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# The application of fundamental indexing to the South African equity market for the period 1996 to 2009

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## ABSTRACT

Over the years the norm in the investment industry has been to use market capitalization-weighted indices as benchmarks to measure investment performance. However, market capitalization-weighted indices, such as the FTSE/JSE All Share Index (ALSI), create a natural return drag because of the overweighting of overvalued stocks and vice versa.

On the other hand, fundamental indexing weights stocks based on their economic footprint in the market rather than their market capitalization. The fundamental indexing approach uses four metrics, namely sales, book values, dividends and cash flows to calculate this footprint.

The fundamental index concept delivered very good results when applied to the South African stock market. The South African Fundamental Index outperformed the ALSI by 4,7% p.a. during the period 1996 to 2009. This return was achieved with a risk profile similar to that of the ALSI. This index also had similar turnover rates relative to the ALSI.

## 1. INTRODUCTION

Benchmarking is a global phenomenon that is specifically designed to look at the problem of how to define whether an investment was successful or not. All the big equity exchanges have created a variety of indices that form the basis for measuring portfolio performance.

The cap-weighted method of calculating indices is the most widely used. As a result, the cap-weighted method has been regarded as the norm and until recently has been unchallenged in the investment world. The S&P 500 (New York), the FTSE (London), the DAX (Frankfurt) and the CAC (Paris) are some of the major indices that are based on this method.

The rationale behind the use of a cap-weighted method for calculating indices is backed by theory created by William Sharpe (1964). His Capital Asset Pricing Model (CAPM) assumes that a cap-weighted index will be efficient. Empirical results have actually shown that this is not the case and that overvalued stocks are over-weighted in cap-weighted indices while undervalued stocks have a disproportionately low weight in these indices (Hsu and Campollo, 2006).

Arnott, Hsu and Moore (2005) designed a new and revolutionary method for calculating an index. This method is called fundamental indexation and it tries to eliminate most of the weaknesses of the traditional cap-weighted model. They tested this method in the U.S. market with encouraging results. Fundamental indices outperformed the S&P 500 by about 2,0% per year. These results are for the period 1962-2004 and exclude transaction costs. Another critical result that this study provided is that the risk (beta) in respect of

the average cap-weighted indices was higher than in the case of the fundamental indices (Arnott *et al.*, 2005). Hsu and Campollo (2006) reproduced these studies for a twenty-year period (1984-2004) and applied it to 23 different countries (excluding South Africa). They then compared their results with MSCI cap-weighted indices. On average, the fundamental indices outperformed the MSCI indices by 3,5% per year. The average volatility of the fundamental indices was less than the volatility of the MSCI indices. Hsu and Campollo's (2006) results are presented in Table 1.

Fundamental indexing tries to counter the shortcomings of the cap-weighted method. Hsu (2004) commented that the problem with normal indexing is the inability of stock prices to represent their fundamentals. In creating the fundamental index company weights are determined initially using six crucial fundamentals rather than market capitalisation.

These six fundamentals are book value, cash flow, revenue, sales, dividends and total employment. In calculating cash flows and revenue, a trailing five-year average is used, and in calculating sales and dividends, trailing five-year gross values are used. Total employment is excluded from the calculations because of the immense difficulty in obtaining accurate data with regard to this specific fundamental. Revenue is also excluded due to the similarity between revenue and sales. In using the fundamental indexing method, separate indices are calculated for the crucial fundamentals excluding employment and revenue. The Fundamental Composite Index therefore consists of an equally weighted combination of cash flows, sales, book values and dividends. This composite index value is the so-called fundamental index value and is the value that is compared to its cap-weighted counterpart. The cap-weighted counterpart in this study is the ALSI.

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**Table 1: Annualised returns: Fundamental vs. MSCI Indices**

Country	Fundamental index	MSCI benchmark	Value added
World	12,36%	8,81%	3,55%
Australia	14,53	11,64	2,89
Austria	16,67	11,07	5,60
Belgium	14,25	12,76	1,49
Canada	14,15	10,39	3,76
Denmark	15,94	14,40	1,54
Finland	16,41	14,83	1,59
France	14,39	11,93	2,45
Germany	12,22	9,90	2,33
Greece	19,32	16,08	3,24
Hong Kong	15,69	13,74	1,95
Ireland	17,18	8,40	8,78
Italy	13,14	10,08	3,06
Japan	2,35	-1,32	3,67
Netherlands	13,49	11,45	2,04
New Zealand	8,07	7,43	0,64
Norway	15,51	10,87	4,64
Portugal	12,63	10,34	2,29
Singapore	8,93	5,76	3,17
Spain	15,90	12,40	3,50
Sweden	16,45	14,25	2,20
Switzerland	13,05	12,53	0,52
UK	12,96	10,21	2,76
US	14,74	12,36	2,39

Source: Adapted from Hsu and Campollo (2006).

One of the main characteristics of the fundamental index is that it tries to retain all the advantages the cap-weighted indices have to offer. This includes liquidity, passiveness and easy access to a wide variety of stocks.

The fundamental index, like most other financial indices, also has hurdles that it has to overcome. Rebalancing of the portfolio in a timely and efficient manner without incurring large transaction costs is possibly the biggest problem. Cap-weighted portfolios rebalance automatically except when a new stock forms part of the securities in the index and subsequently an old stock does not qualify for the index anymore. The fundamental index does not automatically rebalance and has to be observed continuously for rebalancing purposes.

As a result of the excellent results reflected in Table 1, this research will focus on the application of the fundamental indexation technique to the South African equity market. In addition the performance of the fundamental index will be compared with the ALSI on two bases: including and excluding dividends. Most international studies exclude dividends.

The rest of the paper is structured as follows: Section 2 briefly discusses previous studies on the weaknesses of market cap-weighted indices and the application of the fundamental indexing technique internationally. The data used in the study and the methodology applied in the study are discussed in Section 3. The key findings of the study are presented in Section 4, whereas conclusions are given in Section 5.

## 2. LITERATURE REVIEW

Chan, Karceski and Lakonishok (1998) found that fundamental factors explain risk premiums in returns better than macro-economic factors did. The fundamental factors they used were cash-flow-to-price ratios, book-to-market ratios, size and dividend yields. They conclude that fundamental strategies for choosing stocks are best.

Hsu (2004) showed mathematically that if markets are noisy, capitalisation-weighted indices are suboptimal. He found that portfolios based on fundamentals outperformed portfolios based on capital-weighted indices. Arnott (2005) states that capitalisation-weighted indices create a return drag because they overweight stocks which trade above their fundamental value and underweight stocks which trade below their fundamental value.

Arnott (2006) uses the technology bubble of the late 1990s to show that capitalisation-weighted indices are at fault. Technology stock prices increased based on predictions and expectations, and not because of fundamentals. This reiterates the point that noise trading influences market movements away from fundamentals.

There are index-specific problems with market-capitalisation indices. Denis, McConnell, Ovtchinnikov and Yu (2003) did research on how shares are affected by inclusion in an index. They specifically looked at how a share's price reacted after that share was included in the S&P 500 Index. The results showed that including a share in the S&P 500 Index resulted in it having higher earnings per share forecasts relative to non-benchmark companies and a subsequent improvement in realized earnings. The reason for this is that index companies are analysed more than non-index shares. Inclusion in the S&P 500 is therefore not an information-free event. Chen, Noronha and Singal (2006) showed that even though market indices are seen as passive, the index loses money when it is reconstituted. The Russell 2000 lost about 130 basis points per year because of the resulting transaction costs of reconstituting alone.

Arnott and West (2006) did further research on fundamental indices. They found that fundamental indices' relative returns were higher in international markets and in the case of small company indices. The

small composite fundamental index outperformed the Russell 2000 by 3,6% per year from 1979 to 2006. Estrada (2006) specifically looked at a fundamental index based only on the dividend measure. It was found that the Fundamental Dividend Index outperformed the Capitalisation Index by 1,9% per year. This research was done from 1974 to 2005 in 16 different countries.

These results demonstrate that over a long period of time the fundamental index concept clearly adds value relative to market capitalisation indices. However it has not been received well in all quarters of the investment community. The concept that the market is full of noise trading and that it does not represent the underlying fundamentals of shares is controversial.

Perold (2007) argues that holding a market capitalisation index does not change the probability that a share is overvalued or undervalued. He states that market capitalisation indices do not impose performance drags on shares. Fama and French (2007) suggest that fundamental indexing is a triumph of marketing. They state that it is only a new way of marketing value investing and no new idea.

### 3. DATA AND METHODOLOGY

#### 3.1 Data

To create a fundamental index that represents the South African stock market a composite database was established which combines the best attributes of four different databases, each with its own advantages and disadvantages. The following four databases were used: the Datastream database from the University of Cape Town, I-Net Bridge, McGregor BFA and Reuters. The published annual financial statements of a representative sample of companies were compared with the financial values contained in the four different databases in order to decide which database should be used for each of the data items.

##### 3.1.1 Survivorship bias

McGregor and I-Net Bridge account for survivorship bias. The data of all previously delisted companies was obtained from I-Net Bridge as well as McGregor. McGregor contained delisted company data not available on I-Net Bridge.

##### 3.1.2 Book values

Book values for the specified companies were basically identical in the four databases after some adjustments. For book values the databases were used in the following order: Datastream followed by I-Net Bridge, McGregor and Reuters. Should a company's data therefore not appear in the Datastream or I-Net Bridge database, which was often

the case for some delisted companies, McGregor was used. In very few instances Reuters was used.

##### 3.1.3 Dividends

Dividends are best described by the Datastream database because of its monthly rebalancing system. This system shows in exactly which month interim as well as final dividends are paid. This eliminates look-ahead bias.

Datastream values were therefore used where possible. The order in which the databases were used was the same as in the case of book values. The only problem with the above-mentioned order is that the companies not included in the Datastream database were not free of look-ahead bias. Therefore, because all the data of delisted companies were either obtained from McGregor or from I-Net Bridge, all the delisted companies' data suffers from look-ahead bias. Delisted companies on average form a fairly small part of the market and are therefore not seen as a big problem.

##### 3.1.4 Sales

Sales was a difficult value to standardise. It was found that the values in the Datastream, I-Net Bridge and McGregor databases were basically equal in terms of the values pertaining to the resources and industrial sectors. However, for the financial sector only McGregor data was used. The reason for this is that resources and industrial companies sell physical products and the number of products sold can be quantified. On the other side of the spectrum financial companies do not sell physical products. Financial companies generate turnover or sales from a range of sources. This range of sources necessitated the creation of a standardised definition of sales for financial institutions. The McGregor database provides a detailed breakdown of the income statement for each company. A definition for the sales of financial companies was created using a composition of different income statement items. Resources and industrial databases were therefore used in the same order as dividends and book values. However, for financial companies only the McGregor database was used.

##### 3.1.5 Cash flow

Cash flow values were obtained from the McGregor income statement values. One of the most commonly used values in the definition of a company's cash flow is *net cash flow before operating income*. This value is obtained from a company's cash flow statement. The databases used in this study were inconsistent and incomplete in terms of their cash flow statements. Due to these inconsistencies it was decided to create a standardised definition of the cash flows of each company by also using the income statement values in the financial companies' sales scenarios.

### 3.2 Methodology

The methodology employed in this article is based on that used by Arnott *et al.* (2005) in creating the Research Affiliates Fundamental Index (RAFI). The FTSE/JSE RAFI is based on the following formula:

$$\sum_{i=1}^n \frac{(p_i s_i f_i c_i)}{d} \quad \dots (1)$$

where

- $p_i$  = the latest trade price of security  $i$
- $s_i$  = number of shares in issue used by FTSE/JSE for security  $i$
- $f_i$  = free float factor as published by FTSE/JSE, expressed as a number between 0 and 1, where 1 represents a 100% free float.
- $d$  = divisor, a figure that represents the total issued share capital of the index at the base date.
- $c_i$  = RAFI adjustment factor
- $n$  = number of securities in the index

The value  $c_i$  is calculated by dividing a company's fundamental value  $r_i$  by its free float adjusted market capitalisation. Therefore:

$$c_i = \frac{r_i}{p_i s_i f_i} \quad \dots (2)$$

Even though formula (1) could therefore be simplified, it was decided to construct it in the same way as the normal FTSE/JSE cap-weighted index calculation times the  $c_i$  factor. This allows for a consistent index not influenced by rights issues, stock splits and companies being deleted from or added to the index.

Calculating the value of  $r_i$  the following six-step process therefore has to be followed:

- Choose an appropriate index universe – the ALSI in this case.
- Calculate each stock's percentage representation of the universe using only sales values.
- Calculate each stock's percentage representation of the universe using only cash flow values.
- Calculate each stock's percentage representation of the universe using only book values.
- Calculate each stock's percentage representation of the universe using only dividend values.

- A company's RAFI fundamental value is defined as the average of the four percentage values. Where a company pays a zero dividend the RAFI fundamental value is the average of the three remaining percentage values.

The fundamental index thus created is rebalanced annually on 31 December. December has been chosen because of the simplicity to compare companies at the end of the year.

The constituents of the fundamental index used in this study are the same as the constituents of the comparable benchmark, namely the ALSI.

Using the ALSI constituents rather than calculating new constituents created an advantage in terms of the calculation of the divisor. The methodology was created in such a way that the calculation of the divisor for a RAFI and cap-weighted ALSI would be the same.

Although the JSE changed the methodology of index calculation on 24 June 2002 from the JSE Actuaries Index Series to the FTSE/JSE Index Series, it recalculated the new index back to July 1995. In order to have a consistent index for the measurement of the fundamental index it was decided that the period of investigation would start on 1 January 1996. The JSE Indices Department supplied the recalculated index values dating back to 1995. These recalculated index values were used to select the universe of stocks for the fundamental index. The database containing the recalculated ALSI data included all the listed companies per period as well as their free float factors. The period of investigation ends on 31 December 2009.

Because dividends can have a material impact when comparing indices, it was decided to construct indices which include dividend income in addition to price-only indices. In the case of the market cap-weighted index the ALSI Total Return Index data was used. Because dividend data was needed for the creation of one of the fundamental factors, it was readily available for the construction of a Total Return Fundamental Index.

The methodology presented by Arnott *et al.* (2005) was also used to create four separate fundamental indices where the weighting percentage of each fundamental factor is 100%. These were referred to as the Fundamental Sales Index, the Fundamental Cash Flow Index, the Fundamental Book Value Index and the Fundamental Dividend Index. A separate index was therefore created for each of the four fundamental factors where the weight of a company in the specific index would be directly related to the percentage that the company represents of the economic market represented by the specific fundamental factor.

4 RESULTS

4.1 RAFI composite price index

Figure 1 plots the RAFI Composite Price Index against the ALSI from 1996 to 2009. The figure clearly shows that the RAFI Composite Price Index consistently added alpha in terms of the ALSI. The figure was plotted in such a way that both indices had the same starting value on 1 January 1996. The ALSI increased from 5598,73 on 1 January 1996 to 27666,45 at the end of 2009, whereas the RAFI Composite Price Index increased to a value of 49161,86. Over this period, the ALSI had a total return of 394,2% compared to the

RAFI Composite Price Index which had a total return of 778,1%.

Figure 2 shows the breakdown of annual returns for both indices. The RAFI Composite Price Index outperformed the ALSI in 12 of the 14 years with the only underperforming years being 1997 and 1998. Table 2 shows the underperformance to be 1,5% in 1997 and 1,2% in 1998. Underperformance in the period 1997 to 1998 was consistent with results obtained from the USA market. The technology bubble created markets during that period where stocks were priced purely on growth prospects rather than on fundamental values.

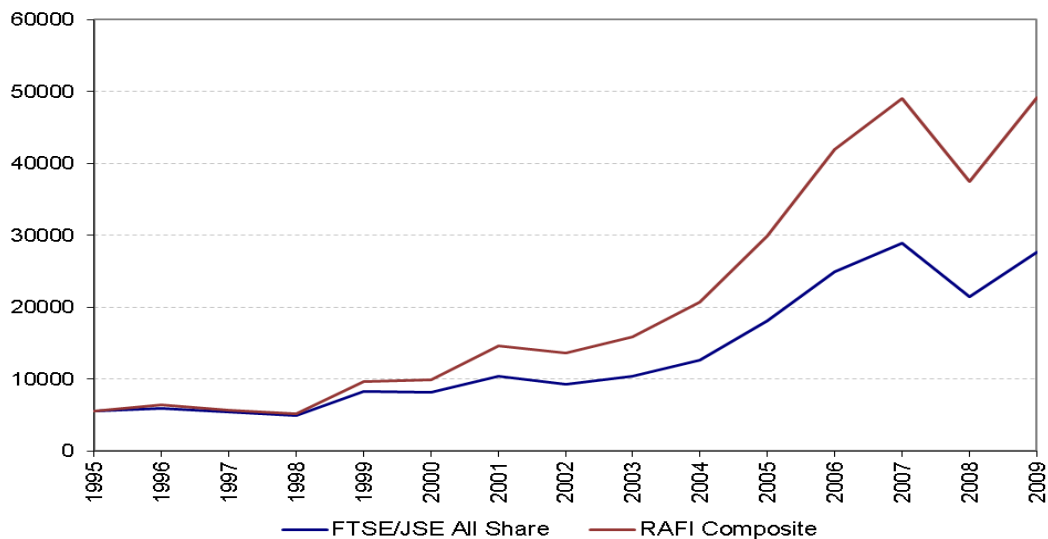


Figure 1: South African RAFI Composite Price Index compared to the FTSE/JSE All Share Index

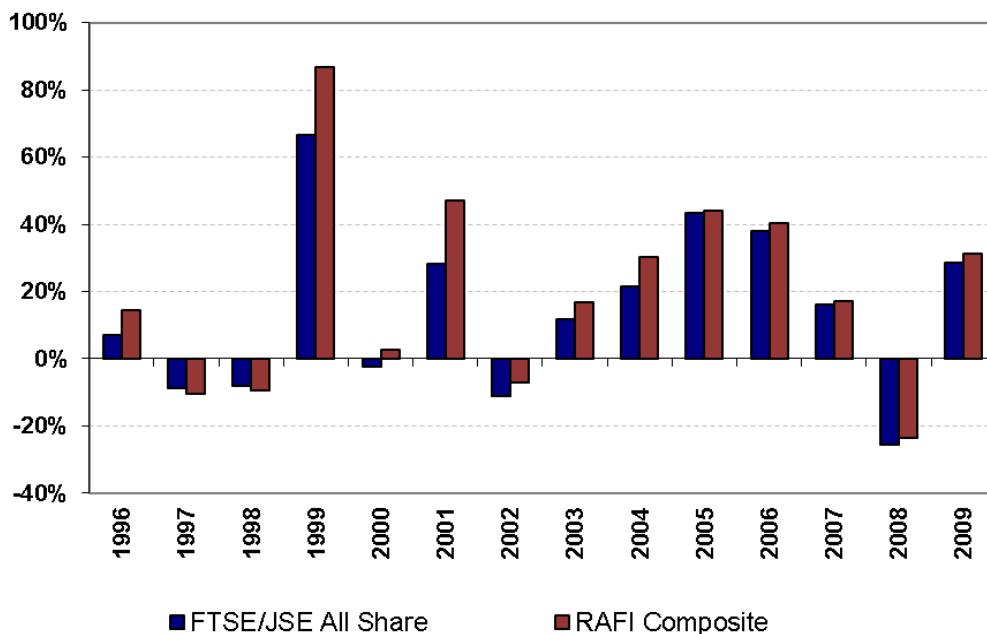


Figure 2: Annual returns of the RAFI Composite Price Index compared to the FTSE/JSE All Share Index

**Table 2: Annual returns RAFI Composite Index versus FTSE/JSE All Share Index (%)**

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
<b>FTSE/JSE All Share</b>														
Return per year	7,09	-8,84	-8,23	66,62	-2,31	28,08	-11,28	11,89	21,49	43,35	37,91	16,15	-25,72	28,63
Compound yearly return since 1995	7,09	-1,20	-3,60	10,53	7,84	10,97	7,48	8,02	9,44	12,44	14,54	14,68	10,91	12,09
<b>RAFI Composite</b>														
Return per year	14,55	-10,35	-9,42	86,90	2,51	47,17	-7,18	16,88	30,35	44,12	40,22	16,97	-23,64	31,15
Compound yearly return since 1995	14,55	1,34	-2,38	14,83	12,25	17,43	13,55	13,96	15,68	18,25	20,10	19,83	15,75	16,79
Excess yearly return	7,46	-1,51	-1,19	20,28	4,82	19,10	4,09	4,98	8,87	0,77	2,31	0,82	2,09	2,53
Excess compound return	7,46	2,53	1,22	4,29	4,41	6,46	6,07	5,94	6,24	5,81	5,55	5,16	4,84	4,70

Even though the RAFI Composite Price Index underperformed in certain years, it always had positive excess compound returns. This means that if investors invested R1 in the RAFI Composite Index at the beginning of 1996 they would always have had more money compared to an initial investment of R1 in the ALSI.

The RAFI Composite outperformed the ALSI by 4,7% on a compound yearly basis for the 14-year period over which the study was conducted.

#### 4.2 RAFI composite total return index

The results of the performance of the RAFI Composite Total Return Index compared to its benchmark, the ALSI Total Return Index, are summarized in Figures 3 and 4.

The ALSI Total Return Index delivered a total return of 632,16% for the period from 1996 to 2009. The RAFI Composite Total Return Index delivered 1109,49%.

This is equal to a return of 15,25% compounded annually for the ALSI Total Return index and 19,49% p.a. for the RAFI Composite Total Return Index. This is an outperformance of 4,2% compounded annually over the 14 year period.

The RAFI Composite Total Return Index outperformed the ALSI Total Return Index in 10 of the 14 years with the only underperforming years being 1997, 1998, 2005 and 2007. This is similar to the yearly performance figures of the price indices. Table 3 shows the underperformance to be 2,1% in 1997, 0,9% in 1998, 0,1% in 2005 and 1,1% in 2007.

#### 4.3 Single factor fundamental indices

The sales, dividend, book value and cash flow metrics were used to form their own fundamental indices. The results can be seen in Figure 5. These fundamental indices are only compared on a total return basis.

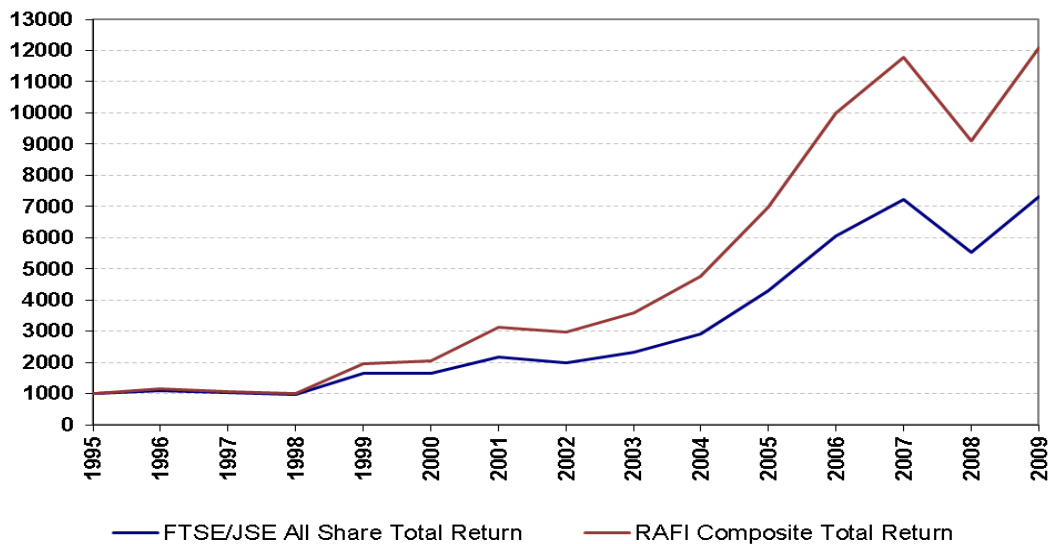


Figure 3: South African Fundamental Total Return Index compared to the FTSE/JSE All Share Total Return Index

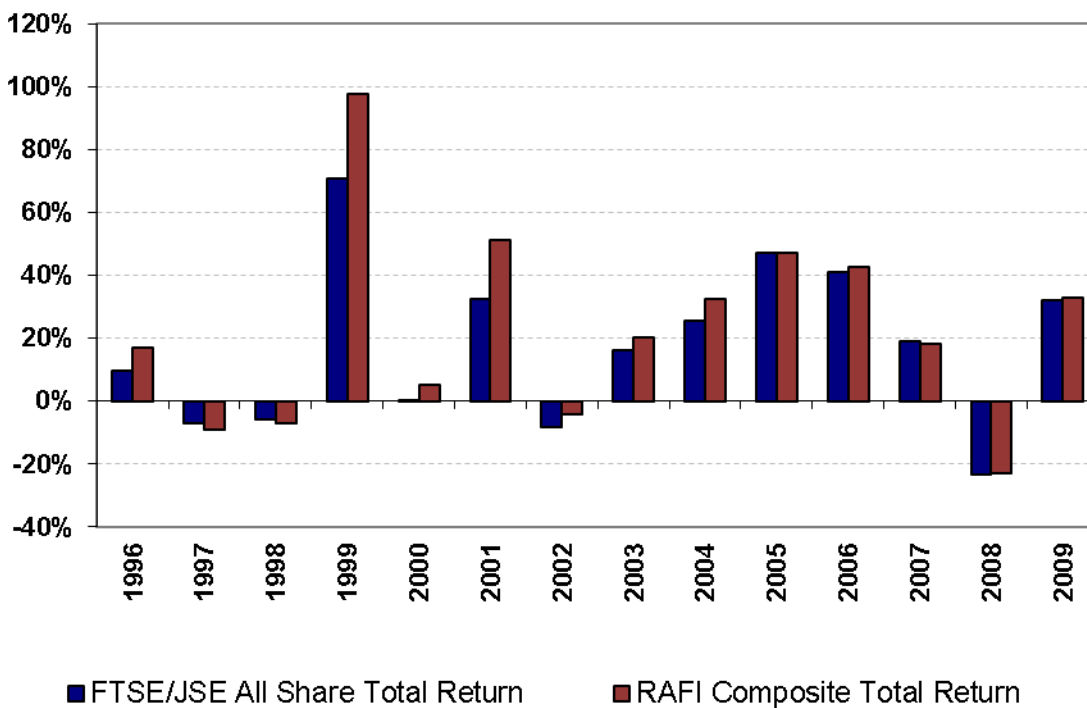
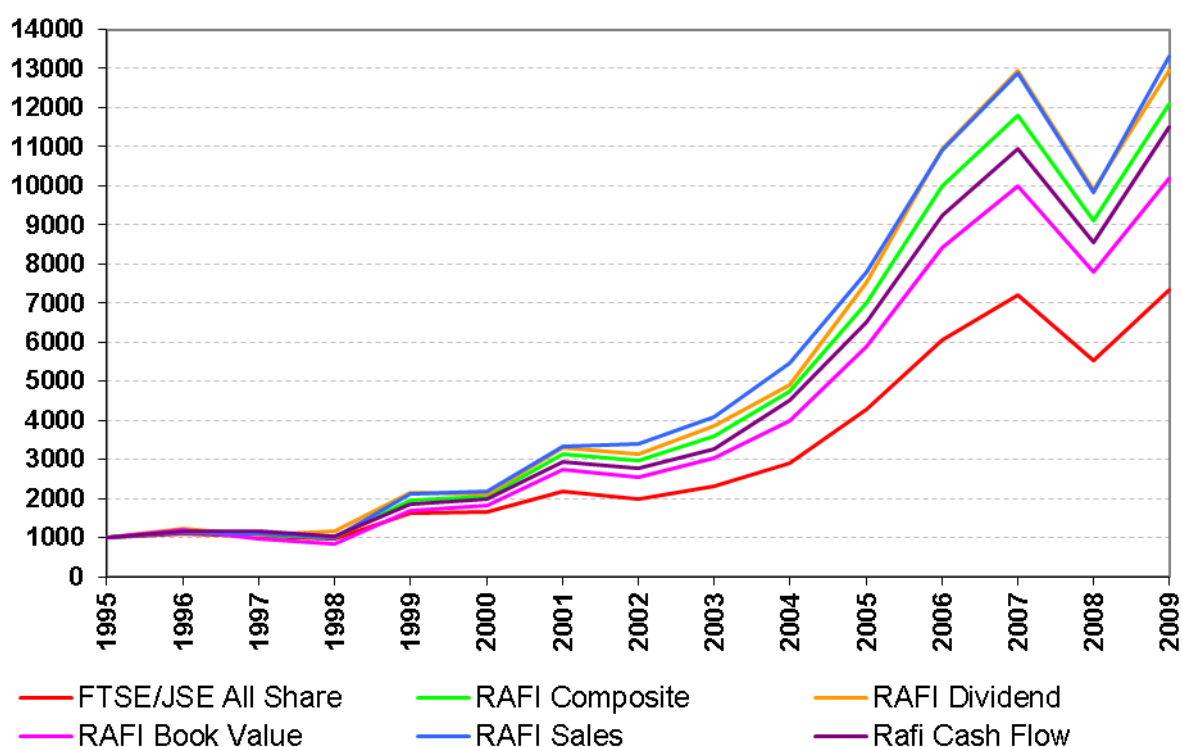


Figure 4: Annual returns of the RAFI Composite Total Return Index compared to the FTSE/JSE All Share Total Return Index

**Table 3: Annual returns RAFI Composite Total Return Index versus FTSE/JSE All Share Total Return Index (%)**

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
<b>FTSE/JSE All Share</b>														
Return per year	9,53	-6,91	-5,91	70,82	0,35	32,61	-8,31	16,08	25,44	47,25	41,23	19,19	-23,23	32,13
Compound yearly return since 1995	9,53	0,98	-1,37	13,14	10,46	13,88	10,41	11,10	12,61	15,67	17,79	17,91	14,08	15,28
<b>RAFI Composite</b>														
Return per year	17,20	-9,00	-6,85	97,81	5,01	51,13	-4,36	20,11	32,68	47,14	42,74	18,12	-22,83	32,92
Compound yearly return since 1995	17,20	3,27	-0,22	18,40	15,59	20,87	16,90	17,29	18,91	21,47	23,27	22,83	18,51	19,49
Excess yearly return	7,67	-2,09	-0,94	26,99	4,65	18,52	3,94	4,02	7,24	-0,11	1,51	-1,07	0,40	0,79
Excess compound return	7,67	2,30	1,15	5,26	5,13	7,00	6,49	6,19	6,30	5,80	5,48	4,92	4,44	4,21



**Figure 5: South African Fundamental Total Return Indices compared to the FTSE/JSE All Share Total Return Index**

It can clearly be seen that all four fundamental indices outperformed the ALSI Total Return Index for the 14-year period from 1996 to 2009. The Sales Index outperformed by the biggest margin followed by the Dividend Index, Composite Index, Cash Flow Index and Book Value Index. Only the Sales Index and the Dividend Index outperformed the RAFI Composite Index.

One of the biggest criticisms of the RAFI Index is that it is only a value index in disguise (Fama and French,

2007). Arnott (2006) counters this argument by stating that fundamental indices are only value-biased relative to cap-weighted indices if cap-weighted indices are overweight large growth stocks. Arnott also stated that the Russell 1000 Value Index outperformed the Russell 1000 Index by 1% p.a. since inception in 1979 whereas the FTSE RAFI 1000 Index outperformed the Russell 1000 by 2,3% p.a. over the same measurement period.

The results obtained from analysing the four fundamental indices rebutt the criticism regarding the value bias of fundamental indices. This is due to the fact that value shares are most commonly referred to as the shares with the lowest price-to-book value. In this research the RAFI Composite Index outperformed the Book Value Index by some margin. A portfolio based only on book values would therefore have underperformed the RAFI Composite Index from 1996 to 2009.

The specific annual performance as well as the compound annual performance is shown in Table 4.

The Sales Index was the top-performing index over the period delivering an excellent return of 20,3% compounded. This was an outperformance of 5% p.a. relative to the ALSI Total Return Index. The second-best performing index was the Dividend Index, which delivered a return of 20,1% annually and outperformed the ALSI Total Return Index by 4,8% p.a. The Cash Flow Index delivered 19,1% p.a. and the Book Value Index performed worst with an annual return of 18% p.a., which still outperformed the ALSI Total Return Index by a significant margin of 2,7% p.a.

The Book Value Index was the only index which had periods where the cumulative compound excess return was negative. The Book Value Index's negative excess returns occurred in 1997 and 1998.

The over- and underperformance of all the indices in different time periods are a clear indication of the positive impact created by the diversification aspects of using four fundamental factors rather than one fundamental factor. Using four metrics lowers the risk by covering all aspects of the earnings cycle.

#### 4.4 Risk-adjusted measures

Table 5 shows all the performance measures that were applied to the fundamental indices. The risk-free rate used in all the performance measurement calculations in this study, where needed, is the monthly bankers' acceptance rate at the end of each year.

The p-values for the CAPM alphas of the different indices are also shown in Table 5 with only the p-value

of the Dividend Index being below the confidence level of 5%. The other p-values are relatively low with the p-value of the Book Value Index being the highest.

Table 5 shows that the different performance measures for this research deliver relatively consistent results. Based on the Sharpe Ratio, Sortino Ratio, Treynor Ratio, Kappa and Omega Ratios, the worst performing index is always the benchmark index and the best performing index is always represented by the Sales Index or the Dividend Index.

#### 4.5 Turnover

The turnover of both the RAFI Composite and the ALSI indices was determined by calculating which percentage of each year's holdings has to be replaced with new holdings, allowing for the weights of the holdings in the respective indices. The turnover analysis in Table 6 shows that the RAFI Composite on average had a turnover of 16,3% in respect of its portfolio holdings whereas the ALSI on average had to change 15,8% of its holdings per year. As would be expected, the RAFI had higher turnover rates in most years relative to the ALSI. Since the year 2000 the turnover rates on RAFI and the ALSI have been fairly similar.

When investing in a passive investment strategy transaction costs are important. The RAFI Composite would have required transaction costs similar to the ALSI during this period.

#### 4.6 Concentration

Table 7 shows the weighting of the Top 3, Top 5 and Top 10 shares in the RAFI Composite Index as well as the ALSI. It can be seen that the Top 3, Top 5 and Top 10 shares' weightings in the RAFI Composite Index have been considerably lower than the comparable weightings in the ALSI for the whole measurement period. In particular, the RAFI Composite Index has especially been less concentrated than the ALSI since 2000. This feature results in more stable returns in the case of the RAFI Composite Index.

**Table 4: Annual returns RAFI Composite Total Return Index and single factor total return fundamental indices versus FTSE/JSE All Share Total Return Index (%)**

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
<b>FTSE/JSE All Share</b>														
Return per year	9,53	-6,91	-5,91	70,82	0,35	32,61	-8,31	16,08	25,44	47,25	41,23	19,19	-23,23	32,13
Compound yearly return since 1995	9,53	0,98	-1,37	13,14	10,46	13,88	10,41	11,10	12,61	15,67	17,79	17,91	14,08	15,28
<b>RAFI Composite</b>														
Return per year	17,20	-9,00	-6,85	97,81	5,01	51,13	-4,36	20,11	32,68	47,14	42,74	18,12	-22,83	32,92
Compound yearly return since 1995	17,20	3,27	-0,22	18,40	15,59	20,87	16,90	17,29	18,91	21,47	23,27	22,83	18,51	19,49
Excess yearly return	7,67	-2,09	-0,94	26,99	4,65	18,52	3,94	4,02	7,24	-0,11	1,51	-1,07	0,40	0,79
Excess compound return	7,67	2,30	1,15	5,26	5,13	7,00	6,49	6,19	6,30	5,80	5,48	4,92	4,44	4,21
<b>RAFI Dividend</b>														
Return per year	22,57	-12,84	8,88	83,68	-0,86	56,52	-5,11	22,51	27,37	53,40	45,50	18,19	-23,62	30,88
Compound yearly return since 1995	22,57	3,36	5,17	20,90	16,20	22,11	17,79	18,37	19,34	22,37	24,31	23,79	19,28	20,07
Excess yearly return	13,04	-5,93	14,79	12,86	-1,22	23,91	3,20	6,42	1,93	6,15	4,27	-1,01	-0,39	-1,25
Excess compound return	13,04	2,38	6,54	7,76	5,73	8,23	7,38	7,27	6,73	6,70	6,52	5,88	5,20	4,79
<b>RAFI Book Value</b>														
Return per year	18,28	-19,35	-13,91	105,81	8,25	49,75	-7,62	20,07	30,79	47,90	43,29	18,47	-21,99	30,93
Compound yearly return since 1995	18,28	-2,33	-6,35	14,02	12,84	18,29	14,19	14,91	16,57	19,38	21,38	21,13	17,10	18,04
Excess yearly return	8,75	-12,44	-8,00	34,99	7,89	17,14	0,69	3,98	5,35	0,65	2,06	-0,72	1,24	-1,21
Excess compound return	8,75	-3,31	-4,98	0,88	2,38	4,41	3,78	3,80	3,96	3,71	3,59	3,23	3,02	2,76
<b>RAFI Sales</b>														
Return per year	12,03	-2,83	-9,30	115,44	2,34	53,01	1,84	20,03	34,51	42,50	40,02	17,86	-23,79	35,72
Compound yearly return since 1995	12,03	4,34	-0,42	20,77	16,84	22,21	19,07	19,19	20,80	22,81	24,28	23,73	19,21	20,32
Excess yearly return	2,50	4,08	-3,39	44,62	1,99	20,40	10,14	3,94	9,07	-4,76	-1,21	-1,33	-0,56	3,59
Excess compound return	2,50	3,36	0,95	7,62	6,37	8,33	8,66	8,08	8,19	7,14	6,49	5,83	5,13	5,04
<b>RAFI Cash Flow</b>														
Return per year	15,55	-0,34	-10,95	80,21	8,18	47,20	-6,04	17,84	38,42	44,74	41,78	18,11	-21,75	34,34
Compound yearly return since 1995	15,55	7,31	0,84	16,59	14,86	19,71	15,64	15,91	18,22	20,64	22,42	22,06	17,95	19,05
Excess yearly return	6,02	6,57	-5,04	9,39	7,82	14,59	2,27	1,76	12,98	-2,51	0,55	-1,09	1,48	2,20
Excess compound return	6,02	6,33	2,21	3,45	4,40	5,83	5,23	4,81	5,61	4,97	4,63	4,15	3,87	3,77

**Table 5: Performance measures applied to fundamental indices**

Portfolio	Total Return (%)	Compound return (%)	Excess Return (%)	CAPM Alpha	Standard deviation (%)	Beta vs Ref	Tracking error (%)	Information ratio	Sharpe Ratio (%)	Sortino Ratio (%)	Treynor ratio (%)	Kappa	Omega	p-value of Alpha
FTSE/JSE All Share	632,16	15,28			25,76	1,000			31,74	35,39		0,6121	2,633	
RAFI Composite	1109,49	19,49	4,21	4,81	31,26	1,216	8,23	0,511	45,10	72,20	12,69	1,0650	3,643	0,07
RAFI Dividend	1194,40	20,07	4,79	6,41	29,56	1,113	8,11	0,590	50,92	81,68	14,52	1,1666	3,778	0,04
RAFI Book Value	919,23	18,04	2,76	2,77	34,09	1,350	11,33	0,243	38,11	54,42	10,74	0,7483	3,000	0,38
RAFI Sales	1232,17	20,32	5,04	5,62	34,33	1,302	12,76	0,395	45,06	81,80	12,97	1,2541	4,000	0,20
RAFI Cash Flow	1049,08	19,05	3,77	4,51	27,60	1,050	5,73	0,658	46,07	69,62	13,23	0,9574	3,654	0,05

**Table 6: Turnover per year for RAFI Composite and FTSE/JSE All Share Indexes (%)**

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Average
RAFI Composite	12,65	21,49	19,92	27,52	18,00	17,26	21,59	11,53	12,56	10,06	9,64	15,67	16,14	14,33	16,31
FTSE/JSE All Share	14,42	35,17	33,87	23,83	14,23	12,83	15,23	10,69	12,95	7,45	7,78	11,37	13,58	8,38	15,84
Difference	-1,78	-13,68	-13,95	3,69	3,77	4,43	6,36	0,84	-0,39	2,61	1,86	4,31	2,57	5,95	0,47

**Table 7: Top share weightings (%)**

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
<b>FTSE/JSE All Share</b>														
Top 3	21,87	16,60	16,77	25,06	28,31	31,53	30,39	30,87	25,70	28,60	29,48	31,97	30,20	31,94
Top 5	31,81	25,55	25,39	34,32	38,94	41,23	40,83	40,22	36,01	39,51	39,18	42,95	42,85	42,57
Top 10	44,05	38,37	39,33	48,55	58,81	57,93	57,16	55,45	53,49	56,22	56,64	60,49	58,69	59,48
<b>RAFI</b>														
Top 3	16,23	15,51	16,11	21,65	19,89	21,38	21,60	21,08	21,55	22,48	22,44	27,37	30,94	30,55
Top 5	24,03	23,43	24,43	30,05	28,53	29,79	29,87	29,19	29,95	31,09	30,96	35,48	39,03	38,71
Top 10	39,56	39,45	40,62	45,96	45,14	46,25	46,57	45,66	46,85	47,99	47,39	52,59	55,09	54,71
<b>Difference</b>														
Top 3	5,64	1,09	0,66	3,41	8,42	10,15	8,79	9,79	4,15	6,12	7,04	4,60	-0,75	1,39
Top 5	7,78	2,12	0,96	4,27	10,41	11,44	10,96	11,03	6,06	8,42	8,22	7,47	3,83	3,86
Top 10	4,49	-1,08	-1,29	2,59	13,67	11,68	10,59	9,79	6,64	8,23	9,25	7,90	3,60	4,77

## 5. CONCLUSIONS

This study compares the performance of the ALSI, a market-cap weighted index, with the performance of a fundamental index which bases its weights on four metrics which replicate the economic footprint of each share in the index. These metrics are sales, book values, dividends and cash flows.

The results are consistent with global results, showing that the RAFI Composite Price Index outperformed the ALSI by 4,7% p.a., compounded annually during the period 1 January 1996 to 31 December 2009. This return was achieved with a similar risk profile as the

ALSI. The RAFI Composite Total Return Index also outperformed the ALSI Total Return Index by 4,2% p.a. during this period. In addition, the RAFI Index had a turnover similar to the benchmark index and also had a significantly lower concentration of shares.

The fundamental index outperformance clearly disproves the efficient market hypothesis (EMH). Selecting a portfolio of stocks based on their financial values outperforms a portfolio replicating the normal market-cap index which according to the EMH should not be possible. The success of fundamental indices proves that market capitalisation indices are not optimal and deliver sub-optimal returns.

The following are recommended for further study:

- Investigate the reasons why fundamental indices outperform market cap-weighted indices.
- Create more data points, for example monthly performance numbers, and analyse the correlations between the relevant fundamental indices, market cap-weighted indices and possibly other variables such as interest rates and economic growth.
- Investigate fundamental sectoral indices such as a resources index and a financial index, and compare the performance of these indices with the current FTSE/JSE resources and financial indices.

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