

THE EFFECT OF THE SOUTH AFRICAN MARKET CONCENTRATION ON PORTFOLIO PERFORMANCE

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Abstract

Portfolio risk is mainly a function of portfolio concentration and covariance between the assets in a portfolio. This study shows that South Africa experiences a high level of market concentration and that assets with large weights in the FTSE/JSE All Share Index (ALSI) have large covariances with each other. Together these two phenomena suggest that a high level of portfolio risk can be expected. Active portfolio managers in South Africa generally attempt to decrease portfolio concentration by deviating from the benchmark's weighting structure in order to decrease their portfolio risk. The effect of such a portfolio construction process on the measurement of relative performance, where the ALSI is used as the benchmark, was investigated by means of a simulation process. The results indicated that during times when those shares with larger weights in the index perform well, the probability of outperforming the ALSI is very small, while the probability of outperforming the ALSI during times when those same shares perform poorly is very high. These findings suggest that investors need to be educated about the bias regarding relative performance measurement using broad market indices, while alternative or additional methods of performance measurement need to be investigated to minimise this bias.

Keywords: stock market, South Africa, performance measures

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Introduction

In general, "market concentration" is defined as the tendency of a market to be dominated by a few big companies. The literature suggests that emerging countries show much higher levels of market concentration than do developed countries (Du Plessis, 1979, Roll, 1992, Bekaert et al., 1995, Aggarwal et al., 1999, Bradfield et al., 2004). A study done by Roll (1992), for instance, showed that South Africa had the third highest level of market concentration in the world as measured by the Herfindahl-Hirschmann Index, following Mexico and New Zealand. Together with this high level of concentration, South Africa showed the highest level of equity index variance as measured by the standard deviation. In the literature it is suggested that a positive relationship exists between the level of market concentration and portfolio risk. Bradfield et al. (2004) argue that owing to this relationship between market concentration and portfolio risk, portfolio managers are inclined to deviate from the market's weighting structure in order to decrease portfolio risk, where the market is defined as the FTSE/JSE All Share Index (ALSI). During the time period from 2002 until 2007 most of the South African General Equity Unit Trust portfolio managers

outperformed the ALSI during the bear phase (a time period during which security prices fall significantly) while underperforming the ALSI during the bull phase (a time period during which security prices rise significantly). The objective of this study was to investigate the possibility of a relationship between the tendencies of portfolio managers to hold less concentrated portfolios in order to decrease portfolio risk, and their performances during different market phases.

This paper is organised as follows: First an overview of the literature on the relationship between market concentration, covariance and portfolio risk is provided. The approach followed in executing the study is discussed in the research methodology section, followed by the results of the empirical study. From these results emanate recommendations regarding the use of a broad market index such as the ALSI as a relative performance measurement technique, which is discussed in the conclusions section.

Literature overview

According to Clarke (1985), market concentration refers to the degree to which production for or in a particular market or industry is concentrated in the

hands of a few large firms. Various measures of market concentration are described by Clarke (1985) of which the best-known and most widely used measure in the literature is the Herfindahl-Hirschman Index (HHI). The HHI index was the result of two independent studies by Albert O Hirschman (1945) and Orris C Herfindahl (1950), in which each of them used their own version of what is now known as the HHI index. Since the establishment of the HHI index, some prominent economists have touted the HHI as superior to other concentration measures (Laine, 1995). In 1982 the HHI was adopted by the United States Department of Justice for measuring market concentration in governmental merger analysis. In his study on benchmark concentration regarding the FTSE 100 Index, Tabner (2007) found that a range of other measures discussed by Clarke (1985) showed time series paths that were very similar to those of the HHI index. For these reasons, it seems that the HHI index is the most appropriate concentration metric to be used in measuring market concentration, and was therefore utilised in this study.

The HHI is calculated by summing the squares of the market shares of all the participants in a given market. In mathematical terms, the HHI index can be formulated as follows:

$$HHI = \sum_{i=1}^N W_i^2 \quad (1)$$

where W_i is the market share (or investment weight) in the i^{th} counter (or company listed on the index in this case) and N is the number of securities in the index. Thus, the higher the HHI, the more concentrated the market is.

In his Nobel-prize-winning article, Markowitz (1952) has described how to combine assets into efficiently diversified portfolios. This approach assumes that variance can be used to quantify the risk of a portfolio. Against this background the terms "portfolio variance" and "portfolio risk" will be used interchangeably in this paper. Elton et al. (2003) argue that the total risk of a portfolio, using variance as the measurement, can be calculated using the following formula:

$$\sigma_p^2 = \sum_{i=1}^N w_i^2 \sigma_i^2 + \sum_{i=1}^N \sum_{j=1, j \neq i}^N w_i w_j \sigma_{ij} \quad (2)$$

where w_i is the weight of the i^{th} security in the portfolio, σ_i is the variance of security i , σ_{ij} is the covariance between securities i and j and N is the number of securities in the portfolio. Covariance is a measure of the degree to which two variables move together (DeFusco et al., 2004).

Using formulas (1) and (2), assuming that the securities are uncorrelated and have the same variance, and applying algebra, Bradfield et al. (2004)¹ derived the following formula:

$$\sigma_p^2 = \overline{\sigma_p^2} \times HHI \quad (3)$$

where $\overline{\sigma_p^2}$ is the average security variance.

Formula (3) indicates that, under these assumptions, the degree of concentration as measured by the HHI index has a direct impact on the portfolio variance and therefore portfolio risk. When these assumptions are relaxed, Elton et al. (2003) point out that portfolio variance can be expressed as follows:

$$\sigma_p^2 = \frac{1}{N} \overline{\sigma_i^2} + \frac{N-1}{N} \overline{\sigma_{ij}} \quad (4)$$

The above formula only holds, however, if the securities in the portfolio are weighted equally, i.e. when portfolio concentration is zero. The first term of formula (4) indicates that as the number of securities increase, the portfolio variance decreases, and for large N values the contribution of individual security variance to portfolio variance is insignificant. The second term indicates that for large N values the portfolio risk converges to the average covariance across the securities.

Although some (rather unrealistic) assumptions have been made by Bradfield et al. (2004) and Elton et al. (2003) in deriving equations (3) and (4), these equations show that portfolio risk is mainly a function of concentration (weighting structure) and covariance respectively (Bradfield et al., 2004). Understanding the contribution of these two components to portfolio risk and reverting back to the first term of equation (2), it can be stated that if securities with larger weights also have higher variances, portfolio risk will increase. The second term of equation (2) suggests that if securities with larger weights also have larger covariances with each other, portfolio risk will increase (Bradfield et al., 2004). In other words, if a high level of concentration is combined with high levels of variance and covariance associated with those securities contributing the most to the high level of concentration, portfolio risk will be higher. This relationship was also examined and confirmed by Bekaert et al. (1995).

Throughout the literature it seems that emerging markets, like South Africa, experience a higher degree of market concentration and therefore a higher level of market volatility compared to developed markets (Du Plessis, 1979, Roll, 1992, Bekaert et al., 1995, Aggarwal et al., 1999, Bradfield et al., 2004). One of the first studies done on the level of concentration in South Africa was that by Du Plessis (1978) who showed that economic power in South African manufacturing was highly concentrated. Roll (1992) showed that South Africa had the highest level of volatility and the third-highest degree of concentration in its national stock market out of 24 countries analysed (including both developed and emerging markets). Looking back to equation (2), these studies imply that one would expect South Africa to show a higher-than-average level of portfolio risk.

Markowitz (1952) tested the rule that the investor does (or should) consider expected return a

desirable thing, and variance of return an undesirable thing. He found that this rule is sound both as a maxim for, and hypothesis about, investment behaviour. Therefore it can be argued that a higher degree of concentration, combined with higher individual security volatility and covariances, leads to investors (and portfolio managers) making an effort to move away from these securities when constructing portfolios, in an attempt to decrease portfolio risk.

As part of their research, Bradfield et al. (2004) explore this proposition by comparing the concentration level of the ALSI, which is defined as the South African "market" for the purposes of this study, to the average concentration level of the equity component of South African General Equity Unit Trusts. They have found that the ALSI has a concentration level (as measured by the HHI) of nearly 1.5 times higher than the average concentration of the unit trusts, which highlights the aversion South African managers have to the high level of concentration in the South African market, supporting Markowitz's (1952) findings. Since active managers are paid for both return enhancement as well as risk management (or enhanced return adjusted risk outcomes), the average South African General Equity Unit Trust manager tries to move away from the highly concentrated index by either excluding some of the larger securities (measured on a market capitalisation basis) or else underweights those securities relative to the ALSI. The question is, however, if portfolio managers deliberately move away from the ALSI's weighting structure to construct less concentrated (and therefore less risky) portfolios, how will this decision affect relative performance when maintaining the ALSI as the benchmark to which portfolio results are compared?

Methodology

The research done by Du Plessis (1979), Roll (1992) and Bradfield et al. (2004) has shown that South Africa has a very high level of market concentration. Following Bradfield's approach and extending the period under review (a historical period of 3 years was used by Bradfield et al.), the level of market concentration in South Africa was measured by applying the HHI method on the ALSI. The main variable needed to calculate the HHI is the market capitalisation for each company listed on the ALSI. The data was sourced from I-NET Bridge and the FTSE-JSE directly. The annual HHI was calculated over a period of 6 years (2002 until 2007).

Next, a correlation matrix was produced over the same period to provide an indication of the level of covariance between those securities carrying the largest weights in the index. Keeping in mind that portfolio risk is a function of concentration and covariance, the results of the first two steps can be used to determine the expected level (expressed as high or low) of portfolio risk for the ALSI.

Finally the impact of the portfolio construction process, which is a function of the expected level of portfolio risk (Bradfield et al., 2004) on portfolio performance results relative to the benchmark (ALSI), was measured by means of a simulation process. Random portfolios were generated by assigning random weights to the ALSI constituents, assuming a specific tracking error (the allowed level of deviation from the ALSI). This process was repeated a thousand times each for different levels of assumed tracking error during a bear market as well as during a bull market, resulting in a thousand portfolios for each of the assumed tracking errors within the specific market phase. A distribution of the returns of these random portfolios was generated for both the bull and bear markets. The simulated portfolio returns were compared to the ALSI return, making it possible to determine whether the portfolio construction process affects the range of possible returns relative to the ALSI. For the simulation process, ALSI constituent return figures were used as the main variable, and were sourced from I-Net Bridge as well as the FTSE/JSE.

Results

The HHI was calculated for the ALSI on a monthly basis over the period 2002 until 2007. The HHI ranged between 4% and 7.3%, with an average of 5.2% over the 6-year period. This result is very much in line with the 5.3% HHI calculated by Bradfield et al. (2004) over a 3-year period. Different interpretations of the value of the HHI were found in the literature (see for example Roll, 1992 and Laine, 1995). The basic "rule" is that the higher the HHI, the more concentrated the market is. The question is whether 5.2% is high or not? Some interpretations found in the literature might suggest that this is not a meaningful number, but the following analysis of the HHI which was done for the ALSI specifically, will help to put this number into perspective.

Figure 1 shows the level of concentration as measured by the HHI for the ALSI when omitting a number of the top shares (where "top shares" are defined by market capitalisation).

Figure 1

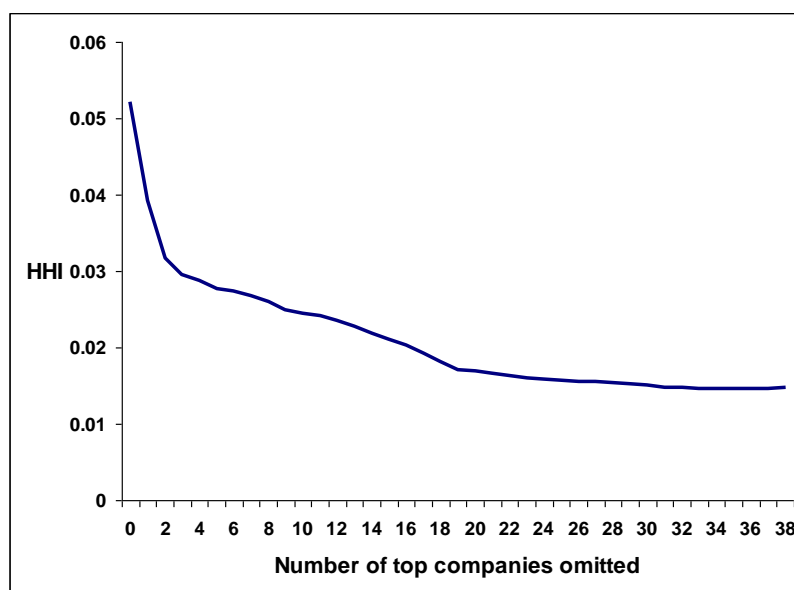


Figure 1 shows that when all the shares in the ALSI are included (this is on average 160 shares), the HHI is 5.2%. When only the top 2 shares are omitted, a steep drop in the HHI to a level of 3.2% is experienced, indicating that the top 2 shares alone contribute almost 40% to the total level of concentration. Omitting the top 5 shares results in an HHI of 2.7%, almost half of the HHI value when all the shares are included, meaning that the top 5 companies contribute almost 50% to the level of

concentration found in the index. As the number of shares that are omitted increase, the HHI decreases, but at a slower rate, until it stabilises at around 30 shares. This means that the ALSI is dominated by only a few shares, as indicated by the substantial decrease in the level of concentration when the top few shares are omitted. Table 1 was generated to further assist in the interpretation of the calculated HHI:

Table 1

		Percentage of index weight					
		100%	90%	80%	70%	60%	50%
Number of shares	1	1	0.81	0.64	0.49	0.36	0.252
	2	0.5	0.405	0.32	0.246	0.18	0.127
	3	0.333	0.27	0.214	0.164	0.12	0.085
	4	0.25	0.203	0.16	0.123	0.09	0.064
	5	0.2	0.162	0.128	0.098	0.073	0.052
	10	0.1	0.081	0.064	0.05	0.037	0.027
	15	0.067	0.054	0.043	0.033	0.025	0.018
	20	0.05	0.041	0.032	0.025	0.019	0.014
	30	0.033	0.027	0.022	0.017	0.013	0.01
	40	0.025	0.02033	0.0163	0.013	0.01	0.008
	50	0.02	0.016	0.013	0.011	0.009	0.007
100	0.01	0.008	0.007	0.006	0.006	0.0067	

The values in Table 1 represent the HHI value for a hypothetical index of 160 shares (similar to the ALSI), assuming that a specific number of shares (first column) represent a specific weight (first row) in the index, while the remainder of the 160 shares are equally weighted. For example, if it is assumed that only one share out of a total of 160 shares carries 100% of the index weight (which is the extreme case), the HHI will be 1 (or 100%). If the top 2 shares each carry a weight of 50% of the index, the HHI will be 0.5 or 50%, and so on. The highlighted HHI is the

value closest to the actual HHI value calculated for the ALSI (5.2%). The purpose of this table and the highlighted values is to compare a concentration level of 5.2% for the ALSI to different scenarios of a similar index (consisting of 160 shares) where a different number of shares contribute a specific accumulated weight in the index. In other words, the 5.2% HHI found for the ALSI is comparable to a similar index of which 20 shares (weighted equally) contribute 100% of the index weight, or put differently, the ALSI has a similar concentration level

of an equally weighted index consisting of only 20 shares. The last row shows the HHI level for an index of which the top 5 shares (weighted equally) represent 50% of the index, while the remaining 155 shares (also equally weighted) represent the other 50%. This is the closest to the actual case for the ALSI, as the top 5 shares of the ALSI (which is of course not equally weighted) represent approximately 40% to 50% (depending on the time of measurement) of the index, showing the same HHI value of 5.2% as the hypothetical index.

The number of shares in the index also has an impact on the level of the HHI. Table 2 below represents the HHI for a different number of shares in a hypothetical index which is comparable to the ALSI, and the assumption is made that the top 5 shares represent 50% of the total index (which is approximately the average aggregated weight of the top 5 shares taken over the 6-year period under review). Put differently, each row in Table 2 represents a hypothetical index, 50% of which is represented by the top 3.125% shares. The 3.125% is calculated under the assumption that the top 5 shares represent 50% of the total index weight, i.e. dividing 5 by 160.

Table 2

Number of shares in index	HHI
10	0.8258
20	0.413
30	0.275
40	0.206
50	0.165
100	0.083
160	0.052

The first row in Table 2 shows that if an index of 10 shares were assumed of which the top 3.125% of shares represented 50% of the index, the HHI would have been 0.8258. According to some of the

interpretations in the literature, this would be regarded as an extremely high level of concentration. If, for example, an index consisted of 40 shares, and the top 3.125% of shares (or 1.25 shares) represented 50% of the index, the HHI would have been 0.206, and would still be regarded as very high. Keeping the percentage of top shares representing 50% of the index constant (on 3.125%), and increasing the number of shares in the index, clearly shows (Table 2) that the HHI level decreases and is therefore a function of the number of shares in the index.

Taking the above analysis of the HHI into account and keeping in mind that the HHI is a function of a number of factors (for example the number of shares), it would seem that an HHI level of around 5.2% for the ALSI can be regarded as high, implying that the level of concentration in the ALSI is high. This means that the first component of portfolio risk, namely concentration (refer to the earlier literature overview), is expected to increase the expected level of risk.

In order to investigate the second component of portfolio risk, covariance, 6 shares that were continuously in the top 10 shares (based again on market capitalisation) over the 6-year period, were identified. At the end of August 2007, these shares represented approximately 41% of the ALSI. The actual value of the covariance is not very meaningful owing to its level of sensitivity to the scale of the variables as well as its wide range of possible values. It is therefore more useful to calculate the correlation coefficient, which measures the strength of the linear relationship between two variables (DeFusco et al., 2004). The correlation coefficient ranges from -1 to +1, where -1 indicates a perfect negative correlation, 0 indicate no linear relationship and +1 a perfect positive correlation. Table 3 represents the correlation matrix for the 6 variables identified, using monthly returns over the 6-year period.

Table 3

	AGL	BIL	SOL	RCH	SAB	OML
AGL	1					
BIL	0.714985	1				
SOL	0.542061	0.629087	1			
RCH	0.560687	0.413939	0.472906	1		
SAB	0.429364	0.30148	0.360472	0.436797	1	
OML	0.251487	0.340407	0.343229	0.598157	0.291276	1

Table 3 shows that most of the 6 shares identified tend to move closely together, indicated by the high correlation coefficients. Because of the high correlation coefficients, it can be said that the second component, namely covariance between the large capitalisation shares, can also be expected to increase the level of portfolio risk. Furthermore, these shares also have high volatility, as measured by the standard deviation, which ranges between 5.3% and 8.1%,

contributing even more to a higher expected risk level.

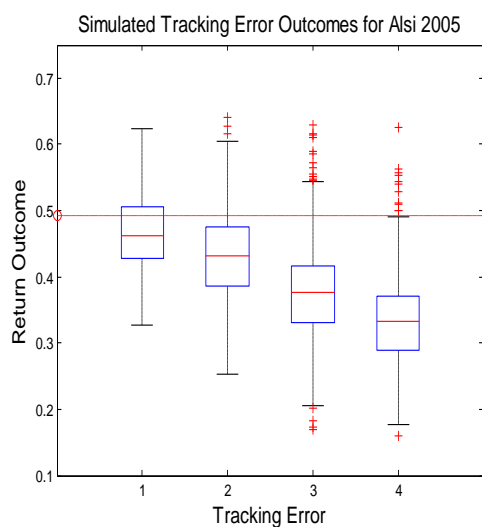
Of the two components of portfolio risk, concentration and covariance, portfolio managers can only control the concentration component by deviating from the ALSI weighting structure when constructing their portfolios (Bradfield et al., 2004). The level of deviation from the ALSI weighting structure is reflected in the tracking error. A higher

tracking error is an indication of the level and number of “bets” a manager takes by over- or underweighting the shares in his or her portfolio relative to the ALSI (in the extreme case, shares might be underweighted by 100%, meaning that the share is not included in the portfolio at all). Managers take these bets to generate alpha, i.e. a return greater than that obtained by the benchmark (or ALSI in this case). But managers also deviate from the ALSI weighting structure to decrease their portfolio risk. One way of achieving a lower level of portfolio risk is by underweighting the large capitalisation shares, and overweighting the smaller capitalisation shares. Evidently from the analysis on the two components contributing to the level of portfolio risk, by underweighting the large shares, the level of concentration will decrease, resulting in a lower level of portfolio risk. Bradfield et al. (2004) have shown that the ALSI has an HHI of nearly 1.5 times higher than the average General Equity Unit Trust fund, which emphasises the tendency of South African portfolio managers to deviate from the ALSI weighting structure, specifically underweighting the large shares, in order to obtain lower levels of concentration and therefore lower levels of risk in their portfolios. However, most of these portfolio

managers still use the ALSI as their benchmark against which their portfolio performance is measured. Using the ALSI as the benchmark creates a concern, as it seems logical to expect that if the top shares (in terms of market capitalisation) are underweighted, the portfolio will underperform the ALSI in periods during which those shares perform well, while the opposite might be true during times when those shares perform poorly.

To determine whether the deviation from the market-weighting structure does indeed result in portfolio under-performance during times when the top shares perform well, and portfolio out-performance when the top shares perform poorly, a simulation process was performed². Random portfolios were generated, and sorted into risk profiles according to tracking error bands. One thousand random portfolios were constructed to derive the manager’s opportunity set (i.e. the range of possible returns for the manager, given the level of tracking error) around the ALSI for 2005. This period can be considered a bull phase, as the ALSI returned approximately 47% for the year. The results are presented in the boxplot in Figure 2.

Figure 2



In Figure 2 horizontal lines are drawn at the median (the lines within each “box”) and at the upper and lower quartiles (the top and bottom lines of each “box”). The vertical line is drawn up from the upper quartile, and down from the lower quartile, to the most extreme data point that is within a distance of 1.5 times the interquartile range (IQR).

The horizontal dotted line represents the ALSI return for 2005. When a tracking error of one is assumed, the boxplot shows that the ALSI return lies within the upper end of the upper quartile of the range of possible returns, indicating that there was a small chance (less than 25%) for a manager to outperform the ALSI, given that he or she does not deviate too much (i.e. assuming a low tracking error) from the ALSI weighting structure. The higher the assumed

tracking error, the smaller is the chance of outperforming the ALSI. For a tracking error of 4, for example, it is almost impossible to outperform the ALSI during this period, shown by the ALSI return lying at a distance of approximately 1.5 times the IQR from the upper quartile. These simulation results suggest that the more a fund manager is deviating from the highly concentrated top performing shares in the ALSI, the more likely it is that he would have underperformed the ALSI.

The same simulation process was performed during a bear phase. The ALSI showed a return of approximately -8% during 2002, which is the period chosen to represent the bear phase for the simulation process. The results of this analysis are provided in the boxplot in figure 3.

Figure 3

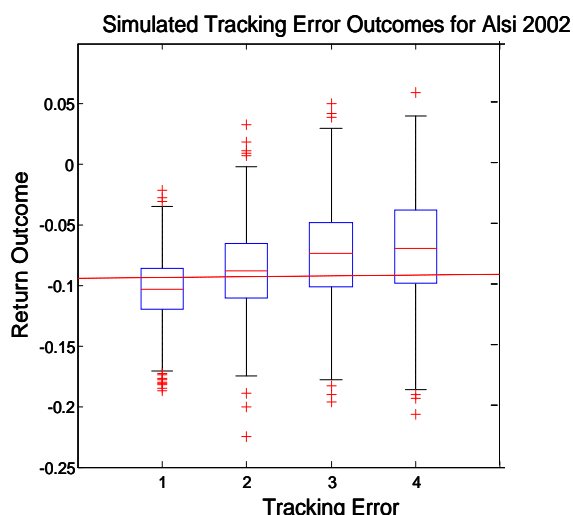


Figure 3 shows that during a bear phase, the opposite results from those obtained during the bull phase analysis can be expected with regard to manager performance. For an assumed tracking error of one, the chance of outperforming the ALSI is more or less the same as during a bull phase (refer Figure 2). However, even the median random portfolio outperforms the ALSI when the tracking error is assumed to be 2, while the number of random portfolios outperforming the ALSI when the tracking error is assumed to be 3, moves towards the 75% mark. Figure 3 indicates that continuing to increase the assumed tracking error results in an increasing probability of outperforming the ALSI. Thus the more the manager deviates from the large capitalisation shares that are performing poorly (and therefore are driving the bear phase), the higher the chance of outperformance.

Conclusion

Following the approach by Bradfield et al. (2004), this study shows that portfolio risk is mainly a function of portfolio concentration and covariance between the assets in the portfolio. Using the Herfindahl-Hirschman Index as a measure of concentration and the All Share Index as the market, the first component, concentration, was investigated and it was found that South Africa experiences a high level of market concentration. The second component, covariance, was investigated by means of a correlation matrix, showing the correlation coefficients of the top 6 shares (according to market capitalisation) of the ALSI over a period of 6 years. These coefficients were generally high, which means that those shares with large weights in the index also tend to move closely together. Combined, these two components suggest that a high level of portfolio risk (assuming the ALSI as the market portfolio) can be expected. As was argued by Bradfield et al. (2004), most South African portfolio managers underweight the large capitalisation shares of the ALSI to decrease their portfolio risk by holding a less concentrated

portfolio. The effect of such a portfolio construction process on the measurement of relative performance, where the ALSI is used as the benchmark, was investigated by means of a simulation process. Random portfolios were generated and sorted into risk profiles according to tracking error bands. The simulation process showed that managers find it very difficult to outperform the ALSI during bull phases, while almost any manager (even investors who are not professional portfolio managers as suggested by the random portfolios created) can outperform the ALSI during a bear phase. These results imply that using the ALSI as the one-and-only yardstick to measure the performance of General Equity Unit Trust portfolio managers is biased. Unfortunately this is the most commonly used method for determining manager performance and skill, as it is easy to understand and very simple to interpret. If the manager underperforms the ALSI, it is a reflection of poor skill; if he outperforms, he gets praised for his above-average ability to pick the right shares. However, the simulation process illustrates that out- or underperformance of the ALSI during a specific phase doesn't have a lot to do with skill, but can rather be ascribed to the manager's attempt to move away from portfolio risk by holding less concentrated portfolios. Therefore using an index such as the ALSI as a measurement of performance, a manager can be regarded as very skilful one year, but incompetent the very next year. The question therefore is whether using the ALSI as the main approach to measure manager performance is fair, as it seems that portfolio performance is dominated more by the effect of market concentration than manager skill. To address this bias, it seems necessary to educate investors about this phenomenon and to investigate or create alternative or at least additional methods that can be used to measure manager performance. It also highlights the inherent dangers in constructing active mandates based on pre-specified tracking errors, since these often force fund managers to take unintended bets, resulting in unintended performance biases.

Footnotes

¹Permission was obtained from Professor David Bradfield to quote their article "Concentration – Should we be mindful of it?" The article is unpublished and intended for clients of Cadiz Financial Strategists only. Professor Bradfield is the Team Leader of the Quantitative Research team at Cadiz Financial Strategists.

² The simulation process was performed by means of a simulation model developed and used by Advantage Asset Managers.

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