"FUNDAMENTAL INDEXES VERSUS THE REST:

COMPARING THE PERFORMANCE OF THE SOUTH AFRICAN ENHANCED RAFI™40 VS MARKET CAP WEIGHTED INDEXES AND ACTIVELY MANAGED FUNDS"

Purpose:

Thesis Topic

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Executive Summary

This paper explores the relative out performance of the South African Enhanced RAFI™40[1] against other general equity portfolios including the JSE All Share Index (ALSI) and a basket of general domestic equity Unit Trusts, as well as and Investec's Domestic General Equity Fund[2].

On a risk-adjusted basis, using conventional performance metrics, namely Sharpe, Sortino and M^2, the RAFI™40 took the top spot. These conventional metrics assume a normal distribution and only take the mean and standard deviation into account.

When using the non-Gaussian metrics, such as the Omega ratio and the M^2 for Omega[3], we found that Investec's General Equity Fund was the superior investment. Since the Omega measures do not make the normal distribution assumption, they are a more accurate representation of risk adjusted returns and hence should demand more weight than the other ratios.

The fact that Investec's returns are net of fees, whilst the ALSI's and RAFI™40's are before fees, adds further strength to the conclusion that Investec's General Equity Fund was the overall top performer[4].

However, as far as passive investment techniques are concerned, the RAFI™40 still performs well against all the other investment types and this out performance is largely due to the index's emphasis towards value shares, as substantiated by our regression.

[1] Henceforth referred to as either the South African Enhanced RAFI™40, Enhanced RAFI™40 or simply RAFI™40.
[2] Henceforth referred to as either the Investec Domestic General Equity Fund or Investec General Equity Fund.
[3] A performance measure similar to the Modigliani-Modigliani (M^2) method, but using Omega for volatility instead - see Methodology section on Omega (Ω)M^2 for Omega (Ω^2) for a more detailed explanation of this metric.
[4] There are certain caveats to this assumption, see Conclusion section for more information.

Introduction

CAPM theory has taught us that the optimal portfolio to hold from a mean-variance perspective is the market portfolio. The logical question to ask is thus, "*how does one go about constructing this portfolio?*" According to Markowitz, the construction of a mean-variance efficient portfolio would involve forecasting the expected share returns for every share in the market and constructing a covariance matrix (Arnott, Hsu, & Moore, 2005).

For most markets, this is too time consuming and impractical. This has led to many academics adopting a market-capitalisation weighted index as a proxy for the "*optimal*" (mean-variance efficient) or market portfolio. Although investing in this passive strategy has translated into a multi-trillion dollar industry (Schwab, 2008), relatively consistent, risk-adjusted out performance of these indexes by certain asset managers and individuals has led to the idea that more efficient investment techniques (both active and passive) could exist. In addition, many academic research papers reject the idea that cap-weighted indexes are the best proxies for the CAPM market portfolio on the basis that they do not include all financial instruments backed by physical assets, such as commodities, consumer durables, real estate and non-traded capital assets such as human capital (Fama & French, 2004).

In his paper entitled "*Fundamental Indexation*", Robert D. Arnott investigates and proposes an alternative index weighting strategy to traditional market capitalization or "*Wall Street*" weightings, triggering an investment following across the world. His novel and now patented investment approach involves weighting the stocks in a broad market index by non-market capitalisation or "*Main Street*" fundamental measures of company size such as revenue (or sales), gross dividends, book value of equity and cash-flow.

Arnott goes on to state that the returns produced by his Fundamental Indexes are, on average, 1.97% higher than the S&P 500 over the 43 year period under investigation, and 2.15% more than the Reference Portfolio (Arnott's replication of the Russell 1000[5] using a technique similar to the one used to construct his Fundamental Indexes). Furthermore, this alpha or excess return figure increases to 2.56% when comparing the highest performing fundamental index (sales) to the Reference Portfolio.

Robert D. Arnott's investment and financial research company, Research Affiliates, implemented his new investment technique under the name: Research Affiliate's Fundamental Index (RAFI™). This style of passive investing has been licensed worldwide, attracting more than US$ 20bn in funds in many countries around the globe (see Figure 1).

[5] The Russell 1000 Index is a stock market index of the largest 1000 US stocks weighted by market cap

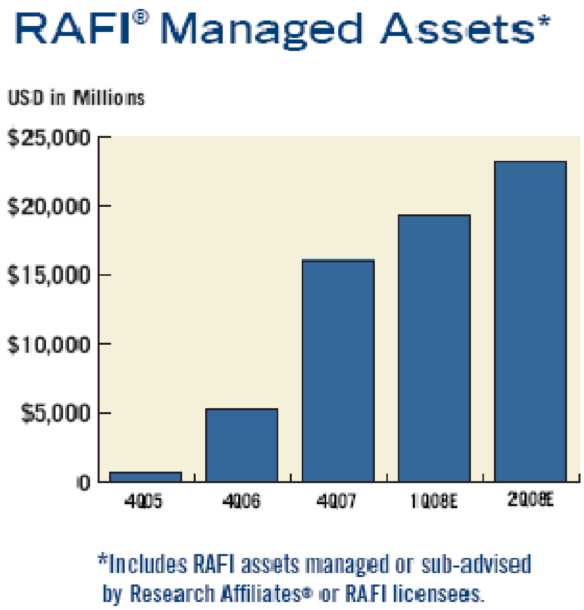

Figure 1: RAFI™ Managed Assets (globally)

Furthermore, the RAFI™ has become so pervasive that the FTSE, JSE and other global bourses have adopted and subsequently listed the index for benchmarking and performance purposes.

Characteristics of RAFI™ and traditional market capitalisation index strategies

Market capitalisation weighted indexes are based on significantly different assumptions to fundamentally weighted indexes. Market capitalisation weighting is based on the concept of the pricing efficiency or near efficiency of the market, while the fundamentally weighted indexes make the assumption that market prices are prone to noise and error.

Cap-weighting stems from the CAPM argument that the optimal portfolio to hold is the market portfolio, which is best achieved by investing in an index of all the stocks on an exchange weighted by share price.

On the other hand, fundamentally weighted indexes disregard the market price of shares in selection and weighting and look instead at underlying corporate fundamentals (such as book value of equity, sales, cash flow and dividends).

In his paper, Arnott lists four main reasons as to the benefits of market capitalisation weighted indexes (Arnott, Hsu, & Moore, 2005):

1. Capitalization weighting is a passive strategy requiring little trading; therefore, indexing to a cap-weighted index incurs far lower trading costs and fees than active management.
2. A cap-weighted index provides a convenient way to participate in the broad equity market.
3. Market capitalization is highly correlated with trading liquidity, so cap-weighting tends to emphasize the more heavily traded stocks, thereby reducing portfolio transaction costs.

4. Because market capitalization is also highly correlated with investment capacity, cap-weighting tends to emphasize the stocks with greater investment capacities, thus allowing large scale investment by pension funds and institutions in these indexes.

In order to ensure that Fundamental Indexes appear attractive relative to their cap-weighted counterparts, most if not all of these attributes have to be retained. Since fundamental measures of size such as cash flow, revenue and book value are highly correlated with capitalisation and liquidity (Arnott, Hsu, & Moore, 2005), a fundamental index would preserve both investment liquidity and capacity, as most of the index's constituents would be large blue chip companies that trade on high volumes.

Fundamental indexes also have volatilities very similar to cap-weighted indexes (Arnott, Hsu, & Moore, 2005), meaning the returns of fundamental indexes and cap-weighted indexes can be compared directly. The most challenging aspect of constructing a fundamental index is in keeping the turnover low, as there is rebalancing (with respect to the relevant size metric, e.g. cash flow, dividends, etc) that needs to be done on a periodic basis, in addition to the usual reconstitution[6].

The Case for Fundamental Indexing

Given this sudden interest in fundamental style passive investing, the question is bound to be asked, "What makes this new technique superior to cap weighting?" The answer to this question lies predominately in an assumption known as the "*noisy market hypothesis*". In this hypothesis, it is supposed that a share's true value is not known, and that throughout time, the market randomly overvalues certain shares and undervalues others. Thus, it is argued that market capitalisation weighted indexes will invest a greater proportion in shares that are overvalued and a lesser proportion in shares that are undervalued[7]. This has led to the opinion that market capitalisation weights create an inherent performance drag, something that a fundamentally weighted index will mitigate if not avoid entirely, by separating the link between price and index weighting through focusing on non-market related ("Main Street") economic measures of company size.

Another proposed merit of fundamental indexation is the belief that it may offer some sort of a buffer to stock market bubbles and their subsequent bursts, by ignoring irrational market sentiment and instead focusing on company fundamentals. The implication is thus that this method offers superior risk-adjusted returns when stock markets turn from bull to bear markets. As Arnott himself states, "*You can have exuberance in a company's share price but not in a company's financial metrics. RAFI™ portfolios thus avoid the huge run-ups and subsequent corrections that have historically plagued cap-weighted indexes.*" (du Plessis, 2007)

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[6] Reconstitution involves replacing a share in an index with another stock previously just not large enough for inclusion in the index but which has now increased to a size larger than another index constituent (e.g. due to share price appreciation in the case of a market cap weighted index).

[7] The concept of over or under valued is explained in terms of an upwards or downwards deviation from what is deemed to be "fair value".

Treynor argues (Arnott, Hsu, & Moore, 2005)that rather than fundamental indexes providing superior returns relative to cap weighting due to the creation of positive alpha, this out performance is more accurately explained by the latter technique's creation of negative alpha because of random pricing errors. A large proportion of these random pricing errors is likely to be attributable to the behaviour of investors who often, through human nature, trade on emotion and herd mentality rather than a company's underlying fundamentals – the age old adage of the markets being driven by a combination of fear and greed (Brabazon, 2000).

Another possible explanation put forward (by Arnott himself) for the supposed out-performance of fundamental indexation is that these indexes inherently have a value bias, assigning greater weights to companies that have strong dividend yields, low PE's etc, and lesser weights to growth stocks than a conventional cap-weighted index. This has been verified by a Fama-French three-factor regression run by Arnott, which indicated that indeed fundamental indexes were exposed to a value factor, and, to a lesser extent, a size factor[8].

Arnott goes on further to state that, should the effects of size and value be removed, fundamental indexes would earn an alpha of –0.1% over the 43 year period (as opposed to a positive alpha close to 2%). Although many asset managers may claim and indeed prove to add positive alpha, few manage to do so with any consistency, meaning active management at best is about who had the luckiest guess in a particular year. However, in the case of fundamental indexing, it must be stressed that the RAFI™ is constructed passively, through a set methodology and hence does not involve any element of chance, guesswork or human error.

Critics of Fundamental Indexing

Although seemingly a sound investment proposition, Robert D. Arnott is not without his critics. In a paper directly criticising Arnott's strategy, Andre F. Perold provides a numerical example, which he claims disproves the "*noisy market hypothesis"* through a simple Bayesian[9] analysis. In his illustration, Perold compares two shares, A and B (each with an equal hypothetical fair value), and shows that provided each one is randomly overvalued or undervalued to the same extent (i.e. same volatility), given that fair-value of the shares is not known by the market, the returns of a cap-weighted or equally (fundamentally) weighted portfolio of both shares are the same, regardless of the price at which A and B are trading (Perold, 2007).

In short, Perold argues that if fair-value is not known by the market (one of the assumptions of the noisy market hypothesis), then mispricing of shares by the market occurs totally randomly, and hence market capitalisation weighting does not alter the probability that a share is over or undervalued.

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[8] It is well documented by Fama and French that investing in small-caps (and value companies for that matter) leads to excess risk-adjusted returns when compared to investing in growth shares, over the long run (Fama & French, The Anatomy of Value and Growth Stock Returns, 2007).

[9] An analysis using statistical and analytical methods as originally proposed by Thomas Bayes.

With regards to the idea that fundamental indexes outperform cap-weighted ones due to their inherent value bias (i.e. being biased towards companies with low PE ratios and high dividend yields for example), Perold puts forward the following arguments.

Although it is well documented that value stocks outperform growth stocks over the long run (Fama & French, The Anatomy of Value and Growth Stock Returns, 2007), what is not yet clear is whether this is due to value stocks being implicitly more risky than growth stocks or whether value stocks are systematically mispriced.

If it is the former case, then there is no out performance by value stocks after adjusting for risk (albeit that this risk may be hidden or difficult to quantify). If however, the latter case holds true, then out performance by fundamental indexes will only persist provided the market continues to consistently misprice value stocks using widely available fundamental information, which is unlikely, in Perold's eyes.

Furthermore, if this mispricing argument is to believed, then there is a risk that the premiums attached to value stocks might be arbitraged away over time, in much the same way the January effect of small caps has been and other such "*paradigms*" (Bogle & Malkiel, 2006).

Bogle and Malkiel also point out that most of the out performance of fundamental indexes (over cap weighting) in Arnott's study occurred between 2000-2004, when the "new economy" (tech stocks) crashed and value stocks again became the darlings of Wall Street. In this four-year period alone, the average annual excess return of a fundamental index weighted by either book value, income, revenues, sales, dividends or employment over the reference portfolio (proxy for the S&P) was 9.44%, far larger than any other period in Arnott's study (see Table 1 below).

Portfolio/Index	1/62-12/69	1/70-12/79	1/80-12/89	1/90-12/99	1/00-12/04
A. Geometric Return(annualised)					
S&P 500	6.58%	5.86%	17.71%	18.57%	-2.15%
Reference	6.80	5.90	17.00	17.94	-1.73
Book	6.94	8.72	18.29	17.09	5.84
Income	7.04	8.64	19.04	17.65	7.60
Revenue	8.26	8.67	19.32	16.99	8.38
Sales	8.26	8.70	19.47	16.84	8.66
Dividends	6.37	8.48	19.15	15.42	7.98
Employment	9.94	8.69	17.74	15.65	7.82
Composite	7.13	8.63	19.04	16.95	7.59
Average (ex Composite)	7.80%	8.65%	18.83%	16.61%	7.71%
B. Value added relative to Reference portfolio					
S&P 500	-0.22 pps	-0.05 pps	-0.71 pps	-0.63 pps	-0.43 pps
Reference	-	-	-	-	-
Book	0.13	2.81	1.29	-0.85	**7.57**
Income	0.23	2.73	2.04	-0.29	**9.33**
Revenue	1.46	2.77	2.32	-0.95	**10.10**
Sales	1.46	2.79	2.47	-1.10	**10.39**
Dividends	-0.44	2.57	2.15	-2.52	**9.71**
Employment	3.14	2.78	0.74	-2.29	**9.55**
Composite	0.33	2.73	2.04	-1.00	**9.32**
Average (ex Composite)	1.00 pps	2.74 pps	1.84 pps	-1.33 pps	**9.44 pps**

Table 1: Return Characteristics of Alternative Indexing Metrics by Decade, 1962-2004

Bogle also refutes the implication that cap weighing is an inferior indexing technique, even in the face of markets being (even temporarily) inefficient (i.e. one in which share prices do not fully reflect all available information and are thus sometimes mispriced). To back this claim up, he provides the following analogy:

Even assuming markets are inefficient, at any one time, all the stocks on a bourse are owned by someone, and so collectively, for the average investor, the optimal portfolio must be a cap-weighted portfolio of the market (or some index approximating the market). He goes on to argue that no active fund manager can consistently be “*above average*”, even with regards to identifying “*under-valued*” stocks (constructing fundamental indexes), and that at best trying to beat the stock market is a zero-sum game, with every overvalued stock being sold to (owned by) one investor and every undervalued stock being bought by (sold to) another. In addition, this simple analogy is described prior to the inclusion of management and trading fees. If fees have to be taken into account, fundamental indexers and active portfolio managers will, at best, under perform the market by the exact amount they charge for their services.

Sticking with fees, Bogle goes on to explain how the increased trading activity related to re-balancing a fundamental index when an economic factor (e.g. dividends) of a company changes is another caveat of fundamental indexing relative to cap weighting (Bogle & Malkiel, 2006). If a company's fundamental factor doubles whilst its share price remains unchanged, twice as many shares in the company need to be purchased to rebalance the index. Arnott himself admits that in constructing his fundamental index and back-testing it on data, he excluded the effect of trading costs and concedes that it would be higher than a cap-weighted strategy due to the need for this annual rebalancing in addition to the usual reconstitution.

In addition, the extra trading related to fundamental indexing can also lead to adverse tax implications. If the share price of a company doubles but its fundamental factor stays the same, then half of the shares in that company need to be sold in order to maintain the correct weighting in the index, leading to further value erosion to the investor through capital gains tax.

Lastly, Bogle points out that over the history of stock market investing, share returns tend to exhibit an inexorable tendency to revert to the mean. If one plots the returns of growth stocks divided by the returns of value stocks over time, one will see that, although value or growth stocks might outperform one or the other, in the long run they generally produce similar returns. Take into account the transaction costs associated with changing between the two styles when trying to second guess the market and the average investor must under perform a market cap weighted index strategy (see graph below).

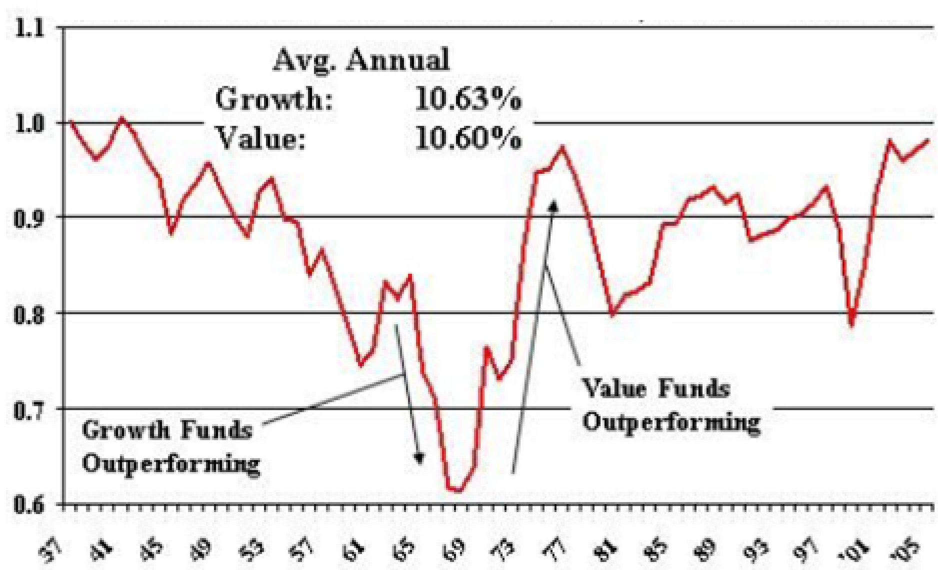

Figure 2: Reversion to the mean - Value over growth returns since 1937

Active versus passive asset management

Wells Fargo launched the first indexed portfolio in 1971. It was created for a single pension fund client. In 1973, Wells Fargo set up a similar mutual fund for trust accounts. In 1976, these funds were combined, and the capitalization-weighted S&P 500 index was used as the benchmark for the combined portfolios (Gastineau, 2002).

These represented the start of the "*new investment instrument*" that Malkiel (1973) and Samuelson (1974) anticipated when Samuelson noted that "*the 'efficient market' or 'random walk' hypothesis accords with the facts of life*" (1974, p. 17). A direct corollary of the efficient market hypothesis is that the market index will be mean-variance efficient.

Low cost information needed to "*manage*" the index funds was already available directly from index publishers. Having little or no need to maintain in-house research analysts, and keeping turnover low these funds could be offered at significantly lower cost than traditional, actively managed portfolios. The reduction in turnover has a knock-on effect beyond reducing trading cost; it also means that the index funds have lower taxable gains than actively managed funds.

The growth in size of market cap index funds and their transparency has lead to traders trying to trade ahead of the index fund positions, eroding fund performance. Ironically, this requires passive index fund "*managers*" to manage their trades more actively.

The lines are very distinctly drawn in the sand between those who believe that actively managed funds can beat the broad market index and those who don't. Sharpe (1991) clearly states his position on this matter:

"*Properly measured, the average actively managed dollar must under perform the average passively managed dollar, net of costs. Empirical analyses that appear to refute this principle are guilty of improper measurement*." (Sharpe, 1991, p. 4)

Sharpe's argument is that if the passive index tracks the market, then before costs, active and passive funds will give the same return since they are the only constituents of the market. It follows that since actively managed funds generally have higher trading and management costs then index funds, after costs, actively managed portfolios will under perform.

His, arguably narrow, definition of a passive investor is one which holds every security in the market in the same manner as the market. Some index fund managers only sample the market or charge fees in excess of their active management brethren. The narrow definition excludes virtually every practically tradable or non-market cap weighted index fund.

In a similar vein, Bogle (2002) argues that there is no qualitative difference in performance between managed and index funds before expenses and goes further on to say that excess returns (if any) will be eroded by management fees:

"*Active managers as a group will fall short of the index by the exact amount of the costs the active managers incur. If the data we have available to us do not reflect that self-evident truth- well, the data are wrong*" (Bogle, An Index Fund Fundamentalist, 2002, p. 35)

On a non-risk adjusted basis lower cost quartile managed funds' returns exceeded that of its index counterpart by a meagre 0.12%, not taking into account survivorship bias, which Bogle suggests would strengthen the argument in favour of the superior performance of index funds relative to actively managed funds.

Malkiel (1995) finds that "*Most investors would be considerably better off by purchasing a low expense index fund, than by trying to select an active fund manager who appears to possess a "hot hand"* (Malkiel, 1995, p. 571). However, Minor (2001) shows that Malkiel's results can be reversed simply by shifting the time period in consideration back by two years, but in his analysis, he has not corrected for survivorship bias, skewing his result in favour of managed funds.

Minor further contends that Bogle made a logical flaw by grouping active fund managers with other individual investors (amateurs) who try to make active investment decisions in saying that managed funds will always under perform the market by the exact cost of their management fees. In reality non-index fund players include amateur individual investors who, if they systematically under perform on a consistent basis, may enable better informed active fund managers to earn returns in excess of the market at the expense of these non-professional players (by selling stocks to "*the greater fool*").

Aim

The aim of this thesis is to examine the performance of the South African Enhanced RAFI™40 technique of passive index investing versus traditional market capitalization weighted indexes (such as the ALSI) and actively managed funds such as Unit Trusts.

With the asset management industry being so competitive and the field of passive investing increasingly attracting funding from pension funds as well as retail investors, the idea of a superior alternative passive investment strategy holds much appeal.

The relative performance of these various investment techniques will be evaluated through computation and comparison of various risk adjusted measures, such as the Sharpe, Sortino, Omega, M^2 for Omega and M^2 metrics as detailed in the methodology section.

This paper also aims to establish whether the RAFI™40 method is characterised by any style-biases, such as being tilted towards value companies. This investigation could go some way in explaining any potential (expected) out performance of the JSE ALSI by the South African Enhanced RAFI™40.

Fundamental Index Construction

The construction of the original RAFI™ as detailed by Robert Arnott involved ranking the 1000 largest companies on the Russell 1000 by the various economic or "*Main street*" measures of company size such as:

- Book value
- Trailing five-year average cash flow
- Trailing five-year average revenue
- Trailing average five-year gross sales
- Trailing average gross dividends
- Total employment

Each company was then re-ranked in the Fundamental Index according to each measure above. A composite fundamental index was also tested, and this involved re-ranking the Russell 1000 by taking an average of four of the six economic measures of size (employment and revenues were excluded).

Every year, on the 1st January, the Fundamental Index would be constructed using information on all available US stocks based on the last trading day of the previous year. This meant that, since companies report on a quarterly basis, information used for ranking purposes is, at best, lagged by one quarter. This process is known as rebalancing, which one of the disadvantages of fundamental indexing as previously noted.

Since Arnott's research paper, the RAFI™ has received such a following that this index is now replicated by the JSE/FTSE for comparison purposes and daily index levels are listed on many bourses (although not directly investable). Since this move, the RAFI™ index creation methodology is now publicly available information (although protected from replication by patents) and South Africa has since created its own RAFI™ index comprising of 40 shares (known as the FTSE/JSE RAFI™40).

The methodology for the creation of this fundamental index, known as the JSE/FTSE RAFI™40, is as follows: (JSE, 2008)

- The constituents of the index are formed from the universe of shares that make up the FTSE/JSE All Share Index.
- The universe companies are ranked by each of the following four fundamental measures of company size: sales, cash flow, book value and dividends.
- The percentage weight that each company represents of the total value of each fundamental measure is then calculated.
- Trailing five-year averaged data is used to minimize the substantial volatility in the fundamental index factors that otherwise would have been present if annual data had been used. The five-year averaging also reduces index-rebalancing turnover.
- If there are fewer than five years of data available, the average of the years of data that are available is taken.
- A composite fundamental value is given to each company by taking the average weighting of each fundamental measure.
- If a company does not pay out dividends, the average of the other three metrics is taken.
- The company's RAFI™ fundamental value (RFV) is defined as 10,000,000 times the composite weight.
- The companies are then ranked in descending order of their RFV, and the 40 largest are chosen for inclusion in the RAFI™40.
- The weighting factor used in the index calculation is then derived by dividing the RFV of each company by its free-float adjusted market capitalisation.

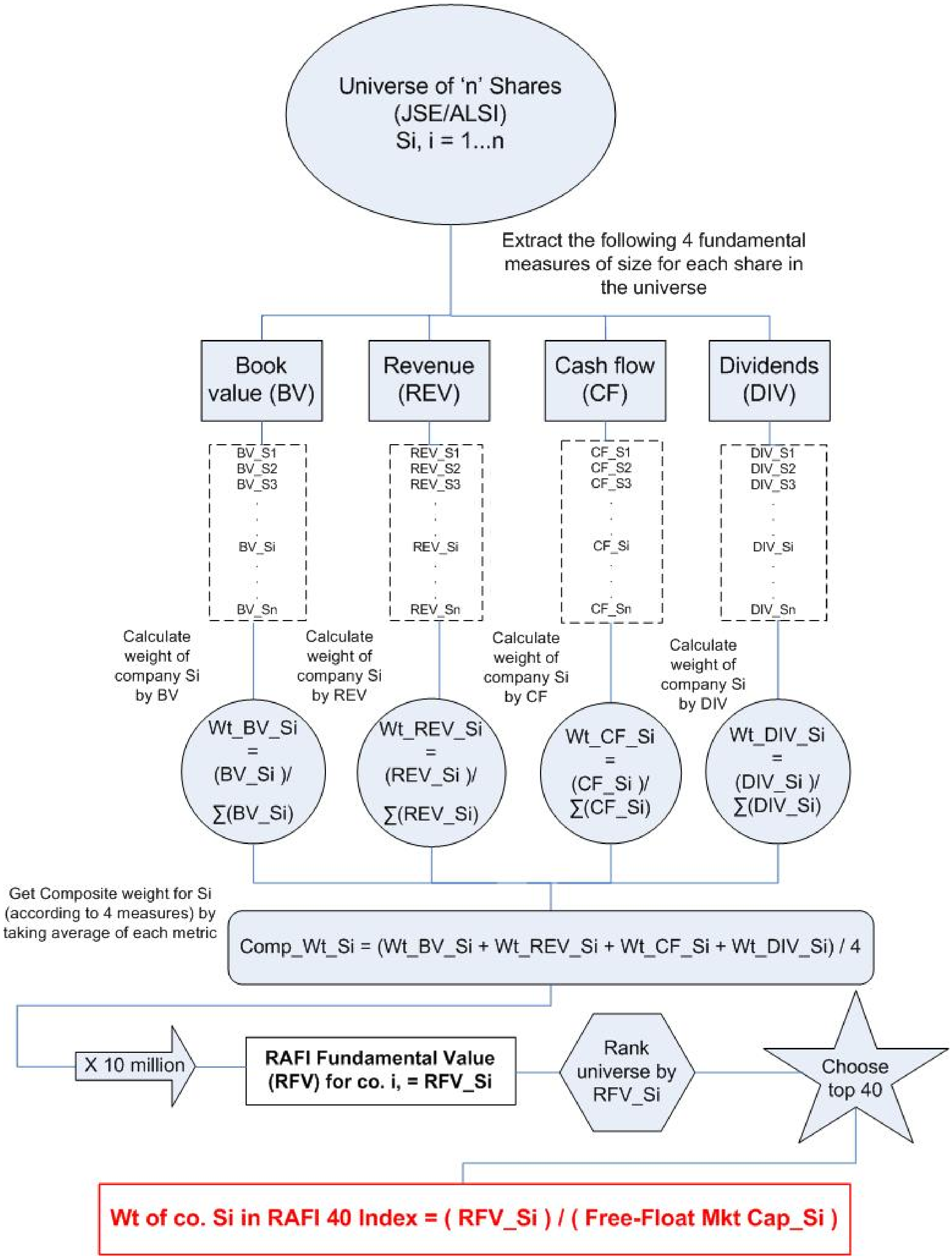

Figure 3: Flow diagram illustrating RAFI™40 Index Construction Methodology

For indicative purposes, as at February 2008, the top 10 constituents as well as the sector breakdown of the RAFI™40 were as follows (**Error! Reference source not found.** and **Error! Reference source not found.** respectively):

Rank	Security	Sector	FTSE/JSE RAFI40 Index Weight (%)	FTSE/JSE Top40 Index Weight (%)	Difference (%)
1	Anglo American	Mining	11.66	17.87	-6.21
2	BHP Billiton	Mining	9.38	15.17	-5.79
3	Sasol	Oil & Gas	8.22	6.71	1.51
4	Old Mutual	Life Insurance	5.46	2.85	2.61
5	Anglo Platinum	Mining	4.76	3.12	1.65
6	Impala Platinum Hlds	Mining	5.53	5.52	-1.00
7	SAB Miller	Beverages	4,38	4.88	-0.50
8	Standard Bank Group	Banks	4.06	3.60	0.46
9	Compagnie Financiere Richemont AG	Personal Goods	3.73	6.31	-2.58
10	ArcelorMittal South Africa LTD	Industrial Metals	3.11	1.11	2.00
		Total	59.30	67.15	-7.85

Table 2: FTSE/JSE RAFI™40 Index Top 10 Constituents

ICB Code	Sector	FTSE/JSE RAFI40 Index Weight (%)	FTSE/JSE Top40 Index Weight (%)	Difference (%)
0530	Oil & Gas Producers	8.22	6.71	1.51
0570	Oil Equipment, Services & Distribution	-	-	-
1350	Chemicals	0.67	-	0.67
1730	Forestry & Paper	1.74	0.88	0.86
1750	Industrial Metals	5.19	1.11	4.08
1770	Mining	36.84	48.50	-11.66
2350	Construction & Materials	1.71	2.14	-0.43
2710	Aerospace & Defence	-	-	-
2720	General Industrials	3.90	2.94	0.95
2730	Electronic & Electrical Equipment	-	-	-
2750	Industrial Engineering	-	-	-
2770	Industrial Transportation	0.55	0.45	0.10
2790	Support Services	1.08	1.02	0.06
3350	Automobiles & Parts	-	-	-
3530	Beverages	4.38	4.88	-0.50
3570	Food Producers	0.74	0.64	0.11
3720	Household Goods	0.44	0.62	-0.19
3740	Leisure Goods	-	-	-
3760	Personal Goods	3.73	6.31	-2.58
3780	Tobacco	-	-	-
4530	Health Care Equipment & Services	-	0.36	-0.36
4570	Pharmaceuticals & Biotechnology	-	-	-
5330	Food & Drug Retailers	0.53	-	0.53
5370	General Retailers	-	-	-
5550	Media	-	1.46	-1.46
5750	Travel & Leisure	-	-	-
6530	Fixed Line Telecommunications	2.47	1.00	1.47
6570	Mobile Telecommunications	2.48	6.12	-3.64
7530	Electricity	-	-	-
7570	Gas, Water & Multiutilities	-	-	-
8350	Banks	11.07	8.10	2.97
8530	Nonlife Insurance	0.41	-	0.41
8570	Life Insurance	10.72	4.30	6.42
8730	Real Estate	1.56	1.43	0.13
8770	General Financial	1.59	1.03	0.57
8980	Equity Investment Instruments	-	-	-
9530	Software & Computer Services	-	-	-
9570	Technology Hardware & Equipment	-	-	-
	Total	100	100	

Table 3: FTSE/JSE RAFI™40 Index Sector Breakdown

Portfolio Investability

The RAFI™40 is about 19% of the size of the ALSI from a net market cap perspective, i.e. cap ratio[11] = 19.0136%. This means that the RAFI™40 is about five times smaller than the ALSI, and so less investable. However, given that over a trillion dollars worth of funds are currently managed using passive investment techniques such as cap-weighted indexation, reducing this large number by a factor of five only is not enough to make the RAFI™40 unappealing from an investment capacity perspective. Additionally, since the RAFI™40 is a broad market passive index, it is fairly diversified and will still appeal to large institutions and pension funds, two of the largest sources of investment funds.

Attribute	FTSE/JSE RAFI 40 Index	FTSE/JSE Top 40 Index
Number of Constituents	43	41
Net Market Cap (ZARmn)	712,518	3,747,399
Constituents Weights (%)		
Average	2.33	2.44
Largest	11.66	17.87
Smallest	0.10	0.19
Median	1.56	1.01
Top 10 Holdings (% Index Market Cap)	59.30	67.15

Table 4: FTSE/JSE RAFI™40 Index: Portfolio Characteristics

In terms of investable RAFI™ products available in South Africa, there are two companies that have licensed the use of Research Affiliates patented Fundamental Indexing technique. They are Plexus Asset Management and Old Mutual's Umbono Fund Managers. The two companies have licensed Research Affiliates "Enhanced" and "plain vanilla" RAFI™ methodology respectively. The enhanced RAFI™ technique differs from the plain vanilla technique previously described through the additional application of two specialized accounting filters. These filters include a financial distress filter (scrutinizing debt coverage ratios) as well as a quality of earnings screen (e.g. consistency of earnings; comparing net operating assets) to enhance the fundamental index. The object of these inclusions is to down weight companies that could disappoint on the earnings side or that stand a higher chance of bankruptcy, thereby reducing the fund's volatility.

For the purposes of this paper, we will be looking at the performance of the South African Enhanced RAFI™40 versus the ALSI as well as general equity unit trusts. For this reason, we will be using RAFI™40 performance data garnered from Plexus Asset Management, which was also back-tested for a period of 14.5 years on stocks on the JSE.

Plexus introduced Fundamental Indexing on 20 August 2007 (inception date of its first fund), offering a product known as the Plexus RAFI™40 Enhanced SA Strategy Fund A1 based on the technique described

[11] Cap ratio is the ratio of the market cap of one investment/company to another.

above. In terms of benchmarking, Plexus uses the JSE/FTSE TRI as its performance benchmark and charges a 20% out-performance fee as well as a 1% annual management fee.

Methodology

Since our study involves a performance comparison of the RAFI™40 rather than a documentation of how to construct such an index (which adds no value as this is already public knowledge and has been done already by two companies in SA as well as the JSE), we decided to source RAFI™40 performance data from one of the companies in South Africa providing these funds rather than reinventing the wheel.

Our research and contacts lead us to use Plexus Asset Management, who were very helpful and forthcoming in providing the necessary data. Not only did they provide the performance data of their enhanced RAFI™40 fund since inception, but they also provided the RAFI™40 data back tested for 14.5 years.

In order to compare various data with similar start and end dates (for uniformity and accuracy), we decided to source most of our data from Plexus. This included data on the JSE/ALSI Total Return Index (TRI) values/returns, general domestic equity unit trust data, risk free rate (Alexander Forbes' Short Term Fixed Interest or STeFI[13] index) and general domestic equity value unit trust fund data, most dating back to 14.5 years ago (from June 2008 to 31 January 1994).

The only exception was data on the value funds which was only available back 11.25 years to May 1997 from July 2008. However, this is enough data (135 months worth) against which to perform the value regression needed to achieve the second part of our aim (determining the source of any out performance by the RAFI™40 over any of the other investments).

All data sourced was on a monthly basis, and in the form of percent return. The back tested RAFI™40 data excludes trading costs and management fees. The unit trust data (general equity and value) is net of recurring fees but excludes initial fees. The JSE Total Return Index also excludes costs. All data assumes reinvestment of dividends.

However, to try and avoid any bias or possible errors, we decided to verify the data's integrity ourselves (where possible), by conducting sense checks using data from other online sources such as Datastream.

These included checking independently sourced returns for various indexes such as the JSE TRI, risk free rate (using short term government treasury rates) etc over the period concerned using dates as similar as possible to the Plexus data and comparing these to results obtained using plexus data.

In order to compare the returns and risk profiles of each investment type, we used the following metrics or ratios:

- Non-risk adjusted return
- Geometric, compound and annual returns
- Volatility

[13] The STeFI index approximates the performance of money market instruments in the market.

- Growth of R100 (non-risk adjusted) over time period(14.5 years)
- Sharpe ratio
- Sortino ratio
- Modigliani-Modigliani (M^2) measure
- Total period M^2
- 5 year Trailing M^2 measure
- Omega
- Total period Omega, M^2 for Omega ($Omega^2$)
- 5 year Trailing $Omega^2$ measure
- Alpha
- Information ratio
- Beta

The benchmark for most of these ratios is the JSE/ASLI TRI or the risk-free rate, where applicable. As a primer to the measurement of the ratios, the various moments (returns, standard deviation, skewness and kurtosis) of the return distribution for an investment are explained under the Appendices section of this report.

What follows is a brief description of each of the performance ratios/measures used in this thesis.

Sharpe Ratio

The Sharpe ratio is also known as the reward-to-volatility ratio or Sharpe measure. The measure was devised by William Sharpe [1966] as a way to combine the excess return with the risk associated with gaining that excess return into a single measure. The Sharpe Ratio is defined as the excess return (over the risk free rate) per unit of risk associated with the excess return. It is given by the following equation:

$$Sharpe\ Ratio = \frac{E[R_P - R_f]}{\sqrt{var[R_P - R_f]}}$$

Equation 1

Where R_P is the return of the portfolio and R_f is the risk free rate.

The Sharpe ratio is used to distinguish how well the return of an asset compensates the investor for the risk taken, or the "risk premium". Investors should look to maximise their returns, while minimising their exposure to risk. For a given level of return a rational investor will choose the lower variance option, while when choosing according to equal volatility or variance, a rational investor should choose the higher return. Therefore the investor should aim to maximise the Sharpe ratio of their investment.

The return or variance on the market portfolio is not a parameter of the Sharpe ratio. The implicit bench mark is the risk free rate of return, while the excess return refers to the excess return over the risk free rate.

The standard deviation is a measure of the total risk exposure of the portfolio. Hence diversification does not affect the Sharpe ratio. For this reason the Sharpe Ratio is a useful measure for an investor who puts all his money in one fund, in this situation, only total risk matters

In the mean-variance space, the Sharpe ratio is defined as the gradient of a line drawn from the risk free rate to the portfolio. It is many an asset manager's objective to derive an optimal efficient portfolio, and one of the ways to do this is to maximize the Sharpe ratio of a portfolio within the Markowitz mean-variance framework. Thus, the higher the Sharpe ratio, the better the performance of the fund manager, relative to his peers for example.

The Sharpe ratio is closely related to the t-statistic which measures the statistical significance of any excess returns (Steiner, 2008). Formally, the t-stat will equal the Sharpe ratio multiplied by the square of the number of data points (monthly returns in our case) used in the calculation.

The Sharpe ratio by definition has the risk-free rate as the "benchmark" against which returns are measured. Because the Sharpe ratio uses total volatility in its computation (and not just market risk or beta) diversification plays no part in performance measurement and hence is an ideal ratio to use for investors investing all their cash in a single fund.

For our performance comparison, the Sharpe ratio for the Enhanced RAFI™40, JSE ASLI40, basket of general domestic equity unit trusts, and Investec's Equity Fund were calculated and compared, based on the annual average return and volatility over the entire period under review (14.5 years). For the risk free rate, monthly returns of the South African money market (as represented by the SteFI) were used.

Sortino Ratio

The Sortino ratio (similar to Sharpe) measures the excess return of a portfolio over an acceptable/target minimum return per unit of downside deviation relative to the minimum acceptable return (MAR).

It is given by the following formula:

$$Sortino\ Ratio = \frac{R_P - R_M}{\sigma_{DOWNSIDE}}$$

Equation 2

Similarly,

$$Sortino\ Ratio_{ANNUAL} = Sortino\ Ratio_{MONTHLY} \times \sqrt{12}$$

Equation 3

Why do we use this ratio? Most portfolio managers have a minimum targeted rate of return below which returns are considered unfavourable. Since risk is usually associated with unfavourable outcomes, only returns below the minimal acceptable return represents risk and so downside deviation from the minimal acceptable return is used instead of total volatility.

Generally, the minimal acceptable return or threshold used is the return on cash or it may be an index such as the JSE ALSI for a general equity fund or broad but non-market cap index such as the RAFI™40.

Downside deviation (an asymmetric risk measure), can be calculated using the following formula:

$$\sigma_{DOWNSIDE} = \sqrt{\frac{1}{(T-1)} \sum_{R_i < R_{MAR}} (R_i - R_{MAR})^2}$$

Equation 4

Where $\sigma_{DOWNSIDE}$ is the downside deviation, T is the number of time periods (in years or months), R_i is the portfolio return for time period i, and R_{MAR} is the minimum acceptable return.

Just as is the case with the Sharpe ratio, higher the Sortino Ratio indicates superior performance. Thus, the ratio is the actual rate of return in excess of the investor's target rate of return, per unit of downside risk.

In short, the Sortino ratio is a risk-adjusted performance metric that measures the actual rate of return in excess of the investor's targeted return, per unit of downside risk.

Benefits of using the Sortino ratio over the Sharpe ratio include the fact that high volatility can often be created because a fund's return suddenly surprised extraordinarily on the upside, which is a favourable outcome and hence this "good volatility" should not be punished (as it is in the Sharpe ratio).

Criticism of the ratio arises out of the old saying: "*We understate the possibility of past risks that did not harm us*" (Iluka Hedge Fund Consulting, 2004) . By differentiating between positive and negative (good and bad) volatility, we assume that there could have been no other outcome besides the one which actually occurred and that this will persist into the future. Even if a fund returns stellar results, by ignoring overall volatility, we are not presenting a full picture of the risks that were inherent in achieving that return. In other words: *"Just because you got away with it doesn't mean you didn't take any risk!*" (Iluka Hedge Fund Consulting, 2004, p. 4)

With these ideas in mind, we calculated the Sortino ratio for each investment technique over the total period and converted the ratio to an annualized figure. We then ranked each investment by this ratio to try and determine which method offered superior risk adjusted returns according to this performance metric.

Modigliani-Modigliani (M^2)

A similar approach to one proposed by Graham and Harvey, the M^2 or M-squared (from Modigliani-Modigliani) measure comes from the work of Leah Modigliani and Nobel laureate Franco Modigliani (1997). The measure expresses the risk-adjusted performance as a percentage return. The Modigliani-Modigliani measure adjusts the performance of a given asset to its risk exposure using volatility as a proxy for risk.

Virtual portfolios are constructed consisting of the asset in question combined with a risk free asset in proportion so as to make the standard deviation of the combined portfolio the same as the market portfolio. In essence, this measure expresses what return would have been achieved if the asset had the same standard deviation as the market index.

It should be noted that the Modigliani-Modigliani measure uses the same information as the Sharpe ratio - it simply presents it in a percentage return format. Since the M^2 measure is nothing more than a positive linear transformation of the Sharpe ratio, ranking investments by these two measures will give the same result. However, using the M^2 measure on a trailing 5 year annual average basis (shifted by a month at a time) allows us to plot a graph of our results (over 14.5 years) in easily-interpretable percentage terms rather than using an unintuitive ratio (Steiner, 2008).

This method of expressing the performance allows investors to optimise their portfolios to achieve the highest return possible for their particular risk appetite. Most fund literature only contains figures for the mean and standard deviation of returns of their portfolios. This measure combines the two to provide guidance on how to rank the returns on funds with different strategies and therefore different risk levels (Arugaslan, Edwards, & Samant, 2008).

One criticism levelled at the M squared measure is that it does not allow for curvature in the efficient frontier. The assumption is made that the risk free return has zero variance and zero covariance with other assets. This assumption that is only true if the maturity of the cash instrument exactly coincides with the evaluation period. Graham et al (Graham & Harvey) point out that there is a negative correlation between the interest rate changes and both stock and bond returns. So the zero variance-covariance assumption could result in misleading inference about the performance of low volatility funds where substantial leverage is needed to achieve the benchmark volatility. In a sample of well diversified funds, this is not an issue. In this paper we will acknowledge the assumption that index funds and unit trusts in question are sufficiently well diversified to satisfy the zero variance-covariance assumption.

The second assumption that the M^2 measure makes is that only the first two moments of the distribution, namely mean and variance are taken into account. The assumption follows that differences in skewness and kurtosis are do not affect this measurement. This assumption is discussed further in the sections detailing the Omega and Omega-Squared measures.

The risk free asset used was the SteFI. The reason we used this measure as the risk-free rate is three-fold:

Firstly, this was the risk-free data that Plexus (our chief source of data) had in hand, which corresponded nicely with the rest of our data, mainly due to all sources possessing the same record dates (good for comparability and consistency).

Secondly, the SteFI is a an accurate proxy for the risk free rates as it averages all the money market rates used by various banks, providing a broader and less skewed representation of the market as a whole (compared to using the money market rate from one institution).

Thirdly, it is as good a proxy for the risk-free rate as any other, and matches closely to the Treasury Bill rate of the South African government (this was confirmed by a comparison of monthly returns which proved that the data matched almost precisely, with differences being accounted for by the use of different start or record dates).

Mathematically the formula for RAP_{M^2} (Risk Adjusted Performance using M-squared) measure is expressed as:

$$RAP_{M^2} = \frac{\sigma_M}{\sigma_i}\left(\mu_i - r_f\right) + r_f$$

Equation 5

σ_M = standard deviation of the returns of the market index

σ_i = standard deviation of the returns of fund i

μ_i = average return of asset

r_f = risk-free interest rate

In most instances, the benchmark is taken to be the market index, and in this study it is the JSE/ASLI40 TRI. In this paper, we rank each investment type by its M^2 return over 14.5 years. In addition, we also perform a 5 year trailing annual average M^2 return over the period and plot the results to see which investment was superior over these shorter time spans.

Omega (Ω)

Omega can be used to rank manager performance without the need to apply idealised utility functions to the data. The previous ratios and measures are implicitly based on the assumption that returns are normally distributed. Normal or Gaussian distributions, named after the great German mathematician Carl Friedrich Gauss, are built on the observation that randomness in the natural world tends to cluster about a mean value and the frequency of observations decrease as they deviate from the mean.

"*Millions saw the apple fall, but Newton was the one who asked why*."

- Bernard Baruch

On October 19, 1987 the Dow Jones Index fell an unprecedented 29.2 percent in a single day of trading – an event which according to the normal distribution had a 1 in 1050 likelihood of occurring (Mandelbrot 2004). This has been the case with many market booms and particularly, busts - the normal distribution has failed to predict or explain many extreme price movements in financial markets. The beauty of the Omega measure is that it does not make any assumptions regarding the function that describes the distribution.

Furthermore, the previous ratios and measures use only the first two moments of the normal distribution, namely, mean and variance and do not take into account higher moments such as skewness and kurtosis to describe the return distribution. However, Kazemi et al (2003) has shown that the Omega measure is most sensitive to changes in mean and variance and that higher skewness and kurtosis have a relatively small impact on Omega unless the threshold is substantially lower than the mean return.

Omega, proposed by Keating and Shadwick (2002), originally as "Gamma", is increasingly popular, because its implications are intuitive and it is simple to compute. The precise value is directly determined by each investor's individual risk appetite. Mathematically it is expressed as:

$$\Omega = \frac{\int_{L}^{+\infty} \big(1 - F(x)\big) dx}{\int_{-\infty}^{L} F(x) dx}$$

Equation 6

F(x) = the distribution function of the returns (ranked in ascending order)

L = the threshold return

This can be communicated graphically in the case for a simple bet in Figure 4. Closely resembling expected the utility theorem, Omega is the ratio of the utility of the upside is weighed against the loss on the downside. Where utility of an outcome is the product of the outcome's probability and the utility of that outcome.

This is also analogous to the ratio of an imaginary call option value (if the returns exceed the threshold) against the value of a virtual put option value (in the case that returns are less than the threshold).

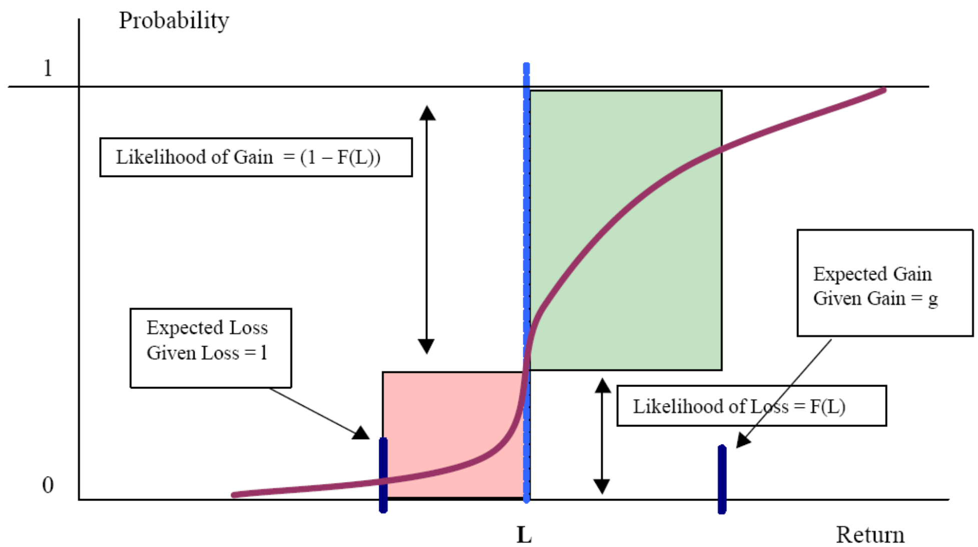

Figure 4: Graphical representation of Omega in the case of a simple bet

An extension of the simple bet, or two-outcome case is shown in Figure 5, where the areas above and below the distribution function are measured in smaller and smaller possible outcomes. The limit to zero of smaller and smaller parts yields the integrals of the function seen in the formula.

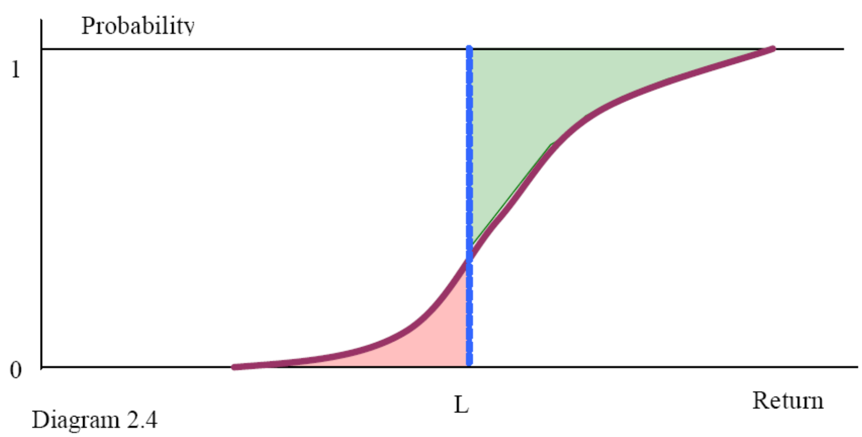

Figure 5: Omega demonstrated graphically

M^2 for Omega (Ω^2)

For the purpose of evaluating the portfolios presented in this paper we introduce a new measure dubbed "M^2 for Omega" or "Omega-squared". It combines favourable features of the M-squared measure and the Omega measure.

Although the M-squared measure is very useful due to its easily interpretable percentage return format, it uses the variance as a proxy for risk and there for makes the assumption that the returns are normally distributed and that only mean and variance are factors in risk adjusting returns.

Instead of standard deviation, we take the downside risk as expressed in the Omega measure and weight the asset in question with the risk free so as to make the total downside exposure the same as the market downside exposure. This downside exposure is the integral of the sorted distribution function from the threshold, L, to the limit of negative infinity. Mathematically it is expressed as:

$$RAP_{\Omega^2} = \frac{\int_{-\infty}^{L} F_m(x)dx}{\int_{-\infty}^{L} F_i(x)dx}\left(\mu_i - r_f\right) + r_f$$

Equation 7

F(x) = the distribution function of the returns (ranked in ascending order)

L = the threshold return

μ_i = average return of asset

r_f = risk-free interest rate

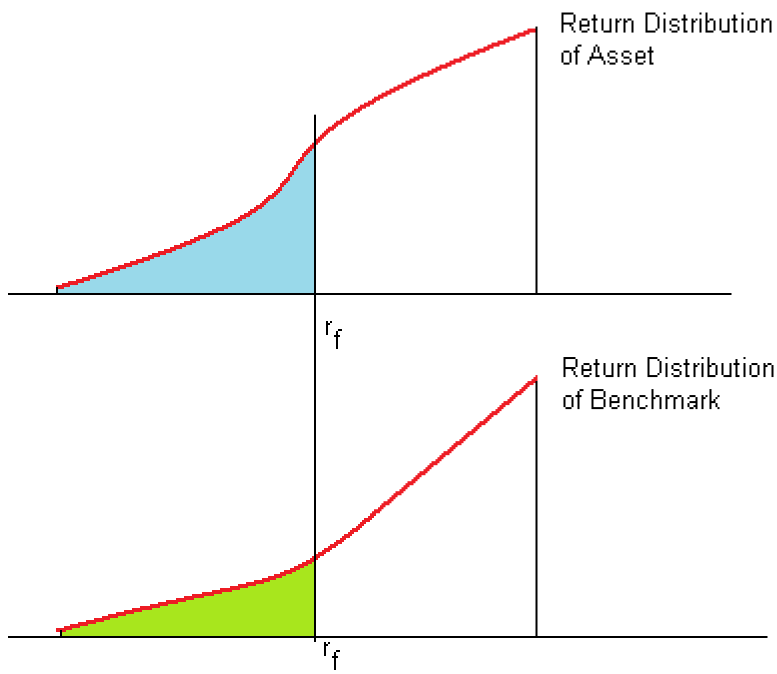

Figure 6: Graphical representation of downside ratios used in M^2 for Omega measure

In our application of this measure, the threshold used was the average annualised rate of return on the risk free asset. In effect this scales the return of the asset by the returns that fall short of the risk free rate. Shown graphically, the return of the asset is scaled by the ratio of the blue area to the green area in Figure 6.

Information Ratio

The information ratio is defined as the excess return (above the benchmark) of a fund divided by the active risk the manager takes in deviating from the benchmark. Put another way, it is the fund's alpha divided by the standard deviation of the excess returns.

From the CAPM, alpha (or Jensen's alpha) is defined as the difference between the average realized return of an active portfolio manager with private information and the returns obtained from a passive strategy of investing in the market index for the same level of systematic risk exposure. Thus a comparison of alphas only makes sense if the investments being compared have similar betas.

The alpha of a fund is given by the following equation:

$$\alpha = (R_P - R_f) - \beta \times (R_B - R_f) + e$$

Equation 8

The standard deviation, otherwise known as tracking error, is defined as residual risk, although various definitions proliferate.

As seen from the above CAPM relationship, for a single-index model, the returns of a portfolio can be represented as follows:

$R_P -= \alpha + \beta \times R_B + e$

Equation 9

R_P... portfolio returns
α... alpha
β... beta
R_B... benchmark returns
e... noise, residual risk

Taking the variance of both sides, we get

$v(R_P)^2 = \alpha + \beta^2 \times v(R_B)^2 + v(e)^2$

$v(\dots)$ = standard deviation function

With $\beta = corr(R_P, R_B) \times \frac{v(R_P)}{v(R_B)}$

Equation 10

Where $corr(R_P, R_B)$ is the correlation matrix between portfolio and returns.

$v(R_P)^2 = \alpha + corr(R_P, R_B)^2 \times v(R_P)^2 + v(e)^2$

After a few more shuffles of the equation, we can eventually isolate what we are looking for, namely the volatility of the error term, otherwise known as the residual risk.

$$TE = v(e) = v(R_P) \times \sqrt{1 - corr(R_P, R_B)^2}$$

Equation 11

Tracking error is thus defined as residual risk and is dependent on the portfolio volatility and correlation with the benchmark.

Thus, using the definitions of alpha and tracking error as worked out above, the information ratio can be expressed as follows:

$$Information\ Ratio = \frac{Excess\ Return}{Tracking\ Error}$$

Equation 12

Accordingly, each investment was ranked using the information ratio, the details of which can be found in the results section.

Results

In this section we will be dealing with the results of our performance comparison between the RAFI™40 and other investment types including the STeFI (proxy for money market or risk free investment), ALSI, average of South African general domestic equity funds and Investec's general equity fund (top performing fund out of the basket studied).

We will begin by looking at various moments of each investment's return distribution, followed by a performance appraisal using various metrics such as: Sharpe ratio, Information ratio, Sortino ratio, and Omega ratios as well as the M^2 measure.

We will also present the results of a regression between the RAFI™40 returns and an average of the returns of a basket of South African value unit trust funds to determine whether there is a value style bias in the construction of the RAFI™40 that could explain the existence of any risk adjusted out performance relative to the other types of investments.

Relative performance of RAFI™ 40

Table 5 shows return attributes of the various funds over a 14.5 year period starting January 1994, ending July 2008. The period includes a variety of market conditions consisting of at least two bear markets and two bull runs, namely the commodities boom (2002-2006), tech/internet rise and collapse (1998 -2001) as well as the recent Sub prime credit crunch. This period gives a good picture of the extremes to be expected from the market. It was the longest period of data that was available from our source at Plexus.

The first column in the table shows the nominal end value of R100 invested in January 1994 in the various funds. The RAFI™40 gave the best non-risk adjusted return over the period, and R100 invested from January 1994 to July 2008 would have grown to R 1,667.24, which is an average annual return of 21.47%. Investec's General Equity fund came a close second in non-risk adjusted returns, growing R100 to R1, 575.10, which is an annual average return of 20.94%.

Interestingly, the ALSI had the highest annual volatility of 19.97%, while it had the second lowest return, second only to holding the risk-free money market. The money market is shown to be a good proxy for the risk free rate with an annual volatility of just 0.92% over the 14.5 year period.

Investment Type	End value of R100	Ave Annual Return[15]	Annual Volatility	Annual Excess Return[16]
STeFI (Money Market)	R 535.86	12.27%	0.92%	-4.78%
RAFI™40[17]	**R 1,677.24**	**21.47%**	18.81%	**4.41%**
ALSI (benchmark)**Error! Bookmark not defined.**	R 981.03	17.06%	19.97%	0.00%
Ave of Gen UT[18]	R 1,091.14	17.92%	**16.80%**	0.86%
Investec Gen Equity**Error! Bookmark not defined.**	R 1,575.10	20.94%	18.43%	3.89%

Table 5: Return Characteristics of Alternative Investments, Jan 1994 - July 2008

The historical data for the ALSI and the RAFI™40 were not adjusted for management and performance fees, due to the limited data that that was readily accessible. This issue will be discussed separately.

[15] Returns are geometric
[16] Annual Excess Return over benchmark (ALSI)
[17] Before management and performance fees
[18] After management fees

Growth of R100

The graph below plots the nominal growth of R100 invested in each of the funds considered. It shows that Investec's General Equity fund was the highest returning fund until June 2005, which had been occasionally, marginally outperformed by the RAFI™40. Up until December 2000, Investec General Equity was the fund with the best return. Over the months until December 2005, Investec General Equity and the RAFI™ were almost in lock step. Subsequently the RAFI™40 started to outperform, with the difference being eroded since November 2007.

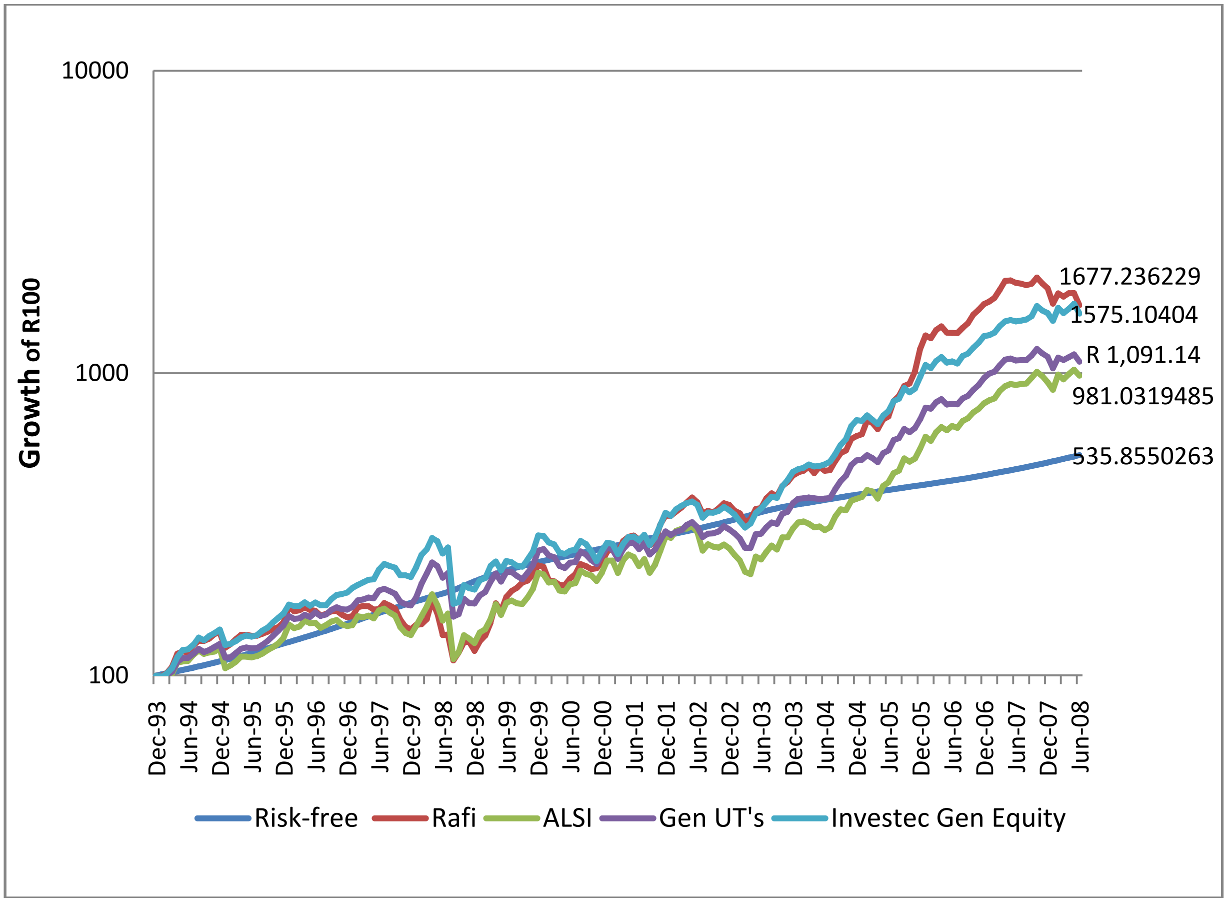

Figure 7: Nominal growth of R100

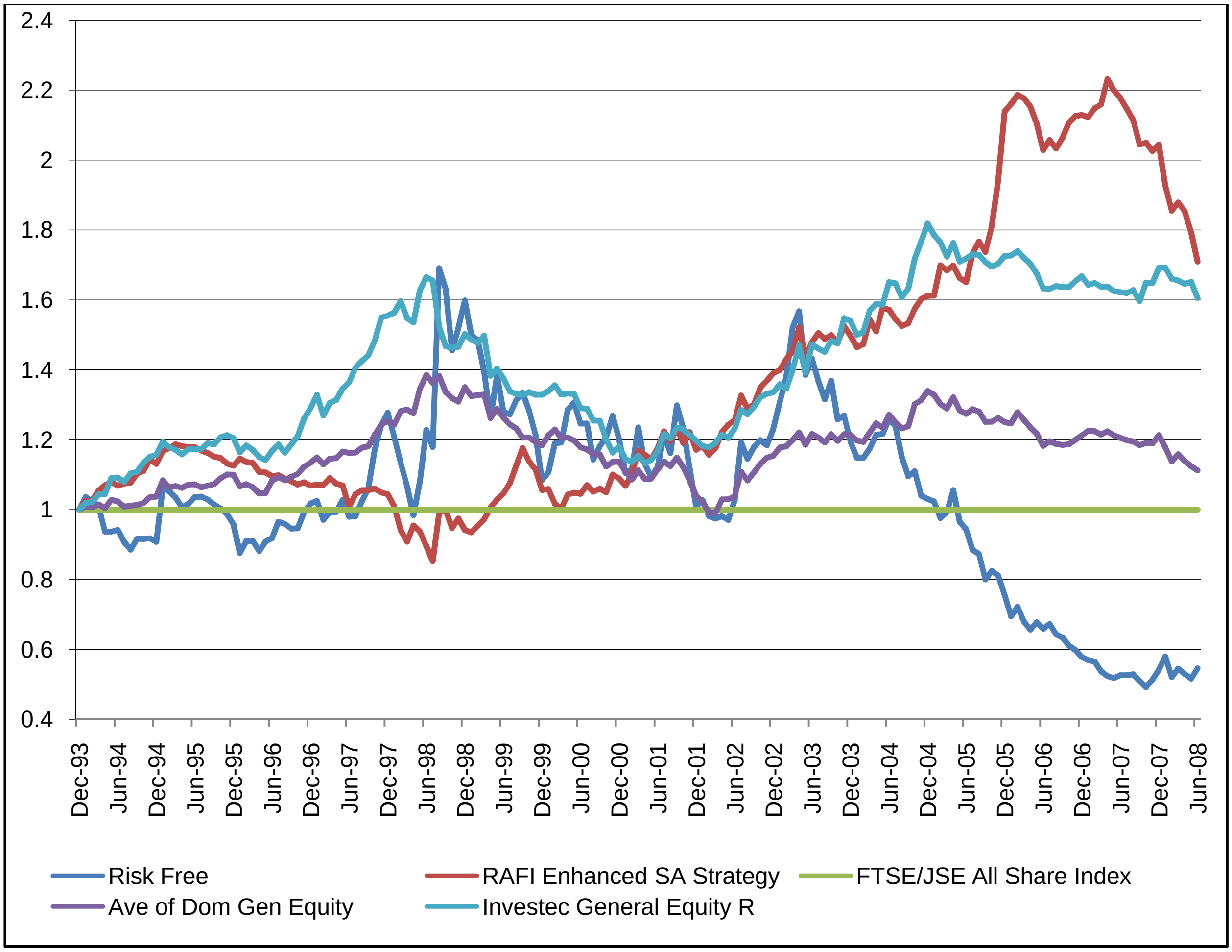

Figure 8: Cumulative Investment Performance Relative to ALSI

Performance Ratios

With respect to the Sharpe ratio, Sortino ratio and the M^2 risk adjusted return the RAFI™40 marginally beats Investec's General Equity fund. Both of these funds significantly outperform the ALSI on these measures. The same ranking is expected from the Sharpe ratio and from the M^2 risk adjusted return as they are a linear transformation of each other.

Using the Omega measure, Investec's General Equity Fund is the best with the RAFI™40 close behind. Clearly there are higher moments in the distribution that are not captured by the Sharpe ratio, Sortino ratio and the M^2 risk adjusted return which the Omega measures take into account.

Investment Type	End value of R100	Sharpe ratio	Sortino Ratio[19]	M^2	Omega	$Omega^2$
STeFI (Money Market)	R 535.86	-	-	12.27%	0.990	12.27%
RAFI™40	**R 1,677.24**	**0.489**	**0.759**	**22.03%**	1.515	22.86%
ALSI (benchmark)	R 981.03	0.239	0.340	17.06%	1.314	17.06%
Ave of Gen UT	R 1,091.14	0.336	0.469	18.98%	1.400	19.28%
Investec Gen Equity	R 1,575.10	0.470	0.647	21.66%	**1.582**	**23.12%**

Table 6: Investment performance according to ratio

Table 7 shows the higher level moments of returns, which are far from the ideal, not to be normal, as evidenced by the large excess kurtosis of Investec's General Equity fund. Omega better takes into account the expected gain and loss of the return distribution without assuming a Gaussian distribution. Thus the Omega measures are our performance ratio of choice when comparing returns between the investments analysed in this thesis.

Investment Type	Skewness	Excess Kurtosis	Monthly Return		3 Month Return		12 Month Return	
			Max	Min	Max	Min	Max	Min
STeFI (Money Market)	**0.55**	**-0.25**	1.74%	**0.58%**	5.22%	**1.77%**	19.26%	**7.35%**
RAFI™40	-0.18	1.49	18.94%	-17.81%	**44.11%**	-29.87%	**118.7%**	-34.15%
ALSI (benchmark)	-0.72	4.42	**22.13%**	-29.71%	31.69%	-33.65%	72.53%	-29.82%
Ave of Gen UT	-1.32	7.21	12.51%	-28.23%	30.65%	-31.84%	61.31%	-17.60%
Investec Gen Equity	-1.92	12.00	13.74%	-34.88%	27.73%	-37.87%	66.66%	-24.96%

Table 7: Outlier risks of Alternative Investments, Jan 1994 - July 2008

Figure 9 compares the return distribution between the RAFI™40 and Investec's General Equity Fund graphically. Note the Kurtosis and Skewness of the two investment techniques.

[19] Minimum Acceptable Return or threshold used is the Risk free rate

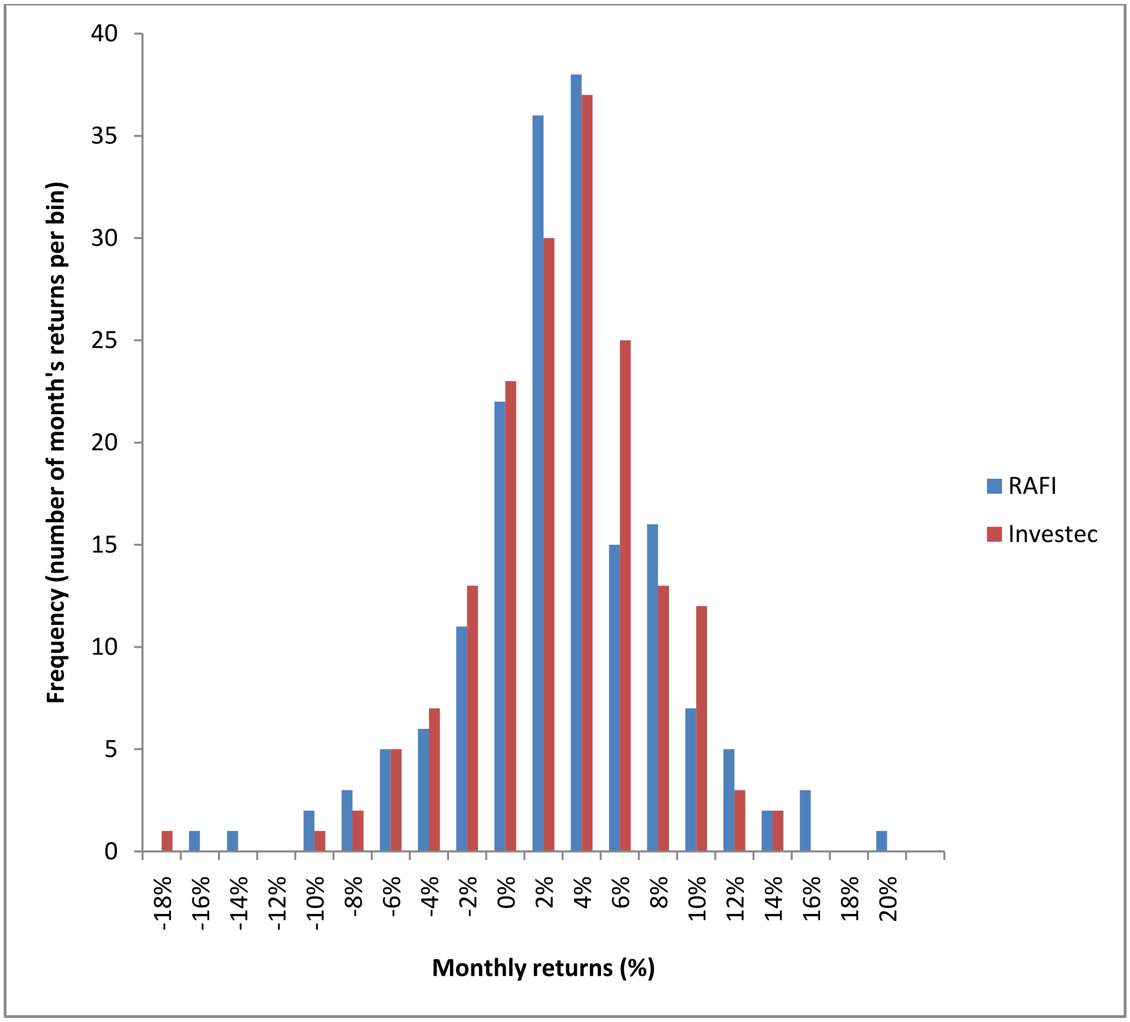

Figure 9: Histogram of Investec and RAFI™40 Monthly Returns (01/1994 – 07/2008)

Overall Investec's General Equity fund looks to have performed the best out of all the investments over the total time period when using the Omega ratio. Further substantiation of the this conclusion is provided through the close proximity in risk adjusted returns as measured by the Sharpe ratio, Sortino ratio and the M^2 risk adjusted returns of Investec's General Equity Fund when compared to the RAFI™40.

Given that the RAFI™40 results are before fees (which include a 1% annual management fee and 20% outperformance of the ALSI), it appears that Investec's active management approach is the winning investment strategy.

This conclusion, however, begs the following question: Is Investec's General Equity fund simply a random outlier amongst unit trust funds which on average more closely approximate the performance of the ALSI?

Further caution needs to be exercised when jumping to the conclusion that Investec's results will be a sustainable eventuality in the future. It cannot be said with certainty that this (or any other active portfolio) asset management house can always possess the “hot hands” which are needed to consistently outperform the broad market. The RAFI™40 is purportedly a passive investment technique requiring less skill and involved management of sophisticated human capital to deliver the supposedly superior (when compared to the ALSI) performance.

However, the RAFI™40 too is not without its shortcomings. Since the RAFI™40 is “enhanced”, with “quality of earnings” and “financial distress” filters, the exact extent to its non-discretionary nature is questionable. Furthermore, since the historic returns data of the RAFI™40 has been back-tested, we cannot say with certainty that these returns would have happened *a priori*.

Lastly, as has been demonstrated in our regression of the RAFI™40 versus the general basket of value unit trusts, most of the RAFI™40’s excess returns over the ALSI benchmark can be attributed to a strong value tilt. In his paper on fundamental indexes, Arnott proposes that this premium may be due to the market systematically mispricing value shares. The risk thus remains that the markets will arbitrage this pricing anomaly away in the future, thereby mitigating any out performance by fundamental indexes (like the RAFI™40).

CAPM Characteristics

Investment Type	End Value of R100	Corr[20]	CAPM Beta	Excess Return[21]	CAPM Alpha	Info Ratio of Alpha
STeFI (Money Market)	R 535.86	-10%	-0.0045	-4.78%	0.02%	0.024
RAFI™40	R 1,677.24	87%	0.819	**4.41%**	**5.28%**	0.568
ALSI (benchmark)	R 981.03	100%	1.000	N/A	N/A	N/A
Ave of Gen UT	R 1,091.14	95%	0.802	0.86%	1.81%	0.354
Investec Gen Equity	R 1,575.10	92%	0.851	3.89%	4.60%	**0.646**

Table 8: CAPM Characteristics of Alternative Investments

From CAPM Characteristics

it can be seen that all the equity instruments possessed a high correlation to the ALSI. Furthermore, it is evident that the RAFI™40 had the greatest value add by not completely diversifying (possessing a non-unitary beta), as is evidenced by the highest alpha. The general unit trusts only managed to add an alpha of 1.81% even though they actively took on the most non-systematic risk.

We can see that from an information ratio perspective, Investec’s General Equity fund leads the pack. This is due to the Investec’s higher correlation with the ALSI, leading to a correspondingly lower tracking error, considering factors of Equation 11:

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[20] Correlation with ALSI

[21] Annual Excess return over ALSI

$$TE = v(e) = v(R_P) \times \sqrt{1 - corr(R_P, R_B)^2}.$$

Return Characteristics

Table 9: Return Characteristics of alternative investments by 3 year period, Jan 1994 - July 2008

Investment Type	1/94-6/96	7/96-6/99	7/99-6/02	7/02-06/05	7/05-6/08
A. Geometric Return(annualised)					
STeFI (Money Market)	11.12%	**17.52%**	11.16%	10.37%	9.22%
RAFI™40	17.86%	3.61%	**27.15%**	24.33%	**32.60%**
ALSI (benchmark)	14.31%	5.22%	19.63%	13.51%	31.06%
Ave of Gen UT	17.39%	10.77%	12.05%	21.52%	25.26%
Investec Gen Equity	**20.38%**	11.12%	15.31%	**26.83%**	28.13%
B. Value added relative to ALSI					
STeFI (Money Market)	-3.19%	**12.30%**	-8.47%	-3.14%	-21.84%
RAFI™40	3.55%	-1.61%	**7.52%**	10.82%	**1.54%**
ALSI (benchmark)	0.00%	0.00%	0.00%	0.00%	0.00%
Ave of Gen UT	3.08%	5.55%	-7.58%	8.01%	-5.80%
Investec Gen Equity	**6.07%**	5.89%	-4.32%	**13.32%**	-2.93%
C. Annualised standard deviation of returns					
STeFI (Money Market)	**0.49%**	**0.53%**	**0.32%**	**0.69%**	**0.47%**
RAFI™40	13.95%	25.11%	16.11%	16.12%	20.23%
ALSI (benchmark)	14.16%	27.66%	20.67%	19.20%	15.04%
Ave of Gen UT	11.29%	24.20%	17.16%	14.37%	13.99%
Investec Gen Equity	12.14%	27.21%	18.56%	15.02%	15.40%
D. Sharpe ratio					
STeFI (Money Market)	N/A	N/A	N/A	N/A	N/A
RAFI™40	0.483	-0.554	**0.992**	0.866	1.155
ALSI (benchmark)	0.225	-0.445	0.410	0.164	**1.452**
Ave of Gen UT	0.555	-0.279	0.052	0.776	1.146
Investec Gen Equity	**0.763**	-0.235	0.224	**1.096**	1.228

In the first period, the Investec's General Equity fund takes first place from a risk adjusted returns perspective (Sharpe ratio). The investment that came out tops the most number of times (i.e. in each 3 year period) was, once again Investec. However, there was no consistently clear winner across all periods, indicating that one cannot (over the short run) and consistently (in the long term), choose the best actively managed fund or correctly time the broader market.

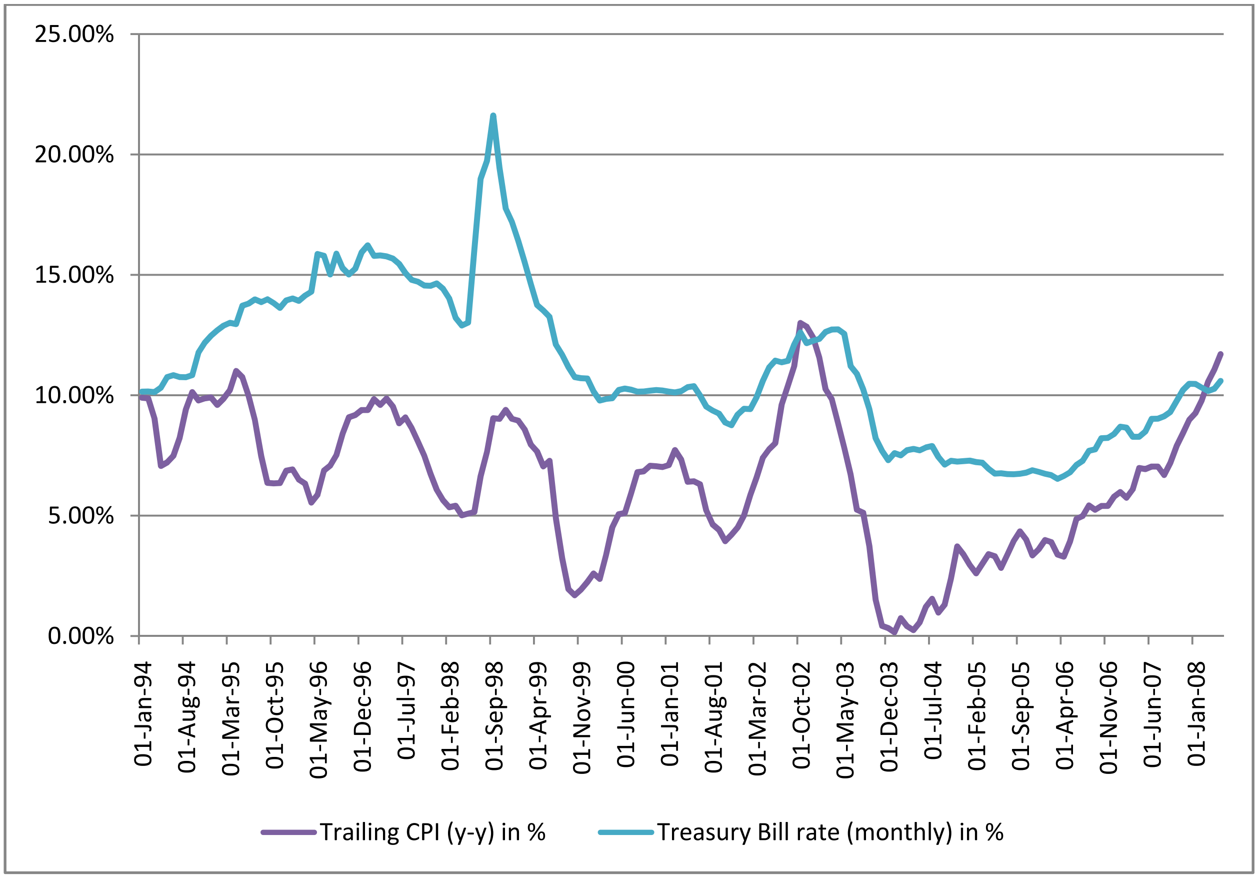

Figure 10: Graph of CPI (trailing, year on year) and Treasury Bill rate (monthly) between 1994 - 2008

During the 1996-99 Asian currency and Russian debt crisis as well as the high interest rate environment that ensued in South Africa (see Figure 10), both the RAFI™40 and ALSI were punished by investors due to emerging market contagion, general risk aversion and flight to quality (first world markets and safer instruments). This irrational pessimism affected the returns of active managers to a lesser extent due to their agility. For example, active fund managers were able to place assets in safe haven investments such as gold during high interest rates environments and into defensive shares, such as basic food retailers, and non-discretionary spend companies, (such as hospitals and tobacco firms), during recessions. This points to considerable downside protection and hidden value add by active fund managers. In the last period, the RAFI™40 and ALSI both rallied as did actively managed funds, albeit to a lesser extent.

An interesting period is July 2002 to June 2005 when the RAFI™40 dramatically diverges from the ALSI along the lines of actively managed funds. This characteristic can possibly be attributed to significant rand strength during this time, as seen in Figure 11, leading to the mining-overweight ALSI suffering relative to other more fundamentally aligned investments.

Figure 11: Rand/Dollar Exchange Rate (monthly)

The RAFI™40 – nothing more than a value tilt?

It has been widely purported that the excess returns of fundamental indexes may be due to nothing more than this investment technique being overweight value shares, such as stocks with high PE ratios, high dividend yields etc. Eugene-Fama and French proved that investing in a basket of value (and small-cap)-oriented shares will result in out performance of growth or broad based market capitalisation weighted indexes, over the long run (Fama & French, 2007).

To verify this conjecture, we performed a regression of the RAFI™40 returns using 134 monthly returns against a basket of general equity value unit trusts. The results validate this previous finding as is illustrated by the regression output tables obtained below.

Regression Statistics	
Multiple R	0.85395657
R Square	0.72924182
Adjusted R Square	0.72717496
Standard Error	0.03053022
Observations	133

ANOVA

	df	*SS*	*MS*	*F*	*Signif. F*
Regression	1	0.329	0.32887	352.827	5.55E-39
Residual	131	0.122	0.00093		
Total	132	0.451			

	Coeff	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.00131	0.00281	0.46690	0.64135	-0.00425	0.00688	-0.00425	0.00688
0.0102	0.99982	0.05323	18.7836	0.00000	0.89452	1.10511	0.89452	1.10511

Table 10: Summary for RAFI™40 regressed against average of Value Fund

The regression shows that the RAFI™40 has a beta of roughly 1 with respect to the value unit trusts, meaning a 1% jump in the returns of the basket of value unit trusts will cause a roughly 1% rise in the RAFI™40 returns. In terms of the accuracy of our regression model in explaining deviations of the data (value and RAFI™40 returns) from their sample means, our results show an R-squared of 73%, indicating that our model is fairly accurate. Statistically, the 2-sided t-test result confirms this, with a value of 18.78 obtained from the regression, indicating that the correlation is significant to well above the 99% confidence level.

Lastly, to verify whether the exposure to value was relatively constant for the duration of the review (134 months or just over 11 years), a five-year trailing (by a month) regression was performed between the RAFI™40 returns and the unit trust value returns. Our calculations show that, shifting this 5 year window by a month at a time (resulting in 75 estimates of betas, correlations and R^2's), and taking the average of these values, we get a beta value roughly equal to one (see Table 11), meaning the exposure to value is relatively constant over time and hence our finding is valid.

	Beta	Correlation	R^2
Highest	1.1223	87.51%	76.58%
Lowest	0.8878	79.56%	63.30%
Std dev	21.37%	8.82%	14.72%
Average	1.002532	83.47%	69.74%

Table 11: Five year trailed (by 1 month) regression of RAFI™40 vs unit trust value fund returns (monthly)

Conclusion

Although the RAFI™40 proved to be the best investment from a risk adjusted perspective over the entire period (14.5 years) according to three of the four performance ratios (including the Sharpe, Sortino and M^2), it is the Omega ratio that holds the most interest for us. This is because the Omega ratio, unlike the other three performance ratios mentioned above, does not limit itself to looking at one or more specific moments of the return data's distribution, but instead uses an independent method not linked to any particular characteristics of the distribution. It is thus a catch-all, encompassing all of the moments of the return's distribution, and hence carries the most weight in our eyes when determining the best performing investment.

With this in mind, our preferred metric of choice for performance comparison would be our novel Omega-squared metric, a modification of the Omega ratio very similar to the M^2 method. The reason for this modification is that it makes ranking the performance of multiple funds much more intuitive as it provides risk adjusted returns in percentages, which is easier to interpret than a ratio. Our results show that returns adjusted using the Omega squared measure for the RAFI™40 are 22.861% while the ALSI yielded 17.056%. What is significant, however, is that both these figures are before fees and hence can be compared directly (since the management fees are 1% for both). The out performance fee is not that critical, as any excess return by the RAFI™40 would still result in better returns than the ALSI. Thus, when compared to the ALSI, the RAFI™40 is a superior investment technique.

The general domestic equity funds lose out to the RAFI™40 by 3.5% when using this measure. However, it should be noted that the general domestic equity returns are net of fees and hence this conclusion is unfairly flattering for the RAFI™40. The difference is enough however that once the 1% management fee is included in the RAFI™40 returns, it will still do better than the basket of general domestic equity funds (by roughly 2.5%).

Over the 14.5 year review period, Investec's General Equity fund proved to be the star unit trust performer and hence was included in our analysis to see how the RAFI™40 measured up against the best of breeds in terms of active portfolio management. From an Omega-squared perspective, Investec managed to beat the returns of the RAFI™40 (23.12% versus 22.86% respectively), and this too net of fees. This difference amounts to an average out performance of 0.26% per annum over 14.5 years. This figure is more likely closer to 1.26%, given the 1% management fee (albeit before risk-adjustment) not included in the RAFI™40 return calculations. This still places the RAFI™40 firmly in second place versus the rest of the investments (risk-free, ALSI and General Unit Trust Basket).

Thus, our conclusion is that Investec's General Equity Unit Trust is the best performing investment from the most holistic (by including all the moments of the distribution) risk-adjusted perspective over the period in review (14.5 years from January 1994 to July 2008). However, there are notable caveats to this conclusion.

The first being that whilst Investec have proved to be fairly good at outperforming the market on a consistent basis over the 14.5 year period, there is no guarantee that they will be able to do so indefinitely and be able to create as much positive alpha in the future (old disclaimer[22] of past performance not being indicative of future returns). This may be due to existing fund managers not performing as well in the future, or incumbent talent retiring or leaving for rival firms, to name but a few human capital related risks (to mention nothing of exogenous factors).

The second is that as the asset management industry becomes more competitive, asset managers will tend to drive markets to become more efficient, meaning it will be more difficult to outperform the broad market cap-weighted index in the future.

On the other hand, one benefit of investing in an actively managed fund like Investec's General Equity Fund over the RAFI™40 is that the astute asset manager can better shelter an investor's returns during a bear phase by moving the bulk of the portfolio into defensive shares by virtue of his flexibility, whereas passive techniques allow for no or little discretion. The second 3-year period in Table 9 demonstrates this clearly as is evidenced by the ALSI's heavy underperformance (of over 12%) relative to the STEFI whilst Investec managed to add over 5% value when compared to the ALSI (with roughly the same standard deviation).

For the investor who is not convinced that asset managers (including Investec) are able to consistently outperform the market, he might be more inclined to invest in the RAFI™40 (a passive investment technique), taking heart from the fact that it earned a respectable second place out of the five investments analysed.

Advantages of following this route include the fact that, as a passive investment technique, the RAFI™40 requires little or no stock-picking skills on behalf of the asset manager and hence will not fall prey to error of judgement or human emotion.

Secondly, it does not suffer as much from human capital risk – if an asset manager leaves a firm, another can easily manage the RAFI™40 fund on his behalf with no impact on performance.

Disadvantages of choosing the RAFI™40 include the fact that this investment will tend to under perform the market during the height of a boom (when growth shares dominate). This is according to Research Affiliates newsletter (published June 2008). However, they do go on to state that RAFI™40 out performance is more pronounced in emerging markets due to slightly less efficient markets (when compared to say, the S&P). Thus, when looking at period 5 in Table 9, we see that the RAFI™40 balks the former trend and in fact outperforms the cap-weighted ALSI during the boom period that ensued.

A further risk with regards to the efficacy of the RAFI™40 as a superior investment technique (than say, the ALSI) is the fact that any out performance by the RAFI™40 is most likely due to the market mispricing value shares, and that this anomaly may disappear in the future through improved market efficiency and arbitration.

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[22] See Appendix for a copy of a typical investment disclaimer from Investec

Appendices

Investec's Fund Disclaimer

Collective investment schemes in securities (unit trusts) are generally medium to long term investments. The value of participatory interests (units) may go down as well as up and past performance is not necessarily a guide to the future.

Fluctuations or movements in exchange rates may cause the value of underlying international investments to go up or down. Unit trusts are traded at ruling prices and can engage in borrowing and scrip lending. Forward pricing is used.

Quantifiable deductions are the initial fee whilst non-quantifiable deductions included in the net asset value price may comprise brokerage, MST, auditor's fees, bank charges, trustee and custodian fees. Commissions and incentives may be paid and if so, would be included in the overall costs.

A schedule of fees and charges and maximum commissions is available on request from the company/scheme. If required, the portfolio manager may borrow up to 10% of the market value of the portfolio to bridge insufficient liquidity.

Unit trust prices are calculated on a net asset value basis, which is the total value of all assets in the portfolio including any income accrual and less any permissible deductions from the portfolio. Different classes of units apply to the fund and are subject to different fees and charges. Fund valuations take place at approximately 16h00 SA time each day.

Purchase and repurchase requests must be received by the Manager by 15h00 SA time each business day. Performance figures are based on lump sum investment (if applicable). This portfolio may be closed in order to be managed in accordance with the mandate (if applicable).

* The TER shows the percentage of the average Net Asset Value of the portfolio that was incurred as charges, levies and fees relating to the management of the portfolio. A higher TER ratio does not necessarily imply poor return, nor does a low TER imply a good return.

The current TER cannot be regarded as an indication of the future TERs. A copy of our performance fees FAQ is available at www.investecfunds.co.za. Investec Fund Managers SA Ltd, the unit trust manager, is a member of the Association of Collective Investments.

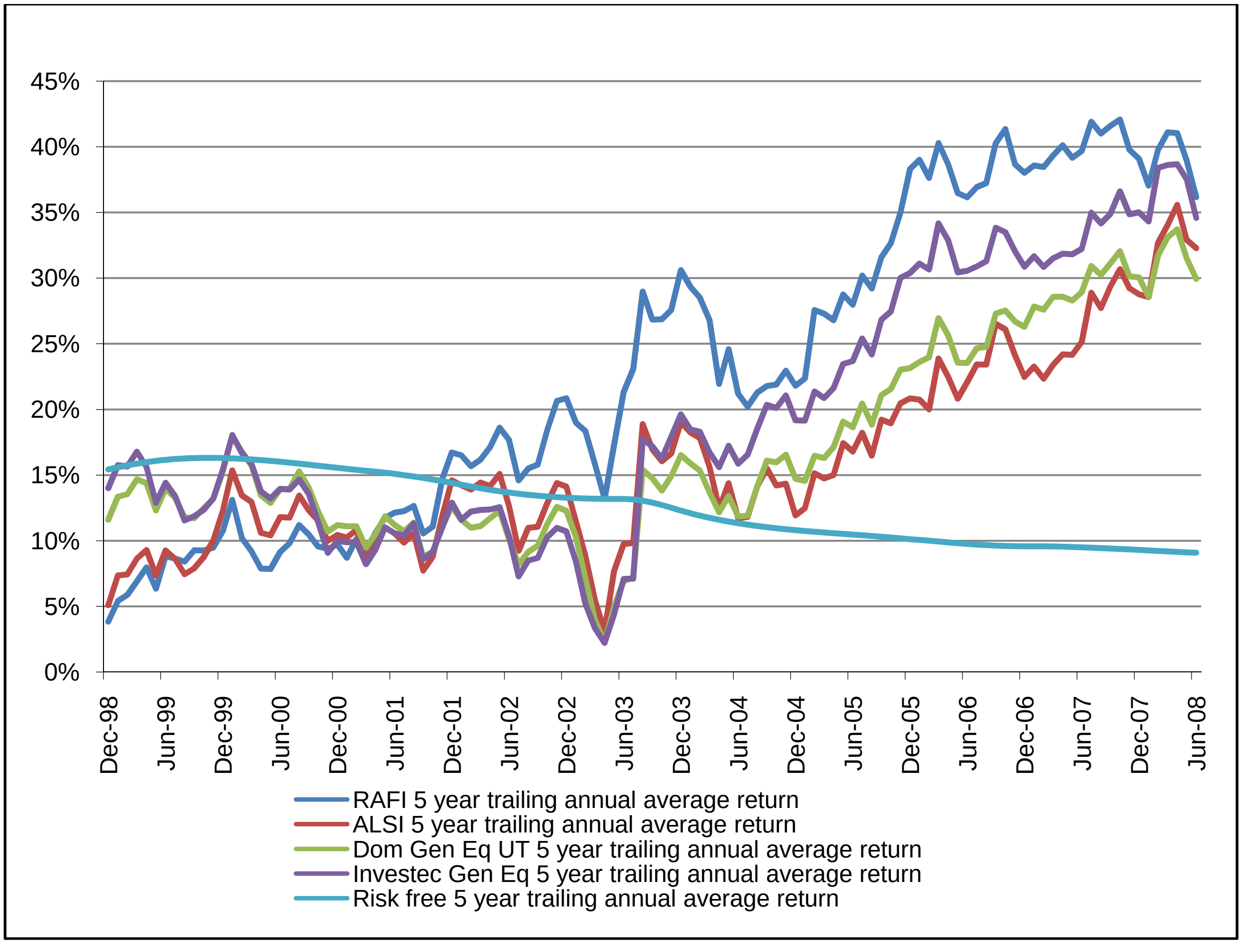

Figure 12: 5 year Trailing annual average return per investment

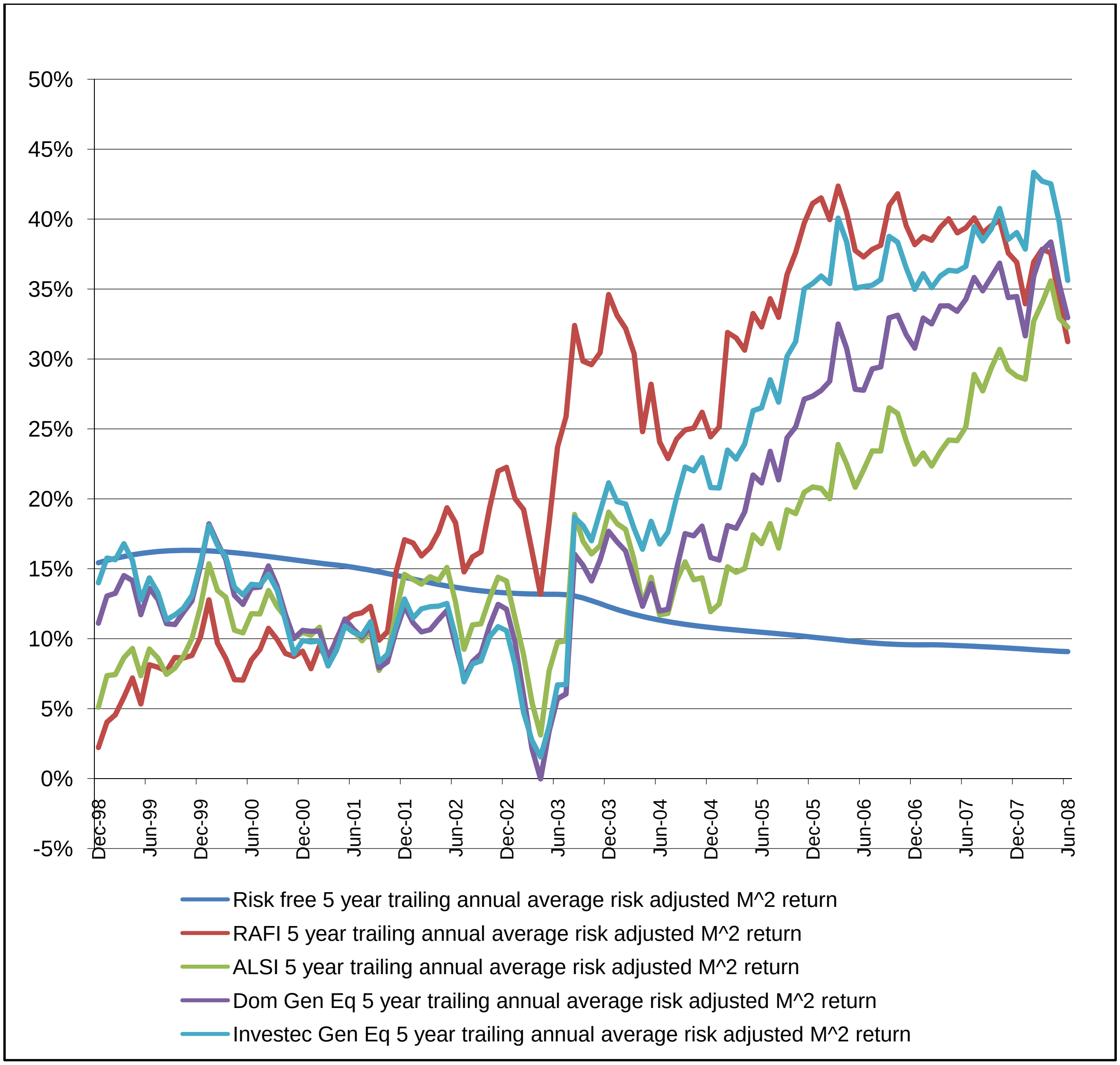

Figure 13: Trailing 5 year annual average risk adjusted (M^2) return per investment

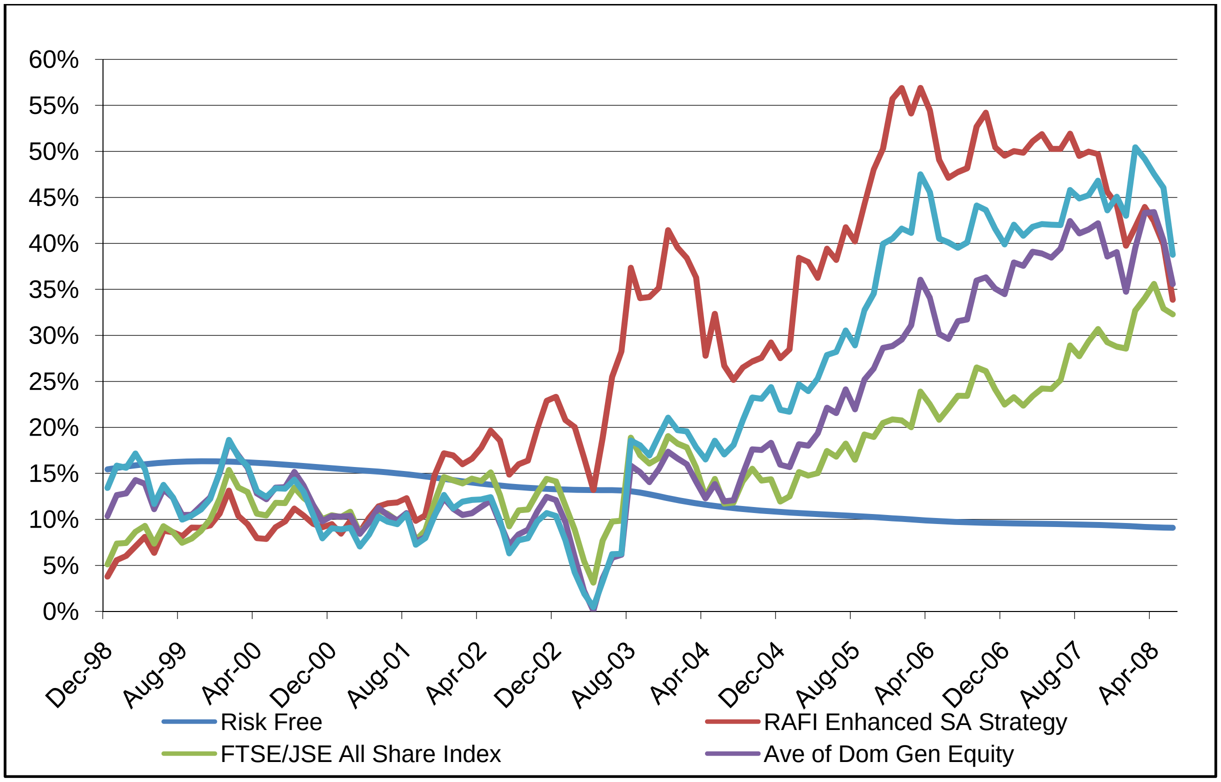

Figure 14: 5 year trailing annual average risk adjusted (Omega^2) return per investment

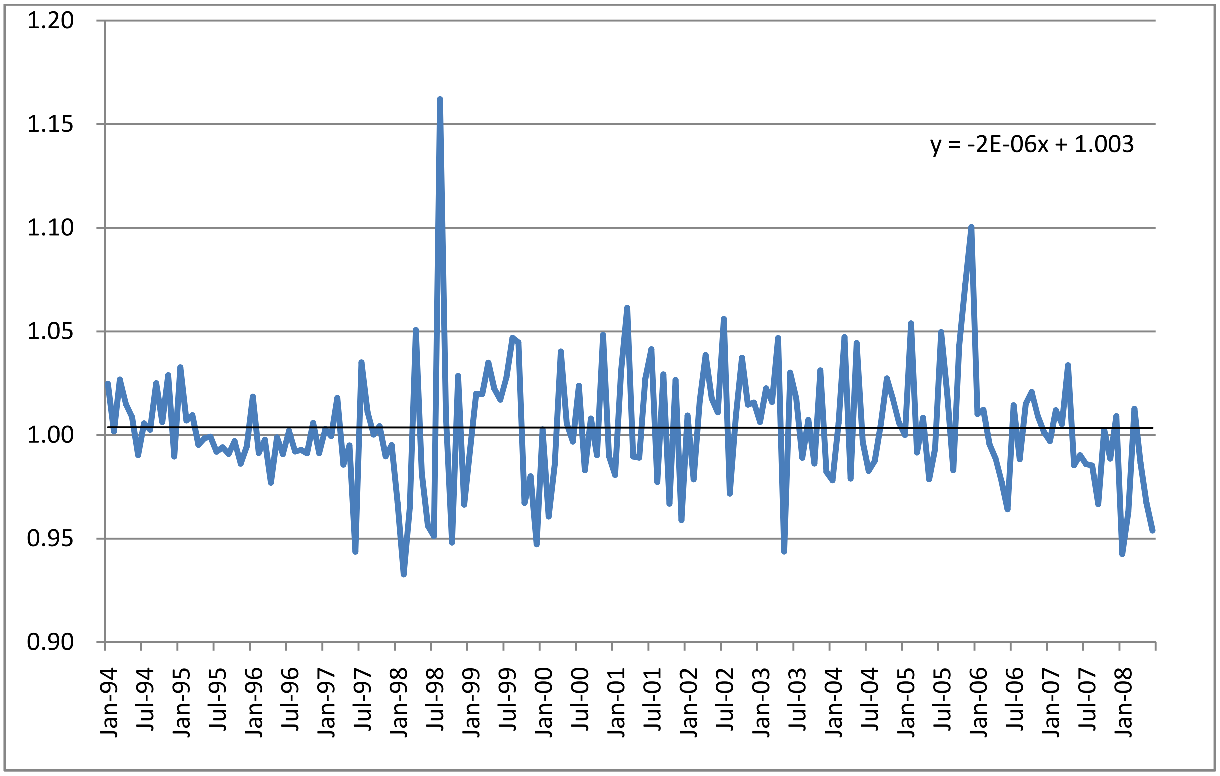

Figure 15: Reversion to a mean? (Monthly RAFI over ALSI returns)

The shape of the return distribution – Skewness and Kurtosis

The kurtosis of a data set refers to its excess peakedness about the mean and relative thickness of the tails with respect to a normal distribution. Hence in Excel, the function "kurt" refers to excess kurtosis or kurtosis greater than or equal to the value of three, the kurtosis of the normal distribution.

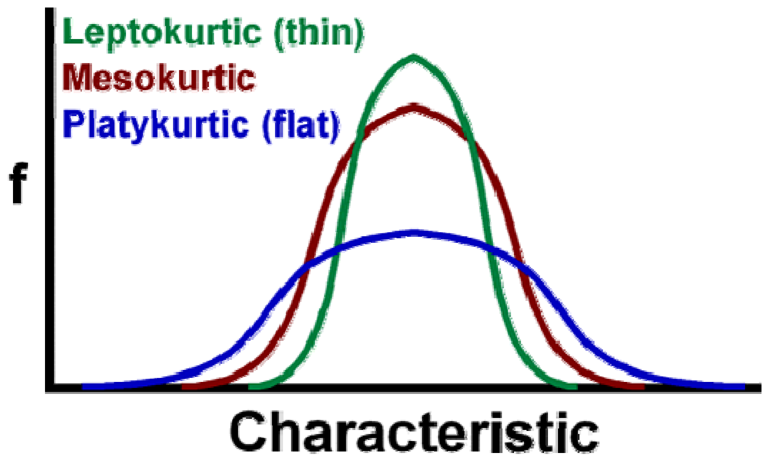

Figure 16: Illustration of Kurtosis

Higher (or very positive, i.e. >3) kurtosis means that more of the variance in returns is due to infrequent but extreme deviations, as opposed to modest but more frequent ones (Wikipedia, Kurtosis)

Skewness on the other hand is a measure of the asymmetry of the returns about the sample mean. For a normal distribution, the skewness is obviously 0. Managers look to maximize skewness as more positive returns are preferred to negative ones.

A return distribution with a very positive skewness has tails that slant more heavily towards the right and vice versa.

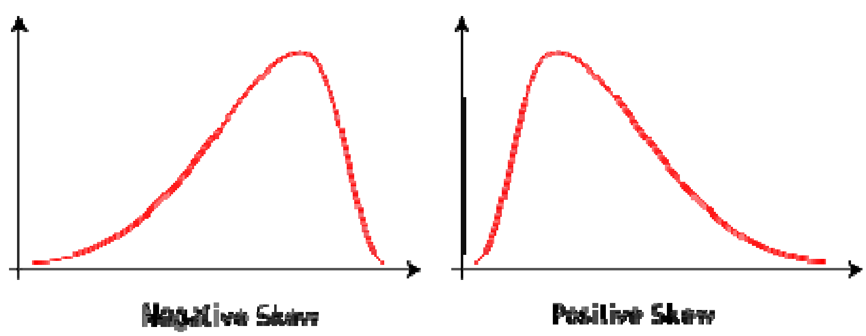

Figure 17: Illustration of Skewness

The skewness and kurtosis of a data set can best be illustrated by drawing a histogram of the return distribution for a data set. In our paper, a histogram of the returns of the RAFI™40 vs Investec's General

Managed fund is drawn for illustrative purposes, and the skewness and kurtosis of all the various investments is calculated and tabulated in the results section.

Geometric, compound and annual returns

There are two types of return, arithmetic and geometric return. For the purposes of evaluating past performance, it is correct to use geometric returns (Bruner, 1998). It is also known as time-weighted returns and is currently the preferred method with which to evaluate historical performance data according to GIPS (Global Investment Performance Standards).

The geometric or time weighted return (TWR) of a series of data is given by the following formula (Whelan, 2004):

$$R^{TWR} = \left(\frac{P_{END}}{P_{START}} - 1\right) \times 100\%$$

Equation 13

Where P_{END} is the unit price at end of period and P_{START} is the unit price at start of period.

For multiple retunes in time (for terms longer than the measurement frequency), the overall or compound return over the period can be calculated as follows:

$$R_{1-n}^{TWR} = (1 + R_1^{TWR}) \times (1 + R_2^{TWR}) \times \ldots (1 + R_n^{TWR})$$

Equation 14

Where $R_{0\text{-}n}$ is the cumulative return over n time periods, and $R_1 \ldots R_n$ is the individual return for time period 1…n.

Asset managers, statisticians and people in general are often interested in annual figures, and so in order to annualize an investment return over a period longer or shorter than a year, the following equation can be used:

$$R_{ANNUAL} = (1 + r_{0-T})^{1/T} - 1$$

Equation 15

Where R_{ANNUAL} is the annualised return over time period T, and $r_{0\text{-}T}$ is the total cumulative return over time period T.

Volatility

When we speak of investment risk, we generally refer to the standard deviation or volatility of a data set of returns. This basically measures the sample data's average variation from the sample mean. The volatility of a data set can be given by the following equation:

$$\sigma = \sqrt{\frac{1}{(T-1)}\sum_{i=1}^{T}(r_i - \mu)^2}$$

Equation 16

Where σ represent standard deviation, T the total time period (years or months), r_i is the return during time period T and μ is the average return of the sample.

Annualising volatility is relatively straight forward; the following equation can be used:

$$\sigma_{ANNUAL} = \sigma_{MONTHLY} \times \sqrt{12}$$

Equation 17

In our thesis, the totals geometric return for each investment type (RAFI™40, ALSI, basket of general domestic equity unit trusts and Investec Equity Fund R) over the entire period was calculated, as well as converted to an annual figure. The monthly volatility over 14.5 years was calculated as described above and annualized.

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