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Relative performance of fundamental indices on the South African equities market .

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Relative performance of fundamental indices on the South African equities market

Japheth Kalua Munyw`oki

A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration.

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ABSTRACT

In portfolio construction, the objective is to seek optimising returns while minimising risk. The evolution of capital markets has led to sophistication with research on scientific ways of stock picking using various metrics, among them indexation.

The proponents of indexation suggest that it is a straightforward way to participate in the broad equity market due to the following factors: low turnover, low cost, relatively low management fees (compared to the fees charged by active managers).

At the advent of indexation, market capitalisation weighting index construction methodology dominated index portfolios. In both the global and South African investment industries, it is a popular methodology, albeit with various variations.

The fundamental indexation methodology bias is to invest in companies that are expected to deliver positive returns based on strong firm centric fundamentals to maximise return.

The purpose of this study is to establish which portfolio construction strategy between fundamental indices and market cap weighted indices performed better in emerging markets during different market cycles using the South African equities market as a proxy. The time period covered is

pre-financial crisis, post-financial crisis and over both time periods. The pre-financial crisis period is between 1st October, 2007 – 31st December, 2013 (Table 4.2) while the post-financial crisis is the period between 1st October, 2007 – 31st December, 2008 (Table 4.3).The entire period of study is between 1st October, 2007 to 31st January, 2016.

The share price data was collected and organised in Excel for both RAFI 40 index and Top 40 index. The Excel sheets have macros to enable data calculations in order not to have incorrect outputs by showing no price movements on non-trading days such as holidays.

The study questioned whether there is outperformance by using a fundamental index as a portfolio construction strategy over market weighted index by evaluating the portfolio returns of RAFI 40 vis a vis the Top 40 index. The rationale was to establish which strategy delivers superior returns over different market cycles.

DECLARATION

I, Japheth Kalua Munyw`oki, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Japheth Kalua Munyw`oki

Signed at ……

On the …….. day of…… 2016

DEDICATION

This thesis is dedicated to my parents, Obadiah & Rose Munyao, who went to great lengths by encouraging and supporting the inculcation of the ethos of academic achievement. My sisters: Miriam Munywoki and Faith Munywoki. Brothers: Manases Munywoki, Jairus Munywoki and Eric Munywoki. To my late brother: Mathew Munywoki, Rest in Peace. To my daughter, Jemimah Munywoki and son, Jonathan Munywoki, for the time not spent with them while undertaking this study. To my wife, Ruvi, my utmost appreciation for the love and support.

ACKNOWLEDGEMENTS

I wish to express my thanks to my supervisors, Prof. Mthuli Ncube and Dr. Thabo Mosala. This thesis would not have been completed without their expert advice and unfailing patience. I am also most grateful for their faith in this study, especially in the sometimes difficult circumstances in which it was written.

I would like to express a special word of thanks to my family and friends who tirelessly listened to my ideas and offered encouragement when it was most needed.

A special thanks to Douglas Mbululu for assistance with statistical software analysis and Jennifer Croll for her help with proof reading.

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1 CHAPTER: INTRODUCTION

1.1 Purpose of the study

The purpose of this research is to evaluate whether there is evidence in the South African securities market that fundamental indices outperform market capitalisation indices. Arnott, Hsu and Moore (2005) and Mar, Bird, Casavecchia and Yeung (2009) tested United States and Australian markets respectively, where evidence suggested that fundamental indices, which select, rank and weight stocks according to fundamental measures of size, such as book value and revenue, outperform market capitalisation weighted indices.

1.2 Context of the study

The challenge with market depth with investable options between asset classes is the selection of the optimal mix options. The information diet is correlated with superior returns.

The estimation of the fair value of a share is a complex and contentious issue in both academic and professional circles. Mar et al (2009) argue that the determination of the fair share value is influenced by many factors including “behavioural traits of investors, availability of information and the valuation tools and methodologies employed by the investor”. Shephard (2007) repudiates the old adage that all investors cannot be wrong by

correctly pointing out collective wisdom being wrong in: “Cisco massively overvalued in 1999, Krispy Kraeme in 2001, Japan in the late 1980`s and tech stocks in the late 1990`s”.

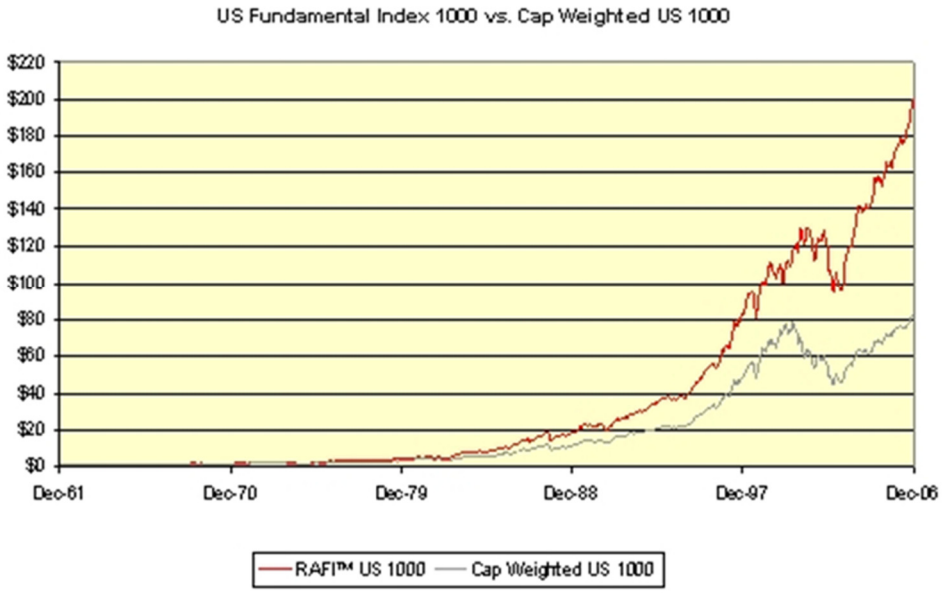
Due to the issues of determining fair value of a share in line with risk and return objectives, investors’ discussions on diversification and portfolio selection as concepts have gained credence. The concept of portfolio selection was introduced by Harry Markowitz (1952), arguing that the optimal portfolio selection rationale was to hold diversified portfolios with constituents (shares) with low covariance with each other. This, he argued, smoothed the volatility of their portfolio returns.

In international markets and in South Africa, investors use different valuation tools and methodologies to select their constituents. The birth of indexation as an investment strategy was soon after the efficient market theory, with the first index fund an equally weighted S & P 500, launched by Wells Fargo in the early 1970`s (Robertson, 2007). Indexation had low transaction costs (fees), low turnover (change in constituents mix), diversification (company specific risk cushion) and transparency (set constituent selection criteria).

Indexation soon gained a large following, leading to conflicting approaches with equal weighting strategy, market capitalisation weighting strategy and

the fundamental measures weighting strategy emerging with a plethora of "enhanced" variations.

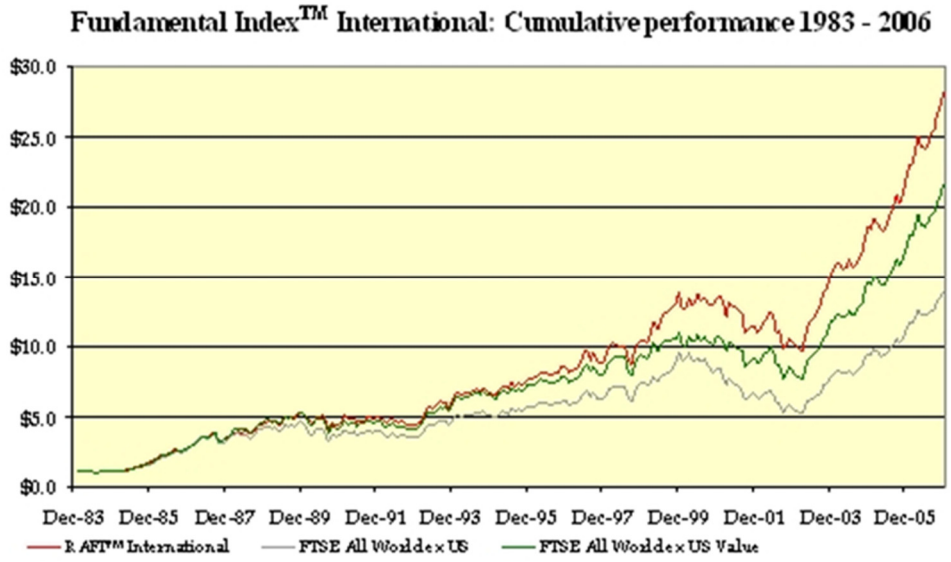
Studies done in the United States between December, 1961 and December, 2006 demonstrated that Fundamental Index portfolios outperformed capitalisation-weighted index portfolios by as much as 2% per year with slightly lower volatility, as depicted by the graph below (Arnott, Hsu & Moore, 2005).



Source: Research Affiliates LLC and Nomura Securities

Figure: 1.1 Fundamental Index portfolios Vs capitalisation-weighted index portfolios between December, 1961 and December, 2006

The studies between December, 1983 and December, 2005 on the international index demonstrate that the Fundamental Index portfolios are even more powerful internationally (i.e. excluding US companies) than in the US market. Across international markets, Fundamental Index portfolios outperformed capitalisation-weighted index portfolios by an average of 2.5% with slightly lower volatility as shown by the following graph.



Source: Research Affiliates LLC and Nomura Securities

Figure: 1.2 Fundamental Index portfolios Vs International cumulative performance between 1983 and 2006

Table 1.1 shows that Fundamental Index portfolios outperformed cap-weighted index portfolios, in all 23 of the developed EAFE nations evaluated.

Table 1.1: Country return statistics through December 2006

23 Country Return Statistics through December 2006

Country	RAFI™ Return	MSCI Return	Excess Return	Tracking Error	Info Ratio	Excess Return t-stat	Start Date
Ireland	20.1%	12.1%	8.1%	8.48%	0.95	**4.15**	1988
Austria	18.4%	13.5%	4.9%	8.87%	0.56	**2.67**	1984
Norway	17.7%	13.2%	4.6%	6.08%	0.75	**3.61**	1984
France	17.3%	13.4%	3.9%	6.72%	0.59	**2.81**	1984
Singapore	12.8%	9.0%	3.7%	6.09%	0.61	**2.68**	1988
United Kingdom	15.3%	12.3%	3.0%	4.12%	0.73	**3.50**	1984
Japan	7.9%	5.0%	2.9%	5.21%	0.56	**2.68**	1984
United States	13.7%	10.8%	2.9%	4.51%	0.64	**3.06**	1970
Finland	15.6%	13.8%	1.8%	20.70%	0.09	0.39	1988
Belgium	16.7%	15.3%	1.4%	5.03%	0.27	1.31	1984
Netherlands	14.0%	13.0%	1.1%	6.04%	0.18	0.86	1984
New Zealand	7.6%	7.2%	0.4%	8.48%	0.05	0.20	1988
Switzerland	12.2%	12.6%	-0.4%	4.06%	-0.10	-0.48	1984
23-Country Average	***14.9%***	***11.8%***	***3.1%***	***2.67%***	***1.17***	***5.64***	***1984***

Source: Research Affiliates LLC and Nomura Securities

This study fills a gap through investigating whether there is evidence in the South African equities market of outperformance of the fundamental weighted indices (cap-indifferent measures) over the market capitalisation indices (Arnott, Hsu, & Moore 2005) as portfolio construction strategies.

For these reasons, this paper addresses the relationship between the cap weighted index and the fundamental index in the South African securities market to evaluate whether the studies carried in the US and Australia correspond.

The paper is organised as follows: the next section introduces the subject of cap weighted indexation and fundamental indexation and examines the relevant literature. The third section discusses the data and methodology in regards to both approaches. The fourth section is the presentation of

findings on the performance of the fundamental index. The fifth section discusses the results and finally, the last section offers suggestions for further research.

In this study, the fundamental index performance is compared to the cap weighted index using Johannesburg Stock Exchange Data for the period 1st October, 2007 to 31st January, 2016.

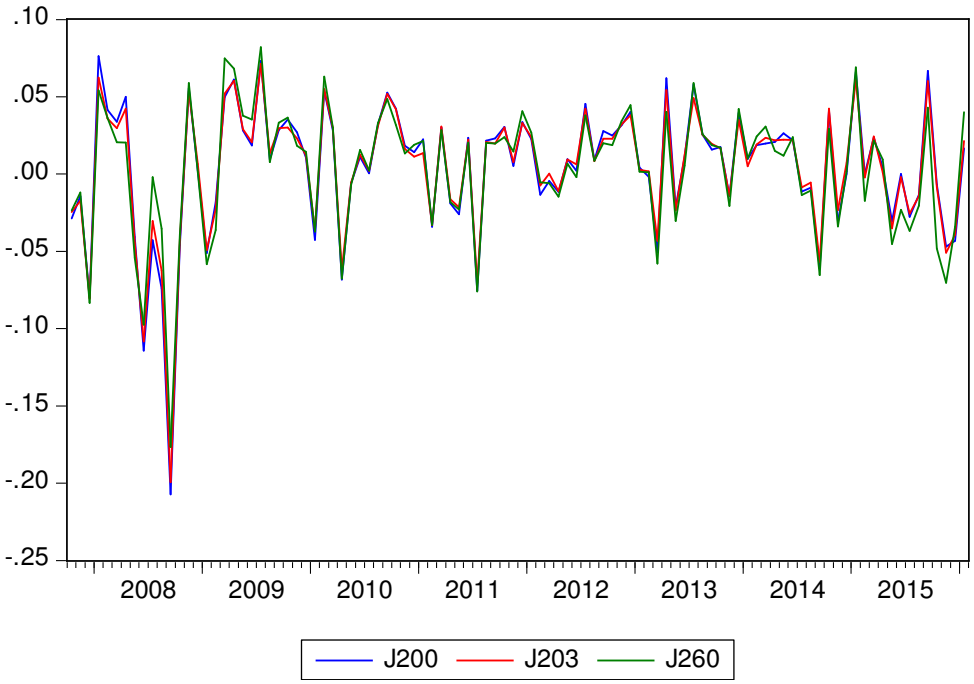


Figure: 1.3 FTSE RAFI 40 portfolio Vs Capitalisation weighted FTSE/JSE All Share and FTSE/JSE Top 40 between 1st October, 2007 and 31st January, 2016

The graphical illustration above shows no significant difference in the portfolio performances of these indices pre-financial crisis, during the financial crisis and after the financial crisis.

Table 1.2: Test of equality in median of the FTSE/JSE RAFI 40 and FTSE/JSE Top 40 from 1st October, 2007 to 31st January, 2016

The data is not normally distributed hence the researcher had to use non parametric tests for the post-financial crisis period (1st October, 2007 to 31st January, 2016).

Test for Equality of Medians Between Series

Date: 02/08/16 Time: 10:19

Sample: 2007M10 2016M01

Included observations: 100

Method	df	Value	Probability
Wilcoxon/Mann-Whitney		0.221127	0.8250
Wilcoxon/Mann-Whitney (tie-adj.)		0.221127	0.8250
Med. Chi-square	1	0.080000	0.7773
Adj. Med. Chi-square	1	0.020000	0.8875
Kruskal-Wallis	1	0.049439	0.8240
Kruskal-Wallis (tie-adj.)	1	0.049439	0.8240
van der Waerden	1	0.013499	0.9075

Category Statistics

Variable	Count	Median	> Overall Median	Mean Rank	Mean Score
J260	100	0.013792	51	99.59000	-0.008049
J203	100	0.012444	49	101.4100	0.008049
All	200	0.012933	100	100.5000	3.11E-17

Using the Wilcoxon/Mann-Whitney test the null hypothesis is that the two portfolios medians are equal. If the p-value is less than 5% we reject the null hypothesis. Hence from the table above, the probability value is bigger than 10% therefore, accept null hypothesis. No significant difference in the performance of these indices even during and after the financial crisis.

Table 1.3: Test of covariance of the indices from 1st October, 2007 to 31st January, 2016

Covariance Analysis: Ordinary
Date: 02/08/16 Time: 11:32
Sample: 2007M10 2016M01
Included observations: 100

Correlation Probability	J200	J203	J260
J200	1.000000		

J203	0.996186	1.000000	
	0.0000	-----	
J260	0.958553	0.969364	1.000000
	0.0000	0.0000	-----

The correlation matrix above indicates that the FTSE/JSE All Share and the FTSE/JSE Top 40 are highly correlated. FTSE/JSE All Share makes up 99% of the FTSE/JSE Top 40. The FTSE RAFI 40 makes up about 97% of the FTSE/JSE Top 40 and about 96% of the FTSE/JSE All Share.

1.3 Problem statement

1.3.1. Main problem

The main purpose of the research is to investigate evidence of outperformance of the fundamental index (using RAFI 40 as the proxy) on the South African equities market versus the capitalisation weighted index (using TOP 40 as the proxy) to establish which strategy tends to give better returns regardless of market cycles.

1.3.2 Sub – problems

The first sub problem is whether there was a difference in returns of the fundamental index and capitalisation weighted index. This is to establish which index between cap-indifferent portfolios with market capitalisation portfolios delivers superior returns.

The second sub problem is whether the returns of the fundamental index outperform capitalisation weighted index. This is to establish the portfolio management question of which strategy tends to perform better in different market cycles.

1.4 Significance of the study

The study fills the gap through establishing whether there is evidence in emerging markets of fundamental indices outperforming market capitalisation weighted indices using the South African securities market as a proxy for other emerging markets.

Interestingly, investing in or benchmarking to capitalisation-weighted indices is widely used, even though the finance literature rejects the mean–variance efficiency of such indices (Mayers1976; Markowitz 2005,).

Blitz and Swinkles (2008) argue that a market capitalisation strategy represents a passive buy - and - hold strategy which is not the case with the fundamental index which requires rebalancing along the lines of new fundamental targets, effectively making the index less costly to replicate.

Perold (2007) disputes that capitalisation weighting as a singular factor results in a performance drag. As Perold (2007) argues if we assume that pricing errors are random and not in any way related to valuation ratios, the theoretical case for a systematic outperformance of fundamental indexation breaks down.

In his study, Perold (2007) argues that cap weighting per se does not create a performance drag, which is disputed by Blitz and Swinkels (2008) as well as by Arnolt, et al. (2005), Treynor (2005) and Hsu (2006).

According to those who believe that the superiority of the fundamental index market, capitalisation by itself introduces a drag on performance by over representing overvalued stocks and vice versa. This school of thought is opposed by Perold (2007), who opines that stocks with high valuation ratios have a higher probability to be overvalued than stock with low valuation ratios.

The study provides guidance to investors on benchmarking techniques using the twin parameters of significance and consistency in the South African context by determining which portfolio is more efficient and optimal to track. Needless to say, researchers will benefit from the new body of knowledge that may lead to further studies in the subject and possibly create interest for more in-depth studies on emerging markets' behaviour in comparison with developed markets.

1.5 Delimitations of the study

The study takes an emerging markets focus using the Johannesburg Stock Exchange as a proxy for other emerging markets. The scope of the study is from the date of the launch of the JSE/FTSE RAFI index, namely, 1st October, 2007 to 31st January, 2016.

The study covers the FTSE/JSE TOP 40 and the FTSE/JSE RAFI 40 index. The study covers the listed companies only with no bonds or preference shares and excludes Altx–X listed equities as the two indices' constituents are listed on the main board. The sector exposure could result in imbalances, which are not investigated in this study.

The study considers pre-financial crisis period as between 1st October, 2007 to 31st December, 2013 while the post-financial crisis as the period between 31st December, 2013 to 31st January, 2016.

1.6 Assumptions

The price data is end of day data; this is to eliminate the intraday volatility for ease of having one measure at a standard time of the day (close of the market).

The price data on cross listed companies is not inclusive of the overnight moves in the other markets that may trade overnight. This is to eliminate sentiment in those markets that might skew the movements of the indices since the other counters are not trading at the same time.

The price earnings (P/E) ratio is the trailing price earnings (P/E) ratio of the company.

The metrics used in the construction of the portfolios are the same with the construction of indices to make the results comparable.

The study did not take into consideration transaction costs, taxes or levies on the buying and selling of the various securities making up the portfolios constructed.

The market has liquidity to ensure the buying and selling of shares in whole units or a fraction of a unit can happen on a willing seller willing buyer basis at any given time.

The metrics used in the construction of the FTSE/JSE RAFI 40 are the same as the Research Affiliates composite fundamental indices globally to make the results comparable.

2 CHAPTER: LITERATURE REVIEW

2.1 Introduction

The traditional market indices in South Africa, namely the FTSE/JSE All Share index and FTSE/JSE Top 40 are capitalisation weighted indices. These indices are constructed by having the weights of the individual shares in these indices dependent on the size of their market capitalisation relative to the total market capitalisation of all the shares in the index. As such, the capitalisation weighted market portfolio provides a good benchmark against which to judge the performance of any other portfolios drawn from the same universe of assets.

The theory of market efficiency was brought to the fore by Markowitz`s (1952) portfolio choice model which assumed investors are risk averse and choose portfolios based upon their expected return and variance. The literature review explores outperformance and impact of composition rationale on outperformance by looking at the market capitalisation weighted indices and fundamental weighted indices. The study focuses on comparing returns of the fundamental indices and the market capitalisation weighted indices.

2.2 Market capitalisation weighted indices

This section discusses the theory underlying market capitalisation weighted indexation, dwelling on the concepts and concludes with a discussion of the pros and cons.

A Capitalisation weighted index is one where the weights of the individual shares in the index are dependent on the size of the market capitalisation relative to the total market capitalisation of all the shares in the index (Mar, Bird, Casavecchia, & Yeung (2009). This implies that the larger components carry a larger percentage weighting and vice versa. The value of the index is computed by adding up the collective market capitalisations of the constituents and dividing it by the number of securities in the index.

On the Johannesburg Stock Exchange, the FTSE/JSE All Share Index is the most representative index. The index represents 99% of the full market capital value on the exchange. The index is a market capitalisation weighted index with all the ordinary shares listed on the stock exchange subject to the minimum free float and liquidity criteria. The market capitalisation of a company is calculated by the number of shares outstanding times the current share price.

The foreign inward listings, pyramid companies, convertible preference shares, loan stocks, Exchange Traded Funds and funds which derive pricing from underlying assets are excluded in this index.

The banded free float methodology is used in the calculation of the net market capitalisation on the constituents of the index.

Liquidity screening is done on an annual basis by the advisory committee set up to oversee the creation and rebalancing of the indices. The requirement is that 0.5% of turnover of shares in issue in at least 10 of the 12 months prior to review are required for eligibility to qualify into the index in the next 12 months. The same rules applied when the companies were being considered for inclusion into the index.

The index was launched in 24th June 2002 with a base date of 21st June 2002. The base value was 10815.08. The index is reviewed quarterly in March, June, September and December on an annual basis. The review covers constituent changes such as changes in names, market capitalisation changes and corporate actions.

The Top 40 index comprises the 40 largest companies on the stock exchange, ranked by market capitalisation. The index contains only 40 out of the roughly 400 shares listed on the exchange but represents over 80% of the total market capitalisation of the stock exchange.

The FTSE/JSE Top 40 Index is a capitalisation weighted index which is comprised of the Top 40 companies on the exchange on the basis of size. The index was developed with a base value of 10399.53 as of June 21,

2002. The index is reviewed quarterly in March, June, September and December on an annual basis.

The popularity of cap weighted indices, notes Mar et al (2009), dates back to the derivation of the Capital Asset Pricing Model (CAPM) formalised by William Sharpe in the late 1960`s, with the initial work on risk-adjusted performance measures by Treynor (1965), Sharpe (1966) and Jensen (1968). Capital Asset Pricing Model (CAPM) was the identification of a cap weighted portfolio consisting of all assets, that is, the market portfolio (the universe). The implication was that the universe would always be an efficient portfolio in that it offers the maximum return for its associated risk taken. The efficient market hypothesis, one of the cornerstones of modern financial theory, suggests that an optimal long term investment strategy is to simply buy and hold the market portfolio. In theory, then, the cap weighted market portfolio offers the highest risk adjusted return and investors can do no better than buying and holding this portfolio, but the real world often departs from the assumptions underlying theories and Mayers (1976) was the first to argue that the mean variance efficient market portfolio should include all risky assets, not just stocks, like the S & P 500 and all other widely used (mean variance inefficient) equity benchmarks do. Markowitz (2005) argued that once real world constraints are taken into account, the cap weighted market portfolio is no longer

mean variance efficient. Thus the cap weighted market portfolio provided a good benchmark against which to judge the performance of any other portfolios drawn from the same universe of assets.

Estrada (2008) enumerates that the advantages represent the investment opportunities available to investors, show the returns of the average investor and prices and weights are at equilibrium values.

The concept of markets clearing at equilibrium has been central to the practical argument of market cap weighted indices. This means that since the weight of each stock in the market portfolio is equal to the market capitalisation of each stock relative to the total market capitalisation then a state of equilibrium cap weighted market portfolio is only possible with this strategy (Estrada, 2008).

Arnott et al (2005) also noted that the cap weighted indices require material adjustment only when new companies become large enough to merit inclusion in an index or when others disappear through merger, failure, or relative changes in capitalisation.

Blitz and Swinkles (2008) also observe that a market capitalisation index has positive exposure to momentum as it sells stocks that have increased in weight and buys those that have done well.

In conclusion, the proponents of the cap weighted index provide the following reasons for their existence: one, they represent the options available to investors within an asset class, two, they reflect the average return of investors in an asset class and three, modern portfolio theory suggests that cap weighted market portfolio is mean-variance efficient, hence provides highest risk adjusted return.

Arnott, Hsu and Moore (2005) argue that if the rebalancing periods are too long, the difference between the policy weights and actual portfolio weights becomes so large that some of the suspected negative attributes associated with cap weighting may be reintroduced.

2.3 Fundamentals weighted indices

Fundamental indices weigh stocks in proportion to their economic fundamentals, that is, weighting is based on fundamental value to market value. A fundamental index is an index where the constituent stocks weights use non price based metrics of company size. The whole universe of stocks is reweighted based on fundamental values (Blitz & Swinkels 2008). Fundamental indices are constructed on the basis of measures of economic importance, such as book value, dividends, earnings or sales that are not contaminated by the irrationalities of price. Thus, the argument is fundamental measures can do a better job of telling us how to invest. The argument is that since fundamental indices favour more value stocks,

it is therefore logical to assume that value investors would have identified the stocks, for example, the original Fama and French study which looked at the value effect in US stocks from 1963 to 1990.

The alternative weighting methodology was first used by Arnott, Hsu and Moore (2005) to detail outperformance of fundamentally selected and weighted indexes using U.S. data extending back to 1962. The measures of company size used were:

- Book value (Book),
- Trailing five-year average cash flow (Cash Flow),
- Trailing five-year average revenue (Revenue),
- Trailing five-year average gross sales (Sales),
- Trailing five-year average gross dividends (Dividends), and
- Total employment (Employment).

The FTSE/JSE RAFI 40 index was launched by the JSE with Research Affiliates on the basis of constituents weighted by fundamental values. The index comprises the top 40 companies ranked by the four fundamental weightings. The index constituents and weights are derived from company centric fundamentals. The four fundamental factors are: Firstly, sales which is company sales averaged over the prior five years. Secondly, the company cash flow averaged over the prior five years, defined as operating income plus depreciation. Thirdly, the company book value at

the review date. Lastly, the total dividend distributions averaged over the last five years, including both special and regular dividends paid in cash.

The index was launched in 1st October 2007 with a base date of 16th March 2007. The base value was 5000. The index has a 10% cap on a single stock to ensure diversification which is reviewed quarterly in March, June, September and December.

The free float screening and liquidity screening of the index is overseen by an independent committee of leading market professionals to ensure index criteria rules are correctly applied to ensure that a continuous and accurate representation of the market is maintained.

Treynor (2005) showed that “market valuation indifferent indices” are superior to cap weighted indices by avoiding the pitfall of overweighting overvalued stocks and underweighting undervalued stocks. Hsu (2006) demonstrated that if prices are noisy and do not fully reflect fundamental metrics, a capitalisation weighted portfolio is sub-optimal because there is a performance drag, due to price inefficiency, reinforcing the argument that price inefficiency can be blamed on market participants who may not trade for reasons related to value (may include: speculators, momentum traders, insiders, institutions). Siegel (2006) hypothesised the “noisy market hypothesis” which replaced the efficient market hypothesis.

First, there is no drag in performance if stock prices are noisy as shown formally by Treynor (2005) and Hsu (2006). Second, fundamental indices appear to have higher returns and lower volatility than cap weighted indices, as shown by the evidence for the U.S. reported by Arnott, Hsu, and Moore (2005). Third, Arnott, Hsu, and Moore (2005) argued that fundamental indices retained the benefits of cap weighted indices. The benefits include: exposure to large caps, concentration in liquid stocks, lower transaction costs, similar or lower volatility and beta, and lastly, high correlation to overall market.

Roll and Ross (1994) have found such cap weighted market indices to be inefficient, on average plotting 0.22% below the mean variance efficient frontier, thus opening up the opportunity for fundamental indices to outperform cap weighted indices.

Those against, point out the grey areas are around definitions of the fundamentals, book value, sales, earnings, cash flow, dividends and how exactly rebalancing should be handled. It is argued that the fundamental index is not new since it only possesses a value tilt which researchers have always known to have a return advantage.

On the one hand, critics say fundamental indexation is more expensive than market capitalisation indexation since you have to rebalance as

valuations change when the company reports its performance, meaning chances of getting net alpha after transaction costs are slimmer.

On the other hand, Estrada (2008) argues that fundamental indices do not represent the investable opportunity set, do not reflect the returns of the average investor, and are not market clearing portfolios.

There is a school of thought that because none of the firm centric measures of size rely on price, none captured the current market valuations of perceived growth opportunities of the companies. So, young companies and fast-growing companies run the risk of being underrepresented in the Fundamental Indices relative to their weights in cap-weighted indices (Arnott, et al. 2005, and p.83-99).

In conclusion, Perold (2007) is of the opinion that fundamental indexing proponents argue that if a stock`s pricing error is uncorrelated with its fair value, the pricing error must be correlated with its market value, which in turn, gives rise to capitalisation weighting, inducing a performance bias. This argument countered by the Bayesian analysis shows that if the pricing error is uncorrelated with the stock's fair value, the pricing error is also uncorrelated with the stock`s market value, conditional on knowing market value. It also seems that fundamental indices, which de-emphasise growth characteristics, would produce lower absolute returns and lower risk than

cap-weighted indices because growth companies usually have the higher market beta risk and correspondingly (in theory) higher expected returns.

Blitz and Swinkels (2008) argue that fundamental indexation is an active investment strategy. This is to say, it is like comparing value and growth companies is the same as selecting between market capitalisation weighted indices and fundamental indices. This is because fundamental indices simply overweight value stocks and underweight growth stocks. They further argue that proponents of fundamental indices fail to explain why in equilibrium a certain group of investors would want to invest in fundamentally unattractive stocks as in the case with market capitalisation weighted stocks. Critics are of the view that fundamental indices cannot represent a buy and hold strategy as a firm`s specific metrics change based on the company`s performance. This leads to the conclusion that they are sub-optimal since the premium derived is used up by administrative and transaction costs on rebalancing.

However interesting a theoretical discussion, investors are in the end interested in the strategy that helps them to maximise the risk–adjusted return of their portfolio.

Scholars and investors alike have been arguing about whether fundamental indexation is not a fancier branding for an active portfolio strategy to which it bears more semblance than passive strategy (Blitz &

Swinkels (2008). There is also a risk that young and fast growing companies, because they mostly do not have strong fundamentals, will be under represented in a fundamental index.

Those against fundamental indexation postulate that it is nothing more that active value indexing. The argument between scholars has been that historically value stocks have outperformed growth stocks and thus fundamental indexation will outperform market capitalisation weighted index (Blitz & Swinkles (2008). Blitz and Swinkles (2008) observed that when they added the value and small capitalisation factor of Fama-French (1992), the fundamental indexation strategy had a large and significant tilt towards value factor, thus concluding that after adjusting for style exposures, fundamental indexation offers zero or small positive added value. Fama and French (1992) looked at the value effect in US stocks from 1963 to 1990 where they found evidence that this is not a new portfolio construction strategy.

2.4 Market efficiency

The theory of market efficiency was brought to the fore by Markowitz`s (1952) portfolio choice model which assumed investors are risk averse and choose portfolios based upon their expected return and variance.

Fama (1970) outlined three forms of market efficiency on the argument that share prices reflect all publicly available information which are:

1. Weak efficiency
2. Semi-strong efficiency
3. Strong efficiency

The view is that there will be no outperformance if all investors were to have the same investment thesis. The argument is in an efficient market therefore, to beat the market, an investor will have to take abnormal risk to earn above market returns.

2.4.1 *Efficiency*

Chandra (2002) opines that market efficiency tests can be done on event studies, portfolio studies as well as statistical methods. The event studies take specific time periods before the event and after the event. The events could be directors' share dealings, dividends declaration, share splits, bonus issues, earnings, repurchases, mergers and acquisitions, option listing, bond listings and other relevant events.

Market anomalies are the metrics used on portfolio studies. This is where security intrinsic metrics are taken into consideration, for example, low price earnings (P/E) ratio, capitalisation or book to market value ratio. This

is ideal for semi strong efficient markets and has been proven to deliver abnormal returns, according to Bodie, Kane and Marcus (2002).

The argument on market efficiency is on whether past prices, other public information and insider information can be interpreted in a beneficial manner to deliver superior returns.

2.4.2 *Efficiency on the Johannesburg Stock Exchange*

Jacobs and Levy (1989) classified the U.S stock markets as efficient on the back of market participants and the abundance of information. The backbone of the efficiency argument is on the fact that the share prices must follow a random walk pattern thus delivering predictable returns with deviations that are insignificant.

The researches undertaken on event studies in the U.S stock markets depict evidently there is efficiency (Fama1991), suggesting it is the best method to test for market efficiency.

Affleck-Graves and Money (1975) tested the JSE for independence from April 1968 to September 1973. In most instances, little evidence of autocorrelation was detected. The findings of this study suggest that the Johannesburg Stock Exchange is weak form efficient.

Hadassin (1976), who used Von Neumann serial correlation to determine if the share returns of 30 stocks listed on the exchange followed a random walk, concluded that the Johannesburg Stock Exchange is not efficient.

Roux and Gilberston (1976), cited by Strebel (1977), tested shares from the gold mining, non-gold mining and industrial categories for independence in price changes, using serial correlation tests and runs tests. The study review by Strebel (1977) suggested due to no adjustments being made for “false” zero returns, possibly as an indication of thin trading, especially in smaller stocks.

Doyle and Chen (2013) tested the All Share index between 1st January 1996 to 21st June 2012 which displayed signs of non-randomness for a window length of 2 days, and randomness for the remaining period.

Kruger et al. (2012) conducted a study on the Johannesburg Stock Exchange testing for nonlinear serial dependence in stock price changes between January, 2002 and December, 2009, and concluded that for the most part, the exchange was an efficient market with brief periods of inefficiency.

Bonga-Bonga (2012, p. 997-1002) applied a time varying GARCH model to weekly stock returns on the Johannesburg Stock Exchange and

concluded that between March, 1995 and December, 2009, the exchange was weak form efficient.

The two studies above suggest that since the 1990s, the JSE has been reasonably constant in exhibiting week market efficiency.

2.5 Market anomalies

Low capitalisation companies had posted abnormal returns in comparison with high capitalisation companies. This has been researched by scholars while investigating market efficiency. Reinganum (1981) and Keim (1990,) researched that firm centric metrics, like size, could also result in abnormal returns. Fama and French (1992) also researched growth and value shares and found that value shares outperformed growth shares. Value shares were defined as shares with low book to market value and vice versa for growth shares.

2.6 CAPM Model

The market model has been the CAPM model which is the benchmark model when calculating market returns. Scholars (Sharpe, 1964; Lintner, 1965; Black, 1972) have used the model to test market efficiency.

The CAPM model depicts the relationship between asset centric risk and expected asset return. Modern financial economics hinge on the CAPM

model which seeks to measure investor behaviour (Sharpe, Alexander & Bailey, 2003).

Therefore, with the understanding that rewards for risk for an asset in the market is the same as the market reward to risk, thus:

$$\frac{E(R_i) - R_f}{\beta_i} = E(R_m) - R_f \qquad \text{(Equation 1)}$$

The market reward-to-risk ratio is the market risk premium and solving for E(Ri), we obtain the capital asset pricing model (CAPM).

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f) \qquad \text{(Equation 2)}$$

Where:

$E(R_i)$ - expected return on the capital asset

R_f - risk-free rate of interest such as interest arising from government bonds

β_i - sensitivity of the expected excess asset returns to the expected excess market returns

$E(R_m)$ - expected return of the market

$E(R_m) - R_f$ - market premium

Bodie, Kane and Marcus (2002) showed that the single index model is the same as the CAPM model. The single index model factors firm specific metrics. The model measures the risk and return of an asset. The relationship was expressed in the equation below:

$$r_{it} - r_f = \alpha_i + \beta_i(r_{mt} - r_f) + \epsilon_{it} \quad \text{(Equation 3)}$$

Where:

r_{it} - return to stock i in period t

r_f - risk free rate

r_{mt} - return to the market portfolio in period t

α_i - stock's alpha, or abnormal return

β_i –stock's beta, or responsiveness to the market return

$r_{it} - r_f$ - excess return on the stock,

$r_{mt} - r_f$ - excess return on the market

ϵ_{it} - residual (random) returns, which are assumed independent normally distributed with mean zero and standard deviation

2.7 CAPM and Single Index Model Comparisons

The CAPM says that the expected return of a security or a portfolio equals the rate on cost of capital. The model works on the basis of the assumptions that there is a single period investment horizon, each investor holds a portfolio of highest expected return given the volatility with a common set of portfolio opportunities and lending and borrowing is at risk free rate and risk premium.

The single-index model assumes that there is only one macroeconomic factor that causes the systematic risk affecting all stock returns. This factor can be represented by the rate of return on a market index, for example, the All Share Index (ALSI).

The assumptions are all stocks respond in the same way to macro-economic factors while the reality is every stock responds differently.

The systematic risk, for example, wars, recessions and interest rates cannot be diversified away while firm specific (unsystematic risk) can be diversified away by increasing exposure of the portfolio.

CAPM is still widely used because of simplicity while the challenge on the single factor model is the fact that the beta does not capture all the systematic risk.

In contrast to the CAPM that has only one risk factor, the arbitrage pricing theory has multiple risk factors (betas). Essentially each risk factor has a corresponding beta.

2.8 Beta calculation

The beta (β) is a measure of the risk arising from exposure to general market movements as opposed to stock centric factors. The market portfolio of all investable assets has a beta of exactly 1. A beta below 1 can indicate a volatile investment whose price movements are not highly correlated with the market, a good example being treasury bills.

A beta above one generally means that the asset is both volatile and tends to move up and down with the market. Negative betas are possible for investments that tend to go down when the market goes up, and vice versa. A good example is equity put options.

When calculating beta using the single index model the slope of the regression line is the beta. The equation is:

$$r_{it} - r_f = \alpha_i + \beta_i(r_{mt} - r_f) + \epsilon_{it} \qquad \text{(Equation 4)}$$

Where:

r_{it} - return to stock i in period t

r_f - risk free rate

r_{mt} - return to the market portfolio in period t

α_i - stock's alpha, or abnormal return

β_i –stock's beta, or responsiveness to the market return

$r_{it} - rf$ - excess return on the stock,

$r_{mt} - rf$ - excess return on the market

ϵ_{it} - residual (random) returns, which are assumed independent normally distributed with mean zero and standard deviation

A common expression for beta is:

$$\beta = \frac{\mathrm{Cov}(r_a, r_b)}{\mathrm{Var}(r_b)} \qquad \text{(Equation 5)}$$

Where:

Cov (r_a,r_b) –covariance operators

Var (r_b)- variance operators

This can also be expressed as:

$$\beta = \rho_{a,b}(\sigma_a/\sigma_b) \qquad \text{(Equation 6)}$$

Where:

$\rho_{a,b}$ - correlation of the two returns

σ_a and σ_b - respective volatilities.

When using the CAPM model, the beta is calculated by regression and the equation is as per below:

$$r_{it} - r_f = \alpha_i + \beta_i(r_{mt} - r_f) + \epsilon_{it} \qquad \text{(Equation 7)}$$

Where:

$E(R_i)$ - expected return on the capital asset

R_f - risk-free rate of interest such as interest arising from government bonds

β_i - sensitivity of the expected excess asset returns to the expected excess market returns

$E(R_m)$ - expected return of the market

$E(R_m) - R_f$ - market premium

Chandra (2002) touched on other methods of beta calculation including financial information, cross sectional regressions and fundamental information.

2.9 Conclusion of literature review

Arnott, Hsu and Moore (2005) constructed six fundamental indices and a composite index for the sample period from 1962 to 2004 and compared the performance of the fundamental indices to that of the S & P 500 index. The fundamental indices were found to have an annual turnover of 13.09% compared to the S & P 500`s 6.3%. This difference would explain little of the additional 2% return attributable to the fundamental indices.

Proponents of the market capitalisation index point out that it is the only portfolio that every investor can hold while the fundamental index cannot be held in equilibrium by every investor. This is because theoretically an overweight stock position by one investor should also be an underweight position by another investor. Blitz and Swinkles (2008) pointed out that proponents of fundamental indexation have failed to explain why, in equilibrium, an investor would want to invest in fundamentally unattractive stocks. Arnott et al (2005) report a sharp ratio improvement and improved information ratio for fundamental indices. Critics argue the improvements

are not spectacular because the index seeks to maximise return by one empirical return irregularity which is the value premium. Thus, these are inferior compared to quantitative value strategies which optimise risk return characteristics using multi-factor quantitative investments strategies such as medium term price momentum effect, the short term reversal effect (Jegadeesh, 1990), the earnings momentum effect (Chan, et al., 1996), the accruals effect (Sloan, 1996), and the low volatility effect (Blitz & van Vliet, 2007).

Estrada (2008) maintains that this may be viewed as a strategy designed to overcome the shortcoming of one of the key recommendations of modern portfolio theory – the buying and holding of the market portfolio. This argument positions fundamental indexation as a strategy enhancing returns and generating alpha.

Plaxco and Arnott (2002) pointed out that rebalanced portfolios typically have higher Sharpe ratios than un-rebalanced portfolios, which suggest that the possible outperformance of a buy and hold portfolio may be the result of greater risk (Erb & Harvey, 2006).

The emergence of the fundamental index was greeted with mixed reactions with Siegel (2006) calling it “a revolution” and “the next wave of investing” while Bogle et al (2006) questioned whether the “new paradigm” was sustainable.

Voyles (2006) points out that the downside with indexation as a portfolio strategy has not answered the question on what happens when there is one stock in a cluster that an investor does not like.

Savage and DeGroot (2006) believe that index funds are a rational, intelligent approach for investors without the expertise, time and interest to venture into active portfolio management, which is an advantage.

2.10 Hypothesis

In determining whether or not the mean variance indifference anomaly existed on the Johannesburg Stock Exchange during the period between 1st October, 2007 and 31st January, 2016, two hypotheses were formulated;

2.10.1 *Hypothesis one:*

The first hypothesis investigated whether there was a difference in returns of the fundamental index and capitalisation weighted index.

H_0: There was no difference in the returns of the fundamental index and capitalisation weighted index

H_a: There was a difference in the returns of the fundamental index and capitalisation weighted index

A two–tailed test was used for testing the difference in the returns of the fundamental index and capitalisation weighted index

2.10.2 *Hypothesis two:*

The second hypothesis investigated whether the returns of the fundamental index outperform the capitalisation weighted index.

H_0: The returns of the fundamental index was less than or equal to the capitalisation weighted index

H_a: The returns of the fundamental index were greater than the capitalisation weighted index

A one–tailed test was used for testing the outperformance of the fundamental index over capitalisation weighted index.

3 CHAPTER: RESEARCH METHODOLOGY

The methodology used to test the hypothesis in section two is described below.

3.1 Research methodology

The study follows quantitative research methodology to examine whether cumulative returns from fundamental indices outstrip the capitalisation weighted indices in the South African equity market. Second, whether the returns are greater than in comparison with market capitalisation weighted indices.

3.2 Research design

3.2.1 *Step 1: Definition of variable on which portfolios are classified*

This study considered the weighting methodology as the variable of classification.

3.2.2 *Step 2: Classification of the stocks into portfolios on the bias of the weighting methodology*

The first trading day of the month from 1st October, 2007 to 31st January, 2016 was arbitrarily selected for the creation of the two portfolios using data from the Johannesburg Stock Exchange. The data is further analysed for periods between 1st October, 2007 to 31st December, 2013 (pre-

financial crisis) and between 31st December, 2013 and 31st January, 2016 (post-financial crisis).

The look ahead bias on the research could not be eliminated since it was impractical to select companies with the same financial year end. The look ahead bias was introduced when whole population was used.

Bodie, Kane and Marcus (2003) postulate that at least thirty two stocks must be in a diversified portfolio to have a normal distribution. The samples for the portfolio selection are still valid on the basis of best practical composition considering the population sizes.

The portfolio composition took cognisance of the fact that review periods ensure portfolio characteristics are maintained and balanced between the portfolios.

3.2.3 *Step 3: Calculation of actual returns*

On the calculation of returns, the assumption was shares in each portfolio are equally weighted with South African Rands 1 invested in each share with a buy and hold policy for each year.

The monthly returns are calculated by the equation below:

$$\text{Monthly return of portfolio} = \frac{\text{Sum of monthly returns for each share}}{\text{Number of shares in the portfolio}} \quad \text{(Equation 8)}$$

The transaction costs were not considered in this study and closing price at portfolio formulation date was used for the calculations.

The shares delisted were not considered and the ones suspended showed no return for the suspension period. The calculation caters for the bonus shares, rights issues and splits.

3.2.4 *Cash dividends value assumptions*

The assumption was dividends were evenly paid out over the year since ascertaining exact dates was not practical. The calculation was on the basis of the equation below:

$$R_{it} = 100 * \ln_e (P_{it} + D_{it/12}) / P_{it-1} \quad \text{(Equation 10)}$$

Where:

R_{it} – return on share $_i$, over period $_t$

P_{it} – share $_i$ closing price at the end of period $_t$

P_{it-1} – share $_i$ closing price at the end of period $_{t-1}$

D_{it} – cash dividend paid share $_i$ over period $_t$

3.2.5 *Step 4: Calculation of abnormal returns*

The abnormal return is the difference between actual and expected return. The study calculated continuously compounded returns for each portfolio as per the equation below:

$$A(R_{pt}) = R_{pt} - E(R_{pt}) \qquad \text{(Equation 10)}$$

Where:

$A(R_{pt})$ – abnormal returns on portfolio p in period t

R_{pt} – returns earned by portfolio p in period t

$E(R_{pt})$ – expected returns earned by portfolio p in period t

The expected return on the portfolio was computed using the equation below:

$$E(R_{pt}) = R_f + [E(R_{Mt}) - R_f] - R_f]\ \beta_p \qquad \text{(Equation 11)}$$

Where:

$E(R_{pt})$ – expected returns earned by portfolio p in period t

B_p – beta of portfolio p

$E(R_{Mt})$ – compounded returns earned by market portfolio in period t

Rf – monthly risk free rate while in this study the researcher used the 91 day Treasury Bills rate

3.2.6 *Risk free rate*

The risk free rate was obtained from the Reserve Bank of South Africa as the monthly 91-day Treasury Bills rate. The equation is as shown below:

Monthly 91-days TB rate = [1+annual 91-days TB rate) $^{1/12}$ – 1]
(Equation 12)

3.2.7 *Beta of portfolio*

In this study, the researcher calculated the beta of the portfolio using the average of the betas of the firms in the portfolio as per equation below:

$$[R_{l,t} - R_f] = \text{constant} = \beta_l * [R_{m,t} - R_f] \qquad \text{(Equation 13)}$$

Where:

$R_{l,t}$ – monthly return earned by share in period t

β_l – beta of the share i

$R_{m,t}$ – monthly return of the market in period t

R_f – risk free rate

3.2.8 *Regression methodology*

The calculation of historical beta has to factor in the period, return interval and the market index proxy.

In this study, the measurement period was 1st October, 2007 to 31st December, 2015. The beta was calculated over a 100 month period which

was the same as international studies (Basu, 1977; Aggarwal, Rao & Hiraki, 1990). The period was considered by the researcher to be long enough to have a significant sample and short enough not to include future likely relationships.

The choice of intervals was monthly to eliminate bias of non–trading days if the researcher was to consider daily values.

The main market index is the All share Index (ALSI) which the researcher used as the market proxy (Chandra, 2002).

3.2.9 *Beta calculation*

The researcher considered that as long as there is consistency between asset returns and market proxy is maintained, discrete or continuously compounded returns can be used in beta calculation (Bradfield, 2003).

3.2.10 *Historical beta stability*

The beta for the data set from 1st October, 2007 to 31st December, 2015 showed historical alignment to the market, as documented by Blume (1975). To address misalignment with beta at portfolio creation stage, adjustment was made using the Merrill Lynch beta calculation methodology having a higher weighting on the historical beta at 0.66 and 0.34 to average market wide value (Sharpe, Alexander & Bailey, 2003). The formula is as below:

$$B_a = (1/3 \times 1.0) = (2/3 \times \beta_h) \quad \text{(Equation 14)}$$

Where:

B_a and β_h are adjusted to historical figures respectively

3.2.11 *Assessment of average returns*

The researcher had one hundred (100) monthly actual and abnormal returns for two portfolios with the mean monthly abnormal return calculated as per equation below:

$$R_{pt} = \sum_{i=1}^{3} \quad \sum_{t=1}^{12} Rpt, j, t/N \quad \text{(Equation 15)}$$

Where:

R_{pt} – mean monthly abnormal return for portfolio p

N – Number of monthly observations

The statistical paired test was used to assess the difference in returns since the portfolios are date dependent and correlated, thus not correlated and can be paired.

The assumptions on t – tests are the data is continuous, not dependent and distribution follows a normal distribution. The researcher looked out for skewness and outliers. When n is greater than or equal to fifteen, one sample or t test can be used according to Moore and Mccabe (2003). T statistic can be used on skewed distributions when n is larger than 40.

In the two-tailed test the null and alternative hypothesis were stated as follows:

H_o: $\mu_d = 0$ – The population distribution of differences has a mean of zero

HA: $\mu d \neq 0$ – The population distribution of differences does not have a mean of zero

Where:

μ_d – mean of the population distribution of differences

The researcher stated the one–tailed test hypothesis as follows:

H_A : $\mu_d < 0$ – left tail alternate hypothesis

H_A : $\mu_d > 0$ – right tail alternate hypothesis

The paired t–test statistics are as per the equation below:

$$t = \frac{\bar{d}}{\sqrt{s^2 / n}} \qquad \text{(Equation 16)}$$

Where:

d bar - mean difference

s^2 - sample variance

n - sample size

t - t quantile with n-1 degrees of freedom

In determining whether the sample differences could have come from a population with a mean of zero a two-tailed test was applied to establish if the research should accept the null hypothesis or reject it. The decision rule of a two–tailed test of hypothesis at the 0.05 significance level for n – 1 degrees of freedom is illustrated in the diagram below.

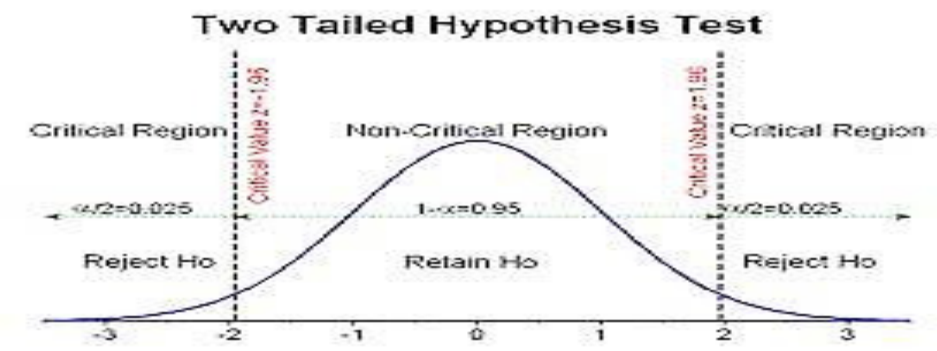


Figure 3.1: Two tailed decision rule at 0.05 significance level

The E Views 7 probability calculator with n – 1 degrees of freedom was used in calculating the critical t values. The decision rule states if paired t – statistic value t n-1 is greater than critical t value means the population distribution of differences does not have a mean of zero.

On the one–tailed test, the decision rule is to reject the null hypothesis if the right tailed test at the 0.05 significance level for n – 1 degrees of freedom as illustrated in Figure 3.2 below.

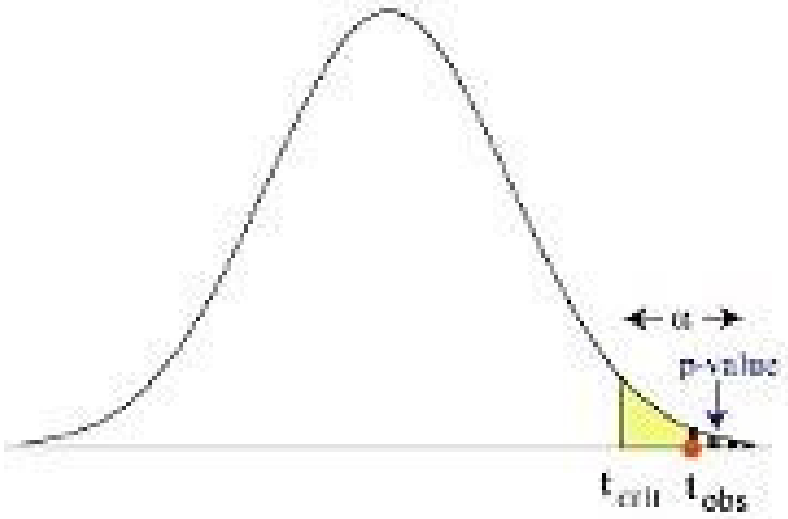


Figure 3.2: Right - tailed decision rule at 0.05 significance level

The E Views 7 probability calculator with n – 1 degrees of freedom was used in calculating the critical t values. The decision rule if paired t – statistic value t n-1 is greater than critical t value means the population distribution of differences does not have a mean of zero.

3.2.12 *Frequency changes of measured returns*

The data was monthly prices which the researcher used to calculate the annual returns after compounding as per the following equations:

$$\text{Mean}_{(\text{annually})} = 12 \times \text{Mean}_{(\text{monthly})} \quad \text{(Equation 17)}$$

$$\text{Standard deviation}_{(\text{annually})} = \sqrt{12} \times \text{Standard deviation}_{(\text{monthly})} \quad \text{(Equation 18)}$$

3.2.13 *Risk – adjusted performance measures*

The Sharpe's, Treynor's and Jensen's measures were used to calculate the risk adjusted performance measures of the portfolios.

The Sharpe's measure is calculated by subtracting the risk free rate from the return of the portfolio and dividing the standard deviation of the portfolio. A higher Sharpe's ratio implies that the portfolio is realising sufficient returns for each unit of risk. The measure is calculated as per the equation below:

$$S_p = (R_{pt} - R_f)/ \sigma_p \quad \text{(Equation 19)}$$

Where:

S_p – Sharpe's measure for portfolio p

R_{pt} – average rate of return on portfolio p

R_f – average rate of return on a risk free rate

σ_p – standard deviation of the average monthly returns for portfolio p

The Treynor's measure calculates the returns in excess of what could have been earned on a risk free asset. The measure is calculated as per the equation below:

$$T_p = (R_{pt} - R_f)/ \beta_p \qquad \text{(Equation 20)}$$

Where:

S_p – Treynor's measure for portfolio p

R_{pt} – average rate of return on portfolio p

R_f – average rate of return on a risk free rate

β_p – beta for portfolio p

The four year period January 2001 to December 2006 was used to calculate portfolio beta using the OLS method with the FTSE ALSI index as the market proxy. The regression equation is as below:

Return of portfolio = constant + beta of portfolio x return of market

The Jensen's measure is the average return on the portfolio over and above the one predicted by CAPM as per the equation below:

$$A_p = R_{pt} - [R_f = \beta_p \text{ x } (R_{mt} - R_f)] \qquad \text{(Equation 21)}$$

Where:

A_p – Jensen's measure for portfolio p

R_{pt} – average rate of return on portfolio p for time period t

R_{mt} – average rate of return on the market

R_f – average rate of return on a risk free rate

B_p – beta for portfolio p

The Jensen's measure is the alpha value of the regression which means positive alpha indicates the portfolio did better than the market on a risk adjusted basis during the time period of study and vice versa.

The regression equation is show below:

$$(R_{pt} - R_f) = A_p + \beta_p * (R_{mt} - R_f) \qquad \text{(Equation 22)}$$

3.2.14 Fundamental Weighted Indices

3.2.14.1 Composition

The composition of the Fundamental Index is based on financial ratios, the capitalisation of a company is adjusted with a calculated fundamental factors.

The calculation of the Fundamental Factors is based on the financial ratios Return on Assets, Gross, Dividend Yield and Price to Book Value Ratio among other variations.

3.2.14.2 Constituent Weighting Calculation on the Index

$$Capitalisationt = \sum_{i=1}^{N} (\mathrm{Pi, t} * \mathrm{Qi, t} * \mathrm{FFi, t} * \mathrm{RFi, t})$$

Where:

P_i, ... Price of i^{th} Stock in ZAR

Q_i ..... Number of Shares of i^{th} stock

FF_i ..... Free Float Factor of i^{th} stock

RF_i ..... Representation Factor of i^{th} stock

N ..... Number of Companies contained in the index

t ..... Time of Index Calculation

3.2.14.3 Index Calculation

$$Index_t = \text{Base Value} * \left[\frac{\text{Capitalisation}}{\text{Base Capitalisation}}\right] * AF_t$$

Where:

Index ..... ……. Value of the Index

Base Value. ……. Base Value of the Index

Base Capitalisation……. Base Capitalisation of the Index

$Capitalisation_t$…….. Capitalisation of the Index at time t

AF_t..... …….. Adjustment Factor of the Index at time t

t……..... Time of Index calculation

3.3 Population and sample

3.3.1 *Population*

The population is the FTSE/JSE RAFI 40 and the FTSE/JSE Top 40 on the Johannesburg Stock Exchange between 1st October, 2007 and 31st January, 2016. The population does not include bonds, preference shares and debentures.

3.3.2 *Sample and sampling method*

For the purposes of this study the population was the FTSE/JSE RAFI 40 and the FTSE/JSE Top 40 closing index levels on the Johannesburg Stock Exchange between 1st October, 2007 and 31st January, 2016.

3.3.3 *Sample bias*

The Johannesburg Stock Exchange is a relatively small stock exchange compared to the New York Stock Exchange. The time considered was a period of 100 months which was between 2007 and 2016. In consideration to survival bias, companies were all still listed to the end of the study period.

The financial year ends for the companies were all different since it is not a requirement to have this at the same time for listed companies which understandably was impossible practically to match.

3.4 Data specifications

The test period data from the indices companies was daily data with returns calculated monthly; data with the South African Rands (ZAR) as the settlement currency with the assumption that cross-listed companies did not trade overnight which therefore means that the end of day closing price on the Johannesburg Stock Exchange was not impacted.

3.5 Data collection

The primary data was from McGregor BFA, Bloomberg and Excel files from the Johannesburg Stock Exchange. The data included the following:

- Monthly closing share prices
- Closing indices value
- Earnings
- Market capitalisation
- Dividend pay-out amounts

The Treasury bill rate was from the Reserve Bank of South Africa and BFA McGregor. There was no provision made for brokerage commissions and any other costs.

Alternative data sources, included company financial reports, Reuters and Bloomberg. Where data could not be extracted from any of the sources, the calculations from data obtained was used to fill data gaps.

3.6 Limitations of the study

This study did not review the performance of the portfolios data from the date the market opened but only from to 2007. Therefore, the study is not representative of performance during all time periods.

The intention of the study was not fundamental merits as a valuation tool when making investment decisions and only covered the stocks on the FTSE/JSE RAFI 40 and FTSE/JSE Top 40 on the Johannesburg Stock Exchange listed companies and not all the stocks on the exchange.

The objective of the research was not market efficiency and was a multi-industry sector study and ignored the possibility that some sectors have better consistent and significant returns over different time periods.

The primary data sources were the Johannesburg Stock Exchange, Bloomberg and BFA McGregor. The other information was obtained from financial reports of the individual companies.

3.7 Data reliability and integrity

The data was obtained and cross correlated over various sources, therefore considered reliable. The characteristic of the data was tested for correlation.

The aspect of the created portfolios tracking the indices was an indication that the data was reliable.

The calculations were based on fundamental formulas to ensure consistency.

3.8 Validity and reliability

3.8.1 *Internal validity*

The study used techniques used by investment professionals and also scholars' research that is documented in portfolio studies and portfolio evaluation techniques.

The study has taken into cognisance the internal validity in order to have accurate conclusions, according to Leedy and Ormrod (2001).

3.8.2 *External validity*

The researcher, for practical purposes, used the two indices as a representative sample due to the number of listing on the Johannesburg Stock Exchange. The methodology used has been used for international

studies and generalisations can be made from the results of the study (Leedy & Ormrod, 2001).

4 CHAPTER: PRESENTATION OF RESULTS

4.1 Introduction

The first step was to ensure that the source data collected from the various sources for this study is credible. Monthly fundamental weighted index was constructed from the monthly share returns from all firms used for the portfolio study. This index was compared against the FTSE/JSE Top 40 market capitalisation – weighted index. If the two closely tracked each other, it could be concluded that the data was reliable and accurate.

The starting date of the index was 1st October, 2007. The figure 4.1 shows how closely the two indices tracked each other throughout the review period between 1st October, 2007 and 31st January, 2016.

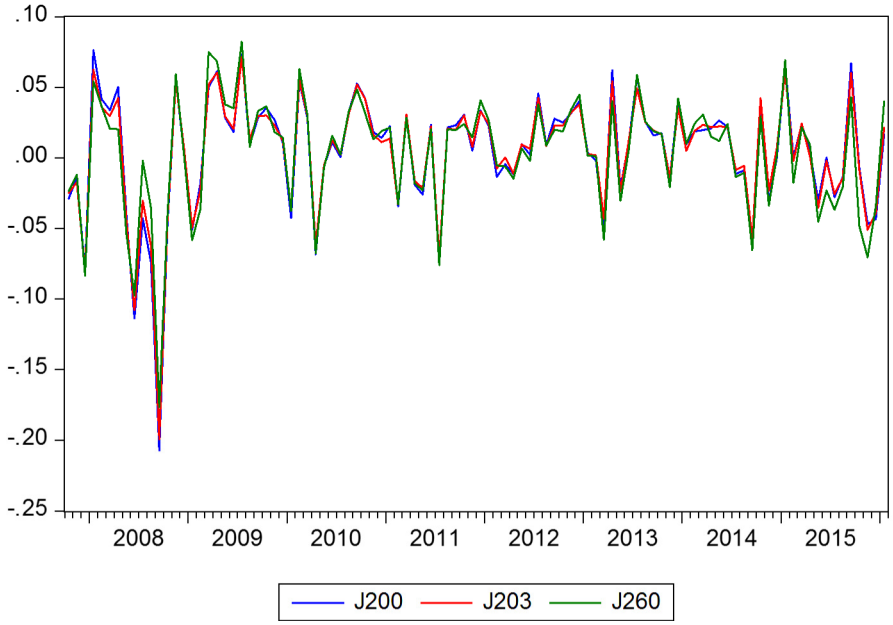


Figure: 4.1 Graphical illustration of the indices correlation from 1st October, 2007 to 31st January, 2016

The graphical illustration above shows the correlation among the FTSE/JSE All Share Index, FTSE/JSE Top 40 and the FTSE/JSE RAFI 50 indices Fundamental Index and the FTSE/JSE Top 40 index and not the predictive relationship. This illustrates the dependence between the two data sets but not the probabilistic independence.

Table 4.1: Descriptive statistics of the Indices from 1st October, 2007 to 31st January, 2016

	J200	J203	J260
Mean	0.004450	0.004627	0.003512
Median	0.011066	0.012444	0.013792
Maximum	0.076365	0.071235	0.082071
Minimum	-0.207229	-0.199441	-0.176681
Std. Dev.	0.042657	0.040286	0.041196
Skewness	-1.551539	-1.659775	-1.117912
Kurtosis	8.007190	8.512165	5.588407
Jarque-Bera	144.5877	172.5140	48.74483
Probability	0.000000	0.000000	0.000000
Sum	0.445010	0.462723	0.351158
Sum Sq. Dev.	0.180143	0.160675	0.168010
Observations	100	100	100

Jarque-Bera test for a normal distribution has a skewness coefficient of zero while on the table above we have -1.66 and – 1.12 for FTSE/SE RAFI 40 and FTSE/JSE Top 40 index respectively. The Kurtosis coefficient is three for a normal distribution while on the table above we have 8.51 and 5.59 for the FTSE/JSE RAFI 40 and FTSE/JSE Top 40 index respectively. Therefore the returns are not normally distributed based on the results of the skewness test and the Jarque - Bera measure. The data is not normally distributed since it is negatively skewed and has high peakedness or higher kurtosis. This result therefore leads to non-parametric measures.

The graph below is the regression line of the betas of the Fundamental Index and the FTSE/JSE Top 40 Index which indicates the correlation and prediction relationship by regression of Fundamental Index from the FTSE/JSE Top 40 Index beta.

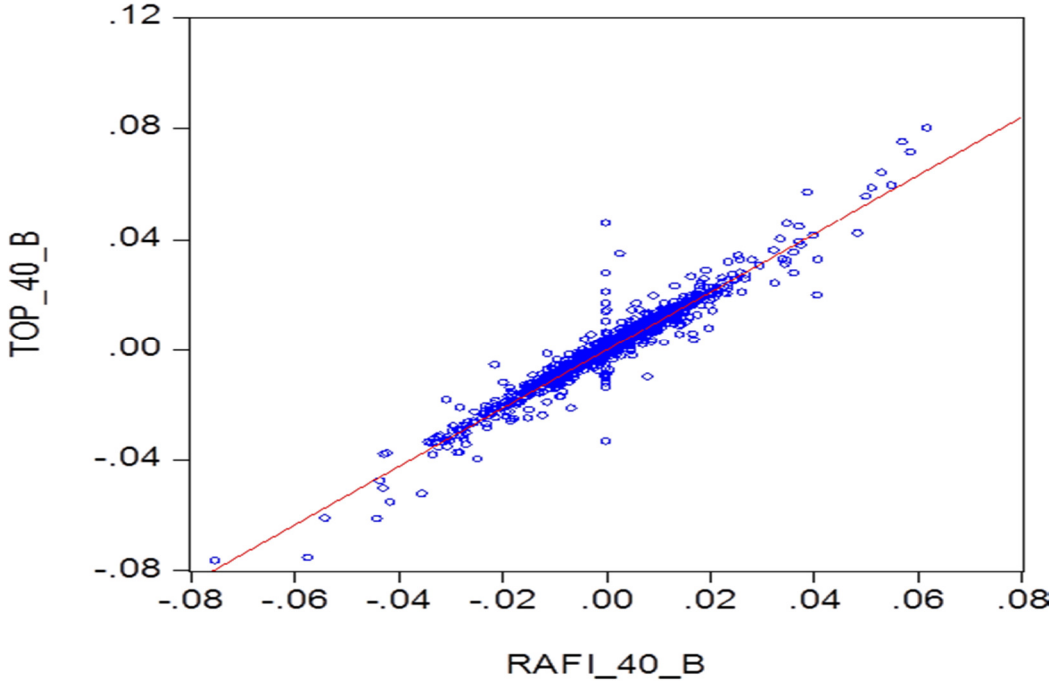


Figure: 4.2 Results of regression line fitted between the FTSE/JSE RAFI 40 and FTSE/JSE Top 40 from 1st October, 2007 to 31st January, 2016

Table 4.2: Test of equality in median of the FTSE/JSE RAFI 40 and FTSE/JSE Top 40 from 1st October, 2007 to 31st December, 2008

The data is not normally distributed hence the researcher had to use non-parametric tests for the pre-financial crisis period (1st October, 2007 to 31st December, 2008).

The researcher used the Mann-Whitney test as a dependence test on the assumption that the variables in the analysis can be split into independent and dependent variables comparing the mean scores as per the table below.

Test for Equality of Medians Between Series
Date: 12/17/14 Time: 11:13
Sample: 10/02/2007 12/31/2008
Included observations: 327

Method	df	Value	Probability
Wilcoxon/Mann-Whitney		0.063647	0.9493
Wilcoxon/Mann-Whitney (tie-adj.)		0.063647	0.9493
Med. Chi-square	1	0.159744	0.6894
Adj. Med. Chi-square	1	0.102236	0.7492
Kruskal-Wallis	1	0.004079	0.9491
Kruskal-Wallis (tie-adj.)	1	0.004079	0.9491
van der Waerden	1	0.006393	0.9363

Category Statistics

Variable	Count	Median	> Overall Median	Mean Rank	Mean Score
RAFI 40	313	-0.000412	159	313.9617	0.003170
TOP 40	313	-0.000962	154	313.0383	-0.003170
All	626	-0.000668	313	313.5000	-1.17E-07

The null hypothesis is that the distributions of both Fundamental Index and Top 40 index are identical, what this means is that there is a 50% probability that an observation from a value randomly selected from Fundamental Index data set exceeds an observation randomly selected from the Top 40 index data set.

Using the Wilcoxon/Mann-Whitney test, the null hypothesis is that the two portfolios medians are equal. Therefore, if the p-value is less than 5% we reject the null hypothesis. Hence from the table above the probability value is bigger than 10% therefore, we accept the null hypothesis. There was no significant difference in the performance of these indices even during and after the financial crisis.

Table 4.3: Test of equality in median of the FTSE/JSE All Share index and FTSE/JSE RAFI 40 from 1st October, 2007 to 31st January, 2016

The data is not normally distributed as per the Jarque-Bera measure hence the researcher had to use non parametric tests. Using the Wilcoxon/Mann-Whitney test the null hypothesis is that the two portfolios medians are equal.

Test for Equality of Medians Between Series

Date: 02/08/16 Time: 10:14
Sample: 2007M10 2016M01
Included observations: 100

Method	df	Value	Probability
Wilcoxon/Mann-Whitney		0.233344	0.8155
Wilcoxon/Mann-Whitney (tie-adj.)		0.233344	0.8155
Med. Chi-square	1	0.080000	0.7773
Adj. Med. Chi-square	1	0.020000	0.8875
Kruskal-Wallis	1	0.055021	0.8145
Kruskal-Wallis (tie-adj.)	1	0.055021	0.8145
van der Waerden	1	0.034678	0.8523

Category Statistics

Variable	Count	Median	> Overall Median	Mean Rank	Mean Score
J200	100	0.011066	49	101.4600	0.012901
J260	100	0.013792	51	99.54000	-0.012901
All	200	0.012585	100	100.5000	7.77E-18

The data is not normally distributed as per the Jarque-Bera measure hence the researcher had to use non-parametric tests. Using the Wilcoxon/Mann-Whitney test, the null hypothesis is that the two portfolios medians are equal. If the p-value is less than 5% we reject the null hypothesis. Hence from the table above the probability value is bigger than 10% therefore, we accept the null hypothesis. There was no significant difference in the performance of these indices even during and after the financial crisis.

Table 4.4: Analysis of the FTSE/JSE RAFI 40 and FTSE/JSE Top 40 from 1st October, 2007 to 31st December, 2013

The researcher took the period between 1st October, 2007 and 31st December, 2013 as the period pre financial crisis, during and after the financial crisis to conduct an ANOVA test which partitions the variability among all the values into one component that is due to variability among group means and another component that is due to variability within the groups as per the table below.

Test for Equality of Means of TOP_40_B
Categorized by values of TOP_40 and RAFI_40
Date: 12/02/14 Time: 11:54
Sample (adjusted): 10/02/2007 12/31/2013
Included observations: 1629 after adjustments

Method	df	Value	Probability
Anova F-test	(7, 1621)	1.742908	0.0950

Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	7	0.002575	0.000368
Within	1621	0.342106	0.000211
Total	1628	0.344681	0.000212

The F ratio is the ratio of two mean square values. If the null hypothesis is true, the F value will be close to 1.0. Hence there was no significant difference in the performance of these indices even during the financial crisis.

Table 4.5: Test of covariance of the indices from 1st October, 2007 to 31st January, 2016

Covariance Analysis: Ordinary
Date: 02/08/16 Time: 11:32
Sample: 2007M10 2016M01
Included observations: 100

Correlation Probability	J200	J203	J260
J200	1.000000 -----		
J203	0.996186 0.0000	1.000000 -----	
J260	0.958553 0.0000	0.969364 0.0000	1.000000 -----

The correlation matrix above indicates that the FTSE/JSE All Share and the FTSE/JSE Top 40 are highly correlated. FTSE/JSE All Share makes up 99% of the FTSE/JSE Top 40. The FTSE RAFI 40 makes up about 97% of the FTSE/JSE Top 40 and about 96% of the FTSE/JSE All Share.

Table 4.6: Granger causality test of the FTSE/JSE All Share and FTSE/JSE RAFI 40 from 1st October, 2007 to 31st January, 2016

Pairwise Granger Causality Tests
Date: 02/08/16 Time: 13:29
Sample: 2007M10 2016M01
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
J200 does not Granger Cause J260	98	0.38847	0.6792
J260 does not Granger Cause J200		0.30565	0.7374

Two null hypotheses are being displayed in the above output.

If F ≥ 3.84 then H (A) (Alternate hypothesis is accepted)

If F < 3.84 then H (o) (Null hypothesis is accepted)

For the null hypothesis 1, in the above figure F ≥ 3.84, therefore Alternate hypothesis is not going to be accepted which means FTSE/JSE All Share does not Granger Cause FTSE/JSE RAFI 40.

Whereas, for the null hypothesis 2, in the above figure F < 3.84, therefore null hypothesis is going to be accepted which means FTSE/JSE RAFI 40 does not Granger cause FTSE/JSE All Share.

Hence this proves that the above cause and effect relationship is unidirectional and not bidirectional.

Table 4.7: Granger causality test of the FTSE/JSE Top 40 and FTSE/JSE RAFI 40 from 1st October, 2007 to 31st January, 2016

Pairwise Granger Causality Tests
Date: 02/08/16 Time: 13:30
Sample: 2007M10 2016M01
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
J203 does not Granger Cause J260	98	0.01696	0.9832
J260 does not Granger Cause J203		0.23368	0.7921

Two null hypotheses are being displayed in the above output.

If F ≥ 3.84 then H (A) (Alternate hypothesis is accepted)

If F < 3.84 then H (o) (Null hypothesis is accepted)

For the null hypothesis 1, in the above figure F ≥ 3.84, therefore Alternate hypothesis is not going to be accepted which means FTSE/JSE Top 40 does not Granger Cause FTSE/JSE RAFI 40.

Whereas, for the null hypothesis 2, in the above figure F < 3.84, therefore null hypothesis is going to be accepted which means FTSE/JSE RAFI 40 does not Granger cause FTSE/JSE Top 40.

Hence this proves that the above cause and effect relationship is unidirectional and not bidirectional.

Overall, the FTSE/JSE RAFI 40 does not outperform the other indices pre financial crisis, during and after the financial crisis. The conclusion could be that this is expected as the FTSE/JSE RAFI 40 is a constituent of the FTSE/JSE All share and the FTSE/JSE Top 40 Indices.

4.2 Classification of companies into portfolios in each review period

The period of review was between 2007 and 2016 and the companies selected were listed equities on the Johannesburg Stock Exchange except preference shares, debentures and companies with negative earnings per share.

4.3 Betas of FTSE/JSE Top 40 and FTSE/JSE RAFI 40

The values were calculated in the review period for beta and adjusted beta of companies constituting the fundamental index portfolio and FTSE/JSE Top 40 portfolio as well as the betas and adjusted beta of the portfolios.

Table 4.9 shows the output of beta estimates of the portfolios. The beta calculation was computed as described in 3.6.4.2. The lower the beta values between zero and one the lower the volatility.

Table 4.8: Beta estimates of FTSE/JSE Top 40 and FTSE/JSE RAFI 40 between 31st October, 2007 and 31 December, 2013

		BETA	
Date	**Rf**	**RAFI 40**	**TOP 40**
31-Oct-07	9.43	1.161	0.976
31-Dec-07	9.43	0.988	1.060
31-Dec-08	9.96	1.235	1.089
31-Dec-09	10.06	0.207	1.510
31-Dec-10	10.43	0.640	1.417
31-Dec-11	10.54	1.136	1.189
31-Dec-12	10.52	1.189	1.223
31-Dec-13	10.37	0.896	1.044

The period chosen by the researcher is for the purposes of capturing the beta relationships pre- and during the financial crisis and slightly after the financial crisis. There is inverse correlation of the betas in the December 2009 period.

4.4 Returns of FTSE/JSE Top 40 and FTSE/JSE RAFI 40 between 31st October, 2007 and 31 December, 2013

Table 4.7 shows the output of beta estimates of the portfolios. The beta calculation was computed for the Sharpe, Treynor and Jensen's measures as shown by equation 19, 20 and 22 respectively.

Table 4.9: Sharpe, Treynor and Jensen's measures

	SHARPE		TREYNOR		JENSEN	
Date	**RAFI 40**	**TOP 40**	**RAFI 40**	**TOP 40**	**RAFI 40**	**TOP 40**
31-Oct-07	-1.182	-1.245	-0.016	-0.017	0.001	0.001
31-Dec-07	0.382	0.424	0.009	0.010	-0.001	0.000
31-Dec-08	6.675	4.530	0.021	0.014	0.002	0.003
31-Dec-09	7.870	4.366	0.007	0.004	0.000	-0.008
31-Dec-10	0.990	0.807	0.006	0.005	0.001	0.000
31-Dec-11	1.337	1.356	0.023	0.024	0.000	0.000
31-Dec-12	1.195	1.191	0.020	0.020	0.000	0.000
31-Dec-13	1.589	2.349	0.005	0.007	-0.002	0.001

4.5 Summary of the results

The relative performance of the FTSE/JSE RAFI 40 and FTSE/JSE TOP 40 is consistent with the results reported by Arnott, et al (2005, p.83-99) and Estrada (2008, p. 93-109), showing that fundamental indices do outperform cap weighted indices.

Whether the FTSE/JSE TOP 40 is more or less risky than the FTSE/JSE RAFI 40 depends on whether risk is measured by volatility or beta. In terms of volatility, the FTSE/JSE TOP 40 is slightly riskier that the FTSE/JSE RAFI 40, as reflected by standard deviations respectively. In terms of beta, the FTSE/JSE RAFI 40 is slightly less risky than the FTSE/JSE TOP 40, as reflected by their betas respectively. Arnott, et all (2005) found that fundamental indices are more or less volatile than the S & P 500 depending on the weighting scheme and that the composite fundamental index is slightly less volatile than the S & P 500. Hsu (2006), in contrast, found that composite fundamental indices are less volatile then their respective MSCI benchmarks in 14 of the 23 countries they considered, and more volatile in the other 9 countries. The global fundamental strategy considered by Estrada (2008) and based on a price insensitive, objective, and transparent fundamental variable – dividend per share – out performs a global cap weighted strategy in terms of returns (by 1.9% a year) and risk adjusted returns. He also found that the fundamental strategy was outperformed by a simple, low cost value strategy in terms of returns (by 1.7% a year) and risk adjusted returns.

The risk adjusted return of each index is defined as the arithmetic mean return divided by volatility, and according to this measure, the FTSE/JSE RAFI 40 outperformed the FTSE/JSE TOP 40.This result is consistent with the findings reported by Arnott, et al.(2005) who showed that the Sharpe ratio of fundamental indices is higher that of the S & P 500. Estrada (2008) also reported that fundamental indices outperform cap weighted indices on this measure.

The FTSE/JSE RAFI 40 not only has a higher negative skewness and higher kurtosis than the FTSE/JSE TOP 40, it also has a lower worst month return and higher best month return. Because negative skewness and kurtosis are usually viewed as risk related attributes detrimental to investors, these coefficients seem to confirm that the FTSE/JSE RAFI 40 is somewhat riskier than the FTSE/JSE TOP 40.

5 CHAPTER: DISCUSSION OF THE RESULTS

The fundamental index is relatively small rendering the full replication of international studies not possible. The main results are consistent with Estrada (2008). The FTSE/JSE RAFI 40 has a higher return, lower volatility, and higher risk-adjusted return than the FTSE/JSE TOP 40. The superior performance of the Fundamental index over the 2007 – 2016 periods was achieved smoothly over time.

In agreement with Blitz and Swinkels (2008), fundamental indexation is very likely to be inferior compared to more sophisticated quantitative investment strategies, this bias might also be caused by comparing performance over a short time.

5.1 Introduction

Using the portfolio study methodology, the results as presented in chapter four indicated the fundamental index on the Johannesburg Stock Exchange tended to outperform the market capitalisation index between 2007 and 2016. This was consistent with international studies that showed better performance could be achieved with a fundamental index tracking as contrasted with a market capitalisation index.

5.2 Calculations on the indices

In order to compare the performance of a cap weighted index and fundamental index, two portfolios were calculated. The cap weighted index (FTSE/JSE Top 40) was calculated as follows: at 1st October, 2007, a sum of ZAR 1 was invested in the constituents according to their relative market cap of each constituent relative to the sum of all constituents. This investment was passively held through 31st January, 2016 when the portfolio was liquidated.

The fundamental index was calculated as follows: at 1st October, 2007, a sum of ZAR 1 was invested in the constituents according to their relative fundamental weighting of each constituent relative to the sum of all constituents. Returns for this fundamental index were calculated on a monthly basis through the year, at which point the index was rebalanced according to the relative fundamental weight on a yearly basis. This computation of monthly returns with annual rebalancing at the end of December proceeded in the same fashion through to 31st January, 2016 when the portfolio was liquidated.

For reference, a sum of ZAR 1 was also invested on the all share index at 1st October, 2007 and passively held through 31st January, 2016, at which time the portfolio was liquidated. As will be demonstrated later, the performance of this index is very similar to that of the cap weighted index (FTSE/JSE Top 40).

The performance of the two indices was not adjusted for transaction costs (such as trading costs and price impact) and taxes, which is consistent with the Arnott, et al. (2005) methodology, most academic research, and the standard practice of index providers.

5.3 Discussion pertaining to Hypothesis 1

Arnott, et al. (2005) discussion on the sources of excess returns of fundamental indices showed that about two thirds of the excess returns delivered by the composite fundamental index relative to the S & P 500 are due to exposure to the size and value factors; the remaining one third of outperformance is inherent to the technique, but not statistically significant.

This is also consistent with Estrada (2008), who found that using the cross sectional correlation between average dividend yields and mean compound returns, both calculated over the entire sample period suggested that at least part of the superior performance of the dividend weighted index is due to its exposure to the value factor and to a lesser extent to the size factor.

This is also consistent with Schoenfeld's (2006) findings which demonstrated that size, style, and industry exposures account for almost 90% of the return generated by the FTSE/JSE RAFI. Schoenfeld showed that the RAFI has large exposures to the book-to-price and earnings–to-price (value) factors and that about 40% of the FTSE/JSE RAFI`s return can be attributed to sector weightings. Schoenfeld also found that the FTSE/JSE RAFI is highly correlated with the S & P 500/Barra Value and Russell 1000 Value indices, and that the FTSE/JSE RAFI tends to outperform the market when value does well and to underperform when value does poorly.

5.4 Conclusion

In this paper, the researcher has examined the added value of the concept of fundamental indexation. First, he has argued that because the weight differences between a fundamental index and a market capitalisation weighted index are entirely due to differences in valuation ratios, fundamental indices are by definition a new breed of value indices. Next, fundamental indices resemble active investment strategies rather than classic passive indices because: one, they appear to be inconsistent with market equilibrium, two: they do not represent a buy and hold strategy and three: they require several subjective choices. The risk return characteristics of fundamental indices are likely to be inferior compared to more sophisticated quantitative strategies, which also try to exploit other anomalies, in addition to the value effect (Blitz & Swinkels, 2008).

Arnott, Hsu and Moore (2005) demonstrate that the superior performance is robust across decades, business cycles, bull and bear markets, and interest rate regimes.

The genesis of fundamental indexation is arguable; some see it as an answer to the shortcomings of the practical recommendations of modern portfolio theory, whereas others see it simply as a strategy devised with the goal of enhancing returns and generating alpha.

In light of the results of the hypotheses, there was no evidence to suggest the existence of the fundamental metrics effect on the Johannesburg Stock Exchange using the FTSE/JSE RAFI 40. This study has documented that no fundamental metrics effect exists on the exchange.

The importance of this study is significant for the investor community in the Johannesburg Stock Exchange. The existence of the fundamental metrics effect on the Johannesburg Stock Exchange means that an investor, choosing a simple trading strategy of holding a portfolio of the FTSE/JSE RAFI 40, can earn higher returns that the one holding the entire population of listed companies. Investors in the South African market may appreciate the fact that the fundamental metrics may impact their portfolio performance.

The results of this study can be used to contribute to the body of research in the South African market on the form of market efficiency on the Johannesburg Stock Exchange.

6 CHAPTER: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

In this section the researcher brings out the conclusions of the study, makes recommendations and suggestions for further research.

6.2 Conclusions of the study

The purpose of this research was to determine whether the investment performance of listed companies on the Johannesburg Stock Exchange was related to their fundamentals. The approach used in this study was to investigate whether fundamental indices outperform market capitalisation weighted indices on a risk adjusted basis.

The portfolio study methodology was used for testing performance returns of the listed companies on the Johannesburg Stock Exchange. At 5% significance level, it was found that during the period 2007 and 2016 the fundamental index had no difference in returns with those of the market capitalisation index. The results of the study were not consistent with international studies.

There was no significant difference in the portfolio performances of these indices pre-financial crisis, during the financial crisis and after the financial crisis using parametric and non-parametric tests.

6.3 Recommendations

It is useful to consider a portion of these excess returns relate to two unique factors: strong short–term momentum on the part of index deletions and poor long term returns on the part of new issue additions.

Erb and Harvey (2006, p. 69) opine that a portfolio diversification return would be zero if all the assets in the portfolio had standard deviations of zero. A portfolio diversification return would also be zero if the correlations of all assets in the portfolio were exactly 1. Unless the conditions hold, however, the diversification return is likely to be a valuable source of portfolio return.

Given the many academic studies on the evidence of market anomalies on the Johannesburg Stock Exchange further investigation of the fundamental indices strategies enhancements can be made in future.

7 REFERENCES

Affleck-Graves, J. P., & Money, A. H. (1975). A note on the random walk model and South African share prices. *South African Journal of Economics*, *43*(3), 382–388.

Aggarwal, R., Rao, R.P. & Hiraki, T. (1980): Regulations in Tokyo Exchange security returns: P/E, size, and seasonal influences, *Journal of Financial Research*, 13(3),249-263

Arnott, R.D., Hsu, J. & Moore, P. (2005). Fundamental Indexation. *Financial Analysts Journal,* 61 (2), 83-99.

Basu, S. (1977): Investment performance of common stocks in relation to their price-earnings ratios: A test of the efficient market hypothesis, *Journal of Finance*, 32(3), 663-681.

Black, F. (1972): Capital market equilibrium with restricted borrowing, *Journal of Business*, 45(3), 444-445.

Blitz, D. & Swinkels, L. (2008). Fundamental indexation: An active value strategy in disguise, *Journal of Asset Management,* 9(4), 264-269.

Blitz, D.C. and van Vliet, P. (2007). The Volatility Effect. *Journal of Portfolio Management*, 34(1), 102-113.

Blume, M. E. (1975): Betas and their regression tendencies, *Journal of Finance*, 30(3), 785-795.

D Bradfield, D. (2003): Investment Basics XLVI. On estimating the beta coefficient, Investment Analysts Journal, 32:57, 47-53

Bodie, Z., Kane, A. & Marcus, A.J. (2002): *Investments*, fifth edition, India: Irwin/McGraw-Hill.

Bonga-Bonga, L. (2012). The evolving efficiency of the South African stock exchange. *International Business and Economics Research Journal*, *11*(9), 997–1002.

Bogle, J. C., & Burton G. M.. (2006). Turn on a Paradigm? *Wall Street Journal*, June 27, A14.

Chan, L. K. C.,Jegadeesh, N.& Lakonishok, J. (1996). Momentum Strategies. *Journal of Finance*, 51 (5), 1681-1713.

Chandra, P. (2002): *Investment Analysis and Portfolio Management*, New Delhi: Tata McGraw-Hill.

Doyle, J., & Chen, C. (2013). Patterns in stock market movements tested as random number generators. *European Journal of Operational Research*, *227*(1), 122–132.

Erb, C.B. & Harvey, C.R. (2006). The Strategic and Tactical Value of Commodity Futures. *Financial Analysts Journal,* Vol. 62, No. 2 (Mar. - Apr., 2006), pp. 69-97

Estrada, J. (2008). Fundamental Indexation and International Diversification. *Journal of Portfolio Management,* 34(3), 93-109.

Fama, E.F. (1970) Efficient capital markets: A review of theory and empirical work, *Journal of Finance*, 25 (5), 383-417.

Fama, E.F. (1991): Efficient capital markets: II, *Journal of Finance*, 46(5), 1575-1617.

Fama, E.F. & French, K.R. (1992): The cross section of expected stock returns, *Journal of Finance*, 47 (2), 427 – 464.

Hadassin, I. (1976). An investigation into the behaviour of earnings and share prices of South African listed companies. *Investment Analysts Journal*, *8*(1), 13–24.

Hsu, Jason (2006). Cap-Weighted Portfolios Are Sub-Optimal Portfolios. *Journal of Investment Management*, 4(3), 1 - 10.

http://www.google.co.za/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwiCu8-qvpLLAhXBog4KHcx7AQMQFggqMAA&url=http%3A%2F%2Fwww.ftse.com%2FAnalytics%2FFactSheets%2FHome%2FDownloadSingleIssue%3FissueName%3DJ203&usg=AFQjCNFy2BeejmJO3yNTxGaj0WjSkPH5WA.Accessed on: 25th February 2016.

http://www.google.co.za/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0ahUKEwjH27LPzJLLAhXFfRoKHdRBA3sQFgg7MAE&url=http%3A%2F%2Fwww.ftse.com%2FAnalytics%2FFactSheets%2FHome%2FDownloadSingleIssue%3FissueName%3DJ200&usg=AFQjCNHcf4PiMOFElWN3cpF_rK096iuFqQ.Accessed on: 25th February 2016.

https://www.jse.co.za/content/JSEBrochureItems/FTSE-JSE%20RAFI%2040%20Index%20Brochure.pdf. Accessed on: 25th February 2015.

Jacobs, B.I. & Levy, K.N. (1989): The complexity of the stock market, *Journal of Portfolio Management*, 16 (1), 19-27.

Jegadeesh, N. (1990) Evidence of Predictictable Behaviour of Security Returns. *Journal of Finance*, 45(3), 881-898

Keim, D.B. (1990): A new look at the effects of firm size and E/P ratio on stock returns, *Financial Analysts Journal*, 46(2), 56-67.

Kruger, R., Toerien, F. and MacDonald, I., 2012. Nonlinear serial dependence in share returns on the Johannesburg Stock Exchange. *The African Finance Journal*, *14*(2), pp.64-84.

Leedy, P.D. & Ormond, J.E. (2001): *Practical research: planning and design*, 7th Edition, Upper Saddle River: Merrill Prentice Hall.

Lintner, J. (1965): The valuation risk assets and the selection of risky investments in stock portfolios and capital budgets, *Review of Economics & statistics*, 47 (1), 13-37.

Mar, J., Bird, R., Casavecchia, L. & Yeung, D. (2009) Fundamental Indexation: An Australian Investigation. *Australian Journal of Management,* 34 (1), 1-20.

Markowitz, H. (1952). Portfolio selection, *The Journal of Finance,* 7. (1), 77-91.

Mayers, David. (1976). Nonmarketable Assets, Market Segregation, and the Level of Asset Prices. *Journal of Financial and Quantitative Analysis*, 11(1), 1- 12.

Moore, D.S. & McCabe, G.P. (2003): *Introduction to the practice of statistics*, 4th Edition, New York: W.H. Freeman and Company.

O'Connor, C. (2006). A fundamental change. *Pensions & Investments,* 34(19), 3-55.

Perold, A. (2007). Fundamentally Flawed Indexing. *Financial Analysts Journal,* 63(6), 31- 37.

Plaxco, L. M., & Arnott, R.D. (2002) .Rebalancing a Global Policy Benchmark. *Journal of Portfolio Management*, 28(2),9-22.

Reinganum,M.(1981) Misspecification of capital asset pricing: Emprical anomalies based on earnings yield and market values. *Journal of Financial Economics*, 9, 55-81.

Robertson, K. (2007). Passive aggressive. *401 (k) Advisor,* 14(9), 81-104

Roll, R. & Ross S.A. (1994) On the cross-sectional relation between expected returns and betas. *Journal of Finance*, 46(1), 101-21.

Roux, F. J. P.,& Gilbertson, B. P. (1976). *The behaviour of shares prices on the Johannesburg Stock Exchange*. (Report; no. F76/67). South Africa: Johannesburg Consolidated Investment Co., Ltd.

Savage, S. & DeGroot, J. (2006). A better way of indexing? *Kiplinger's Personal Finance,* 60(8), 60-60.

Schoenfeld, S., 2006. Are Alternatively Weighted Indexes Worth Their Weight?. *Northern Trust report, April*.

Sharpe, W.E.F. (1964): Capital asset prices: a theory of market equilibrium under conditions of risk, *Journal of Finance*, 19 (3), 425-442.

Sharpe, W.F., Alexander, G.J. & Bailey, J.V. (2003): *Investments*, Sixth Edition, New Delhi: Prentice-Hall, Inc.

Shepherd, S.(2007) Fundamental Indexing: a Better Way to Index? *Benefits Canada,* 31(12)

Siegel, J., 2006. The noisy market hypothesis. *Wall Street Journal*, *14*, p.A14.

Strebel, P. J. (1977). The limited efficiency of the Johannesburg Stock Exchange. *The Investment Analysts Journal*, *10*(1), 15–20.

Treynor, J. (2005)..Why Market – Valuation - Indifferent Indexing Works. *Financial Analysts Journal*, 61(5), 65 -69.

Voyles, B. (2006) New Kid in Town: the Fundamental Index. *On Wall Street,* 16(11), 24-24.

8 APPENDICES

APPENDIX I: Definition of Terms

Abnormal returns

Abnormal returns are above average returns and residuals. Abnormal returns are in excess of those predicted by the Single Index Model which represents the Capital Asset pricing Model (CAPM).

Active investing

Active investing is where an investor invests in a portfolio of risky assets to achieve a return that is above the benchmark by switching between

different asset classes. This strategy incurs more administrative and transactional costs when switching.

Alpha

Alpha is defined as the incremental gains (or losses) from active money management (Stauffer, 2006).

Analyst

Analyst is an investment professional with the skill to make recommendations of either “buying or selling” of a particular stock on the basis of fundamental and technical study.

Bear market

Bear market is when share prices keep a downward trend due to market selling pressure to exit to protect gains by investors or downward trend due to adverse economic or political factors.

Beta

Beta is defined as the returns derived from passive exposure to overall market risk (Stauffer, 2006).

Benchmark

Benchmark is defined as a reflection of current investment opinions (Schoenfeld, 2006).

Bull market

Bull market is when share prices keep an upward trend due to market buying pressure to enter share positions by investors to share in the

expected gains of certain shares due to general optimism or favourable economic or political factors.

Buy and hold

Buy and hold is considered a passive investment strategy with which an investor takes a position in a stock and does not exit for a prolonged period.

Capital Asset Pricing Model (CAPM)

Capital Asset Pricing Model (CAPM) is a share valuation model on the risk vs rewards basis argument where investors will demand extra returns for additional risk.

Capitalisation weighted index

Capitalisation weighted index is a rules based method of constructing a portfolio based on a market value weighting where the components are weighted according to the total market value of their outstanding shares.

Capitalisation indifferent index

Capitalisation indifferent index is a rules based method of constructing a portfolio based on other measures of company size (firm centric

measures) other than those based on market capitalisation, for example, revenues, sales, earnings, dividends and staff (Blitz & Swinkels, 2008).

Closed – end fund

The end fund or mutual fund is a fund traded on the market at market prices where the fund will not redeem shares at Net Asset Value (NAV).

Efficient market hypothesis

Efficient market hypothesis is the theory that share prices already have inbuilt all relevant market information on the share price thus it is impossible to beat the market.

Excess return

The excess return is the difference between actual rate of return on a risky asset and the risk free rate in any particular period.

Forward Price Earnings (P/E) ratio

The forward price earnings (P/E) ratio is the (P/E) ratio calculated on the basis of earning forecasts for the next four quarters.

Index

Index is defined as a benchmark of a portfolio of assets that represents an investable opportunity set (Estrada, 2008).

Indexation

Indexation is the selection of a portfolio of investments from constituents of a universe of investment opportunities based on the set out rules of the

portfolio criteria to manage to deliver on the objectives set out (Schoenfeld, 2006).

Jensen's measure

Jensen's measure is the abnormal rate of return on a security in excess of what would be predicted by the equilibrium model.

Market capitalisation

Market capitalisation is the total value of a company calculated by the share price multiplied by outstanding shares.

Market model

Market model is an index model depicting systematic and unsystematic risk of returns on a security over a given period of time versus the market index.

Outperformance

Outperformance is where the return is above the benchmark selected.

Passive investing

Passive investing is where an investor buys into a portfolio that is representative of the market without switching between asset classes in the short term.

Price earnings (P/E) ratio anomaly

Price earnings (P/E) ratio anomaly is the outperformance of below median price earnings (P/E) ratio securities portfolios over median price earnings (P/E) ratio securities portfolios.

Random walk model

Random walk model assumes that security prices change in random and as such they are unpredictable.

Rebalancing

Rebalancing is the changing of the relative proportion of holding of a share relative to the total holding. This may increase or decrease percentage of proportionate (weighted) holding or even the inclusion or exclusion altogether of a constituent (share).

Risk premium

Risk premium is the return above risk free asset returns which is a reward for taking commensurate risk.

Sharpe's measure

The Sharpe measure is the measure for risk adjusted performance calculated by subtracting the risk free rate from the rate of return for a

portfolio and by dividing the result by the standard deviation of portfolio returns.

FTSE JSE TOP 40 Index

FTSE JSE TOP 40 index is an index that measures the price index of the top 40 companies, ranked by market capitalisation, listed on the Johannesburg Stock Exchange in South Africa.

FTSE JSE RAFI 40 Index

FTSE JSE RAFI 40 index is an index that measures the price index of the top 40 companies, ranked by fundamentals, listed on the Johannesburg Stock Exchange in South Africa.

Survival bias

Survival bias is where companies are systematically excluded since they are inactive or ineligible to be included on an index thus upwards bias on the index which might lead to returns being overstated.

Systemic risk

Systemic risk is the market risk related to risks common across the entire market or economy.

Trailing price earnings (P/E) ratio

Trailing price earnings (P/E) ratio is the price earnings (P/E) ratio calculated using the latest accounting earnings of the company.

Transaction costs

Transaction costs are the costs incurred in the process of either acquiring exposure (investing) or divesting which may include brokerage fees, stock exchange levies, government taxes, and stamp duty which varies from stock exchange to stock exchange.

Treynor's measure

Treynor's measure is a ratio showing the volatility reward by measuring returns in excess what could be earned in a risk free investment per unit of market risk.

APPENDIX II: Test of Equality in Median

Test for Equality of Medians of TOP_40_B
Categorized by values of TOP_40 and RAFI_40
Date: 12/02/14 Time: 11:56
Sample (adjusted): 10/02/2007 12/31/2013
Included observations: 1629 after adjustments

Method	df	Value	Probability
Med. Chi-square	7	3033.583	0.0000
Adj. Med. Chi-square	7	2498.604	0.0000
Kruskal-Wallis	7	8.166621	0.3181
Kruskal-Wallis (tie-adj.)	7	8.166633	0.3181
van der Waerden	7	11.47702	0.1191

Category Statistics

RAFI_40	TOP_40	Count	Median	> Overall Median	Mean Rank	Mean Score
[-0.1, -0.05)	[-0.1, -0.05)	3	0.001212	2	655.8333	-0.292358
[-0.1, -0.05)	[-0.05, 0)	0	NA	NA	NA	NA
[-0.1, -0.05)	[0, 0.05)	0	NA	NA	NA	NA
[-0.1, -0.05)	[0.05, 0.1)	0	NA	NA	NA	NA
[-0.05, 0)	[-0.1, -0.05)	5	-0.003636	2	734.2000	-0.131845
[-0.05, 0)	[-0.05, 0)	705	0.001388	356	824.5270	0.020107
[-0.05, 0)	[0, 0.05)	45	0.000366	21	726.3889	-0.208453
[-0.05, 0)	[0.05, 0.1)	0	NA	NA	NA	NA
[0, 0.05)	[-0.1, -0.05)	0	NA	NA	NA	NA
[0, 0.05)	[-0.05, 0)	59	0.000957	28	834.8814	0.094715
[0, 0.05)	[0, 0.05)	800	0.000845	397	808.5081	-0.017572
[0, 0.05)	[0.05, 0.1)	5	0.000994	2	684.8000	-0.386029
[0.05, 0.1)	[-0.1, -0.05)	0	NA	NA	NA	NA
[0.05, 0.1)	[-0.05, 0)	0	NA	NA	NA	NA
[0.05, 0.1)	[0, 0.05)	0	NA	NA	NA	NA
[0.05, 0.1)	[0.05, 0.1)	7	0.023004	5	1218.429	1.020105
	All	1629	0.001037	813	815.0000	-5.93E-09

APPENDIX III: Sharpe, Treynor and Jensesn's Measures

		BETA		STANDARD DEVIATION		EXPECTED RETURN		SHARPE		TREYNOR		JENSEN	
Date	Rf	RAFI 40	TOP 40	RAFI 40	TOP 40	RAFI 40	TOP 40	RAFI 40	TOP 40	RAFI 40	TOP 40	RAFI 40	TOP 40
31-Oct-07	9.43	1.161	0.976	0.015	0.016	-0.018	-0.019	-1.182	-1.245	-0.016	-0.017	0.001	0.001
30-Nov-07	9.43	1.083	1.214	0.006	0.011	0.000	0.000	0.135	-0.121	0.001	-0.001	0.002	0.000
31-Dec-07	9.43	0.988	1.080	0.025	0.028	0.012	0.013	0.382	0.424	0.009	0.010	-0.001	0.000
31-Jan-08	9.52	1.006	1.166	0.031	0.034	0.053	0.058	1.608	1.691	0.049	0.052	-0.002	0.000
29-Feb-08	9.52	0.360	1.071	0.012	0.014	-0.001	-0.002	-0.001	-0.075	0.000	-0.001	0.002	0.002
31-Mar-08	9.52	0.857	0.931	0.018	0.011	0.002	0.001	0.340	0.089	0.003	0.001	0.006	0.000
30-Apr-08	9.52	0.695	1.100	0.005	0.010	0.011	0.020	2.008	1.930	0.018	0.018	0.001	0.001
30-May-08	9.52	2.125	0.986	0.001	0.001	-0.003	-0.001	-4.983	-5.910	-0.007	-0.008	-0.002	-0.002
30-Jun-08	9.89	0.279	1.172	0.007	0.010	-0.008	-0.013	-2.442	-1.477	-0.025	-0.015	-0.007	-0.001
31-Jul-08	9.89	1.080	1.099	0.024	0.031	-0.036	-0.045	-1.557	-1.574	-0.046	-0.047	-0.001	-0.002
29-Aug-08	9.89	-0.808	1.050	0.009	0.014	0.022	-0.031	-0.134	-2.533	0.002	-0.034	-0.022	-0.002
30-Sep-08	9.89	0.876	1.022	0.038	0.043	-0.021	-0.024	-0.502	-0.618	-0.019	-0.023	0.003	-0.001
31-Oct-08	9.96	0.643	1.106	0.003	0.001	0.043	0.019	2.112	3.921	0.001	0.002	-0.035	-0.013
28-Nov-08	9.96	0.404	1.215	0.024	0.033	-0.037	-0.051	-1.549	-1.626	-0.045	-0.047	0.001	-0.001
31-Dec-08	9.96	1.235	1.089	0.001	0.002	0.003	0.010	6.675	4.530	0.021	0.014	0.002	0.003
30-Jan-09	9.96	1.123	1.165	0.022	0.024	-0.032	-0.035	-1.467	-1.516	-0.032	-0.033	0.000	-0.001
27-Feb-09	9.96	1.137	0.856	0.018	0.018	-0.005	-0.005	-0.543	-0.286	-0.009	-0.005	-0.004	0.000
31-Mar-09	9.96	1.352	1.035	0.009	0.003	0.068	0.023	2.249	6.668	0.005	0.015	-0.047	-0.003
30-Apr-09	9.96	1.154	1.066	0.015	0.021	0.027	0.039	2.509	1.752	0.049	0.034	0.011	-0.001
29-May-09	9.96	1.348	1.053	0.016	0.009	0.055	0.033	2.506	3.814	0.024	0.037	-0.015	0.004
30-Jun-09	9.96	1.072	1.113	0.033	0.033	0.033	0.033	1.021	0.984	0.030	0.029	0.001	0.000
31-Jul-09	9.96	1.213	1.030	0.013	0.012	0.029	0.027	1.894	1.842	0.020	0.019	-0.003	-0.003
31-Aug-09	9.96	1.370	0.813	0.000	0.008	0.000	-0.007	-24.568	-0.739	-0.133	-0.004	-0.008	0.002
30-Sep-09	9.96	0.984	1.041	0.003	0.000	-0.970	0.056	-0.764	10.469	0.000	0.000	0.968	-0.053
30-Oct-09	9.96	0.347	1.061	0.003	0.000	-0.020	0.000	-3.992	-228.931	-0.006	-0.370	0.007	-0.010
30-Nov-09	10.06	0.774	0.996	0.006	0.008	0.012	0.015	1.846	1.765	0.014	0.014	0.001	0.000
31-Dec-09	10.06	0.207	1.510	0.001	0.002	0.009	0.018	7.870	4.366	0.007	0.004	0.000	-0.008
29-Jan-10	10.06	0.952	1.025	0.002	0.001	-0.008	-0.003	-4.126	-7.799	-0.008	-0.014	0.000	-0.004
26-Feb-10	10.06	1.568	1.003	0.008	0.007	0.013	0.011	1.211	1.422	0.007	0.009	-0.002	-0.001
31-Mar-10	10.06	1.460	0.153	0.005	0.007	0.007	0.011	1.415	1.352	0.009	0.009	0.000	0.000
30-Apr-10	10.43	1.146	1.108	0.003	0.002	-0.001	0.000	0.397	-1.168	0.001	-0.002	0.003	-0.001
31-May-10	10.43	0.760	1.355	0.007	0.007	0.007	0.008	0.798	0.985	0.005	0.006	-0.001	0.000
30-Jun-10	10.43	0.996	1.051	0.008	0.006	-0.016	-0.012	-1.024	-1.761	-0.005	-0.009	0.008	0.002
30-Jul-10	10.43	1.182	1.097	0.020	0.020	0.020	0.021	0.991	1.014	0.018	0.018	0.000	0.000
31-Aug-10	10.43	1.103	1.144	0.019	0.019	0.032	0.032	1.533	1.542	0.024	0.025	-0.002	-0.002
30-Sep-10	10.43	1.268	1.107	0.014	0.014	-0.007	-0.007	-0.578	-0.512	-0.008	-0.007	-0.001	0.000
29-Oct-10	10.43	1.221	1.099	0.000	0.001	-0.001	0.007	27.350	6.564	-0.025	0.006	0.009	0.000
30-Nov-10	10.43	1.406	1.188	0.025	0.025	0.019	0.019	0.712	0.746	0.016	0.017	-0.001	0.000
31-Dec-10	10.43	0.640	1.417	0.005	0.008	0.005	0.007	0.990	0.807	0.006	0.005	0.001	0.000
31-Jan-11	10.43	0.686	0.877	0.015	0.014	0.016	0.015	1.045	1.157	0.014	0.015	0.000	0.002
28-Feb-11	10.43	-2.532	1.243	0.006	0.012	-0.004	-0.007	-0.091	-0.654	-0.001	-0.008	0.004	0.000
31-Mar-11	10.43	1.398	0.676	0.004	0.006	0.005	0.006	1.188	0.720	0.007	0.004	0.001	-0.001
29-Apr-11	10.43	1.953	1.084	0.016	0.016	-0.017	-0.017	-1.085	-1.110	-0.016	-0.016	0.000	0.000
31-May-11	10.43	0.776	1.225	0.010	0.009	-0.008	-0.008	-0.860	-0.938	-0.008	-0.009	0.000	-0.001
30-Jun-11	10.43	-0.016	1.611	0.000	0.002	0.001	0.002	11.641	0.146	0.020	0.000	0.003	-0.001
29-Jul-11	10.43	0.990	1.105	0.006	0.007	0.001	0.002	-0.036	0.153	0.000	0.001	-0.001	0.000
31-Aug-11	10.43	1.176	1.108	0.013	0.013	0.003	0.003	0.183	0.148	0.002	0.002	0.000	0.000
30-Sep-11	10.43	1.100	1.155	0.006	0.007	0.008	0.009	1.155	1.173	0.006	0.006	0.000	0.000
31-Oct-11	10.54	1.047	1.128	0.003	0.003	-0.030	-0.027	-7.572	-8.635	-0.015	-0.017	0.008	0.005
30-Nov-11	10.54	0.953	1.589	0.030	0.031	-0.002	-0.002	-0.091	-0.095	-0.003	-0.003	0.000	0.000
30-Dec-11	10.54	1.136	1.189	0.019	0.020	0.026	0.028	1.337	1.356	0.023	0.024	0.000	0.000
31-Jan-12	10.54	1.041	1.290	0.004	0.005	0.011	0.013	2.307	2.187	0.009	0.008	-0.001	-0.002
29-Feb-12	10.54	1.845	0.978	0.000	0.002	0.000	0.000	1.985	-0.655	0.003	-0.001	0.001	-0.001
30-Mar-12	10.54	0.769	1.167	0.006	0.009	0.011	0.015	1.608	1.486	0.012	0.011	0.000	-0.001
30-Apr-12	10.54	0.390	1.127	0.004	0.001	0.005	0.002	0.031	2.509	0.000	0.003	-0.005	0.001
31-May-12	10.52	13.633	7.072	0.004	0.004	-0.001	-0.001	-0.710	-0.458	-0.003	-0.002	-0.001	0.000
29-Jun-12	10.52	1.131	1.111	0.013	0.012	-0.002	-0.002	-0.276	-0.258	-0.003	-0.003	-0.001	-0.001
31-Jul-12	10.52	1.105	1.149	0.018	0.020	0.014	0.016	0.800	0.754	0.014	0.013	0.000	0.000
31-Aug-12	10.52	1.007	1.076	0.002	0.001	-0.015	-0.005	0.542	1.834	0.000	0.000	0.017	0.007
28-Sep-12	10.52	1.276	1.346	0.009	0.010	0.017	0.019	1.790	1.764	0.013	0.013	-0.001	-0.001
31-Oct-12	10.52	2.941	0.710	0.003	0.005	0.004	0.007	1.568	1.336	0.006	0.005	0.001	0.000
30-Nov-12	10.52	17.565	1.574	0.004	0.006	-0.001	-0.002	-0.235	-0.455	-0.001	-0.002	0.001	0.000
31-Dec-12	10.52	1.189	1.223	0.019	0.020	0.023	0.024	1.195	1.191	0.020	0.020	0.000	0.000
31-Jan-13	10.52	0.984	0.833	0.002	0.002	0.004	0.003	0.553	1.443	0.001	0.002	-0.002	0.000
28-Feb-13	10.50	1.178	1.076	0.001	0.000	0.022	0.006	21.736	85.612	0.005	0.021	-0.010	0.005
28-Mar-13	10.50	1.041	1.043	0.003	0.003	0.004	0.004	0.619	0.997	0.002	0.004	-0.001	0.000
30-Apr-13	10.50	1.587	2.166	0.012	0.012	0.009	0.009	0.527	0.665	0.006	0.008	-0.002	-0.001
31-May-13	10.50	0.977	0.964	0.022	0.021	-0.029	-0.028	-1.245	-1.316	-0.024	-0.025	0.002	0.001
28-Jun-13	10.50	1.092	1.088	0.003	0.002	0.009	0.006	3.658	4.790	0.010	0.013	0.001	0.003
31-Jul-13	10.49	1.259	1.202	0.009	0.006	0.023	0.016	2.123	2.862	0.011	0.015	-0.005	0.001
30-Aug-13	10.49	0.713	1.062	0.013	0.014	0.013	0.014	0.873	0.891	0.010	0.010	-0.001	-0.001
30-Sep-13	10.49	1.625	0.726	0.003	0.004	-0.002	-0.002	-1.005	-0.581	-0.004	-0.002	-0.001	0.000
31-Oct-13	10.49	2.031	1.062	0.001	0.003	0.001	0.001	-1.027	0.452	-0.002	0.001	-0.001	0.001
29-Nov-13	10.49	1.237	1.117	0.004	0.003	-0.007	-0.006	-2.307	-2.479	-0.008	-0.009	-0.001	-0.001
31-Dec-13	10.37	0.896	1.044	0.004	0.003	0.008	0.007	1.589	2.349	0.005	0.007	-0.002	0.001

APPENDIX IV: Analysis of Variance (Anova Test)

Test for Equality of Means of TOP_40_B
Categorized by values of TOP_40 and RAFI_40
Date: 12/02/14 Time: 11:54
Sample (adjusted): 10/02/2007 12/31/2013
Included observations: 1629 after adjustments

Method	df	Value	Probability
Anova F-test	(7, 1621)	1.742908	0.0950

Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	7	0.002575	0.000368
Within	1621	0.342106	0.000211
Total	1628	0.344681	0.000212

Category Statistics

RAFI_40	TOP_40	Count	Mean	Std. Dev.	Std. Err. of Mean
[-0.1, -0.05)	[-0.1, -0.05)	3	-0.002496	0.007221	0.004169
[-0.1, -0.05)	[-0.05, 0)	0	NA	NA	NA
[-0.1, -0.05)	[0, 0.05)	0	NA	NA	NA
[-0.1, -0.05)	[0.05, 0.1)	0	NA	NA	NA
[-0.05, 0)	[-0.1, -0.05)	5	-0.000671	0.018174	0.008128
[-0.05, 0)	[-0.05, 0)	705	0.001121	0.015031	0.000566
[-0.05, 0)	[0, 0.05)	45	-0.001803	0.016191	0.002414
[-0.05, 0)	[0.05, 0.1)	0	NA	NA	NA
[0, 0.05)	[-0.1, -0.05)	0	NA	NA	NA
[0, 0.05)	[-0.05, 0)	59	0.002877	0.016392	0.002134
[0, 0.05)	[0, 0.05)	800	0.000581	0.013785	0.000487
[0, 0.05)	[0.05, 0.1)	5	-0.005490	0.016257	0.007270
[0.05, 0.1)	[-0.1, -0.05)	0	NA	NA	NA
[0.05, 0.1)	[-0.05, 0)	0	NA	NA	NA
[0.05, 0.1)	[0, 0.05)	0	NA	NA	NA
[0.05, 0.1)	[0.05, 0.1)	7	0.016252	0.016393	0.006196
	All	1629	0.000871	0.014551	0.000361

APPENDIX V: FTSE/JSE RAFI 40 Index: Top 10 Constituents

Rank	Security	Sector	FTSE/JSE RAFI 40 Index Weight (%)	FTSE/JSE Top 40 Index Weight (%)	Difference(%)
1	Anglo American	Mining	11.66%	17.87%	-6.21%
2	BHP Billiton	Mining	9.38%	15.17%	-5.79%
3	Anglo Platinum	Mining	4.76%	3.12%	1.65%
4	Sasol	Oil & Gas Producers	8.22%	6.71%	1.51%
5	SABMiller	Beverages	4.38%	4.88%	-0.50%
6	Compagnie Financiere Richemont AG	Personal Goods	3.73%	6.31%	-2.58%
7	MTN Group	Mobile Telecommunications	2.48%	6.12%	-3.64%
8	Impala Platinum Hlds	Mining	4.53%	5.52%	-1.00%
9	Standard Bank Group	Banks	4.06%	3.60%	0.46%
10	Old Mutual	Life Insurance	5.46%	2.85%	2.61%
		Total	58.67%	72.16%	-13.49%

Source: Johannesburg Stock Exchange website

APPENDIX VI: FTSE/JSE RAFI 40 Index: Portfolio Characteristics

Attribute	Value
Number of Constituents*	43
Net Market Cap (ZARmn)	712,517
Company Size (AdjustedZARmn)	
Average	16,570
Largest	83,078
Smallest	706
Median	11,102
Weight Largest Company (%)	11.66%
Top 10 Holdings (% Net Market Cap Share)	58.67%

Source: Johannesburg Stock Exchange website

APPENDIX VII: FTSE/JSE Top 40 Index Constituents

Constituent	ICB Sector	Net MCap (ZARm)	Wgt %
SABMiller	Beverages	924,017	13.69
Naspers	Media	856,419	12.69
Compagnie Financiere Richemont AG	Personal Goods	515,753	7.64
BHP Billiton	Mining	321,880	4.77
British American Tobacco PLC	Tobacco	265,634	3.94
MTN Group	Mobile Telecommunications	244,946	3.63
Sasol	Chemicals	231,056	3.42
Steinhoff International Holdings N.V.	Household Goods & Home Construction	194,402	2.88
Old Mutual	Life Insurance/Assurance	181,875	2.69
Firstrand Limited	Banks	135,561	2.01
Totals		**3,871,542**	**57.35**

Source: Johannesburg Stock Exchange website

APPENDIX VIII: FTSE/JSE Top 40 Index Constituents: Portfolio Characteristics

Attributes	FTSE/JSE All-Share
Number of constituents	164
Net MCap (ZARm)	6,750,321
Dividend Yield %	3.25
Constituent Sizes (Net MCap ZARm)	
Average	41,160
Largest	924,017
Smallest	381
Median	8,218
Weight of Largest Constituent (%)	13.69
Top 10 Holdings (% Index MCap)	57.35

Source: Johannesburg Stock Exchange website

APPENDIX IX: FTSE/JSE All Share Index Constituents

Constituent	ICB Sector	Net MCap (ZARm)	Wgt %
SABMiller	Beverages	924,017	16.24
Naspers	Media	856,419	15.05
Compagnie Financiere Richemont AG	Personal Goods	515,753	9.07
BHP Billiton	Mining	321,880	5.66
British American Tobacco PLC	Tobacco	265,634	4.67
MTN Group	Mobile Telecommunications	244,946	4.31
Sasol	Chemicals	231,056	4.06
Steinhoff International Holdings N.V.	Household Goods & Home Construction	194,402	3.42
Old Mutual	Life Insurance/Assurance	181,875	3.20
Firstrand Limited	Banks	135,561	2.38
Totals		**3,871,542**	**68.05**

Source: Johannesburg Stock Exchange website

APPENDIX X: FTSE/JSE All Share Index Constituents: Portfolio Characteristics

Attributes	FTSE/JSE Top 40
Number of constituents	43
Net MCap (ZARm)	5,688,953
Dividend Yield %	3.25
Constituent Sizes (Net MCap ZARm)	
Average	132,301
Largest	924,017
Smallest	10,726
Median	58,989
Weight of Largest Constituent (%)	16.24
Top 10 Holdings (% Index MCap)	68.05

Source: Johannesburg Stock Exchange website