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The Price Efficiency of South African Exchange-Traded Funds

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Abstract

Exchange-traded funds (ETFs) trade at a market-determined price which may differ from their Net Asset Value (NAV), with this price deviation representing both a cost and an arbitrage opportunity for investors. This study examines the price deviations of four domestic and four foreign South African-listed ETFs. Six of these funds are found to trade at a premium to their NAV on average and two at a discount. These differences persist for more than one trading day for five of the funds; thus revealing that they are price inefficient and an opportunity exists for arbitrage. The magnitude of the deviation of the efficiently priced funds is found to be an important determinant of their trading volume and accordingly reveals the efficient execution of arbitrage.

Key words: *Exchange-traded funds, price efficiency, arbitrage, active investment, passive investment*

JEL Classification: *C58, D53, E43, G12*

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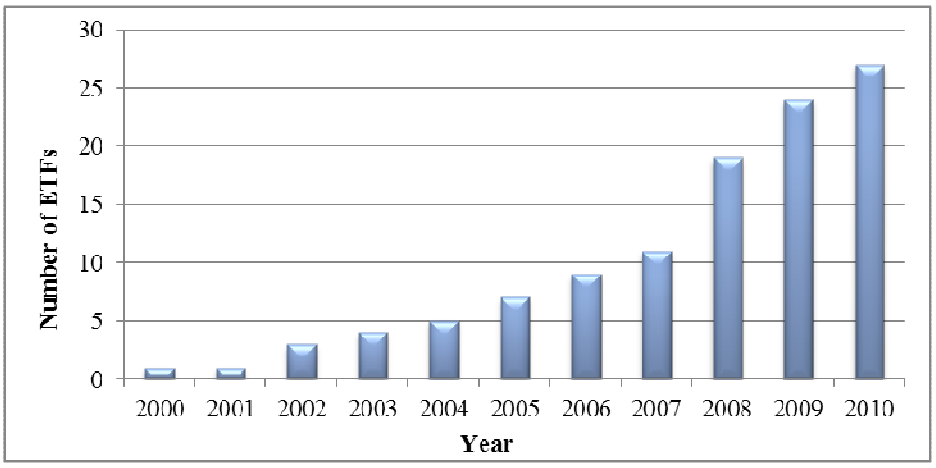
1. INTRODUCTION

The debate surrounding the informational efficiency of markets and the corresponding choice between an active or passive investment strategy has persisted for decades. However, in recent years, there has been a trend towards passive management as the higher returns earned from active management do not consistently justify the higher costs globally (see Frino and Gallagher (2002) for a review of this evidence) and in South Africa (Wessels and Krige, 2005). Traditionally for investors to follow an investment strategy that seeks to replicate the performance of the market (or a sector) they could invest in passively-managed unit trusts or index futures; however, with the emergence of ETFs investors now have an alternative.

The ETF industry has grown substantially worldwide and by 2010 consisted of assets of approximately $1 trillion with 1947 funds from 110 providers on 40 exchanges (JSE, 2010: 6). The first ETF was listed on the Johannesburg Securities Exchange (JSE) in November 2000 and although growth in the market was initially slow both in terms of investors and the creation of funds (as shown in Figure 1), the popularity of this instrument has soared in recent years, with 27 funds and a market capitalisation of R35 billion as at 31 December 2010.

Figure 1: Growth in Exchange-Traded Funds in South Africa, 2000-2010



(Source: McGregor's BFA Database, 2011)

An ETF is a basket of shares, much like a unit trust, with the fund's component shares chosen in order to replicate the returns on the benchmark index as closely as possible. The key distinction between an ETF and a unit trust is that unlike unit trusts which can only be traded once a day at their NAV, ETFs are traded on the exchange like any other share and thus can be bought or sold at any time of the day in the secondary market. In the primary market, ETF shares are created through purchasing the constituent shares and deleted by selling these shares (Gastineau, 2004: 100). However, there are transaction costs involved with creating and deleting units, and it can only be done in large quantities. As a consequence of these trading characteristics, ETFs provide several advantages compared to unit trusts including tax efficiency, lower management fees and greater transparency (for a full discussion of these advantages see Gastineau, 2002).

An ETF has two prices; the NAV, which is determined by the value of the constituent assets, and the market-determined price. It is therefore possible that the market price and NAV of the fund may differ. This has important implications for investors as it represents both a cost and an arbitrage opportunity. However, due to the ability of market participants to create and delete units in the ETF, the difference between the market price and the NAV of the fund should be small, as substantial and persistent differences can be taken advantage of to earn an arbitrage profit for investors (Elton *et al.*, 2002: 462); thus driving prices back towards their true values. Typically, institutional investors are those able to benefit from these mis-pricings as they have the financial capacity to be able to create and delete units in the large quantities that are required, which ordinary investors, on average, do not. If the deviations of price from NAV disappear within one day of trading, the funds are deemed to be price efficient; but if the deviations persist, they are considered to be price inefficient as arbitrage is not being effectively executed to drive prices back to their true value (Gallagher and Segara, 2005: 12; Rompotis, 2010: 302).

A growing body of research has been conducted on ETFs internationally, focusing primarily on the extent to which they achieve their objective of tracking the underlying index or the price efficiency of the instruments. No published research however, has been conducted on this new investment vehicle in South Africa despite the size and growth of the industry. The ETFSA organisation does provide some analysis of the tracking error of these securities, but, investors do not have any information about the price efficiency of South African ETFs. Thus the focus of this study is to consider how closely the market prices of these instruments match their underlying value both in terms of the cost to investors from purchasing overpriced assets and whether arbitrage opportunities exist because of the mispricing.

The remainder of this paper is structured as follows: Section 2 provides a brief review of studies of the price efficiency of ETFs internationally. Section 3 discusses the data, descriptive statistics and method, with the results and analysis presented thereafter. Finally, the conclusions and recommendations for future research are provided in Section 4.

2. LITERATURE REVIEW

The study of Elton *et al.* (2002) was one of the first to provide an analysis of the Spider ETF, which tracks the Standard & Poor's 500 Index. Elton *et al.* (2002: 463) found that, on average, the Spider traded at a discount of 0.018% to its NAV; although both positive and negative price differences were observed. The percentage fluctuations were found to be small, with 80% of observations falling below the absolute value of 0.2% and only 1% of observations exceeding the absolute value of 0.5%. Elton *et al.* (2002: 463) also demonstrated that the mispricing of the Spider fund disappeared within one day; thus limiting the availability of arbitrage opportunities. Moreover, it was identified that the degree of price change in the market had a highly significant positive influence on the amount of trading in the shares of the fund and thus it was concluded that arbitrage was efficiently executed.

Gallagher and Segara (2005) analysed four Australian funds and found that two traded at a premium and two at a discount on average, with the mean differences ranging between -0.0359 and 0.0635%. The daily price differences however varied more in magnitude than that observed by Elton *et al.* (2002), with only approximately 68% of the observations falling between -0.2% to 0.2%, and more than 20% exceeding the absolute value of 0.5%. Although the mean differences between the NAV and the price of the Australian ETFs exceeded those of the Spider fund, Gallagher and Segara (2005) found that the price deviations also disappeared within one day.

Studies of the price efficiency of ETFs in less developed markets have also been conducted with Lin *et al.* (2005) examining the only Taiwan ETF and Kayali (2007) the only Turkish ETF. Lin *et al.* (2005) found that the Taiwan fund traded at a premium of 0.041% on average over the one-year period examined. Greater variation in the daily premiums and discounts was observed compared to those ETFs traded in developed markets; with 37% of the observations falling in the -0.2 to 0.2% category, but only 12.5% exceeded the absolute value of 0.5%. No analysis however, was conducted to ascertain how quickly this mispricing disappeared. Kayali (2007) found that the Turkish ETF traded at a statistically significant discount on average. This deviation was found to only disappear after two trading days; thereby offering investors an arbitrage opportunity.

Jares and Lavin (2004) and Rompotis (2010) examined ETFs listed on a domestic exchange but that track a foreign index. Jares and Lavin (2004) found that the Japanese and Hong-Kong i-Shares listed on the American Stock Exchange traded at an average discount of -0.34% and -0.21% respectively over the period examined; these deviations being much larger than those identified for domestic ETFs. They also confirmed that the deviations did not disappear within one day of trading; thus signalling that these funds were not efficiently priced and an arbitrage opportunity existed. Rompotis (2010) considered 50 i-Shares traded on the Nasdaq, showing that on average the funds traded at a premium of 0.059%. Although this mean

estimate was considerably smaller in absolute terms than those of Jares and Lavin (2004), Rompotis (2010) did find that for 33 of the funds examined, the price deviation persisted for more than one trading day; thus confirming the existence of arbitrage opportunities. Hughen (2003), Harper *et al.* (2006) and Aber *et al.* (2009) confirmed that foreign funds exhibited much larger deviations than those associated with domestic funds. This finding of greater price efficiency of domestic-ETFs confirms the observation of Gastineau (2002: 231) that "…there is no reason to expect the fund's NAV, which is based on currency-adjusted closing prices for the stocks in the primary market, to match the closing fund share price in the U.S., many hours after the primary market for the stocks has closed".

3. EMPIRICAL ANALYSIS

3.1 Data and Descriptive Statistics

The two-year period from 1 July 2008 to 30 June 2010 was examined, with the eight most highly traded funds selected[i] – four domestic and four foreign ETFs. The chosen funds are listed in Table 1. Daily data was collected on the prices of the funds (high, low and closing) and volume of shares traded from McGregor's BFA Database, whilst the NAV data was obtained from Profile Media. This resulted in 501 daily observations for each series.

3.2 Price Efficiency

3.2.1 Price and Percentage Deviations

To examine whether the funds trade at a premium or discount and to assess the magnitude of these deviations, the frequency distributions of the deviations between price and NAV in both Rand and percentage terms were calculated, as shown in equations 1 and 2 respectively.

$$D_t = CP_t - NAV_t \quad (1)$$

$$PD_t = D_t / NAV_t * 100 \quad (2)$$

where: CP_t is the closing price of the fund on day t, NAV_t is the NAV of the fund, D_t is the Rand deviation, and PD_t is the percentage deviation of the fund.

Table 1: ETF Sample

Fund	Issuer	Inception Date	Underlying Index	Expense Ratio (%)
SATRIX 40	SATRIX	01/11/2000	FTSE/JSE Top 40 Index	0.45
SATRIX FINI	SATRIX	01/02/2002	FTSE/JSE Financial 15 Index	0.45
SATRIX INDI	SATRIX	20/01/2002	FTSE/JSE Industrial 25 Index	0.45
SATRIX RESI	SATRIX	10/04/2006	FTSE/JSE Resources 20 Index	0.45
DBX EUROPE	Deutsche Bank	10/10/2005	Euro Stoxx 50	1.14
DBX UK	Deutsche Bank	10/10/2005	FTSE 100	1.14
DBX USA	Deutsche Bank	01/04/2008	MSCI USA Equity	1.14
DBX WORLD	Deutsche Bank	01/04/2008	MSCI World Equity	1.14

(Source: ETFSA, 2011)

This analysis is conducted for each trading day for each fund which thus enables the number of trading days that the price of each fund lies above or below the NAV to be computed. If the price of the ETF exceeds its NAV, the fund is said to be trading at a premium and if the opposite is true the fund is said to be trading at a discount. The mean daily deviations were also computed to determine whether the fund trades at a premium or discount on average. The summary statistics of the frequency distribution for the percentage price deviations only are shown in Table 2[ii].

The SATRIX 40 and INDI were the only funds in the sample that traded at a discount on average; thus indicating that all of the foreign ETFs traded, on average, at a premium to their NAV. It is clear however, that the ETF prices do fluctuate below and above the NAV, with

the domestic funds in particular signalling an approximately equal divide between positive and negative observations. In contrast, for the foreign funds, the price lies above the NAV for at least 65% of the trading days examined. Accordingly, the average percentage discount or premium of the domestic SATRIX funds is considerably smaller than that associated with the foreign DBX Trackers. The magnitude of the mean percentage deviation of the domestic fund prices from their NAVs conform closely to the findings of the international studies at less than 0.1% per day; an absolute value average of approximately 0.04%.

Table 2: Summary Statistics from the Frequency Distribution of the Percentage ETF Closing Market Price Deviation from NAV

Fund	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	No. of Positives	No. of Negatives	No. of Zeros
SATRIX 40	-2.3626	2.4419	-0.0118	0.5042	230	242	29
SATRIX FINI	-4.7682	3.2028	0.0259	0.8291	233	220	48
SATRIX INDI	-2.0061	11.1813	-0.0742	0.7572	197	278	26
SATRIX RESI	-9.1553	9.093	0.0554	1.1419	235	252	14
DBX EUROPE	-6.818	19.4743	0.8029	1.7324	363	134	4
DBX UK	-8.0814	6.9393	0.5894	1.4104	339	161	1
DBX USA	-5.0469	21.723	1.3936	2.1948	387	109	5
DBX WORLD	-6.8719	27.5089	1.7282	2.9471	411	84	6

The mean estimates for the DBX trackers are all considerably larger than those obtained in comparative studies, including that of Jares and Lavin (2004) and Rompotis (2010). The mean differences are more than five times greater than for the SATRIX 40 or RESI, with the lowest being for the DBX FTSE fund at approximately 0.6% on average per day, and highest for the World and USA funds at 1.72 and 1.4% average daily deviations of price from NAV.

As shown in Table 2, the eight funds differ quite markedly in the range of premiums or discounts, with a number of once-off extreme differences between price and NAV

contributing to this. Despite these, on average, the range of approximately -8 to 12.5% exceeds those observed in the international studies, with Elton *et al.* (2002) and Gallagher and Segara (2005) finding that the maximum difference was approximately 2.05% and Lin *et al.* (2005) 2.5%.

There is considerable disparity across the funds with regards to the frequency with which the premiums or discounts reach these extreme values and whether the majority of observations are clustered around zero. In contrast to the study of Elton *et al.* (2002) the number of observations in this study falling within the -0.2 to 0.2% category is small, with the clustering greatest for the SATRIX 40 with approximately 40% of observations falling into this category, which is similar to that of the Taiwan fund. The remaining SATRIX funds average approximately 25% of observations in this range. For the DBX Trackers, the Europe and FTSE funds are highest with 11% and 10% respectively with the remaining two averaging 5% of observations in this range. Given the small percentage of observations that fall into this category for the South African funds, it is not surprising to find that the number of observations that exceed 0.5% in absolute value is substantial; the smallest being the SATRIX40 at 25%, the average across the other SATRIX funds being 43%; whilst the foreign funds all range between 70 and 85% of observations in this bracket. It is thus apparent that these funds exhibit substantial variation in the difference between the price and NAV, with only the SATRIX 40 closely resembling the distribution of any other studies.

3.2.2 Price Persistence

The presence of a premium or discount does not necessarily represent an arbitrage opportunity unless it persists for at least one trading day for an investor to be able to take advantage of the mispricing. The reason for using one trading day as the cut-off between efficient and inefficient pricing is due to the fact that the creation and deletion of units in the ETFs only occurs at the close of trading each day and accordingly, closing prices and NAVs

are used in the analysis rather than data at higher frequencies. To investigate the price efficiency of South African ETFs, a regression of the Rand price deviations on day t of each fund against the previous day price (t-1) deviations were conducted, as shown in equation 3.

$$D_t - \lambda_0 + \lambda_1 D_{t-1} + \varepsilon_t \quad (3)$$

The intercept estimate of this regression model should closely approximate the average difference between the price and NAV of the fund. An insignificant value for λ_1 indicates that the premium or discount does not persist and disappears within one trading day; whilst a significant value would indicate that the price deviations persist and that it is possible for investors to take advantage of these differences. Kayali (2007: 19) and Delcoure and Zhong (2007: 171) suggest that in the case of the latter, it is possible to check for persistence up to two days by adding the two-day lagged price deviation as an additional explanatory variable.

The results from this analysis are displayed in Table 3. The intercepts of the regressions closely approximate the mean values presented in the preceding table (although they are smaller in absolute value) and are significant for all the DBX Trackers, but only two of the SATRIX Funds. For three of the funds (SATRIX 40, SATRIX INDI and DBX USA), λ_1 is insignificant thereby indicating that the premium or discount disappears within a day and investors cannot take advantage of the mispricing. For the remainder of the funds, therefore, an arbitrage profit can be made from the mispricing either through creating or redeeming units of the funds. The premiums and discounts of the SATRIX FINI and RESI, and DBX World fund disappear within two days; whilst for the European and UK funds the price deviation disappears completely after three and five trading days respectively. The price efficiency of the SATRIX 40 and INDI and the DBX USA funds corresponds with the Spider fund in the U.S., the four Australian funds examined by Gallagher and Segara (2005) and a number of the i-Shares considered by Rompotis (2010). The price inefficiency of the other

funds mirrors that of Kayali (2007) for the Turkish ETF, where the premium/ discount of the fund disappeared after two days.

Table 3: Regressions of Persistence of the Price Deviations

	λ_0	λ_1	λ_2	λ_3	λ_4	λ_5
SATRIX 40	-0.00285	-0.004796				
SATRIX FINI	0.000987	0.076895*	-0.015835			
SATRIX INDI	-0.014741***	-0.025323				
SATRIX RESI	0.020340	0.125453***	0.032346			
DBX EUROPE	0.245920***	0.080449*	0.072655*	0.061424		
DBX UK	0.376338***	0.108965**	0.085026*	0.111226*	0.078919*	-0.037165
DBX USA	0.111363***	0.034474				
DBX World	0.147819***	0.178438***	-0.051030			

***, ** and * indicate significance at the 1%, 5% and 10% levels respectively.

3.2.3 Volume Analysis

The information shown in Table 4 indicates that the three funds identified to be price efficient are amongst the most frequently traded in the sample, but they also exhibit the highest daily trading volume as a percentage of shares outstanding (excluding the SATRIX RESI). The latter measurement gives a more accurate representation of trading volumes as it accounts to some extent for the substantial differences in prices of the various funds. It makes sense that those funds identified to be efficiently priced are amongst the most traded in the South Africa market; however, it is of value to consider whether there is direct causation between the volume traded and the size of the premium or discount. That is, whether the funds are priced efficiently because of the execution of arbitrage.

Elton *et al.* (2002) and Rompotis (2010) considered whether the volumes traded of the ETF on each day were affected by the magnitude of the mispricing by estimating a regression with the daily volume of the ETF as the dependent variable and proxies for the measures of risk (given the importance of ETFs as risk-control strategies) and arbitrage as explanatory variables. For this purpose, the absolute values of the daily percentage deviations of fund price from NAV were used as an estimate of arbitrage opportunities. The absolute values were computed as a profit opportunity exists provided there is a difference between the fund price and NAV, irrespective of the sign of the deviation. Market volatility is used as a proxy for times when ETFs are needed for risk control and is measured as the intraday volatility of the fund.

Table 4: Trading Volume Statistics for the South African ETFs

	Average Daily Trading Volume	Daily Volume as a % of Shares Outstanding
SATRIX 40	1333929†	0.56†
SATRIX FINI	706726	0.52
SATRIX INDI	180396†	0.67†
SATRIX RESI	129344	1.18
DBX EUROPE	66374	0.27
DBX UK	80470	0.42
DBX USA	633114†	1.28†
DBX WORLD	1321317	0.33

† Indicate the funds identified to be price efficient in the preceding analysis.

(Source: McGregor's BFA Database, 2011)

As shown in equation 4, intraday volatility provides a measure of the fluctuation in the price of the ETF between the opening and closing of trading. The regression for examining the determinants of volume employed in this study is depicted in equation 5.

$$IV_t = (HP_t - LP_t)/CP_t * 100 \quad (4)$$

$$LVolume_t = \gamma_0 + \gamma_1 IV_{t-1} + \gamma_2 |PD_{t-1}| + \omega_t \quad (5)$$

where: IV_t is the intraday volatility, HP_t is the high price of the day, LP_t is the low price of the day and $LVolume_t$ is the natural log of the daily trading volume of the ETF. Due to the fact that price deviations are measured at the end of the day, the differences should signal arbitrage opportunities for the following day and therefore are lagged one period. The same logic is applicable to intraday volatility and thus this variable is also lagged.

The regression was estimated for all funds and not only those identified to be price efficient, as it enabled the importance of the other determinants of ETF volume to be considered. The results are shown in Table 5. The intercepts are significant for all funds, which indicates that there was a significant constant proportion of shares that were traded independently of the influence of lagged intraday volatility and the premium/discount. This represents a large proportion of investors who are allocating funds towards ETFs as an investment vehicle of choice rather than to take advantage of mispricing or to use as a risk-control strategy. This is not surprising given the growth in the ETF market within South Africa as a consequence of their perceived benefits in terms of flexibility, tax efficiency and lower costs. This finding mirrors that of Elton *et al.* (2002) and Rompotis (2010).

The coefficients on the term intraday volatility are significant at the 1% level for all the SATRIX funds and at the 10% level for the DBX Euro fund only. Thus, it appears that some ETFs in South Africa are being utilised for the purposes of hedging risk; especially those that cover the most common industries and have been in existence for the longest periods. Elton *et al.* (2002: 469) found a significant coefficient for this variable in their regression, whilst the evidence from Rompotis (2010) is mixed. Finally, looking at the coefficients on the deviation term, they are only significant for the SATRIX 40 and DBX USA funds. This is in accordance with the finding in the preceding analysis that for these two funds the price deviation disappears within one day; this now being partially attributable to the efficient execution of arbitrage. The efficient pricing of the SATRIX INDI identified in the previous

analysis therefore cannot be attributed to the execution of arbitrage. For the remaining funds, trading volume was not significantly affected by the magnitude of the premium or discount of the ETF and thus investors/ speculators were not seeking to attempt to profit from this mispricing in the market. These findings mirror those of Rompotis (2010).

Table 5: Volume Analysis

	γ_0	γ_1	γ_2	R^2 (%)
SATRIX 40	13.14321***	10.26881***	20.61323*	3.26%
SATRIX FINI	11.29369***	28.87782***	-5.815346	6.28%
SATRIX INDI	9.727958***	35.47008***	-12.04664	4.72%
SATRIX RESI	10.16750***	8.988228***	-12.80065	1.51%
DBX EUROPE	8.843272***	6.828134*	1.863275	0.7%
DBX UK	6.952595***	6.403356	9.458450	0.5%
DBX USA	8.459227***	-3.710029	16.32066**	0.8%
DBX WORLD	9.184669***	-0.080117	4.791805	0.3%

***, ** and * indicate significance at the 1%, 5% and 10% levels respectively.

The R^2 estimates for the models are all low which corresponds closely to that of Rompotis (2010) but differs substantially from Elton *et al.* (2002: 469), who reported an R^2 estimate of 52% for the volume analysis of the Spider fund. Thus, it can be concluded that volatility and price deviations are not significant determinants of the volume of shares traded in ETFs in South Africa. A possible explanation for this may be the small number of institutional investors in the South African ETF market and moreover, the restrictions placed on speculating and/or short-selling and/or buying on the margin for these institutions; yet these are the investors who would have sufficient funds to be able to take advantage of the mispricing of ETFs through the creation and redemption process.

4. CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

The number of ETFs listed on the JSE has grown substantially in the past five years as these instruments offer investors a convenient and low cost mechanism for tracking the performance of a particular market or sector. This study sought to examine the extent to which the market price of ETFs deviate from their true underlying value, as this represents both an opportunity and a cost to investors.

Six of the funds examined were identified to trade at a premium on average, with only the SATRIX 40 and INDI funds trading at a discount. The percentage deviations, however, varied considerably in magnitude and sign and thus even the domestic ETFs were seen to exhibit greater variation in the difference between price and NAV than has been observed in other markets. However, the greater variation exhibited by foreign funds identified in international literature was mirrored in this study. The premiums and discounts were found to persist for more than one trading day for all funds except the SATRIX 40 and INDI and the DBX USA, where no arbitrage opportunities exist. For the remainder, the differences persist for between two and five days; thus signalling substantial profit opportunities for investors with sufficient capital. Furthermore, an examination of the determinants of the trading volume of ETFs revealed that for the SATRIX 40 and DBX USA funds the price deviation was a substantial determinant; hence confirming efficient arbitrage execution for these two funds. For the remainder, the regressions revealed that a considerable portion of the trading volume is determined independently and for only a few was risk-control an important factor.

This study therefore shows that overall the pricing of ETFs in the South African market is not efficient; thus investors purchasing ETFs must be aware of the possibility that the fund may be trading at a premium to its NAV, whilst also signalling to institutional investors that arbitrage opportunities exist with a number of these instruments. That is not to say however, that ETFs are not a viable means to achieve a passive investment strategy but simply that

their prices may not always reflect their true value. Further research into the pricing of these instruments is necessary to identify in which market price discovery occurs as well as the extent to which they actually achieve their objective of tracking the underlying benchmark.

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[i] Although the New Gold and New Rand Funds are amongst the most highly traded funds, they are not registered as collective investment schemes and accordingly no NAV data is available for these funds.

[ii] The complete frequency distributions for the Rand and percentage deviations can be obtained from the author on request.