impeccable self-control with no remorse while conducting asset

valuations and investment. The everyday investor however does not behave as a rational investor and are known to make systematic errors.

The affect an irrational investor may have on asset pricing can be seen in the following scenario, taken from Thaler (1999). Consider a market where there are two assets, X and Y, and both are evaluated to be worth the same value. There are also, two investors within this market, one rational and the other irrational. If the irrational investor believes that the value of X is higher than the value of Y, nevertheless the rational investor knows they are both worth same value. The implication on the two assets prices can be profound and problematic.

Thaler (1999) argues that when the following conditions are met, the correct assessment of the two assets should prevail. The first condition is that the market must not be dominated by too many irrational investors who possess large capital funds. Secondly, the market must permit costless short selling, in order for rational investors to drive down asset prices if they are raised too high. Thirdly, only rational investors should be permitted to short sell, as irrational investors will counter rational investor's attempts to drive down overvalued assets. The fourth condition is that at some date, there must be consensus between all investors over the real value of the two asset prices. The last condition is that rational investors must invest according to long horizons that include the previous mentioned consensus date. When these conditions are met, the disparities between rational and irrational investors are considered to be nullified. However, these conditions within the real market are improbable to transpire.

When investors speculate and are influenced by their sentiments regarding certain asset values, the equilibrium view for the optimal portfolio will be disjointed amongst investors. Therefore, the behaviour of irrational investors creates irrational markets which are converse to the assumptions of capital market theories and EMH.

2.5.1 Prospect Theory

Expected Utility theory is based on the premise that investors are risk averse when making investment judgments. Prospect theory has a differential view, that though investors are risk averse, investors make investment decisions by favouring to limit losses rather than experience gains. Under uncertain conditions, investors occasionally

are inclined to base their decisions on cognitive physiological beliefs instead of basing their judgement on rational decision making.

According to Kahneman and Tversky (1979) market players tend to overvalue results that are certain and underweight outcomes that are probable. They termed this occurrence as the certainty effect. They argue that investors in uncertain times base their decisions according to some reference point such as the procuring price of an asset. When investors are faced with a circumstance where winning is possible but not likely, most investors select the larger gain according to the reference point. This phenomenon displays general investor's attitude towards risk.

An example of Prospect theory from research conducted by Kahneman and Tversky (1979) can be seen in the following scenario. A group of investors are given the following options and must select only one outcome between the two options. Option one is a probable R4000, and option two is a possible 70% chance of winning R5000 with a 30% chance of winning nothing. Kahneman and Tversky (1979) found that the bulk of the investors choose the probable outcome over the possible higher gain.

What was also identified is that when outcomes are posed as losses, investors select differently to their first option in a reverse pattern. Adjusting the previous example, by making option one a probable loss of R4000 and option two a possible 70% chance of losing R5000. Most investors choose the uncertain option instead of the probable loss option. Investors therefore reverse their judgements when their prospects of succeeding are lower than zero. Kahneman and Tversky (1979) term this phenomenon as the reflection effect.

What is evident from Kahneman and Tversky's (1979) research is that investors are risk averse when faced with beneficial prospects but are risk seeking when faced with negative outcomes. The driver of investor judgement in these scenarios is therefore the certainty factor. Investors prefer probable gains and are averse to risk in uncertain situations.

Expected utility theory maintains that investors act rationally so that they can achieve the highest asset position obtainable. Kahneman and Tversky (1979) have shown that many investors are bias because of their physiological beliefs. Therefore, many investors are less concerned with their final asset monetary value and are more

concerned with the asset's risk and returns during the investment period. This finding violates the expected utility theory, and prospect theory is offered by Kahneman and Tversky (1979) as an alternative for investor decision making.

2.5.2 Behavioural Hypothesis of Investor Overreaction

Research produced by Kahneman and Tversky (1979) on individual's psychological rationale for decision making has shown that investors often do not act rationally, as the premise of theoretical models suppose them to be. Individuals often use cognitive heuristics when making decisions that do not necessarily conform to rational laws of probability. The result is that biases or systematic errors occur that conflicts with the normative behaviour that economic trading models are founded on. These behavioural biases can result in severe disparity in equilibrium conditions required for models like capital market theory and EMH to work. The Investor Overreaction Hypothesis by De Brondt and Thaler (1985) was found on the premise of Kahneman and Tversky (1982) theory on individual psychological decision making that resulted in irregularities found within EMH.

De Brondt and Thaler (1985) note, that according to Kahneman and Tversky (1982), individuals tend to overweight current information neglecting historical information. This is imperative because asset prices are deemed to reflect all information, but when this information becomes available, how would the bulk of investors interpret this new information. According to capital market theory and the EMH, both theories are on the premise that investors behave rationally. Therefore, according to both theories, when new information is inconsistently interpreted between investors, investors that value information differently will realise their disparity and conform their investment back to the market portfolio.

De Brondt and Thaler (1985) question whether all investors interpret new information in unison as expressed by capital market theory. The interpretation of new information is discussed by De Brondt and Thaler (1985) as a reaction to sudden dramatic news events. Capital market theory implies that investors react appropriately, but what is an appropriate reaction to new information is questioned. An appropriate reaction is understood to be rational behaviour given a set of possible outcomes. On the contrary, Kahneman and Tversky (1982) have shown that investors do not always behave in

rational ways. The result of following interrogations, leads De Brondt and Thaler (1985) to believe that on occasion investors tend to overreact to new information.

De Brondt and Thaler (1985) assert that companies with previous poor earnings reports are unfairly adjudged to be worth less than their true intrinsic value. Once an improved earnings forecast is reported for the company, its asset price self-adjusts to correct state due to improved market outlook. Similarly, companies with too high of a price earnings ratio are "overvalued" by the market and its participants. After subsequent realisation of the company's true worth, the share price drops to a fairer representation. This process is termed mean reversion.

Given the previous discussion, De Brondt and Thaler (1985) hypothesise that asset prices that are systematically overvalued will reverse back to their correct price in a predictable manner. Their theory was based on two assumptions. Firstly, an asset that experiences great movement in one direction would respond in the previous period in the opposite direction. This phenomenon was termed the "winner-loser" effect. Secondly, the greater the price fluctuation, the more pronounced the subsequent reversal adjustment will be.

As a result of their research De Brondt and Thaler (1985) were the first to find empirical evidence of weak form market inefficiencies when they observed that share prices on occasion tend to overreact. Preceding their earlier work De Brondt and Thaler (1987) also review seasonality in asset returns trends, when they discuss the "January effect". The January effect coupled with the winner-loser effect is regarded as all a result of investor overreaction hypothesis.

2.6   Anomalies

2.6.1   Value Effect

Capital market theory proposes that investors hold the market portfolio, but what is suggested by Graham and Dodd (1934) is that with the use of accounting measures investors can select shares that would outperform the market. Stemming from Graham and Dodd's (1934) value investing theories, many researchers have found value strategies that have outperformed the market.

Basu (1977) was of the first researchers to show that, with the use of accounting data, higher returns could be obtained contrary to the markets valuations. Basu (1977) demonstrated that shares with low price-earnings ratios produce higher returns in comparison to the market. Basu (1977) considered capital market theory, and found evidence that CAPM's beta did not entirely account for all asset returns. Therefore, the higher excess returns achieved by price-earnings (P/E) ratio indicators were not anticipated by CAPM. However, the share earnings yields were found to be related to risk-adjusted returns. Basu (1977) therefore, attributes the anomaly as evidence of market inefficiency. Basu (1977) hypothesises that security's with low price earnings ratios are "undervalued", because investors become unreasonably cynical of a security's worth after a spate of consistent poor earnings reports. As a result of poor valuations, certain shares were adjudged to be worth far less than their intrinsic worth. The aforementioned theory was termed the "price-ratio" hypothesis by Basu (1977).

Rosenberg, Reid and Lanstein (1985) conducted similar research as Basu (1977) but are the first to use the book-to-market ratio. They found that a security's book-to-market ratio exposed shares that generate higher returns contrary to markets valuations. Rosenberg *et al* (1985) believe their findings to be evidence that the market portfolio is inefficient. Companies with higher book-to-market metrics produce returns higher than there beta's predicted. Similarly, companies with low book-to-market metrics produce lower returns than implied by their CAPM betas.

Fama and French (1992) contend that shares are priced rationally, even when Sharpe's (1964) CAPM beta has shown not to sufficiently explain the cross-section of asset returns. Fama and French (1992) propose that other variables exist, that further contribute to the explanation of asset returns. Therefore, an asset's risk is not entirely measured by its systematic risk but in fact an assets risk is multidimensional in nature. Fama and French (1992) hold the view that an asset's additional risk factors are explained by its size and book-to-market coefficients.

Fama and French (1992) does however confess that the underlying reasons for the excess performance, which can be attributed to the size and value risk factors, over CAPM beta measure are still unknown. The belief is that the size and value risk factors represent hidden risk variables not captured by CAPM's beta, and that

investors willing to invest in those additional risk factors must be compensated for bearing the additional risk.

2.6.2 Contrarian Value Strategy

Lakonishok, Shleifer and Vishny (1994) argue that value strategies outperform CAPM's methods because; the method is 'contrarian' to the 'naïve' investor who invests according to the CAPM ideal. Lakonishok *et al* (1994) construct portfolios utilising four accounting metrics; book-to-market ratio, earnings-to-price ratio, cash-to-price ratio and gross sales measure. Similar to the investor over reaction hypothesis, naïve investors overweight past information on company's performance and trade in a manner that bids up security prices making these shares become 'glamour' shares. Glamour shares are overpriced, whilst shares that receive little attention are severely under-priced. Contrarian investors are aware of the disparity between the two opposing types of shares and take advantage of the undervalued shares.

Lakonishok *et al* (1994) are convinced that value strategies would produce long term superior performance. Lakonishok *et al* (1994) contemplates the reasons for investor overemphasis in glamour shares. They believe, that investors on occasion make poor evaluation errors when assessing shares and that some investors simply consider well-run firms to be good investments. Lakonishok *et al* (1994) also believe that agency problems result in money managers opting for glamour shares as they are much easier to explain to investors in comparison to value shares that may be characterised as distress firms.

2.6.3 Size Effect

Reinganum (1980) tests whether the P/E-ratio effect of Basu (1977) is conditional on the value of the shares market value. What Reinganum (1980) finds, is that once controlling for size, the P/E-ratio effect disappears. What Reinganum (1980) finds interesting is, that when tests were conducted the other way around, by controlling for P/E-ratios, there is a significant relationship evident between lower market-cap shares earning higher returns than larger market-cap shares. Reinganum (1980) therefore, finds that the P/E effect was in fact merely a proxy for size effect.

This phenomenon "size effect", was fortified by research conducted by Banz (1981). Banz (1981) considers the misspecification of the CAPM's market proxy as argued by Roll (1978). Banz (1981) assumed a similar assertion as Roll (1978), when it was found that smaller market capitalisation shares exhibited higher risk-adjusted returns than larger market capitalisation shares. Banz (1981) emphasized that the size effect evident in his research was not explained by Sharpe's (1964) CAPM beta coefficient. This led Banz (1981) to believe there was possibly other risk factors that existed that were not fully captured by CAPM.

After the size-effect was observed, two explanations surfaced for this phenomenon. The first was a perception that smaller companies were less observed and therefore, poor information sets existed on smaller market-cap shares. The second, was a belief that smaller company shares were less frequently traded and often at higher transaction costs. All which resulted in inaccurate risk measurements for small market-cap shares.

Banz (1981) does however, express caution when interrupting any findings questioning the CAPM misspecification. According to Ball (1977), any results from tests of market efficiency can be easily attributed to the misspecification of CAPM. Banz (1981) suggests a similar notion towards Basu's (1977) findings. It is regarded that any tests of either efficient market hypothesis or capital market theory are in fact joint tests of both theories, and anomalies found can be easily attributed to either theory's flaws.

2.6.4 Multifactor Asset Pricing Model

So far the discrepancies with CAPM and the efficient market hypothesis have been highlighted. Though the flaws primarily are apparent with CAPM, it is notable that arbitraging from irregularities shown in the efficient market hypothesis is challenging and not consistently achievable. The anomalies that have been identified earlier are however not explained by either theory or omit how these effects allow certain shares to generate excess returns.

Fama and French (1993) therefore present their three-factor model as better descriptor of the market's average returns as a mean-variance efficient alternative set. Fama and French's three-factor model utilises the traditional CAPM beta coefficient, sensitive to

an assets' size factor (SMB) and value/growth factor (HML). The aim of the three-factor model and especially the SMB and HML factors is to attain the excess returns illustrated by size and value shares strength over growth/glamour shares not identified by the CAPM.

Fama and French (1993) recognise that the though size and value risk factors produce excess returns over CAPM, they confess that the underlying reasons for the superior performance is still unknown. Their belief is that the size and value risk factors in the three factor model represent risk variables not captured by CAPM, and that investors investing in those additional risk factors must be compensated for bearing the additional risk. Fama and French (1993) believe the best explanation for size and value anomalies is De Brondt and Thaler's (1987) overreaction hypothesis. That security prices tend to fluctuate according to investor behaviour. When investors overreact and conduct in 'noise trades', shares are incorrectly valued thereby resulting in shares to be mispriced. Noise trading therefore results in security mispricing, causing predictable pricing anomalies to occur.

2.7   Active versus Passive Portfolio Management

2.7.1   Active Management Debate

The origins of Active Portfolio theory stem from the Treynor and Black (1973) inquiry. Treynor and Black (1973) argue that investors, who have access to special insights in regards to security price trends, gain little benefit from modern portfolio theory and the acceptance of capital market theory's market portfolio. They identified that investment decisions should be based on two components, firstly analysis of shares long term risk and rewards, and secondly, active management to benefit from perceived mispriced shares. The latter requiring judgment, and in a scenario where the investor cannot establish a profitable deviation from the market portfolio, then the portfolio should remain passively tracking the market portfolio.

Black, Fraser and Power (1992) discuss the reasons why active fund managers may be able to identify mispriced shares. Firstly, active fund managers may have the shrewd ability of identify shares that are undervalued by the market. Secondly, active fund

managers may possess a skill in timing security trends and thereby exploit arbitrage opportunities.

Grinold and Kahn (2000) contend that in a market there are typically three types of investors. Investor X who holds a portfolio with positive expected residual returns. Investor Y who holds a portfolio with negative expected residual returns, and investor Z, that follows the market portfolio. Between investors X and Y, one of these investors is the "greater fool". The greater fool theory, states that some investors do not want to admit that they possess inferior information to others, and trade with the likelihood of incurring losses.

Both investors X and Y are active investors. Active investing is the pursuit and continuous effort by investors in picking rewarding shares at opportune points in time. The objective of active management is to obtain excess return (termed alpha) above the portfolios relative market return, or acceptable benchmark. Active investors utilise different techniques in an attempt to outperform the market. These techniques are categorised as asset selection, asset allocation and market timing.

Investor Z is seen as the passive investor. When an investor holds the market portfolio, as popularised by Sharpe (1964), the investor is investing passively. Malkiel (2003) contends that passive investing or indexation achieves a higher return than active investing in markets that are efficient or inefficient. Malkiel (2003) discusses the reasons for indexing strategies superiority over active investing, under the following topics; Efficient Market Hypothesis, Investment performance is a zero-sum game, and risk in active management.

When markets are deemed to be efficient, active investing is seen as a needless exercise as all shares already reflect all available information. It is believed that at stages where the market is at its most operationally efficient, then it is impractical for investors to perform in active investing. Those investors that engage in active investing are likely to underperform in comparison to the market. Investors are therefore better off investing in a low-cost index investment vehicles.

When an investor's market is thought to be information inefficient, the converse is true that opportunities may exist to exploit incorrectly priced assets. In this instance active investing could be beneficial but is dependent on the skill of the active fund

manager. Malkiel (2003) argues that even when markets are not efficient, the anomalies present within the market are usually minor in nature and not worth the costs involved to exploit the phenomenon. Another argument is that any pricing error identified by investors, habitually disappears after discovered as the asset's price adjusts so that all new information is reflected in its price.

Notwithstanding the efficiency of the market, investing actively in a market at a single point in time is a zero-sum game. Where, not all investors can win. According to '*The Arithmetic of Active Management*' by Sharpe (1991), the average of all active investors before administration costs should equal the performance of a passive investment. Consequently the average of all investors after administration costs would result in lower performance than a similar investment within a passive investment vehicle. Sharpe's (1991) theory is on the premise that for every investor that realises a gain on the market, similarly there must be a loser who under achieves the markets index's performance. The market average is therefore the net result from all active investors trading on the market. Therefore, only a few active investors will outperform the market index to the detriment of many active investors.

Indexation is seen as a passive strategy that mimics the movement of a specific index. Investing in an index is essentially investing in a group of shares that either represents a sector of the market or the overall market. Therefore, by investing in an index, the passive investor would be investing in a well-diversified portfolio. The overall risk of the index would therefore experience modest specific risk and involve mainly unsystematic risk. Active funds on the other hand deviate from the market index and therefore incur higher systematic risk. Actively invested funds will experience higher overall risks compared to index tracking funds. When analysing the performance between an active strategy and a passive index strategy on a risk-adjusted basis, it is likely that the index strategy will have a higher or comparable performance.

2.7.2   Fundamental Indexation

The use of security market capitalisations for index construction is the norm within the investment industry. Those investors that follow passive strategies typically track cap-weighted indices. However, Treynor (2005) finds that market cap-indifferent strategies have shown to outperform the market capitalisation based indices.

Arnott, Hsu and Moore (2005) propose that indices constructed according to fundamental measures are more mean-variance efficient than cap-weighted indices. Their argument stems from the indifferent valuation methods used by analysts to value companies. Analysts from the Wall Street would focus primarily on company market values. On the contrary, analysts from the New York Post would value a firm on accounting measures like gross sales, etc. The opposing valuation method suggests there is disagreement between the worth or value of a company between the two institutions. Each method produces different results and creates disparity over what is the accurate valuation of a company's worth or possible growth prospects.

Arnott *et al* (2005) recommend using accounting data as substitute measures of a company's size. The accounting measures suggested are a firm's; book value, cash flow, sales, revenues, dividends or employment. These measures are deemed a fair representation of a company's size as almost all large capitalisation shares exhibit strong liquidity and accounting performance.

The benefits of using accounting measures that are highly correlated with market capitalisation values, ensures that an investor does not deviate much from a cap-weighted index. Arnott *et al* (2005) find that the volatility among their fundamental indices and an opposing cap-weighted index was almost alike. They noticed that fundamental indices and the cap-weighted index depict nearly identical betas. Therefore a passive investor would anticipate higher expected returns with similar systematic risk profiles as a market-capitalisation weighted index.

According to Arnott *et al* (2005), the primary reason why fundamental indices outperform their market capitalisation counterparts is because they are not price-weighted indices. Price-weighted indices tend to overweigh funds in overpriced shares with less investment in under-priced shares. If shares are mispriced, the portfolio constructed according to these miss-pricings would produce a suboptimal portfolio. Their reasoning for the superior performance of fundamental indices is therefore, similar to the view of De Brondt and Thaler's (1987) and Lakonishok *et* al (1994) that glamour shares are extremely overpriced in comparison to their actual fair values, whilst value shares are significantly under-priced.

Chapter 3 :   **LITERATURE REVIEW**

3.1   **Background**

Over the last decade there has been a considerable rise in passive index investment. The trend started within developed markets, where it has since grown in popularity globally. Although, it is the opinion of Arnott and Sheperd (2011) that in emerging markets investors are less inclined to invest passively as the inefficiencies within their markets present opportunities for active investors to arbitrage from.

Malkiel (2003) argues however, the difficulty for active fund managers is to outperform the market on a consistent basis. Malkiel (2003) also contends that investment in the market index will achieve higher returns than actively managed funds in efficient and less efficient markets. Vargas (2007) finds similar evidence within the Spanish mutual fund market, where active strategies underperform in comparison to the market. It is therefore evident that passive investment or indexation within developed and emerging markets has grown as a viable option for investors to pursue and is duly supported by academic financial literature. If active strategies within emerging markets do not achieve higher returns than the market on a consistent basis, then it would suggest that investors could be better off investing in the market index.

Arnott and Sheperd (2011) find fault with cap-weighted indices and argue that cap-weighted indices overweigh funds in overpriced shares. Hsu (2006) finds that the lag in performance between a cap-weighted portfolio and a non-capitalisation weighted portfolio is twice the variance of the market's average pricing noise. Within less efficient markets the pricing noise is thought to be more pronounced and understood to be even worst within inefficient markets. Due to the prominent pricing noise variables, portfolios or indices that are cap-weighted will cease to be mean-variance efficient and therefore experience a return drag in performance.

Arnott *et al* (2005) discover that indices that are fundamentally-weighted provide indices that are more mean-variance efficient than cap-weighted indices. Arnott *et al* (2005) use company data and accounting measures to produce portfolios that are non-

capitalisation weighted. Although, research conducted by Arnott *et al* (2005) used developed markets data, they believe that the trend would be similar for emerging markets. Arnott and Sheperd (2011) use the Emerging Markets RAFI index to illustrate the fundamental index's higher risk-adjusted returns over its cap-weighted counterpart within the same period.

The JSE which is currently ranked 17th largest market in the world is seen as an emerging market[1]. The norm within South African market is for investors to invest in actively managed funds. The perception with the JSE, which is similar to belief of Arnott and Sheperd (2011), is that an emerging market which is less efficient provides opportunities for active investors to exploit. Therefore, minor investment in passively managed funds within the JSE exists.

Contrary to aforementioned beliefs, Wessels (2004) shows that within the period 1988 to 2003 the JSE ALSI achieved higher return than the average of actively invested funds in the JSE. What is also noticeable, since the introduction of ETF's, is that index investment has risen within the JSE (Cameron, 2010)[2]. With growth in support for indexation in the JSE it is relevant to ascertain whether Arnott and Sheperd's (2011) theory, that indices constructed according fundamental attributes will achieve higher mean-variance than cap-weighted indices.

3.2   Fundamental Indexation Discussed

Arnott *et al* (2005) argue that fundamentally weighted indices are more mean-variance efficient than cap-weighted indices. Their justification for fundamentally weighted methods superior mean-variance is that cap-weighted indices are sensitive to price fluctuations. Whereas fundamental attributes are considered to be price-insensitive measures and not as severely affected by noise trading.

Firm market capitalisations are determined by the security's price in relation to the number of shares outstanding. Therefore, a firm's market value is greatly influenced by the share's market price. A share's price is understood to be an approximation of a company's true underlying worth. Shares that demand higher prices are firms that are

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[1]From Profile Group's: Profile's Stock Exchange Handbook, May 2013 Issue.
[2] From SADailyNews24, article "*Investors actively going for passive funds*" by Bruce Cameron, published 3 July 2010.

seen as more valuable and are expected to prosper in the coming future. Therefore, a firm's market value is seen as an indicator of a company's size, as shares with larger market capitalisations are understood to be worth more.

According to Siegel (2006), prices are also affected by momentum traders and speculative investors. This trading behaviour is seen as conflicting to rational utility maximising investor's behaviour and is regarded as noise trading. The result is that security prices are mispriced in relation to its true underlying worth. Arnott *et al* (2005) argue that noise trading results in large growth shares to be overpriced, whereas smaller market-cap shares to be significantly under-priced.

As a replacement for using share market-caps for portfolio construction, Arnott *et al* (2005) suggest that fundamental attributes like company operating and accounting measures be used. The company fundamental attributes they utilise are gross earnings, gross sales, cash flow, equity book value, gross dividends and total employment. These fundamental attributes are argued to be price-insensitive measures and therefore less influenced by dramatic price fluctuations.

3.3   Merits of Fundamental Indexation

The use of market-caps for index construction originates from the mean-variance efficiency of the market portfolio found when capital markets are in equilibrium, as theorised by Sharpe (1964). However, for the capital market to be in equilibrium strict assumptions must be met. These assumptions are understood to be unrealistic and therefore the validity of the market portfolio being the preeminent mean-variance efficient combination will always be questioned.

Under real economic conditions, cap-weighted indices (market portfolio) seldom produce the highest mean-variance (Fama and French, 2003). There are however advantages that cap-weighted indices have over actively managed portfolios. Arnott *et al* (2005) list these advantages within their literature on fundamental indexation. These advantages may cause cap-weighted indices to experiencing a higher return in comparison to actively managed portfolios.

- Cap-weighted indices require less trading as it is a passive strategy. Rebalancing occurs spontaneously as the constituents weighting within the

index changes with price fluctuations. Since there is less trading, cap-weighted indices incur less transaction costs and fees in comparison to actively managed portfolios.

- Cap-weighted indices afford investors the opportunity to invest broadly among the market's largest and most well established firms.

- Cap-weighted indices usually invest a great deal within highly liquid shares, which ultimately reduce rebalancing costs as well.

- Cap-weighted indices commonly invest in those firms that are characterised as having excellent investment capacity.

Arnott *et al* (2005) present their fundamentally-weighted indices as an alternative to cap-weighted methods. They maintain that fundamentally-weighted indices produce portfolios that are more mean-variance efficient whilst retaining many of the benefits of cap-weighted indices.

3.3.1 Preservation of Market Capitalisation Efficacies

Whilst considering portfolio weighting alternatives, Arnott *et al* (2005) sought to find factors that could be used to construct mean-variance efficient portfolios whilst retaining the benefits of market-cap indices. Arnott *et al* (2005) found that the use of fundamental attributes such as company's book value, cash flow, sales, earnings and dividends were highly correlated with large market-cap firms.

These fundamental attributes were found to be ideal, as they would ensure that fundamental indices would emphasise investment in firms that were well established, highly liquid and characterised by greater investment capacity. The only downside was that market-cap indices weighting adjusted with price fluctuations, whereas fundamental indices had to be rebalanced to maintain fundamentally weighted asset allocations. With the frequency of rebalancing, fundamental indices will however, experience higher turnovers than market-cap indices.

3.3.2   Intuitive Measure of Company Size

Arnott *et al* (2005) compared two lists, the top 20 firms ranked by market capitalisations and another list of the top 20 firms ranked by a combination of fundamental measures. They noted that the constituents between the two lists were nearly identical. The major difference was that the fundamental composite list ranked firms in-different to the market-cap list and therefore assigned differing weights to firms in contradiction to constituents of the market-cap list.

Arnott *et al* (2005) intuition is that the top ranked firms in the market-cap list are driven by the market's perception that these firms may grow in the future. In some instances the significance of the market's valuation is such, that firms are valued considerably lower or higher than their fundamental measures. A firm's future share fair value is however unknown. Therefore, the market's valuation is uncertain and may be significantly incorrect, which could result in an adverse effect on an investor's cap-weighted portfolio returns. Adjudging a share's worth by its market-cap is in fact prejudice to the market's perception on that security's uncertain future.

Due to investor noise trading which results in security prices being volatile, Arnott *et al* (2005) were apprehensive that the use of market capitalisations as an indicator of firm size may be biased towards shares that are significantly mispriced in accordance to their true fair value. Arnott *et al* (2005) therefore, suggest alternative measures as indicators of firm's size.

These measures were found to be highly correlated with large companies and therefore highly correlated with many large-cap firms. Fundamental measures are considered to be independent from market's perceptions and investor behaviour and therefore not influenced by price-sensitive factors. The fundamental measures proposed were also found to be readily available and applicable to all global markets.

3.3.3   Noise Resistant Fundamental Attributes

Black (1986) argues that noise must be present in security prices. His argument is based on the fact that investors are risk averse and therefore will always be hesitant to trade on information that is divulged. This allows arbitrage opportunities to exist without any certainty of actually profiting from exploiting such opportunities.

Treynor (2005) emphasises that security markets more than often tend to misprice shares. However, in time the error in pricing always mean reverts back to zero. The issue with the mispricing is that, the existing noise factors create an overvaluation of large-cap shares and an undervaluation of small-cap shares. Treynor (2005) therefore, ponders if firm's market capitalisations are inefficient, then which measures should be used to construct portfolios. Treynor (2005) argues that portfolios constructed according to market value indifferent measures produce higher returns than cap-weighted portfolios. Treynor's (2005) reasoning is that investment in undervalued shares will generate higher returns because undervalued shares are priced less and therefore, more shares are bought in comparison to investment in few overvalued market-cap shares. When the market realises the disparity and corrects itself, the pricing errors will mean revert, and the market value indifferent portfolio will realise a greater return than the price-weighted portfolio. The benefit the market value indifferent portfolio experiences is further compounded by the fact that a greater quantity of shares experiences the appreciation in value. Therefore, Treynor (2005) is adamant that any portfolio can achieve a higher return than price-weighted portfolios; so long the portfolio reduces trading costs and remains diversified.

Arnott *et al* (2005) argue that the fundamental measures they employ are market value indifferent and therefore expect to earn higher returns than price-weighted measures. Arnott *et al* (2005) note that their fundamental indices also produce similar risk profiles to market-cap indices. They also mention that besides accounting metrics being market value indifferent, these metrics have also shown in the past to exhibit share return predictability. Basu (1977) was one of the first to note that shares with high Price-Earnings ratios exhibit higher returns. Lakonishok *et al* (1994) employed Gross Sales, Book-to-market, Cash-to-price and Earnings-to-price ratios for large and small-cap shares to demonstrate that their value strategies outperform cap-weighted portfolios. Arnott *et al* (2005) contend that not only is there fundamentally-weighted strategy superior because they are non-cap weighted, but that their fundamental indices take advantage of financial ratios ability to anticipate share return predictability.

Siegel (2006) announces a paradigm shift imminent within the field of investments, this paradigm known to him as the "*Noisy market hypothesis*". According to Siegel

(2006) the noisy market hypothesis explains why value and small-cap shares tend to achieve higher risk-adjusted returns than those shares chosen by market-cap indicators. Siegel (2006) states that share prices are biased to speculators and momentum traders, which create noise variables within security valuations unrelated to their fundamental values that cause distortion within share prices and results in share mispricing.

Siegel (2006) argues that if a security's market value drops unsupportive of changes to their fundamental values, then it is likely that the security is undervalued. If a security's market value rises unsupportive of changes to their fundamental values, then it is likely that the security is overvalued. The difficulty though, is that not all share price changes may be justified by their fundamental value which therefore limits investors from arbitraging from such discrepancies. Siegel (2006) however, advocates fundamental indexation of Arnott *et al* (2005) as a method of exploiting the inefficiencies of market-cap indices.

3.3.4   Improved Risk-Adjusted Returns

Empirically, Arnott *et al* (2005) find that their fundamentally-weighted indices would achieve significantly higher mean-variance than their counterpart cap-weighted index the S&P 500 index within the period 1962 to 2004. Their fundamental indices were also found to be highly correlated with market-cap indices within almost every asset class. Since fundamental indices exhibit similar risk characteristics to that of market-cap indices, Arnott *et al* (2005) note that fundamental indices exhibit superior Sharpe ratios and therefore produce higher risk-adjusted returns in comparison to S&P 500 index.

Arnott *et al* (2005) considers fundamental indices performances in bull and bear markets. What is evident is that in high market-cap driven bull markets, such as the technology bubbles of the 1989-1991 and 1998-1999, market-cap indices realised slightly higher returns than fundamental indices. When Arnott *et al* (2005), observed all bull market periods and not just market-cap bubble periods, they found that fundamental indices attained on average higher risk-adjusted returns than market-cap indices. Their Fundamental indices were also found on average to achieve higher returns than cap-weighted indices within bear markets.

After considering bull and bear markets, Arnott *et al* (2005) investigated fundamental indices performance in recessionary and expansionary business cycles. Fundamental indices were found to produce significantly high excess returns in recessionary periods while excess returns in expansionary periods were much lower. Though, excess returns were lower in expansionary periods, fundamental indices still delivered value-added returns above market-cap indices, even though at a slower rate in comparison to performances in recessionary periods.

Arnott *et al* (2005) believed that fundamental indices improved mean-variance efficiency would not only be conditional for US Markets, but that superior performance would be realised within all markets developed and emerging. What transpired from Arnott *et al* (2005) findings is a spate of fundamentally-weighted research testing its practicality within other markets.

Hsu and Campollo (2006) promote the use of accounting metrics as indicators of firm's size that can be utilised for portfolio construction. Hsu and Campollo (2006) test the practicality of fundamental indices for 23 countries within the period 1984-2004. They witnessed that for every country the fundamental indices achieved higher returns than their counterpart MSCI cap-weighted indexes. They note that not only were the fundamental indices exhibiting higher returns but were also depicting lower volatilities as well as average betas that were near one. It is therefore, evident that fundamental indices are applicable to a wider scope of markets and not only within USA markets.

Stotz, Döhnert and Wanzenreid (2007) investigate the practically of fundamental indexation on European markets with the use of DJ Stoxx 600 index. Stotz *et al* (2007) discover that their fundamentally-weighted indices would realize higher significant returns than their counterpart cap-weighted index, DJ Stoxx 600 index within the period 1993 to 2007. They further note that combining firm fundamental ratios produce composite metrics that are better indicators of share values than either independent fundamental metrics or market value metrics. Stotz *et al* (2007) therefore, find that the fundamentally-weighted methodology of Arnott et al (2005) is practical within the European Security Exchange Markets.

Further evidence of fundamental indices superiority in European markets is found by Hemminki and Puttonen (2007). They test the performance of the DJ Euro Stoxx 50 index in comparison to fundamentally-weighted indices constructed from the same index participants, and find that their fundamental indices achieve higher returns than the DJ Euro Stoxx 50 index. Six fundamentally weighted indices were constructed and Hemminki and Puttonen (2007) found firm book values, dividends and composite attributes to produce the best returns when used as weighting measures for fundamental index asset allocations.

Arnott and Sheperd (2011) hypothesise that fundamental indexation will display a higher mean-variance alternative to cap-weighted indices within emerging markets. Arnott and Sheperd (2011) test their theory by viewing the performances of the Emerging Markets RAFI index compared to FTSE AW Emerging Markets Index, within the period 1994 to December 2009. The results show that Emerging Markets RAFI index achieves a higher return than the FTSE AW Emerging Markets Index by a near 9% per annum. Arnott and Sheperd (2011) conclude that cap-weighted indices are even more inefficient in emerging markets because of the heightened noise variables affecting security prices. Ultimately, this will result in market-cap indices to experience a larger drag in performance.

Within the South African context, Ferreira and Krige (2011) examine the viability of fundamental indexation methods for the JSE. Ferreira and Krige (2011) find that fundamentally-weighted indices comprised of FTSE/JSE ALSI constituents would realize higher risk-adjusted returns than the JSE ALSI index within the period 1996 to 2009. All fundamentally-weighted indices also, exhibited similar risk profiles as that of JSE ALSI index. This evidence is in support of Arnott and Sheperd (2011) theory, that fundamental indices would produce superior risk-adjusted returns than market-cap driven indices within emerging markets.

3.4   Arguments against Fundamental Indexation

The basis of Arnott *et al* (2005) argument for fundamental indexation and against cap-weighted methods is that cap-weighted indices overweigh investment in overpriced shares and underweight investment in under-priced shares. This has led to enquiries as to what exactly are the performance drivers for fundamentally-weighted indices

excess returns and would they persist in future market trends. This has also led to debates among financial academics on whether cap-weighted methods truly exhibit a drag in performance and whether fundamental metrics possibly are better unbiased estimators of security fair values. Though Arnott *et al* (2005) has shown empirically that fundamental indices achieve higher risk-adjusted returns than cap-weighted indices, the theoretical justifications for fundamental indices excess performance drivers have come under scrutiny. In the following section numerous disputes with Arnott *et al* (2005) fundamental indexation are discussed.

3.4.1 Is Fundamental Indexation simply Value Investing?

Asness (2006) is of the firm belief that fundamental indexation is merely value investing and that in essence the strategy is not an indexing one at all. Asness (2006) argues that fundamental indices tilt their holdings away from market-cap indices towards value shares. Therefore, excess returns that fundamental indices obtain are due to the value tilt in the indices, which is an active strategy undertaken by Arnott *et al* (2005). The notion of value investing pioneered by Graham and Dodd (1934) and researched by many others; Basu (1977), Rosenberg *et al* (1985), Fama and French (1992) and Lakonishok *et al* (1994) have all already documented value strategies ability in earning excess returns. Asness (2006) therefore, argues that proponents' of fundamental indices are merely marketing old findings under a new label and that fundamental indexation is not a new idea at all.

Asness (2006) also, questions whether fundamental indices are even indices at all. Asness (2006) argues that Arnott *et al* (2005) fundamental indices propose investors take active bets against market-cap indices. These active bets in essence make fundamental indices merely predefined active portfolios. Asness (2006) understands an index, to be an investment vehicle that provides a diversified combination of assets that many investors can invest in, whilst not significantly altering the prices of that index's assets. If the majority of investors invest according to market-cap indices, the effect on the market is little or insignificant as market-cap indices already reflect securities market values. However, if the majority of investors invest according to fundamental indices, the effect would be significant as fundamental indices require more funds invested within value and small-cap shares. Asness (2006) contends that if

all followed fundamental indexing, in the end fundamental indices would be identical to cap-weighted indices. Asness (2006) also, considers '*The Arithmetic of Active Management*' by Sharpe (1991), and enquiries, that if fundamental indices provide excess returns to certain investors, and then who are the investors that are losing excess returns. Asness (2006) believes that fundamental indexation is merely active investing and that in some periods the strategy may pay off whilst in other periods, fundamental indices may underperform. Asness (2006) singles out the period 1999 to 2000, where market-cap indices achieved higher returns than value strategies, as an example of the potential poor performance that could be incurred if active fundamental indexation was followed.

Arnott *et al* (2005) admits that fundamental indices will have an inherent value and size bias and considers the effect a resultant from the inefficiencies of market capitalisation indicators. Arnott *et al* (2005) contends that if fundamental indices have a value and size bias, then cap-weighted indices can be argued to exhibit a growth bias. Arnott, Hsu, Liu & Markowitz (2006) find that noise in security prices (i.e. market values) essentially creates value and size anomalies. Arnott *et al* (2006) note that those shares' that generate higher returns are in essence not riskier, as the beta's of value and small-cap shares are similar and therefore, do not exhibit higher systematic risks. Arnott *et al* (2006) attributes the excess returns generated by value and small-cap shares as a result of under valuations by the market due to investor noise trading. Therefore, the noise in security prices creates arbitrage opportunities in which fundamental indices benefit from. However, Arnott *et al* (2005) assert that identifying mispriced shares is challenging, and therefore their fundamental indices do not attempt to find mispriced shares. Fundamental indices simply weight indices in a manner that takes advantage of cap-weighted indices tendencies to overweigh investment in growth shares and under weigh investment in undervalued shares.

Hsu and Campollo (2006) are of the view that fundamental indexation is not merely value investing. They examine the performances of the Russel Value 1000 and 2000 indices in comparison to the US fundamental 1000 and 2000 indices. They find that the fundamental indices achieve higher risk-adjusted returns than both the Russel Value 1000 and 2000 indices. Hsu and Campollo (2006) believe the reason for value indices poorer performance is due to a lack of diversification, as value indices asset

allocation tends to remain prejudice towards large-cap growth shares, whereas fundamental indices will invest more within firms that are growing all fundamentals equally.

3.4.2 Does Capitalisation-weighted Indices Truly Exhibit a Lag in Performance?

Perold (2007) argues that a security can either be overvalued or undervalued according to the noisy market hypothesis of Siegel (2006). Yet, since security fair values are unknown, the market value of any security could decline or appreciate even if the security is overvalued by its unknown fair value. Perold (2007) therefore, argues that cap-weighted methods do not experience a drag in performance, as market values that decline could be offset by market values that appreciate above their already overvalued status.

Fundamental indexers invest on the premise that they benefit from mean reversion in security prices, thereby taking advantage of the volatility in security prices. However, security miss-pricings and mean reversions may be random from period to period. Perold (2007) therefore, takes issue with the naïve rebalancing strategies of Arnott *et al* (2005) fundamental indexation strategies. Perold (2007) highlights four points to consider when evaluating Arnott *et al* (2005) fundamental indices rebalancing strategies versus buy-hold market-cap indices.

Firstly, Perold (2007) argues that any rebalancing strategy may outperform any buy-hold market-cap strategy. Secondly, security mean-reversions may take longer than the acceptable rebalancing interval adopted, in which buy-hold strategies may achieve higher returns than fundamental indices rebalancing strategies. Thirdly, fundamental indices rebalancing strategies may not benefit from shares that under-react and therefore, these indices may sell off shares before they mean revert fully to their correct value. Lastly, certain types of shares have been known to exhibit momentum effects over short periods, while mean reversion tends to occur over longer periods. Investors that obtain information of specific security momentums would benefit more from investing according to this information rather than investing according to naïve rebalancing strategies.

Perold (2007) also takes issue with the notion that fundamental indexers can achieve higher returns than cap-weighted indices with no knowledge of security fair values. If fair values are unknown, investors of non-cap weighted indices will not know whether security market values will revert to their correct fair values, as reversions can be random in nature. Perold (2007) suggests that investors should rather invest by known security market values, by accepting security prices and invest according to probability distributions of security pricing errors. According to Perold (2007) this strategy would realise similar expected returns as non-cap weighted indices regardless whether market values are overvalued or undervalued.

Following Perold's (2007) critique of fundamental indexation, comments and critiques on his article were published by Ennis, Arnott, Markowitz and Treynor (2008). Within this publication, Arnott and Markowitz (2008) criticise Perold's (2007) critique as a flaw, as Perold's (2007) assumptions specifically refer to conditions where markets are operationally efficient. Arnott and Markowitz (2008) agree that if markets are efficient, then there is no excess return achievable above cap-weighted indices. However, Arnott and Markowitz (2008) maintain that CAPM and efficient market hypothesis are unrealistic theories due to their assumptions, but that neither theory is a flaw but merely an approximation of reality. Arnott and Markowitz (2008) therefore, contend that even if their theory is preordained by their assumptions, that their market theories could be seen as more realistic than the assumptions of efficient market hypothesis and CAPM. Arnott and Markowitz (2008) conclude that their findings and many other academic findings support their notion that cap-weighted methods creates a lag in performance.

Within Ennis (2008) publication, Treynor (2008) deliberates Perold's (2007) illustrative examples. Treynor (2008) identifies that Perold (2007) assumes that security fair values may be more or less than their market price. However, Treynor (2008) understands Arnott *et al* (2005) fundamental indices to be based on the premise that security market prices are either above or below their true fair values. The relationship between all variables for every single security can be seen in the below Equation 3.1:

$$\text{Market price} = \text{True fair value} + \text{Error in price} \qquad (3.1)$$

Perold (2008) assumes that the error in price to be uncorrelated with its market price, whereas Arnott *et al* (2005) assumes the error in price to be uncorrelated with security's true fair value. Treynor (2008) identifies mathematically that unless there are no errors in prices, both propositions cannot hold. Therefore, the assumption by Perold (2008) inadvertently rejects the assumptions of Arnott *et al* (2005) and vice a versa.

Within Ennis (2008) publication, Perold (2008) responds to criticisms from Treynor, Arnott and Markowitz (2008) by stating that cap-weighted methods does not experience a lag in performance in efficient and inefficient markets. Perold (2008) relates back to the Equation 3.1 identified by Treynor (2008). According to Perold (2008) the linear relationship of the equation is conditional on knowing security fair values. If Arnott *et al* (2005) do not know what security fair values are then it is impossible for them to condition on fair values. The only observable value that investors can condition on is the shares market price. Therefore, the only variable that can be conditioned on with regards to the distribution of security pricing errors is the security's market price. It is with this understanding that Perold (2008) argues there can be no performance drag in cap-weighted indices.

Perold's (2008) view is based on the index performance attribution to investor's information sets. Investors cannot achieve risk-adjusted returns in excess of cap-weighted indices conditional on fair values, if security fair values are unknown. Perold (2008) agrees that by investing according to security values, the investor could achieve returns in excess of cap-weighted indices. The issue remains however, that fair values are unobservable. Therefore, Perold (2008) asserts for any strategy to outperform cap-weighted methods, an investor must obtain information that is not contained in security's market price.

3.4.3   Are Fundamental Metrics Unbiased Estimators of Fair Values?

Kaplan (2008) considers the propositions of Arnott *et al* (2005), that fundamental indices exploit pricing errors between security market values and their true fair values. On the other hand, fair values are known to be unobservable. According to Kaplan (2008), Arnott *et al* (2005) assert that fundamental metrics take advantage of pricing errors but at the same time are considered to be independent from security market

values. Kaplan (2008) recognises however, that the noise errors in prices must be a determinant of security market values. Therefore, for fundamental metrics to be independent for market values must be false.

Kaplan (2008) argues that in order for fundamental indices to produce more mean-variance efficient portfolios than market capitalisation indicators, it must mean that fundamental metrics are better unbiased estimators of shares fair values. This would imply that fundamental metrics are more fully representative of a security's market information in contrast to the security's market value.

However in the publication "*Letters to the Editor*" Hsu (2008), argues against the assumptions of Kaplan (2008) and asserts that fundamental indices achieve higher returns than cap-weighted indices similarly to how equally-weighted or randomly-weighted indices may outperform cap-weighted indices. That a cap-weighted index tend to over value certain shares and undervalue others, whereas market value indifferent indices place more weight on undervalued shares and less weight in overvalued shares. Since, neither equally-weighted nor randomly-weighted indices are seeking security fair values; Hsu (2008) argues that Kaplan's (2008) assertions cannot hold.

Hsu (2008) further argues that while constructing portfolios investors sought to find the mean-variance combinations that optimises return for acceptable levels of risk. Hsu (2008) asserts that in the construction process, there is no place and need for security fair values. When constructing portfolios in inefficient markets, the usefulness of market cap weights or fair values would be worsened as security prices entail pricing errors that would mean revert back to zero. It is with this understanding that Hsu (2008) asserts that fair value weighting methods have no theoretical grounds and that non-cap weighted indices achieve higher returns than cap-weighted indices only because of the pricing errors in security market values.

In response to Hsu's (2008) critique, Kaplan (2008) within the same publication disagrees with Hsu's (2008) assumptions that fundamental metrics are unbiased indicators of fair value weights that are uncorrelated with security market values. Kaplan (2008) considers investors who have special insights into certain security fair values, and stresses that in these trivial cases, investors would deliberate fair value

weighting into their portfolio construction. Investors that are aware of specific security fair values would skew their portfolio weightings away from overvalued shares and towards undervalued shares. In this process investors would be tilting their portfolios towards specific securities according to fair value weighting strategies.

3.4.4 Does Mean-reversion benefit Fundamental Indices or Cap-weighted Indices?

Edesess (2008) contends that fundamental indexation by Arnott *et al* (2005) is nothing more than marketing techniques to gain support for fundamental indices. Edesess (2008) argues that the theoretical grounds for Arnott *et al* (2005) fundamental indexation strategy are merely claims and assertions. Edesess (2008) investigates the claims of Arnott *et al* (2005), and believes that their fundamental indices are in actual fact active portfolios that tilt weighting towards value and small-cap shares. Since these findings have been documented in years prior to fundamental indices conception, Edesess (2008) believes fundamental indices are merely claims to old empirical findings under a new name and on similar theoretical justifications.

Edesess (2008) disagrees with Arnott *et al* (2005) arguments that cap-weighted indices overvalue certain shares and undervalues others, and bases his argument on their assumptions. Edesess (2008) questions the assumptions underlying Arnott *et al* (2005) fundamental indexation strategy and believes that they are subject to the Schwert rule (Schwert, 2003.). The Schwert rule, states that once an anomaly is identified and recognized in academic literature, the anomaly usually disappears or is weakened. Edesess (2008) summarises the assumptions made by Arnott *et al* (2005). The first supposition, assumes that each security has an unknown fair value. The second supposition is that each security has a known market price that is an assessment of a security's fair value, whereby the difference between the market price and fair value is the estimation error. The last assumption is that the estimation error a security experiences is uncorrelated with its fair value and that the future probability of this error is understood to mean revert back to zero.

Edesess (2008) contends that Arnott *et al* (2005) last assumption is questionable, because it indirectly assumes that estimates of fair value for a group or class of shares do not move together or are not biased towards a specific class. Edessess (2008) uses

the market 'bubble' experienced between 1998 and 2000 as an example of a discrepancy with regard to the last assumption of Arnott *et al* (2005). Within this period; technology, media and telecommunications shares within different markets all soared as the bull market took off and all mean reverted when the market bubble eventually burst, which resulted in the market to experience a bear market trend.

Edesess (2008) further contends that Arnott *et al* (2005) assertions indirectly claim that the noise pricing errors a security experiences are greater than zero. Fundamental indices therefore, sought to benefit from these noise errors in security prices. Edesess (2008) argues that a security's fair value is unobservable and that in time the pricing error that a security experiences will mean revert back to zero. Therefore, the excess returns that a fundamental index experiences will in time be arbitrarily diminished away by the efficiency of markets. In the periods after the market's mean reversion has occurred, fundamental indices should experience lower returns in comparison to cap-weighted indices.

In a rebuttal to Edesess (2008) critique Arnott (2009) claims that Edesess's (2008) argument is flawed. Edesess (2008) contends that security prices and value are equal, and that value is normally distributed around a security's price. When mean reversion occurs, market trends affect both in a manner that they mean revert back at an exact point. Arnott (2009) argues on the principles of Graham and Dodd (1934) that companies exhibit a fair value, which the market price pursues. Therefore, a shares price is either below or under a security's fair value, and not the other way around. Arnott (2009) argues that as security prices and value mean revert, new shocks will occur within the market that forces errors between prices and values to mean revert at differing rates. Arnott (2009) also iterates that it is highly unlikely that shares prices and value mean revert in tandem, as the market trended in 2008. But that the market's 2008 behaviour was an exception to the rule and not an example of the rule itself. Arnott (2009) contends that his understanding of market behaviour is more prevalent to real world conditions and that Edesess's (2008) understanding is unrealistic.

3.4.5   The Validity of Fundamental Indices' Performances

Estrada (2008) questions Arnott *et al* (2005) fundamental indexation argument that their indices are more mean-variance efficient than cap-weighted indices. Estrada (2008) takes issue with the use of firm fundamental attributes and enquires whether fundamental indexation strategies are valid for creating efficient global diversified equity portfolios.

Estrada (2008) pursued to test whether fundamental indexation methods would produce global diversified fundamental portfolios that would achieve higher risk-adjusted returns than their alternative global benchmarks. Estrada (2008) utilised dividends per share from 16 international markets that account for on average 93.4% of the total world market capitalisations. The global dividend-weighted index is calculated by taking each markets dividend per share pay-out relative to all 16 countries dividend per share pay-out and rebalanced annually at end of December. The comparative global cap-weighted index is calculated by taking each markets market index's capitalisation relative to the sum of all 16 countries markets and also rebalanced annually at end of December. The examination period was from December 1973 to December 2005.

Estrada (2008) found that the global dividend index achieved higher risk-adjusted returns than the global market-cap index for the entire period. These findings are in accordance with findings of Arnott *et al* (2005) who advocate fundamental indexation. Estrada (2008) then investigates other approaches to global index diversification. Two other weighting methods are tested, equally weighted and dividend-yield weighted. Both methods utilise the same 16 country constituent base and are rebalanced annually at the end of December.

Estrada (2008) finds that the equally weighted and dividend-yield weighted global indices produce better results than the fundamentally-weighted indices. Estrada (2008) therefore, questions whether fundamental methods are appropriate for global diversification. Estrada (2008) believes that though fundamental indexation produce better risk-adjusted returns than cap-weighted methods, fundamental indexation cannot claim to be superior, as a simple value strategy has shown to produce higher risk-adjusted returns for global diversification.

Blitz, van der Grient and van Vliet (2010) draws attention to the fact that Arnott *et al* (2005) fundamental indexation methods may be influenced by the exact date of rebalancing. Blitz *et al* (2010) believe that fundamental indices performances are sensitive to the exact month chosen to initiate the annual rebalancing. Blitz *et al* (2010) therefore, seek to test the performances of fundamental indices and market-cap indices by rebalancing for every month within a year on an annual rebalancing strategy.

What Blitz *et al* (2010) find is that indices performances are sensitive to the chosen date of rebalancing. They note that in 2009, a fundamental index rebalanced every March displayed a higher return of 10% over its counterpart cap-weighted index. Whilst, in 2009 a fundamental index rebalanced every September displayed a minor return in comparison to its counterpart cap-weighted index. Blitz *et al* (2010) contend that if Arnott *et al* (2005) blended different annual rebalancing dates within their fundamental indexation strategy, that their fundamental indices would still display positive performances but not be ambiguous within short run periods.

Amenc, Goltz and Ye (2012) critics' literature supporting non-cap weighting indexation strategies on the basis of methodical flaws found within the literature. Amenc *et al* (2012) specifically criticise research of Arnott (2011) and Chow, Hsu, Kalesnik and Little (2011) as basing their findings via incorrect comparison methods.

Arnott (2011) contends that the findings of Chow *et al* (2011) demonstrate that portfolio optimization may not lead to improved diversification. Amenc *et al* (2012) take precedence with this statement and argue that the research of Chow *et al* (2011) is based on sample of 1000 constituents. According to Amenc *et al* (2012), increasing the number of constituents within a portfolio tends to defeat the advantages of diversification, as diversification is more beneficial for smaller constituent bases.

Amenc *et al* (2012) also takes issue with Arnott (2011) and Chow *et al* (2011) literature on non-cap weighted and fundamentally weighted indices, in that they do not disclose the bias that stock selection has on their research. Amenc *et al* (2012) argues that for a fair comparison to be made, both indices, fundamentally-weighted and cap-weighted must be based on the same constituent base. Where the constituent base is dissimilar, Amenc *et al* (2012) contests that the return attributed from stock

selection must be disclosed separately from the return attributed to the alternative asset allocation method. Amenc *et al* (2012) also highlights that not only can stock selection contribute to earning higher returns but that a differing stock selection also produces a further source of risk.

Lastly, Amenc *et al* (2012) argues that Arnott (2011) and Chow *et al* (2011) insinuate that there non-cap weighted methods achieve higher returns than cap-weighted indices on a comparative basis. Amenc *et al* (2012) however, emphasizes that the market cap indices with which Arnott (2011) and Chow *et al* (2011) compare their indices with, are managed on weight constraint rules. Arnott (2011) and Chow *et al* (2011) conversely avoid weighting constraints in an attempt to avoid high turnover costs. Amenc *et al* (2012) is of the view that for a proper comparative analysis to take place, both methods must conform to the same rules. If similar index construction methods are not used, then the results may be subject to back testing bias.

Amenc *et al* (2012) refutes the results of Arnott (2011) and Chow *et al* (2011) literature in support of non-cap weighted and fundamentally-weighted indices on the basis that a comparative analysis was not properly undertaken due to the methodical flaws within their research.

3.5   South African Context

Investment in the JSE is characterised by active portfolio management with reluctance in following investment via indexation. According to Beere and Netto-Jonker (2009), in South Africa indexing investment only accounts for about roughly 5% within life assurance and retirement portfolios. This is in contrast to developed international markets where indexing accounts for more than 25% of equity invested funds (James, 2010).

Beere and Netto-Jonker (2009) believe the reason for the lower utilisation of indexing strategies on the JSE is because the market value of the JSE is dominated by resource and mining shares. Therefore, investment in indices tracking the JSE would be highly sensitive to any shocks within the mining and resource sector.

Wessels (2004) undertakes research to compare returns generated from tracking the performance of the JSE ALSI index versus the average of all South African unit trust

active investment within general equity sector within the period 1988 to 2003. Wessels (2004) finds that by tracking the JSE ALSI index, an investor would earn higher risk-adjusted returns than actively managed funds where fees are applicable. What is more interesting is that Wessels (2004) notes that in certain periods one strategy would dominate the other. Wessels (2004) discovers that active funds earn higher returns than the JSE ALSI index in bull markets experienced by all sectors. Whereas, in most bull markets and those dominated by mining and resource sectors see the JSE ALSI index achieve higher returns than actively managed funds. Wessels (2004) therefore, vindicates that indexing may be a beneficial investment style undertaken within the JSE.

Besides the JSE ALSI index, the JSE offers a small number of other indexation products that investors can choose from. However, almost all indices within the FTSE/JSE Index series is constructed and rebalanced according to their constituent's market capitalisations. Within the FTSE/JSE Index series, the first index to be based on various fundamentals was the FTSE/JSE RAFI 40 Index launched in September 2007. The FTSE/JSE RAFI 40 composition is based on constituents; book value or net asset value, total sales, gross dividends and free cash flow. The Index composition is reached by each company being attributed with a fundamental value that is derived by taking the average weight of each fundamental measure.

One possible reason for the dominance of cap-weighted indexation in the South African market is that momentum effects have been observed by Friedrich (2010) within the JSE. Fraser and Page (2000) however, have found that value strategies with momentum strategies have the ability of predicting future JSE security trends especially in industrial shares.

Value strategies historically have shown to be profitable in the JSE. Plaistowe and knight (1986) have previously identified that investment within the JSE according to book value premiums, could possibly be an indicator of abnormal returns. Basiewicz and Auret (2010) in more recent literature apply Fama and French three factor model to show that assets within the JSE are affected by value and size risk factors. Basiewicz and Auret (2010) conclude that the book-to-market ratio has substantial predictive power in identifying security returns within the JSE.

Ferreira and Krige (2011) investigated the performance of the JSE RAFI index versus the JSE ALSI index. They noted that within the period 1996 to 2009, the RAFI composite index achieved higher returns than the JSE ALSI index by 4.7% on an annual compound basis. However, during the period there were years where the JSE ALSI index achieved higher returns than the JSE RAFI index. These periods were synonymous with international market trends, the technology bubble within the year 1999 and the financial crisis experienced in the year 2008. Although, the JSE RAFI index experienced lower returns in certain periods, the gross result is that the JSE RAFI index generated excess compound returns. If an investor had saved equal amounts in both the JSE ALSI and the JSE RAFI index, an investor would find that within all stages of their investment period their investment within the JSE RAFI index would be always cumulatively more than their investment within the JSE ALSI index.

After recognising the performances of the JSE RAFI index, Ferreira and Krige (2011) tested indices weighted by each individual fundamental metric using the JSE ALSI constituents. The four fundamental metrics they employed were the sales, dividends, book value and cash accounting measures. They found that all fundamental indices constructed would achieve higher returns than the JSE ALSI index. However they also noted that only the Sales and Dividend index attained higher returns than the JSE RAFI index, with the Sales index being the best performer.

Ferreira and Krige (2011) contemplated whether fundamental indices were merely value strategies and sought evidence from their research to support or deny this claim. Ferreira and Krige (2011) argue that their JSE fundamental indices cannot be attributed to value biases as the value effect is regarded as share's book-to-market ratio, where the Sales, dividends and RAFI index all would outperform the Book value index within the period 1996 to 2009.

Ferreira and Krige (2011) also find that at different periods, certain fundamentals indices would generate higher returns in comparison to other fundamentals within that period. Ferreira and Krige (2011) therefore, condone the use of all four fundamental metrics for creation of a composite index. Their argument is that by diversifying an index with use of all four metrics would lower the indices overall risk, by insuring that the index will not trend according to a specific accounting metrics business cycle.

Ferreira and Krige (2011) observe their fundamental indices performances on a risk-adjusted basis. The investment performance measures they employ are the Treynor Ratio, Sortino Ratio, Sharpe Ratio, Kappa and Omega Ratios. They note that in all instances, the fundamental indices all achieve higher risk-adjusted returns than the JSE ALSI index with regards to all performance measures, with Sales and Dividend indices being the best performers.

On a cost influence basis, Ferreira and Krige (2011) analyse the turnover experienced by the JSE RAFI index in comparison to JSE ALSI index. The percentage change in indices annual holdings saw the JSE RAFI index produce a turnover of 16.3% where the JSE ALSI index produced a turnover of 15.8%. Ferreira and Krige (2011) acknowledge that the JSE RAFI index is expected to produce higher turnover rates, but were surprised to see that both indices produce an a like turnover rates after the year 2000. Therefore, from the year 2000 onwards the JSE RAFI index would incur transaction costs similar to that of the JSE ALSI index.

Ferreira and Krige (2011) conclude that their findings for the JSE are consistent with international findings, that fundamental indexation methods would achieve higher returns than cap-weighted methods. The JSE fundamental indices proved to be superior on a pure return basis and on a risk-adjusted basis. Ferreira and Krige (2011) also stress that transaction costs are likely to be similar between following the JSE RAFI index and the JSE ALSI index, remembering that the JSE RAFI index produces excess return over the JSE ALSI index.

Therefore, it is evident that fundamental indexation strategies would be feasible as an investment style attempted on the JSE, even though the JSE is regarded as an emerging market. Ferreira and Krige (2011) findings therefore, support Arnott and Sheperd (2011) belief that fundamental indexation would be successful within emerging markets.

Chapter 4 : DATA AND METHODOLOGY

4.1   Introduction

The norm within the investment industry is to construct indices using share market capitalisations. The use of market values is theoretically supported by the concept that the '*market portfolio*' is the mean-variance efficient combination perceived by most investors with similar expectations. According to Asness (2006), cap-weighted indices provide investors with low cost diversified portfolios, that when invested in on a large scale will not significantly impact the prices of that index's assets. However, advocates of price-insensitive weighting methods argue that there are alternative asset allocation techniques that are more mean-variance efficient than cap-weighted methods. Arnott *et al* (2005) provide evidence that constructing indices based on firms' fundamentals is a superior asset allocation approach that produces excellent risk-adjusted returns.

In response to Arnott *et al* (2005) findings, some academics, namely Asness (2006) and Edesess (2008), have attributed the success of fundamental indexation to prior research findings. Asness (2006) and Edesess (2008) argue that fundamental indexation's performances should be accredited to the already discovered value and size effect anomalies. Arnott *et al* (2005) admit that fundamental indices may be tilted towards value and small-cap shares, but reasons that cap-weighted indices are just as biased towards growth shares. Furthermore, Hsu and Campollo (2006) demonstrate that U.S. fundamentally-weighted 1000 and 2000 indices outperform both the Russel Value 1000 and 2000 indices. Arnott *et al* (2005) also, illustrate that their fundamental indices earn higher Fama-French alphas than comparative value indices and therefore, contend that the fundamental indices performances is not entirely driven by value and size risk factors.

Another criticism of fundamental indices performances is that they may be prejudice towards methodologies chosen. Criticisms extend from differing constituent bases within comparisons, to concerns over which rebalancing frequencies to employ. Arnott *et al* (2005) provide direct comparisons between cap-weighted indices and fundamental indices of the same constituent base, to show that fundamentally-

weighted methods produce superior risk-adjusted performances. Arnott *et al* (2005) also substantiate their choice of rebalancing period. Their first justification is that certain accounting data necessary for fundamental index construction is only available on a quarterly or annual basis for the initial years of their research. The second reason is that by rebalancing annually every January, their fundamental indices would incur lower turnovers and therefore lower the turnover transaction costs. Stotz *et al* (2007) has however, also shown that on a comparative basis, rebalancing annually every July, their fundamental indices are more mean-variance efficient compared to the DJ Stoxx 600 index within the period 1993 to 2007.

Within the South African context, Ferreira and Krige (2011) have demonstrated that constructing a fundamentally weighted JSE ALSI index would exhibit higher risk-adjusted returns than the FTSE/JSE ALSI index within the period 1996 to 2009. However, the JSE is dominated by few large-cap shares mainly within the resource and mining sector. Therefore, changing indices asset allocations may be volatile and risky for most investors. According to Basiewicz and Auret (2010), most investors on the JSE trade on large-cap shares, as they are more liquid and information regarding these securities is more frequently available. The leading large-cap constituents within the JSE ALSI are also collectively regarded as the JSE Top 40 index. The JSE Top 40 index is also understood to be fairly representative of the JSE market.

This research undertakes to analyse the performances of indices consisting of the largest FTSE/JSE ALSI constituents in terms of their market values or fundamental attributes. Indices were also constructed with the inclusion of mid-cap shares as well as indices that are inclusive of small-cap shares. Research based on large-caps, mid-caps and small-caps are imperative as Arnott *et al* (2005) imply that fundamental metrics are better indicators of firm's worth and size compared to their market values.

4.2   Problem Statement

Within a compilation of letters by various academics debating the validity of fundamental indexation, Ennis (2008) deliberates the views of Perold (2007) who argues that a share's fair value is conditional to its market price, as share fair values are unobservable. Perold's (2007) assumptions are contrarian to fundamental

indexation advocates, who assume a share's market price to be conditional to its fair value, as share prices are determined in relation to their perceived fair values.

Ennis (2008) believes Perold's (2007) deductions to be false but does however, ponder on the issues he raises, and questions whether the assumptions behind fundamental indexation are more valid than the assumptions supporting cap-weighted portfolios. In numerous prior literatures, there is evidence that the post-application of market capitalisation methods produces genuinely substandard mean-variance efficient portfolios.

This study is undertaken within the South African context, where the sample stocks are chosen from the constituents of the FTSE/JSE ALSI index to form different sized indices according to firm's fundamental attributes and market values. The performances of fundamental indices will be compared to the performances of cap-weighted indices and the JSE ALSI index which represents this study's market proxy.

Sharpe (1964) theorised that all rational utility maximising investors intuitively would hold the market portfolio, and that this portfolio would produce the highest expected return with lowest expected risk. Therefore, CAPM of Sharpe (1964) suggests that the use of market values is paramount in index compilation. In contrast Arnott *et al* (2005) argue that fundamental indices are more mean-variance efficient than cap-weighted indices.

4.3   Research Questions and Objectives

Arnott *et al* (2005) argues that fundamental indices display higher risk-adjusted returns than cap-weighted indices due to cap-weighted methods tendency to overweight overvalued shares and underweight undervalued shares. The cause for weighting discrepancies is a result of share price valuation errors caused by noise trading and other market risk factors (Siegel, 2006). The common objective for investors is to invest in undervalued shares, thereby affording the investor the possibility of profiting from share appreciation. If a share's market price is not the ideal measure for constructing indices, then investors must seek alternative measures for portfolio construction. Arnott *et al* (2005) suggest using company accounting data for index assembly as they are appraised indifferent to company market valuations and therefore not prejudice to the factors affecting firm market capitalisations. Arnott

et al (2005) therefore, argues that fundamental attributes are better indicators of share's prospects and firm's size and worth. It is therefore imperative to test different fundamental attributes recognition of the most well established shares in comparison to market value indicators, to find which fundamental measures are not price sensitive and therefore possibly better indicators of a firm's worth.

Edesess (2008) believes Arnott *et al* (2005) assumptions surrounding cap-weighted methods to be false and contends that the increases in fundamental investments performance are due to an apparent value and size effect. Asness (2006) is also of the view that fundamental indices performances can be attributed to value effect. Hsieh and Hodnett (2012) however, find that constructing indices according to fundamental attributes with the use of Dow Jones Sector Titans Composite Index shows that fundamental indices do not suffer from size effect in comparison to cap-weighted indices in the global context. Arnott *et al* (2005) acknowledges that fundamental indices may be bias towards value strategies but contests that overall performances are not solely attributable to value and size risk factors.

Within the South African context there have been few studies investigating the use of fundamental attributes as anomalies on the JSE and as viable investment approaches to be exploited. Robins, Sandler and Durand (1999) investigate the relationship between size, value and January effect on the JSE, and find that the value effect is not related to size and that the January effect perceived on the JSE is not driven by market capitalisation effects or value effects. Fraser and Page (2000) also discover value effect persistent on the JSE and considers a misspecification of risk for value shares as a possible reason for the anomaly. Basiewicz and Auret (2010) test Fama and French three factor model using JSE constituents and find evidence of value and size effect.

Literature regarding the use of fundamental attributes for realising the value effect on the JSE has been primarily focused on price to book value measures. Little research has been conducted using fundamental attributes dividends, earnings and sales on the JSE equity market. To the author's knowledge, the only research found to test these fundamental attributes within the JSE context is a recent study by Ferreira and Krige (2011).

To ascertain whether value and size effect anomalies, account for the performances of fundamental indices in comparison to cap-weighted indices, further analysis is conducted using the Fama-French (1993) three factor model. The Fama-French three factor model will assist to evaluate the influence value and size effect anomalies have on the performances of fundamental indices.

Apart from the argument that fundamental indices performances are attributable to value and size effect anomalies, fundamental indices are also influenced by the rebalancing frequency they adopt. Advocates of fundamental indexation believe that indices constructed according to market capitalisation methods lag in performance because they experience a subsequent 'cap' drag. The reason for the lag in performance is on the premise that cap-weighted methods over allocate funds to overvalued shares as a consequence of investor over reaction and noise trading (Hsieh and Hodnett, 2012). Investors typically become biased towards past winning shares and over-allocate investment in growth shares.

By reducing rebalancing frequencies, a cap-drag develops within fundamental indices as constituent weights become more price-sensitive. Therefore, rebalancing fundamental indices becomes vital as less frequent rebalancing methods results in indices becoming more cap-weighted and less fundamentally weighted. However, Arnott *et al* (2005) and Ferreira and Krige (2011) only test annual rebalancing frequencies, therefore further investigation into other rebalancing frequencies is warranted.

To realise the research objectives of this study three enquiries were identified. These three questions will test whether constructing indices according to fundamental factors produce superior risk-adjusted results in comparison to indices constructed according to market capitalisation values. These research questions will also sight whether certain indices constructed from fundamental attributes behave in similar manner to that of market value indices. If the fundamental attributed index demonstrates similar traits to that of market value indices then it is deemed that those fundamental attributes could inherently be similarly sensitive to risk factors, such as noise trading, that affect share market values. The research enquiries will also investigate whether fundamental indices performances are biased towards value and

size effect anomalies, and lastly whether less frequent rebalancing causes fundamental indices to experience cap-drag in performance.

The three research questions are as follows:

1. An evaluation on the mean-variance efficiency between fundamentally weighted indices and cap-weighted indices on the JSE within the period 1st January 2000 to 31st December 2009.

2. An investigation into whether fundamental indices represent a unique investment style after accounting for value and size risk factors.

3. Analyse the effects different rebalancing frequencies have on fundamental indices' performances and whether cap drag is evident in their performances.

These research questions will be answered by fulfilling the following research objectives using the methods stated below:

1. Construct monthly-rebalanced fundamentally-weighted indices of 40, 80 and 120 constituents based on firm's market capitalisations and fundamental values such as book value, earnings, dividends, sales on the JSE over the evaluation period from 1 January 2000 to 31 December 2009. In addition, a composite index is constructed derived by assembling the four fundamental attributes of each constituent, based on the same index sizes and examination period as the other constructed indices. The indices are rebalanced at the beginning of each month.

2. Assess the risk-adjusted performance of fundamental indices relative to the performance of market cap indices counterparts over the evaluation period and the two sub periods. The first sub period spans from 1 January 2000 to 31 December 2004 and the second sub period spans from 1 January 2005 to 31 December 2009. The risk-adjusted performance measures employed are the Sharpe ratio, Treynor ratio and Jensen's alpha.

3. Conduct performance attribution on constructed indices using the Fama-French (1993) three factor model over the examination period. The monthly returns of the pre-specified indices are regressed against the market, size

(SMB) and value (HML) risk factors. SMB risk factors are formed by subtracting the returns of the constituent's bottom small market-cap quintile to that of top large market-cap quintile. HML risk factors are formed by subtracting the returns of the constituent's top book-to-market quintile to that of the bottom book-to-market quintile. An Index's SMB coefficient provided an indication to what extent the index was exposed to size risk factors whilst the index's HML coefficient provided an indication to what extent the index was exposed to value risk factors.

4. Evaluate the impact of quarterly and annual rebalancing frequencies have on all constructed indices.

4.4   Data Collection and Sampling

The research sample for this study was sourced from the population of constituents that make up the JSE ALSI index within the period 1st January 2000 to 31st December 2009. The FTSE/JSE ALSI index which was created through an agreement between the JSE and the FTSE group in 2002, is a headline index utilised predominantly for benchmarking. The new agreement brought about a change in classification of sectors and index calculations. The old method which utilised full market capitalisations was replaced with the usage of constituent's free float market capitalisations. The difference between the two being that the free float market capitalisations are exclusive of shares that are not freely accessible to investors. Certain firms confine shareholding to specific individuals or groups and are thus removed from the share's market capitalisation for index calculation purposes.

To instigate the formation of the FTSE/JSE ALSI index firstly the constituents that are eligible for index inclusion are determined. Constituent's inclusion within the JSE ALSI index is governed by JSE's set of rules and policies which also determine the on-going changes in the index's universe. All constitutes free float market-caps are totalled so that each constitute is then weighted by their free float market-cap and the index is initiated at a base value of 100. The sum of all constitutes free float market-caps are also divisible by the latest index divisor which changes when constituents market capitalisations change. The FTSE/JSE ALSI index is then reviewed quarterly

in March, June, September and December where index compositions may change as constitutes enter or leave the index.

This sample encompasses roughly 164 constituents and their inclusion in the index is predominantly based on the highest market capitalisations. The reason for basing the sample on the constituents with the highest market capitalisations is that larger market-cap firms are less likely to delist than firms with smaller market values. By utilising a large sample base of 164 JSE constituents, the sample would also encompasses large, medium and small sized market-cap shares. Due to the constituents with the highest market values chosen, the sample provides a fair and comprehensive representation of the FTSE/JSE market.

Firm specific attributes data utilised for this study include the monthly constituent's; market prices, number of shares outstanding, book values per share, earnings per share, dividends per share, sales per share and composite metrics for the period 1st January 2000 to 31st December 2009. Each constituent's composite measure is identified by combining all four monthly fundamental factors proportions in comparison to their market values. Constituents availability for indices compositions are limited by excluding constituents that fall above the 95th percentile and are found to be within the bottom 5th percentile depending on the index's attribution.

Additional data necessary for this study are JSE ALSI index's monthly returns and monthly risk free rates obtained from the yields on the South African 3-month treasury bills. Data was sourced and downloaded from DataStream International's database.

4.5   Dataset Framework

The JSE ALSI index is utilised as this study's research dataset. It is important to note that the JSE is seen as an emerging market currently ranked 17th largest market in the world. By opting to utilise an emerging market, this research will address the suppositions of Arnott *et al* (2005) and Arnott and Sheperd (2011). Arnott *et al* (2005) research was undertaken within well established markets, but believed their findings to be applicable within other markets. Arnott and Sheperd (2011) show that not only would fundamental indexation be applicable within emerging markets, but argue that fundamental indexation would likely be more beneficial within emerging markets.

They justify that, due to the inefficiencies of emerging markets the extent of noise trading is therefore more apparent. According to Arnott and Sheperd (2011), as pricing noise increases within the market, the more pronounced the performance drag market-cap indices will experience.

The JSE has never been seen as a completely efficient market in the strong form, but there has been research conducted to show that the JSE has improved in efficiency over the last decade. Thompson and Ward (1995) studied the efficiency of JSE market and found the JSE to display characteristics between weak form and semi-strong form market efficiency. Mabhunu (2004) conducted correlation tests to test whether JSE share price changes are dependent of successive share returns, and verified the JSE to be efficient in the weak form. Mabhunu (2004) deliberated further, that the JSE has improved in informational efficiency possibly due to the improvements the JSE has undergone. According to Marais (2008), the South African equity market has improved immensely in the decade prior to 2007, and hence developed in correlation and in custom with well-established markets.

The JSE has recently gone through restructuring reforms that may well have assisted efficiency improvements on the JSE. These changes are relevant to this research study as they occurred in and around this study's, 1st January 2000 to 31st December 2009, examination period.

According to Mkhize and Msweli-Mbanga (2006), prior to 1994 the JSE had to deal with many economic and political issues and specifically international sanctions against the South African Regime at the time. Following the 1994 democratic elections, international sanctions were raised and the JSE went through a deregulation phase in the 1995. The ultimate aim for the deregulation phase was to align the JSE market with international trends. These changes aided the JSE to be competitive and partake in the current expanding international market.

Following the deregulation phase, in 1996 the JSE introduced the Johannesburg Equities Trading (JET) system. This system was designed to improve trading efficiency on the JSE, as orders were centralised and ranked according to date of order initiation and best price. The JET system greatly enhanced JSE liquidity, cost of

trading, security and transparency. The JET system therefore, drastically improved the JSE ability to attract foreign trading activity.

With advances in technology, electronic clearing and settling was introduced by Share transactions totally electronic (STRATE). At the time the JSE JET system operated on paper-based system. In 1999, the paper share certificate trading was replaced with STRATE. STRATE reduced trading failures and greatly resolved non-settlement errors.

In 1999, the JSE experienced a bear market where many successful firms were forced to delist. Delisting reached epic proportions in 2001 as 85 companies were forced to delist in a single year in contrary to foreign international market trends. Many delisted companies opted for other security exchanges as confidence in the JSE declined and the costs and requirements for listing rouse. The JSE was thus forced to make critical changes.

In 2002, the JSE replaced the JET system with a more sophisticated London-based Shares Exchange Trading System (SETS). SETS was far more efficient, as investors experienced instant trading transactions that promoted fair trade as transactions were executed stringent on time priority and precise price. Shares Exchange News Service (SENS) was also established to disclose and distribute, price-sensitive information to all market participants in order to prevent insider trading.

In 2005, the JSE introduced Yield-X Exchange with its other trading platforms, to facilitate trade on a whole host of interest rate derivative type products. These new investment products offered competitively priced options with higher transparency, which promote dnewer entrants trading on the JSE and consequently, increased the JSE liquidity and efficiency.

Mkhize and Msweli-Mbanga (2006), attribute the performance of the JSE to the restructuring phases it has undergone within the period, 1994 to 2004. Marais (2008) argues a similar point, that the reforms implemented by the JSE have significantly impacted on the performance of the JSE to become more alike with developed market behaviour. However, Mkhize and Msweli-Mbanga (2006), do note that in comparison to other emerging markets such as; China, Brazil and Korea, the JSE did not accomplish similar satisfactory performances.

Figure 4.1   Cumulative Returns for One Hundred Rand invested in JSE ALSI Index within the period January 2000 to December 2009.
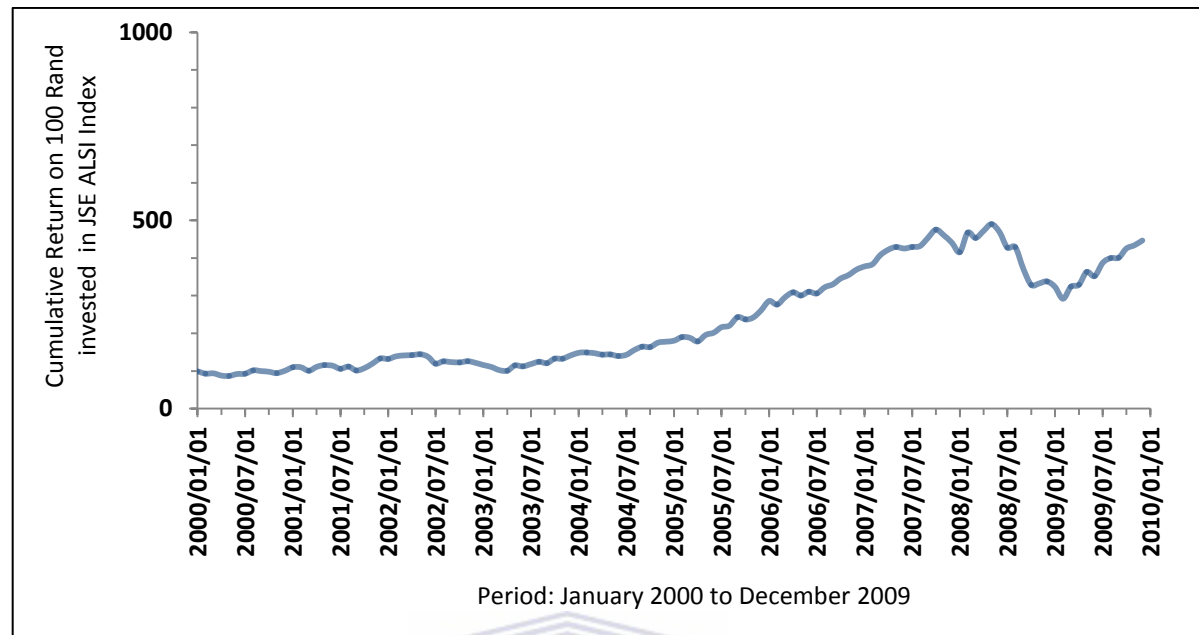
Figure 4.1 displays the performance of the JSE index, had one hundred rand been invested within the index at 31 December 1999. Following financial liberation and reforms implemented prior to 2005, it is noticeable that the JSE drastically spiked in performance within the period 2005 to early 2008. Other markets were also experiencing significant growths such as the U.S. exchanges which peaked in November 2007, before falling into a recession within the next period.

As with the U.S. markets the JSE also went into a sudden bear market within the period mid-2008 to 2009, subsequent to the bull market experienced between 2005 and early 2008. The bear market was however felt by all markets world-wide and was largely due to the sub-prime credit crisis in 2008. According to Madubeko (2010), the impact of the crisis was lesser felt by JSE in comparison to other developed and emerging markets. Madubeko (2010) accredits South African banks risk averseness towards foreign investment as the possible reason why the JSE was lesser impacted by the 2008 global crisis. Following the crisis, the JSE showed steady signs of improvement with growths in its index's performance through 2009.

Another consideration when evaluating JSE performances is that the JSE is renowned in displaying microstructure effects. Microstructure effects are the analysis of financial market's fundamental mechanisms in trade execution. These mechanisms

affect share pricing, bid-ask spreads, trade volumes, trading costs and overall trading activities. Basiewicz and Auret (2010) believe microstructure effects to be evident in the JSE due to the presence of few dominant growth shares listed on the JSE. It has been stated by Neu-Ner and Firer (1997) that the JSE is unique to other exchanges in that the markets economic influence rests predominantly with few constituents. The impact of containing few growth firms is that microstructure effects promote the occurrence of size effects and irrational share mispricing. According to Basiewicz and Auret (2010) the JSE is an illiquid market where the extent of research conducted on all constituents is far less in contrast to U.S. markets. This further compounds the occurrence of microstructure effects on the JSE, which ultimately has an impact on the accuracy of share pricings.

Figure 4.2   Quintile Concentrations for JSE ALSI Index's Constituents by Market Values as at 31 December 2009.
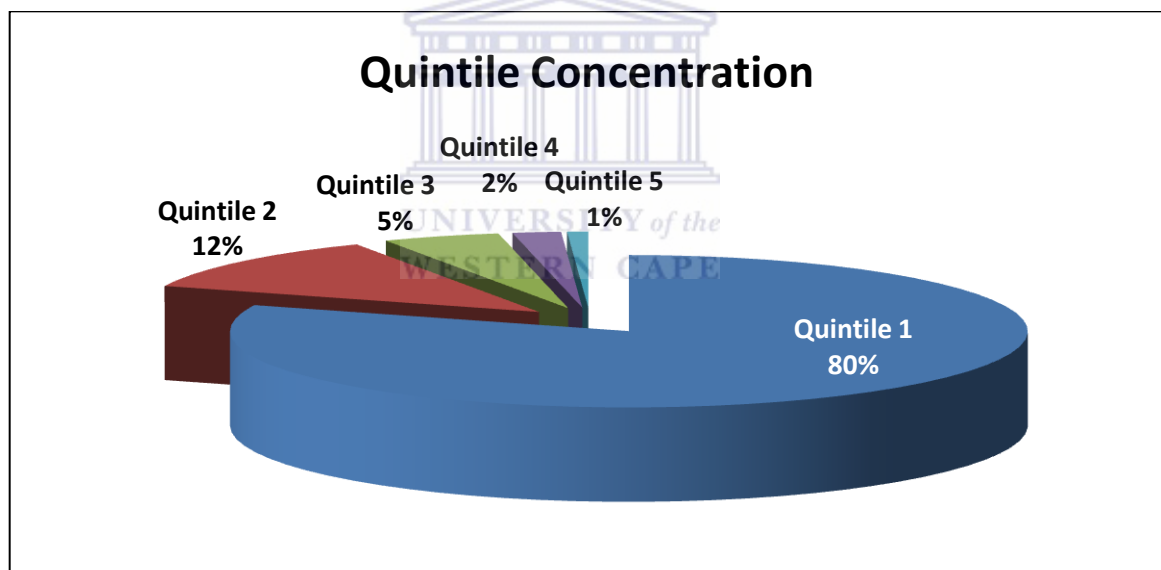
Figure 4.2 illustrates the extent of concentration the JSE is subject to its largest constituents. Quintile concentrations were found by retrieving and ranking the top 160 JSE ALSI index's constituents by market values as at 31 December 2009. Each quintile incorporates 32 constituents each by splitting the JSE ALSI index constituent sample into five quintiles. Within each quintile, constituent's market values are summed to depict the influence of power the top quintile has on the performance of the JSE.

It is evident from figure 4.2 that the JSE has been dominated by the market capitalisations of its top 32 constituents. The JSE ALSI index's top 32 constituents at any given time could account for more or less than 80% of its market value. It is therefore, noticeable that larger firms dominate smaller firms within the JSE ALSI index. Smaller firms on the JSE are known to be less liquid and are therefore unjustly overlooked by many investors. Basiewicz and Auret (2010) find similar issues with dealing with JSE's constituent sample. In order to test Fama-French (1993) three factor model on JSE shares, it was necessary to determine the size factor in the sample. Basiewicz and Auret (2010) find that using the entire JSE constituent universe would result in large shares to be in opposition to extremely small shares. For proper model testing it is more ideal to have large shares versus small shares, but not too small in relation. Basiewicz and Auret (2010) therefore, opt to use the JSE top 200 ranked constituents identified every June. Similarly, this study focuses only on JSE ALSI index constituents and therefore predominantly on the largest JSE shares.

4.6 Methodology

Indices are constructed and weighted according to six monthly attributes, a constituent's; market value, book value, total dividend, after tax earnings, total sales and a composite measure that is found by summing each constituent's fundamental attributes percentages from the sample's total monthly fundamental values.

For each index, the sample's constituents are ranked according to the index's attribution. Since this study is concerned with examining adequate share valuation indicators, constituents with the highest fundamental attributes are selected for index inclusion according to each index's fundamental attribute. The JSE ALSI constituents are often characterised and grouped by three different sizes according to their market capitalisations; large-cap, mid-cap and small-cap firms. The large-cap firms are commonly grouped as the JSE top 40. The mid-cap firms are found to be between the JSE top 40 and till 100th placed ranking on the JSE. Whilst, the small-cap firms have been observed to be between the 86th ranked position and encompass the rest of the lower ranked JSE constituents.[3]

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[3] From JSE: FTSE/JSE Quarterly Index Review Spreadsheet, September 2010.

In accordance, with the JSE share characterisation, this study's top index breadth will encompass the top 40 shares according to each of the six indicators with which the indices weighting schema will be adopted. Maintaining uniformity, the 40 shares following from the top 40 will be considered as the samples mid-cap firms. Therefore, an index of the top 80 shares according to each of the six indicators will be analysed. An index breadth with the inclusion of the mid-caps is imperative, as this will display the six indicators ability at identifying the largest established firms whilst adequately grading firms within the mid-cap range.

Following the inclusion of mid-cap security's and remaining consistent with the previous breadth selection, the next 40 shares from the top 80 will be considered as the samples small-cap firms. Therefore, an index of the top 120 shares according to each of the six indicators will be analysed. This selection will include small-cap firms, and indices performances will be viewed when all three categories of shares are included. These three index breadths are also necessary to evaluate whether Size effects in indices performances are evident

Whilst, noting that the JSE places importance on the top 40 group of shares, fundamental indexation methods commonly look at a large constituent base when performing fundamental weighting methods. Arnott *et al* (2005) chose a constituent base of 1000 shares for which they conducted their fundamental indexation research. Ferreira and Krige (2011) employed the number of constituents that form the JSE ALSI index for their fundamental indexation analysis within the South African context. Therefore, opting to analyse the top 120 shares will satisfy this study's objective on viewing the ability of fundamental indicators to value large, mid and small firms, as well as conforming to other fundamental indexation research methods basing their indices on large constituent bases.

After each index's constituent base is found, each index's asset allocation will be undertaken by weighting constitutes by their fundamental metrics. The weighting method adopted is in accordance with Arnott *et al* (2005) and Ferreira and Krige (2011) research methodology. Index returns are calculated by taking the sum of all constituents' returns for the month multiplied by the constituent's weight within the index. Index risk-adjusted returns and betas are retrieved by applying CAPM to all constructed index's excess returns in regression to the market proxy's excess returns.

The Fama-French (1993) three factor model is also applied to all constructed indices returns to analyse the extent value and size risk factors account for indices performances.

To address the last research objective different rebalancing frequencies has been employed to all constructed indices. Indices are rebalanced according to three frequencies; monthly, quarterly and annually. Quarterly rebalancing was done in adherence to FTSE/JSE indices reviewing practices; on every March, June, September and December. Annual rebalancing was undertaken in accordance to Arnott *et al* (2005) and Ferreira and Krige (2011) research methods, where rebalancing took place every December.

4.7   Possible Research Biases

A certain number of biases may unintentionally influence this research study's results. The biases that have been identified as possible extortions to this study's findings are selection bias, data-snooping bias, survivorship bias, look-ahead bias and outliers. Amenc *et al* (2012) argues that the lack of theoretical guidance for deriving the best fundamental indexation method makes all fundamental research methods potentially only relevant in back-tests. The two biases Amenc *et al* (2012) identifies as potential prejudice to fundamental indices performances are selection bias and data-snooping bias. Selection bias arises where comparisons are made between two indices performances on the basis of differing weighting methods where the constituent bases are not exact. In comparative analyses where sample constituents differ, the selection bias must be disclosed and justified why the bias would not impact the outcomes of the study. For this research, sample selection bias cannot be averted as the objective of this study is to analyse alternative metrics of firm worth and size. Therefore the basis for establishing a constituent's weight within an index would also govern its inclusion within that index. This is also observed with the JSE top 40 index, which weights and selects constituents primarily according to their market capitalisations.

Data-snooping bias implies that research was conducted in a manner that the research was directed or guided towards a certain outcome. The methodology used in this research derives from Arnott *et al* (2005) and Ferreira and Krige (2011). The underlying weighting methodology is not altered in any attempt to skew

performances. Indices performances have also been depicted in sub periods, to illustrate that index's performances are robust in all periods and therefore, not time-period specific.

Survivorship bias, though attempted to be minimized, is foreseeable, as this research is based on historical data which would only include those constituents at the point of data collection. The constituents used in this study, form part of the JSE ALSI index which include approximately the top 164 largest shares from the greater JSE market's universe[4]. As this research focuses primarily on larger firms, it is unlikely that the survivorship bias impact will be severe as larger firms are less likely to delist. Also, the source of data retrieval, DataStream International's database provides a fairly comprehensive dataset for all constituents that satisfy the requirements of this study.

In addition to preventing survivorship bias, the nature of DataStream International's database also limits the effects of look-ahead bias. Look-ahead bias arises when the data necessary to conduct research is not available for the period being examined. Ferreira and Krige (2011) use DataStream database and find the source beneficial as dividends are presented in the precise month that they are paid which therefore removes the potential of look-ahead bias. DataStream International's database updates periodically with changes in constituents market values and accounting data. The accounting data retrieved from DataStream's database are also, in accordance with annual financial statement reporting dates and therefore robust for previous periods and future periods.

Outliers within research datasets, cause certain constituents to receive biased weight allocations. Shares that experience excessive appreciation in any firm-specific attribute in relation to the index's attribution, will prejudicially dominate the weighting schemas within the indices. Similarly, shares that exhibit dismal firm-specific attribute values will unjustly receive a low weight allocation and therefore the affected indices would be under represented by these shares. By winsorising research datasets, outliers are mitigated and indices compositions are prevented from over concentrating weighting allocations towards shares with large firm-specific attributes, dependent on the index attribution.

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[4] From JSE: FTSE/JSE Quarterly Index Review Spreadsheet, September 2010.

Chapter 5 :   **PERFORMANCES OF FUNDAMENTAL INDICES AND CAP-WEIGHTED INDICES**

5.1   Introduction

The sample chosen for this study was the constituents from the JSE ALSI index for the period 1st January 2000 to 31st December 2009. By restricting the sample to only constituents within the ALSI index this limits the potential for survivorship bias as smaller companies are more likely to delist than companies with larger market capitalisations. From this sample, indices are then constructed according to firm market values and five fundamental attributes identified as Book Value, Dividends, Earnings, Sales and a Composite metric that encompasses a combination of the four fundamental indicators. The composite metric for each sample share is calculated at the beginning of each month over the examination period. The composite metric for the *i*th constituent at the beginning of month *t* is computed using Equation 5.1.

$$
C_{i,t} = \frac{B_{i,t-1}}{\sum(B_{1,t} + B_{2,t} + \cdots + B_{n,t-1})} + \frac{D_{i,t-1}}{\sum(D_{1,t-1} + D_{2,t-1} + \cdots + D_{n,t-1})}
$$

$$
+ \frac{E_{i,t-1}}{\sum(E_{1,t-1} + E_{2,t-1} + \ldots + E_{n,t-1})} + \frac{S_{i,t-1}}{\sum(S_{1,t-1} + S_{2,t-1} + \ldots + S_{n,t-1})} \tag{5.1}
$$

Where,

$C_{i,t}$	=	The composite measure of the *i*th Constituent for month *t*.
$B_{i,t-1}$	=	The *i*th Constituent's book value per share at the beginning of month *t*.
$D_{i,t-1}$	=	The *i*th Constituent's book value per share at the beginning of month *t*.
$E_{i,t-1}$	=	The *i*th Constituent's book value per share at the beginning of month *t*.
$S_{i,t-1}$	=	The *i*th Constituent's book value per share at the

beginning of month t.

$\sum(X_{1,t-1} + X_{n,t-1})$ =   Summation of each fundamental factor for all constituents at the beginning of month t.

In Equation 5.1, the value of each firm's fundamental attribute in terms of the book value, dividends, earnings and sales relative to the sum of all the fundamental values in the entire cross-section at the beginning of each month is first calculated. A constituent's fundamental composite indicator is calculated as the sum of the four relative fundamental values for the firm at the beginning of each month. Firms with negative fundamental values, such as negative earnings for a specific period are treated as zero. In instances where a share does not have a specific fundamental value, such as a reported dividend for the period, only the other three fundamentals will be totalled, therefore the base of that share's composite indicator will be computed using the three remaining fundamental attributes.

The composite measure determined by Equation 5.1 is dissimilar to the composite metric derived in calculation methods employed in other prior fundamental indexation empirical researches. Arnott *et al* (2005) adopted an equally weighted strategy for deriving a firm's fundamental composite measure. Similarly, in Ferreira and Krige (2011) the composite measure was derived by averaging the firm's four fundamental values employed. After testing the methods employed by Arnott *et al* (2005) it was found that the naïve summing of all fundamental values was found to skew asset allocations prejudicially towards fundamental values who generally are larger in value in comparison to other fundamental measures. The composite measure calculation is unlike to other fundamental indexation research composite metrics derivation and therefore a new contribution within the field of fundamental indexation.

Once all ratios are calculated for all constituents, the security selection process for the pre-specified indices begins. The attribute values of each share in the sample are first ranked at the beginning of each month. The top 40, 80, and 120 shares for each attribute are selected based on the index specification for each month. Once the identities of the constituents within the indices are determined, the attribute values of the constituents are winsorised to limit the attribute values of the constituents within the 5th and 95th percentile. This process reduces the potential impacts of outliers in the

sample when calculating the constituent weights at the beginning of each month during the rebalancing phase. The weight allocation to each *i*th constituent within each index is calculated using Equation 5.2:

$$w_{X(AW)_{i,t}} = \frac{A_{i,t-1}}{\sum_{k=1}^{n_{Xt}} A_{i,t}} \tag{5.2}$$

Where,

$w_{X(AW)_{i,t}}$ =   The weight of *i*th constituent in the attribute-weighted (fundamental or market-cap) index *X* for month *t*.

$A_{i,t-1}$ =   The value of *i*th constituent firm-specific attribute within the attribute-weighted index *X* based on index's *A* attribution factor at the start of month *t*.

After each indices security selection is completed and the constituents are identified, each attributed index will be weighted by its constituent's attribution factor (fundamental and market values). Therefore, the value of the constituent's fundamental factor will dictate its inclusion in the index and how much funds are to be invested within it. If a sample share has a high book value, a moderate dividend yield and a low market value, it will be heavily invested in within the book value index, moderately invested in within the dividends index and receive low or even no investment within the cap-weighted index.

Each fundamental index's performances are to be assessed according to their annualised return, annualised standard deviation (risk), and on a risk-adjusted returns basis in comparison to the JSE ALSI index and their cap-weighted counterpart. Beta's and max draw-downs for each index were also assessed in comparison to the market-cap indices and the JSE ALSI index.

5.2 Indices Descriptive Statistics

Indices are assessed according to annualised geometric returns and annualised standard deviations and on risk-adjusted returns. Using regression analysis, Beta's were also identified from CAPM pricing instrument for all indices. The risk-adjusted

return measures that were employed to evaluate indices performances are the Sharpe ratio, Treynor ratio and Jensen's alpha measures.

Geometric returns were computed using the following Equation 5.3.

$$r_x = \sum_{j=1}^{n} w_{x_i} * r_i \tag{5.3}$$

Where,

r_X =   Index X monthly return.

n =   Total number of constituents within index X.

w_{x_i} =   Constituent ith weight within constructed indices X.

r_i =   Monthly returns generated by constituent ith in indices X.
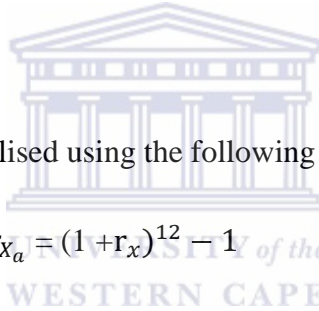
Geometric returns were annualised using the following Equation 5.4.

$$r_{X_a} = (1 + r_x)^{12} - 1 \tag{5.4}$$

Where,

r_{X_a} =   Index X annualised monthly geometric return.

r_X =   Index X monthly geometric return.

Annualised Standard deviations were computed using the following Equation 5.5.

$$\sigma_{X_a} = \sqrt{\frac{\sum_{t=0}^{T}(r_{X,t} - R_X)^2}{T-1}} * \sqrt{12} \tag{5.5}$$

Where,

σ_{X_a} =   Annualised index X standard deviation.

$r_{X,t}$ =   Index X return within month t.

R_X	=	Index X arithmetic average return for period T.
T	=	the number of months within the period.

An investments systematic risk is the asset's portion of risk that cannot be diversified away and represents risk factors that influence all assets on the market. An investment's unsystematic risk is unique in a sense, as it is the excess risk above the market's risk which could be eliminated through process of diversification. As investors are deemed to be risk averse, the CAPM identifies the risk that an investor bears in deviating from the market in an attempt to achieve excess returns that is represented by its intercept, termed alpha.

The CAPM formula can be seen illustrated below, in Equation 5.6:

$$R_x - R_f = \alpha_x + \beta_x(R_m - R_f) + \varepsilon_x \tag{5.6}$$

Where,

$R_x - R_f$	=	Return achieved by index X within the period.
α_x	=	Intercept term between realised and expected returns, assumed to be zero.
β_x	=	Index X estimated beta coefficient.
$R_m - R_f$	=	The return achieved by the market proxy in excess of the market's risk-free rate within the period.
ε_x	=	Error variable that is unexplained by index X beta within the holding period.

The CAPM equation can be seen as a single-factor regression equation, where an asset's excess returns are regressed against the market's excess returns. The asset's excess returns are seen as the dependent variable to be expressed by the regression. Therefore, the alpha term α_x is seen as the intercept and the beta coefficient β_x seen as the regression slope. The asset's error term is seen as the residual factor unexplained by the movements in the market risk premium.

When evaluating an asset's performance, the alpha term depicts an asset's return in excess of what CAPM's anticipated returns for that asset are. Assets that produce a positive alpha are considered under-priced and could produce returns higher than what can be anticipated by CAPM. The asset's beta coefficient is the asset's return sensitivity towards movements within the overall market. The average asset within the market has an expected beta of 1. Assets with a beta greater than 1 are considered riskier than the average asset. Assets with a beta lower than 1 is extremely responsive to market movements and therefore, highly correlated with the market.

Arnott *et al* (2005) used CAPM tests to illustrate the similarities their fundamental indices betas have with cap-weighted indices. They also display the excess returns identified by their fundamental indices CAPM alphas in comparison to alphas achieved by cap-weighted indices.

It is important to note that the statistical terms alpha and beta within the CAPM regression equation are subject to statistical inferences and therefore tested for statistical significance. The regression coefficient's *p*-values are computed to evaluate the statistical significance of CAPM alphas and betas produced by each index.

The Sharpe measure is an investment's excess return over its total risk for a specific period. The Sharpe ratio is determined by the following Equation 5.7.

$$SHARPE_X = \frac{R_x - R_f}{\sigma_x} \tag{5.7}$$

Where,

$R_x - R_f$ =   Return in excess of risk-free rate.

σ_x =   Index X standard deviation over the sample period.

The Sharpe ratio determines the excess return an index achieves for undertaking the total risk of the investment. Conversely, the Treynor ratio measures an index excess return in comparison to the systematic risk it bears within a specified period. The market risk variable is seen as the investments beta coefficient as an indication of an index's systematic risk. The beta coefficient measures an index or a shares correlation

towards its market volatility. The Treynor ratio is determined by the following Equation 5.7.

$$TREYNOR_X = \frac{R_x - R_f}{\beta_x} \qquad (5.8)$$

Where,

$R_x - R_f$ =   Return in excess of risk-free rate.

β_x =   Index X beta coefficient for the sample period, determined by CAPM.

Jensen's alpha determines an index's abnormal return in excess of that expected by the CAPM. The measure therefore, illustrates the potential abnormal returns a share could realise and this is known as its alpha. Positive alphas show realised returns that were above Shares Market Line (SML). High p-values for alpha estimates shows the probability that an estimate of alpha could be a result from pure chance. Jensen alpha's is determined by the following Equation 5.9.

$$JENSEN'S\ ALPHA_x = \left(R_x - R_f\right) - \beta_x(R_m - R_f) \qquad (5.9)$$

5.3   Indices Performances

The performances of all constructed indices are tabled and presented separately in comparison to cap-weighted indices and the JSE ALSI index. As this study attempts to ascertain the mean-variance efficiency between fundamental attributed indices against cap-weighted attributed indices, the market value indices are presented separately but only in comparison to the JSE ALSI index. All the other fundamental attributed indices will be compared to the JSE ALSI index to show fundamental indices performance in relation to the market proxy as well as, in comparison to the cap-weighted counterparts.

5.3.1 Market Value Indices

The cap-weighted indices were computed by ranking the top firms by market values. The M40 index constitutes the top 40 market capitalisation shares and is representative of large-cap firms. As follows the M80 constitutes the top 80 shares and the M120 constitutes the top 120 shares by market-cap. All indices were rebalanced monthly and it is expected that constituents within index compositions change throughout the examination period. Table 5.1 compares the computed market value indices to the JSE ALSI index from a basic performance statistics perspective and from a risk-adjusted return perspective.

Table 5.1   Descriptive Statistics for JSE ALSI Index and Market Value Indices

Panel (a)

BASIC STATISTICS	JSE ALSI Index	Market Value		
		M40	M80	M120
Geometric Return (%)	18.29%	19.38%	19.78%	19.92%
Standard Deviation (%)	19.38%	20.91%	20.19%	19.98%
Maximum Draw-down (Negative)	40.44%	37.47%	35.05%	34.46%
Max Constituent Weight	-	6.02%	5.49%	5.40%

Panel (b)

RISK-ADJUSTED PERFORMANCE STATISTICS	JSE ALSI Index	Market Value		
		M40	M80	M120
Sharpe Ratio (%)	43.94%	47.29%	50.93%	52.17%
Treynor Ratio (%)	8.72%	10.17%	10.93%	11.20%
Jensen's Alpha (%)	0.00%	1.33%	2.01%	2.24%
p-value Alpha	-	0.694	0.536	0.487
Beta	1	0.973	0.940	0.931
p-value Beta	-	0.000	0.000	0.000

The returns for all three market value indices show that they all are expected to display higher returns than the JSE ALSI index. The standard deviations or the risks is however higher for all market value indices in comparison to the ALSI. The maximum draw down or potential loss for all market value indices is however lower

in comparison to the ALSI. With the inclusion of smaller-cap shares within the top 120 cap-weighted index, it is noticeable that the maximum constituent weight declines producing a much more diversified index in comparison to the top 40 cap-weighted index.

According to the returns generated by all three market value indices, all achieved a higher return than the JSE ALSI index but at a significantly higher risk. Considering the higher risk, an investor should be adequately compensated for bearing the additional risk for the investment strategy to be worthwhile. Therefore, the risk-adjusted performance measures are imperative to evaluate whether the underlying index weighting strategy is feasible or not.

From the Sharpe ratios calculated, all indices show positive returns in excess of the market. This highlights that the returns from larger-cap shares sufficiently compensate investors for the additional risk beared. However, it is visible that as small-cap firms are included in index compositions the indices performances improve consistently. It is therefore, evident that the smaller-cap shares likely gain excess returns than larger-cap shares under the period of review.

Similar to the Sharpe ratios, the Treynor ratios indicated that the top 120 market value index strategy as the best performer, whilst also outperforming the JSE ALSI index. The difference between the Treynor and the Sharpe ratio is that the Treynor ratio looks at excess return over a portfolios systematic risk or market risk and not total risk. Therefore, the Treynor ratio displays market value indices achieving a higher risk-adjusted return than the ALSI due to market value indices having more unique risk within their beta coefficients than the JSE ALSI index. However, it is evident that the top 40 market value index has a near beta coefficient to the JSE ALSI index. The JSE is dominated by a few large-cap constituents and this is evident in the beta coefficient of the top 40 market value index, which is highly correlated with the JSE ALSI index. The least correlated beta coefficient is the top 120 market value index which contains smaller-cap shares and therefore contains more unique risk.

All market value indices produced abnormal returns as indicated by their Jensen's alphas. The highest Jensen alpha recorded for market value indices was for the top

120. The top 120 market value index has also the lowest *p*-value or probability of being significant in comparison to the other market value indices.

5.3.2 Book Value Indices

Book value indices were computed and weighted by ranking the top shares by their respective book values. The B40 index constitutes the top 40 shares with highest book values. The B80 constitutes the top 80 shares with highest book values and the B120 constitutes the top 120 shares with the highest book values. All book value indices were rebalanced monthly and it is likely that constituents within the indices changed from time to time. Table 5.2 compares the computed book value indices to the computed market value indices and JSE ALSI index from a basic performance statistics perspective and from a risk-adjusted return perspective.

Table 5.2   Descriptive Statistics for JSE ALSI Index and Market Value Indices And Book Value Indices

Panel (a)

BASIC STATISTICS	JSE ALSI Index	Market Value			Book Value		
		M40	M80	M120	B40	B80	B120
Geometric Return %	18.29%	19.38%	19.78%	19.92%	23.38%	24.13%	24.27%
Standard Deviation %	19.38%	20.91%	20.19%	19.98%	21.02%	20.13%	19.93%
Maximum Draw down (Negative)	40.44%	37.47%	35.05%	34.46%	28.67%	28.04%	29.00%
Max Constituent Weight	-	6.02%	5.49%	5.40%	5.62%	4.93%	4.82%

Panel (b)

RISK-ADJUSTED PERFORMANCE STATISTICS	JSE ALSI Index	Market Value			Book Value		
		M40	M80	M120	B40	B80	B120
Sharpe Ratio (%)	43.94%	47.29%	50.93%	52.17%	66.02%	72.72%	74.17%
Treynor Ratio (%)	8.72%	10.17%	10.93%	11.20%	15.00%	16.62%	16.93%
Jensen's Alpha (%)	0.00%	1.33%	2.01%	2.24%	5.74%	6.89%	7.10%
p-value Alpha	-	0.694	0.536	0.487	0.169	0.091	0.078
Beta	1	0.973	0.940	0.931	0.925	0.881	0.873
p-value Beta	-	0.000	0.000	0.000	0.000	0.000	0.000

All book value indices convincingly outperform all three cap-weighted indices; M40, M80 and M120 and the JSE ALSI index, on expected return basis. The top 40 book value index displayed the lowest return amongst the three book value indices, but has the highest risk and the highest constituent weight. It is noticeable that the standard deviations for all three book value indices are similar to their market value counterparts. However, their drawdowns are considerably lower. Book value indices also induce lower maximum constituent weights dominating index compositions; therefore book value indices are more diversified than cap-weighted indices. From these results the book value indices fair better than the market value indices from a return perspective and from a risk measurement basis.

In accordance to Panel (a) observations, all book value indices within Panel (b) outperform the JSE ALSI index on a risk-adjusted basis. The top 80 and the top 120 book value indices demonstrate significant risk-adjusted outperformance in comparison to cap-weighted indices.

As anticipated, book value betas are lower than cap-weighted index betas. Though the differences are not major, book value indices depict higher Treynor ratios than that of its market value counterparts. This suggests that the book value indices are less correlated to the market value indices yet, still produce considerable returns in excess of cap-weighted indices.

Book value indices also generate higher abnormal returns where, even their *p*-values for their Jensen alphas are more statistically significant than the market value alphas. The *p*-values for the top 80 and the top 120 book value indices Jensen alphas are significant at the 10% significant level.

From the results illustrated in Table 5.2 it is clear that the Book value fundamental has the potential of being a superior attribute in relation to the market value indicator in selecting performing shares. It is evident that the book value indices perform better for indices with large and small sized firms, which also confirms that the book value attribute is not bias towards small-cap firms and therefore unlikely to be severely influenced by the size effect. Fraser and Page (2000) found similar results that the book-to-market measure had better predicting ability than market capitalisation

strategies. The book value attribute therefore is deemed to be a suitable indicator at recognising performing shares relative to constituent's market values.

5.3.3 Dividend Indices

The dividend indices were computed and weighted by ranking the top constituents by their respective gross dividend pay-outs. The D40 index constitutes the top 40 shares with highest dividend pay-outs. The D80 constitutes the top 80 shares with highest dividend pay-outs and the D120 constitutes the top 120 shares with the highest dividend pay-outs. All dividend indices were rebalanced monthly and it is likely that constituents within the indices changed from time to time. Table 5.3 compares the computed dividend indices to the computed market value indices and JSE ALSI index from a basic performance statistics perspective and from a risk-adjusted return perspective.

Table 5.3　　Descriptive Statistics for JSE ALSI Index, Market Value Indices And Dividend Indices

Panel (a)

BASIC STATISTICS	JSE ALSI Index	Market Value			Dividends		
		M40	M80	M120	D40	D80	D120
Geometric Return (%)	18.29%	19.38%	19.78%	19.92%	22.70%	23.38%	23.45%
Standard Deviation (%)	19.38%	20.91%	20.19%	19.98%	20.84%	19.93%	19.77%
Maximum Draw down (Negative)	40.44%	37.47%	35.05%	34.46%	38.54%	36.38%	36.36%
Max Constituent Weight	-	6.02%	5.49%	5.40%	6.72%	6.18%	6.14%

Panel (b)

RISK-ADJUSTED PERFORMANCE STATISTICS	JSE ALSI Index	Market Value			Dividends		
		M40	M80	M120	D40	D80	D120
Sharpe Ratio (%)	43.94%	47.29%	50.93%	52.17%	63.39%	69.68%	70.59%
Treynor Ratio (%)	8.72%	10.17%	10.93%	11.20%	14.13%	15.52%	15.72%
Jensen's Alpha (%)	0.00%	1.33%	2.01%	2.24%	4.99%	6.02%	6.15%
p-value Alpha	-	0.694	0.536	0.487	0.203	0.109	0.098
Beta	1	0.973	0.940	0.931	0.935	0.894	0.888
p-value Beta	-	0.000	0.000	0.000	0.000	0.000	0.000

All dividend indices demonstrate higher returns than that of the JSE ALSI index. In comparing the dividend indices to the cap-weighted indices, all dividend indices achieve higher returns than the cap-weighted indices for all index sizes. The standard deviations for all dividend indices are also lower in comparison to its market value counterparts. It is also; clear that dividend indices returns and risks improve as small-cap firms are introduced to index compositions.

The draw-downs for the dividend indices are however higher in comparison to the market value indices. The maximum constituent weights are also found to be significantly higher for dividend indices in relation to market value indices. Dividend indices expected returns may be higher than cap-weighted indices, but there is a potential risk when considering the possible draw-downs and over allocation of funds to few shares. Therefore, there is caution when using firm dividend attributes as the fundamental displays possible signs of volatility and high risk in relation to market value indicators.

From a risk-adjusted perspective there is a significant higher out performance for all dividend indices in relation to cap-weighted indices. It is also noticeable that the Sharpe ratios between the D80 and D120 indices have not grown thereby alluding to the possibility that the return generated by the addition of smaller firms within dividend indices is not worthwhile. The dividend attribute is likely to evaluate large-firms more successfully than smaller firms.

Fraser and Page (2000) conducted value strategy research on the JSE and found that share dividend price ratios are poor selectors of value shares. Evidence from this study somewhat supports Fraser and Page's (2000) notions as the dividend-weighted strategy works best for identifying larger performing shares.

The Beta's for the dividends indices are less correlated with the market than cap-weighted indices, but are more correlated in comparison to other fundamentally attributed indices. Similarly to book value indices, dividend indices outperform cap-weighted indices according to Treynor ratios.

From a Jensen's alpha perspective dividend indices show higher abnormal returns than market value indices. The p-values for the top 120 dividend index's Jensen alphas are significant at the 10% significance level. The top 40 and 80 dividend

indices show increasing abnormal returns but follow a similar trend to cap-weighted indices where the growth in performance with the addition of small firms increases at a declining rate. It is likely that constituent dividend factors are influenced by risk factors in similar manner to that of market value indicators. Bhatia (2010) found that dividend policy announcements have significant influence on determinants of share prices. This implies that firm dividend attributes may be somewhat price sensitive just as their share market values and therefore not an entirely superior indicator of firm value to constituent market capitalisations.

5.3.4 Earnings Indices

The earnings indices were computed and weighted by ranking the top shares by their respective net earnings after interest and tax. The E40 index constitutes the top 40 shares with highest earnings. The E80 constitutes the top 80 shares with highest earnings and the E120 constitutes the top 120 shares with the highest earnings. All indices were rebalanced monthly and it is likely that constituents within the indices changed from time to time. Table 5.4 compares the computed earnings indices to the computed market value indices and JSE ALSI index from a basic performance statistics perspective and from a risk-adjusted return perspective.

Table 5.4   Descriptive Statistics for JSE ALSI Index, Market Value Indices And Earnings Indices

Panel (a)

BASIC STATISTICS	JSE ALSI Index	Market Value			Earnings		
		M40	M80	M120	E40	E80	E120
Geometric Return (%)	18.29%	19.38%	19.78%	19.92%	22.70%	23.38%	23.45%
Standard Deviation (%)	19.38%	20.91%	20.19%	19.98%	20.84%	19.93%	19.77%
Maximum Draw down (Negative)	40.44%	37.47%	35.05%	34.46%	38.54%	36.38%	36.36%
Max Constituent Weight	-	6.02%	5.49%	5.40%	6.72%	6.18%	6.14%

Panel (b)

RISK-ADJUSTED PERFORMANCE STATISTICS	JSE ALSI Index	Market Value			Earnings		
		M40	M80	M120	E40	E80	E120
Sharpe Ratio (%)	43.94%	47.29%	50.93%	52.17%	64.83%	69.27%	70.35%
Treynor Ratio (%)	8.72%	10.17%	10.93%	11.20%	14.51%	15.51%	15.74%
Jensen's Alpha (%)	0.00%	1.33%	2.01%	2.24%	5.40%	6.09%	6.23%
p-value Alpha	-	0.694	0.536	0.487	0.181	0.117	0.104
Beta	1	0.973	0.940	0.931	0.945	0.906	0.897
p-value Beta	-	0.000	0.000	0.000	0.000	0.000	0.000

The earnings indices have all outperformed the JSE ALSI index. The expected returns generated by the earnings indices are better than it's the market value counterparts but lower in comparison to other fundamental indices. The standard deviations for earnings indices are also higher. The top 40 earnings index also displays a higher drawdown than the ALSI. All earnings indices display drawdowns in excess of all cap-weighted indices.

The earnings indices returns are subdued in comparison to other fundamental indices. As smaller firms are added to the index's composition, growth in returns follows a similar trend to that of cap-weighted indices. Therefore, it is speculated that the earnings attribute is not the paramount indicator of all sized firms, and that the attribute is potentially sensitive to risk factors that similarly affect market value indicators.

According to risk-adjusted Sharpe ratios, all earnings indices outperform the JSE ALSI index. Earning indices all illustrate higher Sharpe ratios than that of cap-weighted indices. The Sharpe ratios for the earnings indices are however alike to dividend indices. Earnings indices also outperform cap-weighted indices on a Treynor risk-adjusted basis. The annualised Treynor ratios for earnings indices further exemplify the parallel performances of dividend indices. Similar to the other risk-adjusted ratios the Jensen alphas for the earnings indices are higher than the Jensen alphas for the cap-weighted indices.

Earnings indices depict the highest beta coefficients in comparison to other fundamental indices. This highlights that the performances of earnings indices are the most sensitive to market risk factors than any other fundamental attribute. Banz (1981) contends that price/earnings ratios are merely a proxy for size effect but unlike size effect, the earnings yield is only conditionally affected by absent factors within CAPM. Although this study adopted earnings-to-market ratios, the risk-adjusted returns results from this study support Banz (1981) finding, that the earnings indices and market value indices show a possible tendency for size effect. Since the effect is the same for both attributes, it is believed that the earnings fundamental suffers from price sensitivity and investor behaviour.

5.3.5   Sales Indices

The sales indices were computed and weighted by ranking the top shares by their respective gross sales. The S40 index constitutes the top 40 shares with highest sales. The S80 constitutes the top 80 shares with highest sales figures and the S120 constitutes the top 120 shares with the highest sales. All indices were rebalanced monthly and it is likely that constituents within the indices changed from time to time. Table 5.5 compares the computed sales indices to the computed market value indices and JSE ALSI index from a basic performance statistics perspective and from a risk-adjusted return perspective.

Table 5.5   Descriptive Statistics for JSE ALSI Index, Market Value Indices
                And Sales Indices

Panel (a)

BASIC STATISTICS	JSE ALSI Index	Market Value			Sales		
		M40	M80	M120	S40	S80	S120
Geometric Return (%)	18.29%	19.38%	19.78%	19.92%	24.80%	24.84%	24.96%
Standard Deviation (%)	19.38%	20.91%	20.19%	19.98%	20.05%	19.58%	19.52%
Maximum Draw down (Negative)	40.44%	37.47%	35.05%	34.46%	36.26%	34.95%	35.46%
Max Constituent Weight	-	6.02%	5.49%	5.40%	5.51%	4.80%	4.77%

Panel (b)

RISK-ADJUSTED PERFORMANCE STATISTICS	JSE ALSI Index	Market Value			Sales		
		M40	M80	M120	S40	S80	S120
Sharpe Ratio (%)	43.94%	47.29%	50.93%	52.17%	76.34%	78.37%	79.24%
Treynor Ratio (%)	8.72%	10.17%	10.93%	11.20%	18.31%	18.75%	18.94%
Jensen's Alpha (%)	0.00%	1.33%	2.01%	2.24%	7.95%	8.15%	8.28%
p-value Alpha	-	0.694	0.536	0.487	0.079	0.064	0.059
Beta	1	0.973	0.940	0.931	0.836	0.819	0.816
p-value Beta	-	0.000	0.000	0.000	0.000	0.000	0.000

The sales indices convincingly display higher expected returns than the JSE ALSI index. In comparison to the cap-weighted indices, the sales indices also outperform their counterparts according to annualised returns and depict lower risks. However, the sales index's risks are higher than the JSE ALSI index. The maximum drawdown is also lower for large firm based sales indices, with the exception of the top 120 index. Therefore, the potential losses for sales indices are lower in contrast to cap-weighted indices. Maximum constituent weights are also lower than that of market value indices, thereby displaying more diversified portfolio alternatives.

On a risk-adjusted basis all Sales indices outperform market value indices in excess of 27% or more according to the respective Sharpe ratios. The top 40 sales index displays a risk-adjusted return 32% over the JSE ALSI index. It is evident that sales indices successfully outperform cap-weighted indices whilst maintaining lower risks and therefore are less volatile than cap-weighted indices.

From the Treynor ratio perspective, the results are similar to that of the Sharpe ratios where all sales indices convincingly display higher risk-adjusted returns to all market value indices. Sales indices are significantly the least correlated fundamental attribute to market value indices from sales index's betas observations. It is evident that the firm's sales attribute are slightly better proxies for selecting performing shares than market value indicators.

The sales indices also produce abnormal returns above the market value Jensen alphas. The *p*-values for the sales indices alphas are also more statistically significant than that of the market value indices. The *p*-values for all sales indices Jensen alphas are significant at the 10% significance level. Arnott *et al* (2005) also find sales weighted index to the best fundamental performer in comparison to the S&P 500 cap-weighted index. The sales fundamental seems to be a good indicator in regard to valuing potential performing shares in contrast to market value indicators.

5.3.6 Composite Indices

The composite indices are computed and weighted by ranking the top shares by their respective composite metrics determined by Equation 5.1. The C40 index constitutes the top 40 shares with highest composite measures. The C80 represents the top 80 shares with highest composite metrics and the C120 constitutes the top 120 shares with the highest composite metrics. All indices were rebalanced monthly and it is likely that constituents within the indices changed from time to time. Table 5.6 compares the computed composite indices to the computed market value indices and JSE ALSI index from a basic performance statistics perspective and from a risk-adjusted return perspective.

Table 5.6   Descriptive Statistics for JSE ALSI Index, Market Value Indices
And Composite Indices

Panel (a)

BASIC STATISTICS	JSE ALSI Index	Market Value			Composite Metric		
		M40	M80	M120	C40	C80	C120
Geometric Return (%)	18.29%	19.38%	19.78%	19.92%	23.78%	24.65%	24.96%
Standard Deviation (%)	19.38%	20.91%	20.19%	19.98%	20.27%	19.30%	18.93%
Maximum Draw down (Negative)	40.44%	37.47%	35.05%	34.46%	38.27%	36.35%	35.92%
Max Constituent Weight	-	6.02%	5.49%	5.40%	4.45%	3.57%	3.36%

Panel (b)

RISK-ADJUSTED PERFORMANCE STATISTICS	JSE ALSI Index	Market Value			Composite Metric		
		M40	M80	M120	C40	C80	C120
Sharpe Ratio (%)	43.94%	47.29%	50.93%	52.17%	70.49%	78.52%	81.69%
Treynor Ratio (%)	8.72%	10.17%	10.93%	11.20%	15.90%	17.98%	18.75%
Jensen's Alpha (%)	0.00%	1.33%	2.01%	2.24%	6.38%	7.74%	8.21%
p-value Alpha	-	0.694	0.536	0.487	0.108	0.05	0.036
Beta	1	0.973	0.940	0.931	0.899	0.843	0.825
p-value Beta	-	0.000	0.000	0.000	0.000	0.000	0.000

The composite indices all exhibited higher expected returns than the JSE ALSI index as well as all market value indices. The composite indices best performance is observed within the top 120 constituent compilation. Not only is the return the highest but the risk is the lowest out of all fundamental attributed indices.

Interestingly, the drawdowns for the composite indices are alike to cap-weighted indices but just worst off by approximately one percent. The maximum constituent weights however suggest that though the drawdowns are similar, the composite indices are much more diversified and it is evident in the C120 index producing the lowest standard deviation. It is therefore apparent, that firm composite metrics successfully identify performing smaller firms and are less successful, but not the worst, at recognizing performing larger firms.

All composite indices outperform cap-weighted indices on risk-adjusted basis for Sharpe, Treynor and Jensen's alpha measures. Surprisingly, the *p*-values for the top 80 and the top 120 composite indices Jensen alphas are significant at the 5% significance level. In continuation with evidence from Table 5.6 Panel (b), the top 40 composite index displays a lower a risk-adjusted return in comparison to sales top 40 index but performs best within the top 120 category for all attributes on Sharpe ratio basis. When evaluating composite indices betas, it is noticeable that the betas are alike to sales index betas, but with the inclusion of book value, dividends and earnings fundamental attributes that are more likely correlated with the market than sales indices, the composite indices betas in turn become more correlated with the JSE ALSI index.

It is interesting to note composite indices performances as the larger top 40 base is influenced by all fundamental attributed values, where it is likely that the top 120 constituent base is more affected by firm sales figures. This illustrates that certain fundamental attributes are more affected by price sensitive risk factors than other fundamentals and that size effect could possibly be prevalent for JSE ALSI shares, as all indices performances improved as smaller firms are added to the index compilations.

5.4   Sub-period Performances

Table 5.7 compares all constructed market value indices and fundamental indices, for all three index breadths; 40, 80 and 120, for the entire review period and for the two sub periods on an annualised geometric return and Sharpe ratio basis.

Table 5.7   Sub-period Returns and Sharpe Ratios for Market Value Indices and Fundamental Indices

Panel (a)

| INDICES ANNUALISED GEAOMETRIC RETURNS R% | | | | | | | | |
| Monthly | Year 2000 - 2004 | | | Year 2005 – 2009 | | | Year 2000 - 2009 | | |
	40	80	120	40	80	120	40	80	120
Market Values	15.40%	16.27%	16.57%	23.49%	23.38%	23.36%	19.38%	19.78%	19.92%
Book Values	22.52%	23.34%	23.79%	24.23%	24.92%	24.76%	23.38%	24.13%	24.27%
Dividends	21.86%	22.67%	22.89%	23.55%	24.10%	24.02%	22.70%	23.38%	23.45%
Earnings	23.03%	23.34%	23.65%	23.38%	23.77%	23.59%	23.21%	23.55%	23.62%
Sales	27.01%	26.87%	27.06%	22.63%	22.84%	22.89%	24.80%	24.84%	24.96%
Composite	26.13%	26.57%	27.39%	22.62%	23.98%	23.86%	23.78%	24.65%	24.96%

Panel (b)

| INDICES SHARPE RATIOS R% | | | | | | | | |
| Monthly | Year 2000 - 2004 | | | Year 2005 – 2009 | | | Year 2000 - 2009 | | |
	40	80	120	40	80	120	40	80	120
Market Values	24.64%	29.73%	31.50%	70.00%	72.18%	72.87%	47.29%	50.93%	52.17%
Book Values	55.88%	62.97%	65.87%	76.56%	82.47%	82.33%	66.02%	72.72%	74.17%
Dividends	56.38%	63.27%	64.68%	69.68%	75.29%	75.73%	63.39%	69.68%	70.59%
Earnings	61.17%	65.47%	67.77%	67.82%	72.35%	72.26%	64.83%	69.27%	70.35%
Sales	84.57%	86.54%	87.72%	67.95%	70.13%	70.70%	76.34%	78.37%	79.24%
Composite	81.92%	90.09%	96.03%	65.56%	75.28%	76.30%	70.49%	78.52%	81.69%

It is important to note that within Table 5.7, the first sub period 2000 to 2004, is characterised by strong growth in the JSE partly due to macro-economic factors such as improvements in international market outlooks and improvements in JSE's trading platforms. Within this period the JSE experienced a bull market which means the market cycle was predominantly upward trending.

Within the next five year period 2005 to 2009, the JSE continued to rise up until 2008, where the subprime credit crisis hit resulting in the JSE to suddenly decline in performance. By 2009 the market recovered and the JSE rose, thus, due to the nature of the JSE market trend this period is considered a bear market.

As illustrated in Table 5.7, within the first sub period market value indices display poor returns in relation to fundamental indices. However, in the next sub-period

market value indices produce returns higher than certain fundamental indices. Except for book value indices, market value indices produce one of the highest risk-adjusted returns for large firms within the period 2005 to 2009. This observation is in accordance with Arnott (2009) view that in 2008, share market values trended irregular to share price calculations, resulting in shares to perform more in accordance to their market value indicators. However, within the same period fundamental indices that included smaller firms outperformed market value indices on a risk-adjusted basis, which could be potentially due to exposure to size and value risk factors.

Book value indices display par returns in relation to other fundamental indices within the first sub period with the exception of sales and composite indices. Nevertheless, in the ensuing period 2005 to 2009, book value indices outperform both market value and fundamental indices on return and risk-adjusted return basis. This is a significant observation as fundamental indices are argued to realise lower returns within bear markets (Edesess, 2008). Academics for years have discussed the affect that a firm's book value has on its share risk and performance. Rosenberg, Reid and Lanstein (1985) were possibly the first to recognize the significance of book-to-market ratio, that shares with higher book-to-market values produce greater returns.

Fama and French (1993) argue that an investment's size and book-to-market factors represent risk in relation to its return. They also contend that book-to-market factors can be associated with investments profitability. Bauman, Conover and Miller (1998) investigate value strategies and find the usage of price-to-book ratios to realise higher returns than growth firm strategies. Hsu and Campollo (2006) show that constructing portfolios according to fundamental attributes such as firm's book values are less sensitive to over allocating funds to poor performing shares, as fundamental values do not necessary follow share price fluctuations.

Within the JSE ALSI context, Baisewicz and Auret (2010) found the book-to-equity ratio to have predictability powers only at 10% significance level, but only on condition that the size risk factors are not taken into account.

The academic findings previously discussed, allude to the fact that the book value fundamental has qualities that can recognise potential profitable shares. Cochrane (1999) discusses Fama-French three factor model and its validity and finds that, after

their anomalies were publicised, the returns generated by the size and book value risk factors have diminished. Cochrane (1999) believes the reason why the book value anomalies performed so well in the past is because they were possibly overlooked by investors. He argues that once investors identified the book value anomaly and more investors invested according to its effect, the irregular premiums generated by the book value anomaly declined. Though the profitability of the book value anomaly could be on the decline, evidence from this research suggests that it is still a profitable value effect to pursue within the JSE ALSI, even in periods of distress.

Earnings indices performances throughout the examination period are subdued in comparison to other fundamental indices performances. Therefore, value effects for other fundamentals are considered to be potentially higher for other fundamental attributed indices than for earnings indices.

Out of all the fundamentals, dividend indices exhibit the lowest returns within bull market period and for the whole examination period. Dividend and earnings indices display higher returns within the bear market in a similar trend to market value indices. This behaviour is more pronounced for dividend indices, and suggests that the dividend attribute could be sensitive to risk factors similar to share market values.

Sales and composite indices perform the best within the bull market period but perform the worst within the bear market period. Composite indices do however, display strong risk-adjusted performances for the top 80 and the top 120 index breadths. This highlights that composite indices are less risky than the sales indices and yet display impressive returns. The composite indices also displayed the highest Sharpe ratio out of all indices for the entire period within the top 120 index category. Composite metrics could be influenced by size and value effects which will be ascertained in the next section, but from return performances perspective, the composite metric provides a satisfactory indicator for identifying performing shares.

The next section will discuss the sources of index performances, with more depth analysis with regard to indices exposure towards value and size risk factors.

Chapter 6 :   **VALUE AND SIZE EFFECTS FOR FUNDAMENTAL**
                        INDICES AND CAP-WEIGHTED INDICES

6.1   Introduction

According to Siegel (2006) the reasoning for the debate between the utilisation of price-sensitive weighting methodologies versus the uses of fundamental-weighting methodologies, is the belief that noise factors exist within share prices. These noise variables come about from investor behaviour and investor overreaction. The result is that share prices tend to deviate from their fair values and therefore be incorrectly priced. Certain firms with poor accounting figures may be overvalued whilst a comparable firm with strong financials may be undervalued. Similarly, larger firms' share prices could be overvalued whilst smaller firm share prices could be undervalued.

Arnott *et al* (2005) argues a similar point, that due to share prices having noise variables embedded within their pricing, market capitalisation indices will never be optimal because cap-weighting methods inadvertently utilise share prices to weigh investment allocations between different constituents. Therefore, the presence of noise variables in share prices results in cap-weighted indices to experience a performance drag.

Arnott *et al* (2005) suggest that firm fundamental attributes be used in index construction. Company fundamentals are thought to be market price in-sensitive. Siegel (2003) found that fundamental indices provide protection to investors from speculative bubbles. Siegel (2003) observed that within speculative bubbles, fundamental indices constituent weightings did not change with its constituent's deceptive share price fluctuations.

There has however, been some criticisms regarding the legitimacy of advocates of fundamental indexation arguments. Critics like Graham (2011) argue that a share's fair value is unobservable and therefore for fundamental indices to be better indicators of share fair value is impossible. Hsu (2005) however, contends that an index need not be fair value weighted but only non-price weighted to outperform its relative cap-

weighted index. Advocates of fundamental indexation believe their fundamentally based methods are superior because they do not rely on share prices as an indication for valuing firm shares but at the same time they do not assume that firm fundamentals are true indicators of a share's fair values.

6.2 Value Risk Factors

The unequivocal prophets for utilising firm accounting data for security analysis can unarguably be Graham and Dodd (1934). They emphasised that shares should be analysed according to certain accounting rules and based on these rules, investors would be able to find shares with good investment prospects. Subsequent to their work, focus was shifted away from evaluating shares on an individual basis to determining the portfolio with the optimal allocation of funds between shares that achieve the highest returns with the lowest risks. The first reliable evidence of value effect can be seen in work by Basu (1977) who constructs price-to-earnings portfolios and finds that portfolios consisting of shares with low price-to-earnings ratios outperform portfolios with high price-to-earnings ratios. Basu (1977) believes that firms that obtain consistent poor earnings reports are unfairly undervalued by the market and hence are under-priced in contrast to their true fair values.

Following Basu's (1977) findings, a spate of academic literature transpired testing the ability of firm accounting metrics relative to their share prices, for identifying portfolios consisting of under-priced shares that yield returns in excess of the market. Various accounting measures were tested, such as firms; book value-to-market, cash flows-to-price, dividend-to-price and gross sales. Lakonishok *et al* (1994) illustrated that a firm's accounting measures relative to their share prices could be coupled together to create portfolios that would outperform other portfolios based on single firm accounting metrics relative to their share prices. Similarly to Basu (1977), Lakonishok *et al* (1994) argues that value portfolios outperform cap-weighted portfolios because value strategies are contrary to naive CAPM methods and that investors place too much emphasis on firm historical data. The result is that certain shares are overlooked and therefore, under-priced and worth much more than their share price suggests, whilst large glamour shares are overemphasised and severely overpriced.

Siegel (2006) does however; warn investors that price corrections may not revert precisely in the manner that it should, as shares may still be undervalued or overvalued following mean reversions. Therefore, though the value effect does exist, it is extremely difficult to arbitrage from.

Reinganum (1981) researches Basu's (1977) P/E effect and finds that when limiting an investment horizon for similar sized shares, the Price-Earnings effect is eliminated but when controlling for security selection on the basis of share price-earnings, then size effect is evident. As 'size' refers to the total of a share's market capitalisation, the size effect is based on smaller market-cap shares tendency to display higher than usual returns in relation to large market-cap firms. If a firm's fundamental attribute displays similar behaviour and stature relative to its market value, then a connection between the firm's two indicators would be considered. Due to the perceived connection between the firm's fundamentals and market values, both would also be considered to be exposed to price sensitivity.

6.3 Size Risk Factors

The term 'size' makes reference to the classification of a share. Shares are classified according to their market capitalisation values on a specified date. Constituents with large market capitalisation values are known as large cap firms and constituents with smaller market capitalisations would be considered as small cap firms.

According to Fama and French (1992) the market tends to reward risk factor traits within shares and portfolios. Since small sized firms are usually deemed riskier, they therefore trade at a premium in comparison to larger sized market-cap shares. Bauman, Conover and Miller (1998) consider Fama and French's (1992) notion, but also believe that market behaviour is another possible reason why small-cap shares on occasion outperform large-cap shares. Bauman, Conover and Miller (1998) find that value strategies significantly outperform growth strategies, but not when the investment pool is only small-cap shares. They therefore, believe that some fundamental attributes are too unstable and therefore are poor indicators for valuing a firm.

Theoretically, academics have struggled to find evidence to explain size effect anomalies in share price behaviour, but currently it is seen as a phenomenon in asset

pricing models. To evaluate whether fundamental attributes are better proxies for identifying performing shares, the fundamental attributed indices would have to outperform market value indices inclusive of all sized shares. Hsieh and Hodnett (2012) found no size effect evident when evaluating the performances of fundamentally-weighted indices versus cap-weighted indices within the global market context. For the JSE the results could be different and are therefore investigated.

Baisewicz and Auret (2010) test the viability of using Fama-French three factor model on the JSE. They found that a size effect persists within the JSE, but believe its existence is due to market microstructure effects and poor liquidity within the market. They further suggest that the mispricing in small-cap shares is partially due to liquidity issues and poor research and analysis on smaller-cap firms.

In light of the aforementioned discussions, it is necessary to evaluate the influence value and size risk factors have on fundamental indices and market value indices utilising constituents from the JSE ALSI index. The instrument that will be utilised to assess the contribution value and size effects have on indices performances is the Fama-French (1993) three factor model.

6.4   Fama and French (1993) Three Factor Model

Fama-French (1993) three factor model uses time-series linear regressions between indices monthly excess return data with excess returns generated by the JSE ALSI index over the full sample period. Excess returns are calculated by excluding monthly risk free rates derived from the yields of South African 3-month treasury bills from indices monthly returns and JSE ALSI index's returns. Risk free rates are subtracted from returns to establish the reward an investor achieves for bearing the unique risk with investing in that asset. The difference is known as an assets risk premium and is subject to an investor's preference towards risk.

In addition to the market's risk factors, Fama and French (1993) include size and book-to-market ratios as factors that could identify additional risk factors in investment's returns not fully explained by CAPM's beta. The results from the Fama-French three factor model provide a richer understanding of the style tilts inherent in the index's returns. The size risk factor was included on the observation that small-caps tend to outperform large-caps empirically. The book-to-market (B/M) ratio risk

factor was included on the observation that shares with higher book-to-market ratios outperform shares that display comparable market values but inferior book-to-market ratios in empirical studies.

Therefore, Fama-French three factor model stems from the CAPM but with the inclusion of size and value risk factors. When an asset/portfolio has significant exposure to the size and value risk factors, the returns of that asset/portfolio are significantly driven by either the movements of the respective risk(s).

The Fama-French three factor model specified below in Equation 6.1:

$$R_x - R_f = \alpha_x + \beta_x(R_m - R_f) + \beta_{HML}R_{HML} + \beta_{SMB}R_{SMB} + \varepsilon_x \qquad (6.1)$$

Where, all variables are similar to the CAPM model except for the value and size risk factors:

β_{HML}	=	Portfolio X's exposure to the value risk premium, R_{HML}.
R_{HML}	=	Value risk premium is the average monthly return difference between the shares in the highest book-to-market ratio quintile to the shares in the lowest book-to-market quintile in the sample.
β_{SMB}	=	Portfolio X's exposure to the size risk premium, R_{SMB}.
R_{SMB}.	=	Size risk premium is calculated by subtracting the average monthly return of shares in the largest market capitalisation quintile from the average monthly return of shares in the smallest market capitalisation quintile.

The size premium represents the difference between the smallest firms versus the largest firms indicated by their market-cap. In this study the largest shares are considered within the top quintile where the smallest firms are considered within the bottom quintile. According to the Fama-French three factor model, the value factor is indicated by the B/M ratio. In this study, the value factor is computed as the difference between the returns indicated by constituent sample's top book-to-market

ratio quintile in comparison to the returns indicated by the sample's bottom book-to-market ratio quintile.

Basiewicz and Auret (2010) tested the applicability of using Fama-French three factor model to explain value and size risk factors on the JSE. They tested Fama-French three factor model asset pricing ability using GRS tests and found the model to successfully price assets on the JSE with minimal pricing errors.[5] Their tests incorporated grouped and ungrouped data. Within the grouped dataset, the value effect persisted, whereas within the ungrouped datasets size effects were found to be more prevalent.

Within alternative non cap-weighted indexation tests, Chow *et al* (2011) used the Fama-French three factor model to observe the potential sources of their constructed indices performances. They found that the value and size risk factors both provided statistical significant sources of outperformance. Their tests did however produce insignificant alphas for each index tested and hence was not commented on further within their findings.

Similar to CAPM, all risk factors and terms with the Fama-French three factor model are tested for statistical significance. Student's *p*-value tests are carried out for each indices alpha, market beta, size factor and value factor to ascertain the relevance of Fama-French three factor model risk factors and terms produced for each index.

6.5 Fama and French Three Factor Model Alphas of Fundamental Indices and Market Value Indices

Alphas are regarded as the differences between an asset's expected rate of return in comparison to the asset's price determined by the asset pricing model. When the Fama-French asset pricing model holds, there is no difference between the two and it is assumed that assets are accurately priced. Another view of alphas is that they are irregular returns realized in excess of what is determined by the Fama-French three factor model. Therefore, those assets that achieve positive alphas generate positive abnormal returns. Alphas are however subject to tests of significance and unless found

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[5] The GRS test refers to statistical tests developed by Gibbons, Ross and Shanken (1989) for identifying the instantaneous significance of a collection of intercepts, whilst presupposing that any identifiable errors are uncorrelated over time.

to be highly significant, the assets alpha found should be treated with caution. Table 6.1 compares all constructed market value indices and fundamental indices Fama-French alphas and *p*-value coefficients, for all three index breadths; 40, 80 and 120, for the entire review period and for the two sub periods.

Table 6.1   Sub-period Fama-French Alphas and *p*-Values.

Panel (a)

INDICES FAMA-FRENCH ALPHAS α								
Monthly	Year 2000 – 2004			Year 2005 – 2009			Year 2000 – 2009		
	40	80	120	40	80	120	40	80	120
Market Values	0.009	0.008	0.008	0.003	0.002	0.002	0.005	0.004	0.004
Book Values	0.007	0.006	0.006	0.001	0.001	0.001	0.002	0.002	0.002
Dividends	0.010	0.009	0.009	0.001	0.001	0.001	0.003	0.003	0.003
Earnings	0.009	0.009	0.009	0.000	0.000	0.000	0.003	0.003	0.002
Sales	0.005	0.005	0.005	-0.002	-0.002	-0.002	0.000	0.000	0.000
Composite	0.005	0.006	0.006	0.000	-0.001	-0.001	0.002	0.002	0.001

Panel (b)

INDICES FAMA-FRENCH ALPHA'S *P*-VALUES								
Monthly	Year 2000 – 2004			Year 2005 – 2009			Year 2000 – 2009		
	40	80	120	40	80	120	40	80	120
Market Values	0.021	0.030	0.029	0.435	0.561	0.614	0.090	0.164	0.195
Book Values	0.243	0.248	0.241	0.782	0.812	0.874	0.497	0.542	0.585
Dividends	0.040	0.038	0.037	0.832	0.852	0.885	0.302	0.329	0.354
Earnings	0.052	0.060	0.058	0.941	0.954	0.993	0.390	0.427	0.464
Sales	0.366	0.365	0.364	0.722	0.722	0.712	0.969	0.975	0.984
Composite	0.257	0.230	0.229	0.963	0.919	0.860	0.531	0.633	0.688

According to Table 6.2, market value indices achieve higher alphas for the sub period 2000 to 2004 and for the entire examination period. Only dividend and earnings indices achieve higher alphas than market value indices within the sub period 2000 to 2004.

Book value indices continually attain moderate Fama-French alphas in relation to market value indices for both sub periods and for the entire review period. Composite indices display lower alphas than book value indices for all periods. Sales indices demonstrate the lowest alphas out of all indices for all periods. Sales indices were the

only fundamental-attributed indices to achieve negative alphas for all index breadths within the sub period 2005 to 2009.

When taking *p*-values into consideration, only market value, dividend and earnings indices are found to display the highest levels of statistical significance within the sub period 2000 to 2004. The market value and dividend indices *p*-values are significant at the 5% significance level whilst all the earnings indices achieve a *p*-value significant at the 10% significance level for the sub period 2000 to 2004. The market value top 40 index achieves a *p*-value that are significant at the 10% significance level for the entire examination period. Therefore, market value, dividend and earnings indices alphas are found to be more reliable than book value, sales and composite indices alphas.

6.6 CAPM and Fama-French Three Factor Model Betas of Fundamental Indices and Market Value Indices

Basu (1977) discovered that returns generated by shares with low price-to-earnings ratios were not reflected by the shares CAPM betas. Basu (1977) believed that hidden risk factors existed that is not fully captured by share CAPM betas. Fama and French (1993) had similar insights as Basu (1977) when including additional factors to the single index model, to gain a richer understanding of the risk factors affecting investment returns. Therefore, Fama-French three factor models are expected to produce betas different to that of CAPM betas.

Table 6.2 displays all constructed market value indices and fundamental indices CAPM betas in comparison to their Fama-French betas for all three index breadths; 40, 80 and 120, for the entire review period and for the two sub periods.

Table 6.2   Sub-period CAPM and Fama-French Betas

Panel (a)

INDICES CAPM BETAS β								
Monthly	Year 2000 – 2004			Year 2005 – 2009			Year 2000 – 2009		
	40	80	120	40	80	120	40	80	120
Market Values	0.996	0.966	0.957	0.947	0.913	0.903	0.973	0.940	0.931
Book Values	0.991	0.934	0.924	0.859	0.827	0.823	0.925	0.881	0.873
Dividends	0.958	0.915	0.911	0.914	0.877	0.868	0.935	0.894	0.888
Earnings	0.969	0.925	0.916	0.925	0.891	0.884	0.945	0.906	0.897
Sales	0.853	0.829	0.826	0.827	0.816	0.814	0.836	0.819	0.816
Composite	0.883	0.810	0.795	0.893	0.848	0.827	0.899	0.843	0.825

Panel (b)

INDICES FAMA-FRENCH BETAS β								
Monthly	Year 2000 – 2004			Year 2005 – 2009			Year 2000 – 2009		
	40	80	120	40	80	120	40	80	120
Market Values	0.991	0.971	0.964	0.920	0.898	0.892	0.935	0.916	0.911
Book Values	0.978	0.939	0.933	0.862	0.841	0.840	0.906	0.876	0.874
Dividends	0.942	0.910	0.910	0.907	0.881	0.875	0.905	0.878	0.875
Earnings	0.966	0.933	0.927	0.923	0.897	0.893	0.922	0.895	0.891
Sales	0.891	0.875	0.874	0.855	0.848	0.847	0.859	0.848	0.848
Composite	0.921	0.864	0.857	0.901	0.872	0.858	0.906	0.869	0.857

According to Table 6.2, it is evident that Fama and French three factor model finds generally lower betas than CAPM betas for almost all market value indices for all periods. Market value indices are considered to be more correlated with the JSE ALSI and therefore would display higher betas in relation to the JSE ALSI. The advantages of the Fama-French model are clear when viewing the contrasting betas produced. The Fama-French model identifies other risk variables not fully captured by CAPM betas and therefore produces lower betas in proportion to their CAPM betas.

From the book value perspective, in certain periods the Fama-French model finds book value indices to be more correlated with JSE ALSI than identified by their CAPM betas. Within the bear market period experienced in 2000 to 2004, it is evident that book value indices are highly correlated with market value indices. In the sub period 2005 to 2009, where a bull market was experienced, it is apparent that book value indices became less correlated with market value indices.

Similar to book value indices, CAPM betas produced by dividend indices are higher within the bull market in contrast to betas determined by Fama-French model which are lower. In the bear market period, the opposite occurs as the Fama-French model finds dividend indices for the top 80 and top 120 indices to be more correlated with JSE ALSI, whereas CAPM finds dividend indices to be less correlated with the JSE.

Earnings index betas are found to be constantly similar with market value index betas. Within the entire examination period book value, dividend and earnings betas were found to be the most correlated with the JSE ALSI regardless from which model they were derived from.

Sales indices were found to be the least correlated with JSE ALSI and this is true for both models betas and as well for both sub periods. In the case of sales indices, it is interesting to note that all betas produced by the Fama-French model were higher than betas determined by CAPM for all periods.

Composite indices follow a similar trend to sales indices. Composite indices betas are less correlated with the JSE ALSI for both models betas, and display higher betas for Fama-French model than for CAPM within both sub periods. It is evident from beta comparisons that sales and composite fundamentals are less correlated with the JSE ALSI than market value, dividends and earnings fundamentals. It is also noticeable that for the different pricing instruments, certain fundamentals indices would depict higher betas for the Fama-French model while other fundamental indices would depict higher beats for CAPM. There is likely a presence of other risk factors found by Fama-French model that deviate betas in both directions dependent on the fundamental. It is probable that the two other factors utilised within the Fama-French model, size and value risk factors, display interesting results for each fundamental index discussed within the next section.

6.7 Size Risk Factors of Fundamental Indices and Market Value Indices

Table 6.3 compares the exposures of all constructed indices to the Fama-French size risk factors (known as the proxy for small firm effect) and the *p*-values of the respective coefficients. The results are shown over the entire review period and for the two sub periods. Certain indices produced negative Fama-French size risk factors,

which occurs when the index's returns are highly correlated with large caps, rather than small caps. This is expected for most of the indices constructed, as shares with higher fundamental values are likely to be larger in terms of their market capitalisation as well.

Table 6.3   Sub-period Fama-French Size Factor Coefficients and *p*-Values

Panel (a)

INDICES SIZE RISK FACTORS (SMB)									
Monthly	**Year 2000 – 2004**			**Year 2005 – 2009**			**Year 2000 – 2009**		
	40	**80**	**120**	**40**	**80**	**120**	**40**	**80**	**120**
Market Values	-0.051	-0.019	-0.010	-0.216	-0.144	-0.119	-0.148	-0.094	-0.077
Book Values	-0.037	0.013	0.027	-0.105	-0.041	-0.014	-0.084	-0.025	-0.003
Dividends	-0.061	-0.025	-0.017	-0.177	-0.106	-0.086	-0.127	-0.071	-0.057
Earnings	-0.023	0.010	0.021	-0.153	-0.095	-0.071	-0.097	-0.050	-0.031
Sales	0.121	0.140	0.146	0.049	0.086	0.099	0.080	0.109	0.119
Composite	0.115	0.159	0.183	0.000	0.080	0.111	0.024	0.097	0.125

Panel (b)

INDICES FAMA-FRENCH SIZE RISK FACTORS *p*-VALUES									
Monthly	**Year 2000 – 2004**			**Year 2005 – 2009**			**Year 2000 – 2009**		
	40	**80**	**120**	**40**	**80**	**120**	**40**	**80**	**120**
Market Value	0.419	0.764	0.866	0.013	0.088	0.153	0.006	0.076	0.146
Book Values	0.699	0.893	0.769	0.267	0.660	0.882	0.203	0.697	0.965
Dividends	0.430	0.731	0.816	0.067	0.255	0.349	0.042	0.236	0.340
Earnings	0.779	0.903	0.786	0.120	0.318	0.449	0.130	0.420	0.611
Sales	0.236	0.153	0.136	0.631	0.393	0.321	0.261	0.112	0.081
Composite	0.162	0.055	0.026	0.997	0.418	0.250	0.703	0.122	0.041

From Table 6.3 initial view, it is observed that indices with small firms included in their index composition show higher exposure to the size risk factor than indices specified for large firms. This is evident in top 40 indices displaying lower size factor coefficients than for top 120 indices. When analysing the exposures of the top 40 indices to the size risk factors, it is noticeable that market value and dividend indices show the highest negative exposures to the size risk factor, whereas the other fundamental indices show the least negative (or even positive) exposures to the size risk factor. Market value indices are expected to display statistically high significant

negative exposures toward the size risk factor, as cap-weighted indices allocate more weight to large-cap shares in comparison to fundamentally-weighted indices.

Since market value and dividend indices illustrate negative exposures to the size risk factor, it is likely that these indices exhibit excess exposure to growth firms and are less invested in smaller firms. It is also noted that book value, dividends and earnings top 40 indices also display greater negative exposures to the size risk factor within the bear market period.

For the entire examination period and the sub period of 2005 to 2009, dividend, earnings and book value indices display high negative exposures to the size risk factor for all three index breadths. It is therefore evident that the returns of book value, dividend and earnings fundamental indices are similarly correlated to large shares as with market value indices returns.

Sales and composite indices were the only fundamental indices to display constant positive exposures to the size risk factor. The sales fundamental did however, display larger exposure to the size risk factor for the top 40 indices whereas, composite indices displayed higher exposure to the size risk factor within the top 120 index breadth. It is therefore evident that sales and composite indices diversify their indices more by allocating more weight to smaller firms in comparison to the other indices.

From Table 6.3 it is evident that out of all fundamental indices, the sales and composite indices are most affected by size effect whilst book value, dividend and earnings indices are least affected. Size effect is also noticeable to be most pronounced in bull market periods for all indices and least manifested in bear market periods. However, most fundamental indices do not produce statistically significant exposures to the size risk factor over both sub periods and for the overall examination period. Therefore, it is evident that the performances of fundamental indices are not attributable to small firm effect.

The indices that achieved Fama and French size factor coefficients that attained p-values that are significant at 5% significance levels are the market value top 40 indices within the bear market period and for the entire period, the dividend top 40 index for the entire period and the composite top 120 index for the bear market period. The indices that achieved Fama and French size factor coefficients that

attained *p*-values that are significant at 10% significance levels are the market value top 80 indices within the bear market period and for the entire period, the dividend top 40 index for the bear market period, the sales top 120 index for the entire period and the composite top 80 index for the bull market period.

6.8 Value Risk Factors of Fundamental Indices and Market Value Indices

Table 6.4 compares the constructed indices exposures to the value risk factor and the *p*-values thereof. The results for the entire review period and for the two sub periods are presented. Certain indices produce negative exposures to the Fama-French value risk factor, which occurs when the index's returns display higher correlation with returns of growth shares rather than value shares in the sample.

Table 6.4   Sub-period Fama-French Value Factor Coefficients and *p*-Values

Panel (a)

INDICES VALUE RISK FACTORS (HML)								
Monthly	Year 2000 – 2004			Year 2005 – 2009			Year 2000 – 2009		
	40	**80**	**120**	**40**	**80**	**120**	**40**	**80**	**120**
Market Values	-0.147	-0.136	-0.136	0.064	0.078	0.085	-0.028	-0.018	-0.015
Book Values	0.006	-0.003	-0.006	0.211	0.221	0.217	0.121	0.115	0.112
Dividends	-0.051	-0.051	-0.053	0.231	0.226	0.224	0.098	0.092	0.091
Earnings	-0.057	-0.056	-0.058	0.240	0.233	0.229	0.103	0.095	0.093
Sales	0.011	0.003	0.003	0.237	0.216	0.210	0.132	0.116	0.113
Composite	-0.003	-0.025	-0.026	0.135	0.159	0.164	0.065	0.063	0.063

Panel (b)

INDICES FAMA-FRENCH VALUE RISK *FACTORS p*-VALUES								
Monthly	Year 2000 – 2004			Year 2005 – 2009			Year 2000 – 2009		
	40	**80**	**120**	**40**	**80**	**120**	**40**	**80**	**120**
Market Values	0.016	0.023	0.023	0.528	0.436	0.392	0.611	0.739	0.777
Book Values	0.951	0.972	0.949	0.064	0.050	0.051	0.074	0.081	0.085
Dividends	0.485	0.466	0.448	0.046	0.045	0.045	0.119	0.129	0.132
Earnings	0.462	0.450	0.436	0.044	0.044	0.044	0.115	0.131	0.135
Sales	0.913	0.972	0.976	0.058	0.077	0.082	0.068	0.098	0.103
Composite	0.974	0.745	0.729	0.268	0.179	0.157	0.315	0.319	0.307

From Table 6.4 is noticeable that market value indices achieve the highest negative exposures to the value risk factor as expected due to the growth orientation within the index. Market value indices attain statistically significant negative value exposures as constituents within the index have relatively lower book-to-market ratios than fundamental indices.

With regard to fundamental indices, dividend, earnings and composite indices also exhibit negative value exposures within the bull market period 2000 to 2004. Book value indices, on the other hand only display negative value exposures for the top 80 and top 120 index breadths within the bull market period. Therefore, the book value top 40 index selects constituents with stronger book values that gain good returns in comparison to the larger index breadths that include smaller firms that do not necessarily contribute to the index's returns. Within the bear market and for the entire review period, book value indices do however, display *p*-values for exposures to value risk factor that are statistically significant at 10% significant levels.

Unlike size effect analyses, the indices value factor coefficients exhibit similar value effects for each fundamental index breadth for all periods. The exposures to the value risk factor are positive for all fundamental indices within the bear market period and for the entire examination period.

The fundamental indices that display the highest negative exposures to the value risk factor are dividend, earnings and composite indices within the bull market period. Earnings and dividend indices value exposures are observed as being influenced by market cycles. Within JSE bull market experienced in the period 2000 to 2004, earnings and dividend indices produce low exposures to the value risk factor. Contrary to this, within the subsequent bear market, earnings and dividend indices with book value and sales indices produce substantial exposure to value effects. Within the bear market, earnings and dividend indices do however, display *p*-values for exposure to the value risk factor that are statistically significant at 5% significant levels.

Composite indices display continuous moderate exposure to the value risk factor within all periods and substantially low exposure to value effects in 2005 to 2009 and for the entire review period. It is also noteworthy to point out that composite indices

performed well in the period 2000 to 2004, with a high negative exposure to the value risk factor but with a higher size effect. The performances for the sub-period 2000 to 2004 may be arguably partly attributable to size effect.

The fundamental indices that produce the most consistent exposures to the value risk factor are the sales indices. Sales indices also demonstrate the strongest signs of size effect and the lowest correlation with the JSE ALSI. Firm sales metrics seem to display the least sensitivity to market value risk factors unlike dividends and earnings indices that display the highest correlations with the JSE ALSI index. According to Arnott *et al* (2005) the sales fundamental indicator produces the fundamental index that best performs in relation to the cap-weighted indices. The evidence in this study concurs with Arnott *et al* (2005) findings, as sales indices produce the least volatility whilst generating the highest returns. There is some caution required for sales indices, as performances dropped substantially within the bear market period 2005 to 2009. While other fundamental indices outperformed sales indices within this period.

It is noticeable that returns of fundamental indices are more highly correlated with growth shares within the bull market period as negative (and low positive) exposures towards the value risk factor are observed. Conversely, within the bear market period and for the entire examination period, fundamental indices all display positive exposures towards the value risk factor. Therefore, the performances of fundamental indices within the bear market period could be argued to be attributed to value effect and only partially argued to be attributed to value effect for the entire examination period.

Chapter 7 :   REBALANCING EFFECT FOR FUNDAMENTAL INDICES AND CAP-WEIGHTED INDICES

7.1   Introduction

The argument advocates of fundamental indexation have against the use of market capitalisation values, is that the CAPM model is assumed to be mean-variance efficient but yet fundamental indices continually display higher risk-adjusted returns. Hsu and Campollo (2006) argue that market capitalisation indices tend to overvalue certain shares and under value others. Investors therefore investing in a passive market-cap index could be unknowingly investing in a portfolio that has over allocated funds to overvalued shares and less to undervalued shares. What this suggests is that cap-weighting methods are inefficient and therefore experience a lag in performance.

Since the rise of fundamental indexation, there has been intense debate over the merits of fundamental indexation versus the inefficiencies of cap-weighting methods. The debate is generally around the assumptions on which the merits of fundamental indexation are preordained. Kaplan (2008) argues that Hsu's (2006) findings are based on incorrect assumptions, that the provision of funds based on a firm's fundamental attribute sizes is an unprejudiced estimator of a shares fair value. The issue with this assumption is that generally optimal portfolios are constructed as a trade-off between appropriate risk and return. In this case, portfolio construction does not allow for the usage of share fair values.

In reply to Kaplan's (2008) critique, Hsu (2008) stresses that his assumptions were not that fundamental attributes were better predictors of shares fair value, but that the study's results found that fundamental weighting methodologies display higher mean-variance than capitalisation weighting schemes. Hsu (2008) further iterates that it was found that random weighting and equal weighting methodologies have also displayed higher returns than cap-weighting methods, with no aim of identifying share fair values. Hsu (2008) simply found that cap-weighting methods inherently place a lag on portfolio performance, because cap-weighting methods tend to overweight funds in certain shares and underweight in others.

Vardharaj and Fabozzi (2007) find that a portfolio's performance can be attributed mainly to its investments asset allocation decisions. Stewart (2005) however believes that the importance of asset allocation has diminished but what has risen as a more important issue, is when and how to rebalance funds between different investment allocations. The choice of an investments rebalancing frequency can affect an investments exposure towards certain security risk factors. An investor has the dubious decision to allow allocated funds invested in a constituent to deviate from the specified allocations to gain return from the shares appreciation. Alternatively, the investor may have to peg the share back to the stipulated weighting allocation. Allowing shares within the portfolio to fluctuate from the specified weighting allocation, inherently changes the weighting allocation of the portfolio. The change in the portfolio allocation is a result of share price fluctuations.

What could transpire from leaving portfolios rebalanced less frequently than desired is that certain shares may be overinvested in whilst other shares may be under allocated funds. For fund managers, when investing on behalf of their clients, their clients would stipulate a risk preference and an investment strategy would be drafted in accordance to the clients risk appetite. When a portfolio has a longer rebalancing period and the weighting allocation is different from the specified weighting allocation, the portfolio no longer adheres to an investor's investment strategy.

The effect that the absence of rebalancing has on a portfolio is similar to the inefficiencies of cap-weighting methods described by Hsu (2008). Hsu and Campollo (2006) argue a similar case that cap-weighting methods tend to over allocate funds to overvalued growth shares and under invest in undervalued shares. In both instances, less frequent rebalancing and cap-weighting methods, the deviation in share prices impacts the performances of the portfolio. Essentially, when a portfolio is not rebalanced the portfolio weighting allocation becomes marginally cap-weighted. Since Hsu and Campollo (2006) find that cap-weighting places a drag on performance, it would be hypothesised that less frequent rebalancing would have the same affect.

7.2 Rebalancing

When a portfolio is constructed, each constituent will be specified a certain proportion of funds invested within their share according the size of their market value or fundamental. This study utilises constituents within the JSE ALSI index. The constituents within the JSE ALSI range from different business sectors and are categorized according to their sector.

Eatkins and Stansell (2007) stresses, that rebalancing is necessary to avoid a portfolio from over allocating investment within any asset. Portfolio rebalancing is an exercise of correcting portfolio proportions back to the original specified weighting allocation and composition. With time, asset prices fluctuate necessitating the need for portfolios to be reset back to the initial allocation strategy.

Within this study the constructed portfolios are weighted according to firms with the highest market values or fundamental attribute values. This methodology was chosen for allocating funds between different constituents within indices. The rebalancing strategy selected for this study was monthly rebalancing. This strategy was seen as the optimal strategy to pursue as it would maintain the derived proportions found for each constituent within each index.

There are conversely different rebalancing strategies, such as; calendar interval, threshold drift and a hybrid strategy which is a mix between threshold and calendar interval. Calendar interval rebalances a portfolio according to specified points in time such as monthly, semi-annually or annually. Threshold drift rebalances a portfolio whenever an asset allocation fluctuates to a predefined weighting limit. Hybrid mix is when a portfolio is rebalanced when either the calendar or threshold drift criteria is met.

For this study only the calendar interval rebalancing strategy was tested. This strategy was convenient and allowed each index to be analysed on alike comparative basis. Threshold drift rebalancing strategy would influence results as; one index might reach the identified threshold earlier than others and therefore, be rebalanced at different points in time than other indices. Also, threshold drift rebalancing could result in one index being more rebalanced than others which is not ideal for this study.

The three rebalancing frequencies that were tested were; monthly, quarterly and annual rebalancing. The examination periods start date for the sample chosen is 1st of January 2000, therefore the rebalancing intervals will commence from that date. The rebalancing dates for quarterly rebalancing are at end of March, June, September and December. These dates are in accordance to FTSE/JSE index rebalancing review dates. The rebalancing dates for annual rebalancing are at the end of every December. The annual rebalancing date is in accordance with Arnott *et al* (2005) and Ferreira and Krige (2011) fundamental indexation methodologies.

The indices that were chosen for the rebalancing performance comparisons were the top 40 indices for the respective market value and fundamental attributes. The reason for the choosing the top 40, is due to the index breath containing less constituents which results in each constituent requiring a higher weighting based on the size of their fundamental or market value. This would provide clearer rebalancing effect than the top 80 and top 120 breadths, as constituent weights change with share price fluctuations. Though the top 40 is understood to be the larger market-cap shares, the indices were constructed on attribute ranking therefore making each index security selection and asset allocation unique.

7.3 Returns for Top 40 Fundamental Indices and Market Value Indices

In Table 7.1, the rebalanced top 40 market value and fundamental indices are comparatively analysed, and the annualised returns of the indices are displayed according to the two sub periods and for the entire review period.

Table 7.1   Returns for Rebalanced Market Value Indices and Fundamental Indices

Panel (a)

	Sub Period 2000 to 2004 Top 40 Indices Annualised Returns R%					
	M40	B40	D40	E40	S40	C40
Monthly	15.40%	22.52%	21.86%	23.03%	27.01%	26.13%
Quarterly	15.34%	24.33%	21.32%	22.24%	28.65%	26.31%
Annually	15.16%	23.37%	19.16%	18.93%	30.94%	23.80%

Panel (b)

	Sub Period 2005 to 2009 Top 40 Indices Annualised Returns R%					
	M40	B40	D40	E40	S40	C40
Monthly	23.49%	24.23%	23.55%	23.38%	22.63%	22.62%
Quarterly	23.52%	23.50%	22.69%	23.17%	22.32%	22.23%
Annually	22.59%	22.05%	21.73%	22.42%	21.52%	21.66%

Panel (c)

	Entire Review Period Top 40 Indices Annualised Returns R%					
	M40	B40	D40	E40	S40	C40
Monthly	19.38%	23.38%	22.70%	23.21%	24.80%	23.78%
Quarterly	19.37%	23.91%	22.00%	22.71%	25.45%	23.39%
Annually	18.82%	22.71%	20.44%	20.66%	26.15%	21.74%

From an annualised return perspective, it is clear that all top 40 indices besides sales top 40 indices display lower returns when their indices are less frequently rebalanced. The top 40 market value, dividend, earnings and composite indices display strong evidence that when an index is less frequently rebalanced, and traces of market-cap weighting are present, then the indices returns decline. Surprisingly the top 40 book value index return increased for quarterly but drastically declined for annual rebalancing. It is also noticeable that returns for dividend, earnings and composite indices follow a similar trend to market value indices, with monthly rebalancing demonstrating good performance, then quarterly rebalancing producing modest performance and annual rebalancing producing the least expected returns. When observing composite indices performances, it must be remembered that composite measures are metrics that encompass all four fundamental attributes and in the case of

rebalancing effect; the constituent composite measures would be influenced by their dividend and earnings fundamentals.

The top 40 sales index is the only index that displays contradicting evidence to that of the other fundamental indices, in that less frequent rebalancing does not put a drag on its performance. It is possible that the sales fundamental attribute has the ability for recognising undervalued firms and are likely to appreciate in the future as when share price mean reverts to their true fair values.

Earlier within this study it was noted that earnings indices display similar returns as the market value indices. According to Fama and French (1995) share prices are a reflection of discounted expected earnings. It is possible that constituent earnings attributes have similar risk factors that are related to share market values. This belief is supported by Banz (1980) that the price earnings effect was merely a proxy for size effect. For the JSE, Basiewicz and Auret (2010) find size effect evident when using market values as an indicator of size. Other discussions by Vincent (2010) suggest investor trading is positively affected by earnings announcements. This would all propose that certain firm earnings fundamental values may have price sensitivity risk factors that influence their market values in a similar manner.

It is evident in dividend indices return characteristics that they are similar to cap-weighted indices, which suggests that changes in share prices could be affected by firm dividend announcements. This is probable, as the general return behaviours of dividend and earnings indices have been more similar with market value performances in contrast to the other fundamental indicators.

Book value, and sales indices are the only two fundamental attributes that display opposing return performances. The book value and sales indices, themselves display contradicting return patterns. It's possible that constituents selected for top 40 sales index that is annually rebalancing performs well at certain points in time such as January and December. These months are highly affected by annual rebalancing. Therefore, a firm's sales fundamental value would be impacted by seasonal trends. For the book value indices, it is possible that the book value attribute might be superior indicator of current share value or performance. Fraser and Page (2000)

consider a similar conclusion, that a firm's book-to-market ratio is a superior predictor of share performances a month in the future.

After looking at the return characteristics of market value and fundamental indices with different rebalancing frequencies, it is only appropriate that the risks and risk-adjusted returns for the different indices are examined.

7.4 Risks for Top 40 Fundamental Indices and Market Value Indices

In Table 7.2, the rebalanced top 40 market value and fundamental indices are comparatively analysed, and the annualised risks of the indices are displayed according to the two sub periods and for the entire review period.

Table 7.2   Risks for Rebalanced Market Value Indices and Fundamental Indices

Panel (a)

	Sub Period 2000 to 2004 Top 40 Indices Standard Deviations σ					
	M40	B40	D40	E40	S40	C40
Monthly	20.86%	21.95%	20.57%	20.87%	19.81%	19.37%
Quarterly	21.02%	22.21%	20.55%	20.79%	20.25%	19.39%
Annually	20.72%	20.87%	19.73%	20.02%	21.09%	18.20%

Panel (b)

	Sub Period 2005 to 2009 Top 40 Indices Standard Deviations σ					
	M40	B40	D40	E40	S40	C40
Monthly	21.08%	20.24%	21.27%	21.60%	20.45%	21.17%
Quarterly	21.06%	20.00%	21.17%	21.33%	20.23%	20.91%
Annually	21.41%	20.17%	21.68%	21.25%	20.42%	21.29%

Panel (c)

	Entire Review Period Top 40 Indices Standard Deviations σ					
	M40	B40	D40	E40	S40	C40
Monthly	20.91%	21.02%	20.84%	21.15%	20.05%	20.27%
Quarterly	20.98%	21.04%	20.78%	20.97%	20.17%	20.09%
Annually	21.00%	20.44%	20.64%	20.56%	20.70%	19.89%

What is immediately noticeable from Table 7.2 is that less frequent rebalancing generally induces less volatility and total risk for most of the top 40 indices. The decline in risk is possibly due to the fact that the methodology chosen was to weight

indices according to constituent market value indifferent indicators which saw smaller firms gaining a larger weight than signified by their share price. Smaller firms are generally known to be riskier than larger well established shares. The fundamentally-weighted method could therefore be a riskier methodology than cap-weighted methods for JSE constituents. A similar trend is found in research by Akinwunmi (2010), where his equal weighted indices standard deviations also declined as his portfolios were less frequent rebalanced.

Though it is evident that most of fundamental indices risks decline, what is also noticeable is that sales indices display lower risk for more frequent rebalancing strategies. This suggest that the sales fundamental attribute selects or weights indices more towards larger firms in a similar manner observed for market value indices. Sales indices also exhibit higher returns for annual rebalancing, implying that sales indicators follow momentum effects similarly found in market value indicators. The alternative view could be that the sales fundamental attribute has superior security selection abilities, which generate excessive returns due to larger share appreciations in contrast to other fundamental indices, thereby invoking a larger volatility for less frequent rebalancing.
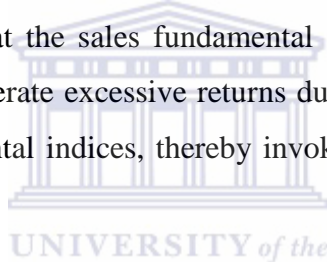
When analysing book value, dividend and earnings indices performances for different rebalancing frequencies, it is possible that size risk factors affect each of the fundamental indices. In the previous section it was found that book value, dividend and earnings indices all display similar low size effect in contrast to sales indices. Since size risk factors are determined by subtracting index's small shares by their large shares, the low size effect for book value, dividend and earnings indices suggest that smaller firms are given more weight than within sales indices. As these fundamental indices become more cap-weighted, investment in smaller firms' declines whilst larger firms receive increased investment. As a result, the more cap-weighted the fundamental indices become the less volatile it becomes. This could potentially be the case for book value, dividend and earnings indices as they display less volatility when they are more cap-weighted similar to risks exhibited by the monthly rebalanced market value index.

From this section it would seem that book value, dividend and earnings indices have common traits in contrast to sales indices. In the previous sections, dividend and

earnings indices displayed a likeness with market value indices, but in this section sales indices follow a similar trend to market value indices, as becoming more risky when the index is less frequent rebalanced.

7.5 Risk-adjusted Returns for Top 40 Fundamental Indices and Market Value Indices

In Table 7.3, the rebalanced top 40 market value and fundamental indices are comparatively analysed, and the Sharpe ratios of the indices are displayed according to the two sub periods and for the entire review period.

Table 7.3   Sharpe Ratios for Rebalanced Market Value Indices and Fundamental Indices

Panel (a)

	Sub Period 2000 to 2004 Top 40 Indices Sharpe Ratios R%					
	M40	B40	D40	E40	S40	C40
Monthly	24.64%	55.88%	56.38%	61.17%	84.57%	81.92%
Quarterly	24.17%	63.36%	53.80%	57.63%	90.78%	82.78%
Annually	23.66%	62.84%	45.10%	43.29%	98.06%	74.42%

Table (b)

	Sub Period 2005 to 2009 Top 40 Indices Sharpe Ratios R%					
	M40	B40	D40	E40	S40	C40
Monthly	70.00%	76.56%	69.68%	67.82%	67.95%	65.56%
Quarterly	70.18%	73.80%	65.90%	67.70%	67.17%	64.53%
Annually	64.71%	66.00%	59.94%	64.40%	62.64%	60.69%

Table (c)

	Entire Review Period Top 40 Indices Sharpe Ratios R%					
	M40	B40	D40	E40	S40	C40
Monthly	47.29%	66.02%	63.39%	64.83%	76.34%	70.49%
Quarterly	47.05%	68.51%	60.19%	62.99%	79.09%	69.18%
Annually	44.42%	64.66%	53.01%	54.31%	80.47%	61.56%

From the risk-adjusted return basis, it is evident that the performances of all indices besides sales indices display higher Sharpe ratios with more frequent rebalancing (except in sub period 2005 to 2009). Book value indices exhibit their highest risk-

adjusted returns for quarterly rebalancing strategies. Sales indices generally demonstrate higher risk-adjusted returns when less frequent rebalanced. Dividend, earnings and composite indices all follow a similar trend to market value indices and achieve their best risk-adjusted returns with monthly rebalancing.

There seems to be a clear relationship between market values, composite, dividend and earnings indices. Porta, Lakonishok, Shleifer and Vishny (1997) advocate that the expectations of future earnings announcements have a positive effect on share price valuations. Skinner and Sloan (2000) further find evidence of share price movement after earnings announcements are made. Academic literature suggests a relationship between constituent market values, earnings and dividends fundamentals. This study was conducted on the basis that fundamental attributes are price-insensitive measures. What has now become evident is that dividend and earnings fundamental attributes has a relationship with the risk factors that affect share market prices. Therefore, dividend and earnings are not fully exempt from the price sensitivity risk factors that affect share market values within the JSE context.

The book value index depicts higher returns than the market value, dividend and earnings indices for monthly rebalancing. This is in accordance with Fraser and Page (2000) who find that the book-to-market measure has the ability to foresee returns for JSE shares. They also highlight that dividend firm fundamentals have less predictive power. Book value indices illustrate higher Sharpe ratios when more frequently rebalanced for either monthly or quarterly rebalancing. Therefore, the presence of cap drag within book value indices potentially weakens the risk-adjusted returns it produces A similar trend is found in Hsieh and Hodnett (2012) that cap-weighted indices display lower returns compared to indices constructed on a fundamental basis.

Except for the sub period 2005 to 2009, sales indices are the only indices that display higher risk-adjusted returns when annually rebalanced. Within the bull market period the sales indices exhibit excessive Sharpe ratios in relation to all other indices. However, within the bear market period the sales indices demonstrate a similar behaviour to other fundamental indices, by declining in risk-adjusted returns when less frequently rebalanced. Evidence here suggests that firms' sales attributes are superior indicators of performing shares within bull markets but are poor indicators within bear markets. A study by Chan *et al* (2004) using seasonally dissimilar

quarterly sales growth rates found that portfolio returns to be higher for months after June due to sales figures trending according to seasonal periods within different years. This could possibly be the reason why sales indices displayed higher risk-adjusted returns within the bear market period, as firms chosen by sales figures are likely to be under-priced at the beginning of the year.

Except for sales attributes indices, all the market value indices and the other fundamental indices all demonstrate declining risk-adjusted returns as their indices are less frequently rebalanced. When the indices are less rebalanced they are no longer only fundamentally weighted and they become marginally share price-weighted, as indices security allocation is affected by the fluctuations in constituent's share prices. As the drop in index's Sharpe ratios is synonymous with indices becoming more cap-weighted, it is evident that cap-weighting methods inherently place a drag on the performances of fundamental indices.

Chapter 8 :   CONLUSIONS AND RECOMMENDATIONS

8.1   Synopsis

Cap-weighted methods of index construction are considered optimal in efficient markets due to the theoretical upbringing and academic literature supporting cap-weighted methods. Cap-weighted methods spawn from modern portfolio theory whereby Sharpe (1964) theorised that the mean-variance optimal portfolio identified by all utility maximising investors is in fact a reflection of the market. The CAPM by Sharpe (1964) was considered under rigorous assumptions which many do not hold.

Modern portfolio theory was hypothesised by Markowitz (1959) following earlier work on mean-variance portfolio combinations. Markowitz (1952) deliberated current investment literature from financial academics such as Graham and Dodd (1934). Graham and Dodd (1934) argued that security selection should be done by identifying undervalued shares. The issue that Markowitz (1952) had with portfolio literature at the time was that, academics believed that a portfolio's risk can be eliminated with the use of diversification. Markowitz (1952) shows that a portfolio's risk is however, not eliminated but only lessened by diversification.

Markowitz (1952) demonstrates with the use of a covariance matrices and security correlations, that a portfolio can expect a higher return at a substantially lower risk, by merely allocating security weights in proportions that satisfies a higher mean with a lower variance. Markowitz (1952) essentially solved the asset allocation problem. Markowitz (1952) achieved this with the insight that a share should not be examined in isolation, as recommend by Graham and Dodd (1934), but that consideration should be taken on how shares co-varies with other securities within the portfolio.

Following from these affirmations with additional contributions by Tobin (1958), modern portfolio theory is realised by Markowitz (1959). Markowitz (1959) shows that the mean-variance optimal portfolio can be found where the CML is tangent to the efficient frontier of risky assets. At this point, the optimal combination between investment in riskless asset and risky assets is identified. Also at this point, the combination of risky assets is identified. The combination of risky assets defines the

investment proportion to be allocated to each share within the portfolio that maximises the portfolio's expected return with least expected variance.

Sharpe (1963) mull over the problematic calculations necessary for finding Markowitz (1959) mean-variance optimal portfolio. Sharpe (1963) strived to develop a model that eased the computational complexities, by producing his own model called the diagonal model. From these endeavours with insights from Treynor (1961), CAPM was comprehended by Sharpe (1964).

The CAPM is realised as a result of research conducted by Sharpe (1964) with later independent contributions from Linter (1965) and Mossin (1966). The CAPM prices capital assets when the capital market is in equilibrium. The capital market is said to be in equilibrium when investors with homogenous expectations view all assets equally. Investors are also said to be rational market players and concerned with only wealth utility maximisation. At the point of equilibrium, any investor that deviates from the mass investor viewpoint is investing in a mean-variance inefficient portfolio that is likely to produce suboptimal risk-adjusted returns. When the ill-advised investor recognises the disparity, it is understood that the investor will trade in manner so that the portfolio resembles that of the mass investor's perceptions.

As each asset's expected return is established by its relation to the market. The proportion to be invested within each asset can be seen by the asset's total capital divisible by its total market value. This proportion is agreed by all investors for all assets which results in the most mean-variance efficient portfolio to be in fact a reflection of the market. The market itself satisfies the conditions of mean-variance efficiency and therefore, is found to be within the efficient frontier. Therefore, the portfolio that satisfies the highest mean-variance efficiency is the market; consequently the portfolio that delivers the highest expected return with least variance is in fact the market portfolio.

With the establishment of CAPM, certain academics opposed Sharpe's (1964) theory and criticised CAPM. The first notable critic is Roll (1977), who argues that CAPM is un-testable due to the market portfolio consisting of all assets worldwide and that it will forever be un-testable due to the assumptions that underpin its existence. The following year Roll (1978) identifies a mayor potential flaw in CAPM, by arguing

that due to the market portfolio being unobservable, many tests of CAPM use different market indices as proxies. The issue with the use of market proxies is that the proxy may not be an ideal reflection of the market portfolio, in which the asset's beta coefficients would not be an accurate reflection of its systematic risk.

Basu (1977) conducted research using share price to earnings ratios, to test whether firm earnings figures could assist in identifying undervalued shares. Basu (1977) was surprised to note that shares with low P/E ratios produced consistent excess returns contrary to market valuations. Basu (1977) therefore questioned CAPM beta coefficients which did not account for the value effect identified by firm P/E ratios. Reinganum (1980) examines Basu (1977) research, and finds that when samples are controlled for similar sized shares then the P/E effect disappears. Banz (1981) considers Reinganum's (1980) findings and believes Rolls (1978) argument regarding the misspecification of CAPM betas to be true. Banz (1981) documents size effect as he shows that smaller firms earn higher returns in contradiction to their CAPM betas. This illustrates, together with Basu's (1977) findings that anomalies and other risk factors exist that are not fully captured within asset CAPM betas.

Khaneman and Tversky (1979) were next to find evidence that contravenes modern portfolio theory. They observed that not all investors acted in a rational behaviour as assumed by Markowitz (1959) and Sharpe (1964). Khaneman and Tversky (1982) find that certain investors overvalue newer information in contrast to share historical data, which influences investor trading valuations and trading behaviour. De Brondt and Thaler (1985) use Khaneman and Tversky (1982) irrational investor behaviour theories to support their theory that on occasion investors tend to overreact. De Brondt and Thaler (1985) understand the market portfolio to a result of mass rational investor trading behaviour. For the market portfolio to stand, it would require an agreement by the majority of investors who value assets in a homogenous manner. De Brondt and Thaler (1985) question whether all investors interpret new information in unison, and believe that investor's reaction towards new information creates disparities within share valuations.

Arnott *et al* (2005) argues a similar point to that of De Brondt and Thaler (1985) in support of their fundamental indexation. They argue that share prices are influenced by investor trading behaviour and that CAPM regularly misprices shares. Arnott *et al*

(2005) is of the firm belief that large growth shares are consistently overvalued whilst small value firm shares are undervalued. The disparity with share price valuations causes cap-weighted indices to be less mean-variance efficient than thought by CAPM advocates.

Arnott *et al* (2005) propose that indices be constructed according to non-market value indicators, as market value indicators are considered price sensitive measures. The market value indifferent indicators Arnott *et al* (2005) propose to be used are firm accounting fundamental metrics such as firm; book value, dividends, earnings and sales figures. Arnott *et al* (2005) find that fundamentally-weighted indices produce higher risk-adjusted returns than cap-weighted indices within developed U.S. markets. Arnott *et al* (2005) therefore, argues that fundamental methods produce indices that are more mean-variance efficient than cap-weighted indices.

This study's research endeavoured to extend Arnott *et al* (2005) findings within the South African context. The JSE is regarded as a less efficient market than U.S. markets; therefore similar research within JSE context could produce results contrary to Arnott *et al* (2005) findings.

Fundamental indices also receive much criticism as being findings similar to already perceived anomalies. These anomalies being value and size effect, where critics argue that fundamental indexation is merely an old a phenomena packaged under a new name.

This study therefore, attempts to ascertain whether fundamental indices produce more mean-variance efficient portfolios than cap-weighted indices within the JSE context. This research also strives to evaluate fundamental indices performances, and whether they are bias towards value and size effect anomalies. This research also considers rebalancing frequencies employed and the effect that they have on fundamental indices risk-adjusted performances.

8.2   Findings and Interpretation

All fundamentally-weighted constructed indices display higher returns that their cap-weighted counterparts and the JSE ALSI index for the entire examination period, 2000 to 2009. Fundamental indices also display higher risk-adjusted Sharpe ratios,

Treynor ratios and Jensen's alphas than cap-weighted indices. This suggests that fundamental indices provide portfolios that are more mean-variance efficient than cap-weighted indices in the JSE context.

With regards to performances, it must also be noted that market value indices exhibited slightly higher returns and risk-adjusted returns than earnings, sales and composite fundamental indices within the bear market period. According to Arnott (2009) the 2008 crisis resulted in all markets to trend in downward cycles which resulted in share market values to be abnormally adequate indicators of valuable shares. Arnott (2009) does however stress, that such occurrences in history are the exception to the usual market cycles. Nonetheless, book value and dividend indices remained displaying positive risk-adjusted returns in the bear market period proving that certain fundamental metrics could be better predicators of valuable shares.

From performance attribution perspective, certain fundamental indices displayed consistent size biases whilst others exhibited size and value biases within certain periods. All indices displayed relatively low size effect (except for sales and composite indices) and low value effect within the bull market period and lower size bias and significantly higher value bias within the bear market period.

Book value, dividend and earnings indices display comparative insignificant low size effect within all periods. Dividend and earnings indices display comparative value effect within all periods. Book value and sales indices display comparatively higher value effect within all periods. Sales and composite indices display comparatively low size effect within all periods, whilst composite indices display subdued value effect for the entire examination period.

The evidence found in this research suggest that fundamental indices returns demonstrate lower value and size bias in contrary to the perceptions of fundamental indices critics. This study's findings also identify that in certain periods fundamental indices experience either low size effect and insignificantly low value effect or substantially low size effect and high value effect as each effect displays opposing presence dependent on the nature of the market cycle. Therefore, though fundamental indices at times exhibit value or size effect, this research shows that either effect is

dependent on the period and not easily bias to fundamental indices performances for the entire investment period.

The only fundamental that present consistent partial exposure to value and size risk factors is the sales indices. Sales indices are also found to be the least correlated with the JSE ALSI. Sales indices are however risky as they provide excessive returns in bull markets but substantially lower returns in bear market periods. For the entire period though, sales indices display the highest risk-adjusted returns for indices inclusive of smaller JSE firms. According to Arnott *et al* (2005) firm sales figures are the best fundamental metrics that outperform cap-weighted indices. This study concurs with Arnott *et al* (2005) as sales indices achieve high risk-adjusted returns than all other indices within the entire review period.

Composite indices follow a similar trend to sales indices, displaying low returns and moderate exposure to value risk factors within the bear market whilst, showing higher exposure to size risk factors and better returns within the bull market. Composite indices do however provide better returns when smaller firms are included in the index composition. This implies that composite metrics are better valuators of performing shares no matter the size of the firm.

Book value indices display low exposure to value and size risk factors, whilst demonstrating modest returns within the bull market period and exceptional returns within the bear market period. Evidence here suggests that book value metrics are better indicators of performing shares in all market cycles, as book value indices always outperform cap-weighted indices on a risk-adjusted return basis.

For earnings and dividend indices, this research finds traces of trends similar to market value indices. Earnings and dividend indices are also found to be most correlated with the JSE ALSI in comparison to other fundamental indices. Earnings and dividend indices also exhibit exposures to size and value risk factors in a similar manner to market value indices. According to Yoon and Stark (1995) share valuations based on earnings forecasts are indirectly affected by firm dividend pay-out announcements. These findings imply that firm earnings and dividend fundamentals are sensitive to hidden risk factors that affect market value indicators in a similar manner.

From a rebalancing effect perspective, it is noticeable that with the exception of sales indices within the bull market period, fundamental indices performances decline as they are rebalanced less frequently. With less rebalancing fundamentally-weighted indices to a degree inherently become marginally cap-weighted which alters the index weighting composition. Since the decline in performance is synonymous with fundamental indices becoming more cap-weighted, it is clear that cap-weighting places a lag on indices performances.

The sales indices are the only fundamental indices that improve in performance as the index becomes less frequently rebalanced. It is hypothesised that firm sales indices are affected by seasonal sales trends and therefore influenced by rebalancing timing as the sales indices display higher returns in latter parts within the year. Another possibility is that firm sales metrics identify undervalued shares which appreciate throughout the year as shares mean revert to their correct fair values. This possibility also ties in with the premise that sales fundamental is superior to other fundamentals in identifying under-valued shares.

In conclusion, fundamental indices all outperform cap-weighted indices on a risk-adjusted basis , certain fundamental values are biased towards value and size risk factors dependent on the period, the book value fundamental is a constant outperformer in comparison to market value indicators in bull and bear markets, dividend and earnings fundamentals display characteristic traits similar to market value behaviours, fundamentally-weighted indices returns decline as they are less frequently rebalanced and the sales fundamental displays the most consistent exposure to size and value risk factors and exhibits tendencies of being superior identifier of performing shares. This evidence concurs with Arnott *et al* (2005) findings that fundamental indices produce more mean-variance efficient indices than cap-weighted indices, and that cap-weighted index methods places lag on indices performances.

8.3   Recommendations for Future Research

This study only analysed essentially four fundamental metrics, where other metrics like employment and cash flow could have been used. The fundamentals used in this study were found to be readily available for most JSE ALSI constituents; whereas other figures would be incomplete for many firms. Besides the composite metric,

other different combinations of fundamental measures could have also been tested as certain fundamentals could play off the strengths and weakness of other fundamental metrics to produce a fundamental metric that is far more superior to all fundamental metrics.

Considering that indices performances were compared between fundamentally weighted and cap-weighted but according to fundamental security selection in contrast to market value index compositions. Further research could have be undertaken to analyse the affect fundamental weighting has on indices with exact same constituent bases. Therefore, no potential security selection bias would be evident for fundamental indices performances. Arnott *et al* (2005) do however argue that cap-weighted indices are bias towards growth shares therefore it is important that indices were selected and weighted according to their firm's fundamental attributes.

Fundamental indices are also considered recent innovations within finance literature. Therefore, on-going tests will be necessary to ascertain whether the performances of fundamental indexation would persist within future market trends for developed and emerging markets.
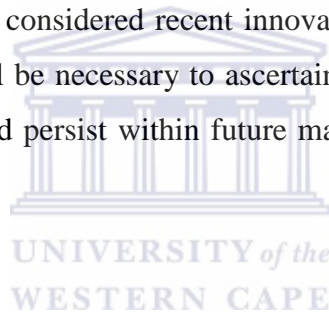
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