PORTFOLIO
INSIGHTS

Sustainable Insight
CAPITAL MANAGEMENT

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Diversification vs. Concentration:

The effect of number of stocks and active share on portfolio risk

The two sides of the debate

The majority of investors feel reassured by portfolios which hold a diverse set of securities, adhering to the belief that the investor should not put all their eggs into one basket. Such a notion is widely supported by the business school community when discussing portfolio theory, in which investors strive to achieve the optimum balance between risk and return (the efficient frontier). Under the assumption that correlations are not perfect (i.e. equal to 1), multiple securities in a portfolio diversify away the specific component of portfolio risk.

> Multiple securities in a portfolio diversify away the specific component of portfolio risk

Of course adding additional stocks will in the end only reduce risk to a point, market risk will still exist within the portfolio. Diversification results in lessening the impact from each individual component and therefore mutes portfolio volatility.

FINRA warns investors about the dangers of concentration risk and provides suggestions on how to manage this[1]. It should be noted that the concentration risk in a portfolio may change over time. For example, if a stock performs extremely well relative to other stocks in the portfolio, the investor could find that this single position constitutes an increasing portion of the portfolio.

In other words, a high return in one stock has increased the marginal risk associated with the position of the stock in the portfolio. Note that an exception to this is when the stock position has a negative marginal contribution to tracking error in which case an increase in the active exposure would decrease tracking error.

However not all investors agree on the necessity of diversification. It is possible to over-diversify a portfolio whereby adding more stocks has limited, if any, marginal effect on portfolio volatility and the large number of securities held means that no single investment has any meaningful impact on the portfolio return. Furthermore, the requirement to buy and sell more securities is likely to push up the transaction costs of the portfolio impacting the net return of the fund.

Warren Buffett warns that diversification can be a '*low hazard, low return*' strategy. He adds, "*Wide diversification is only required when investors do not understand what they are doing*." Some investors are wary of active managers who hold too many stocks, fearing that they are 'benchmark huggers' or 'closet indexers'. As most active managers charge higher management fees than their passive competitors, on a net of fees basis the investor may have been better served purchasing the lower expensed index fund.

> Wide diversification is only required when investors do not understand what they are doing.
>
> –Warren Buffett on diversification

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1 www.finra.org/Investors/martInvesting/AdvancedInvesting/ConcentrateonConcentrationRisk/

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Defining our terms

Before considering the diversification versus concentration question in more detail, we need to define a few terms which we will use to explore this matter.

One of the most common portfolio measures used by investors and active asset managers is **tracking error**. Tracking error is also referred to as **active risk** and these terms are often used interchangeably. Tracking error is the estimator of active volatility, i.e. volatility relative to a benchmark portfolio, and is calculated as the standard deviation of the active returns of the managed portfolio, where active return is defined as the return difference between the managed and benchmark portfolios, usually based on monthly data.

An active portfolio manager is attempting to maximize **active return** subject to targeting and controlling tracking error. By way of contrast, a passive manager is endeavoring to minimize tracking error as much as possible and is striving to achieve benchmark-like returns. When tracking error is estimated historically it is termed 'realized' or 'ex-post' tracking error; if a risk model is being used to forecast tracking error it is termed 'ex-ante' tracking error. Tracking error is typically expressed as an annualized percentage.

For the sake of clarity we wish to make clear the difference between **total risk** and **active risk** of a portfolio. Our experience is that the two measures are sometimes confused.

As we have stated above, active risk refers to risk which can be attributed to active management decisions, i.e. active risk is a function of the differences between the managed portfolio and the benchmark portfolio. In contrast, total risk is calculated as the standard deviation of total returns of the managed portfolio, i.e. no comparison to any benchmark is made.

> Our experience is that total risk and active risk are sometimes confused.

Later in this research we refer to **active beta**. **Beta** is a measure of a portfolio's sensitivity to the market portfolio (we will assume that the market portfolio is represented by the benchmark portfolio). By definition the beta of the benchmark equals 1. A portfolio with a beta less than 1 indicates it is less sensitive to market moves, whereas a portfolio with a beta greater than 1, indicates a greater sensitivity to the market. Active beta measures the difference between the portfolio beta and the benchmark beta (which equals 1).

The final term we would like to define is **active share**. This quantity is calculated as half the sum of the absolute values of the differences in portfolio and benchmark weights. Active share ranges in value from 0% to a maximum of 100%. Higher active share values imply large deviations away from the benchmark. A value of 0% implies the manager is passive. The measure is designed to determine the degree of active management in a portfolio. There is an ongoing discussion as to whether portfolio managers should be required to release active share data on their funds.

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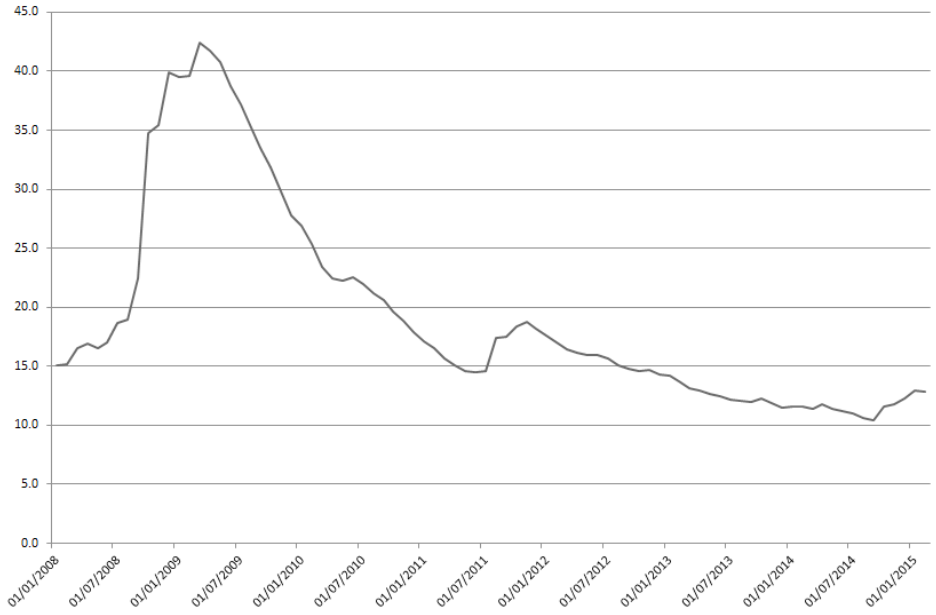
Defining our methodology

In the charts below data is sourced from the S&P 500 index. All forecast tracking error data shown in the analysis is sourced from MSCI Barra's multi-factor equity models[2], as at 30 March 2009 and 31 December 2014.

We use simulation techniques to draw out and interpret the relationships amongst number of stocks, tracking error, and active share. The simulations are run 100 times and include portfolios that contain from 20 to 480 stocks. We show different time periods to demonstrate the sensitivity of the results to changes in the overall level of market volatility. See *Figure 1*.

FIGURE 1: S&P500 INDEX FORECAST TOTAL VOLATILITY (2008-2014)



Source: MSCI Barra, SICM

2 www.msci.com/products/portfolio_management_analytics/equity_models/

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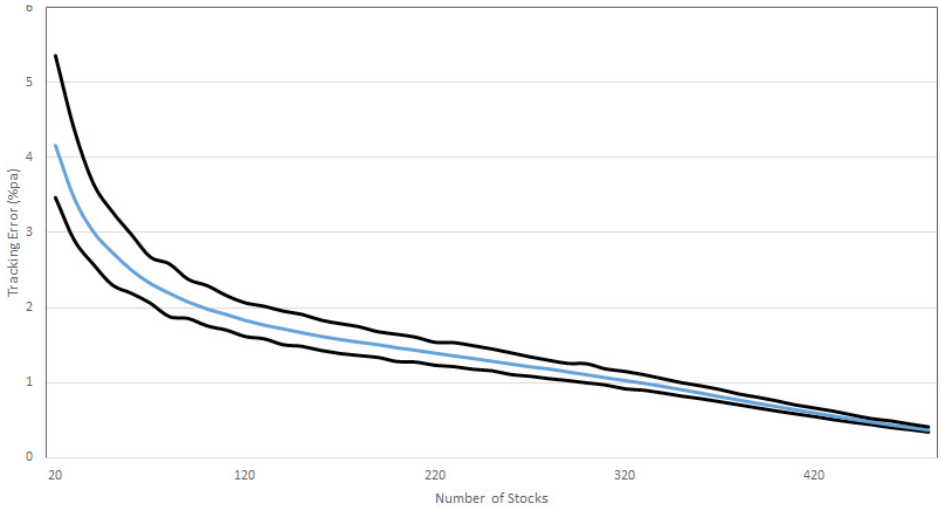
Risk Measure 1: Number of stocks

Firstly we would like to discuss the importance of the number of stocks held in a portfolio and to consider the adequacy of this measure as an indicator of the risk associated with a portfolio. In the analysis that follows we will always be using active variables, i.e. tracking error and active share. *Figure 2* illustrates the relationship between the number of stocks held in an actively managed portfolio (on the horizontal axis) versus the portfolio ex-ante tracking error measured against the S&P 500 Index (on the vertical axis). The blue line shows the median values of the relationship while the upper black line shows the maximum values and the lower black line the minimum values.

It is clear that holding portfolios with lower numbers of stocks leads to higher tracking error values. This result supports the argument proclaiming the benefits of diversification. However, as we can see from *Figure 2*, the relationship between stock numbers and tracking error is not a linear one, and, as we will see shortly, it is also not stationary in time.

A median tracking error of 3% pa against the S&P 500 was achieved with 40 stocks. Fixing the number of stocks does not provide a robust method of controlling portfolio active risk, or for that matter, total risk. If the investor's active risk appetite is for a maximum tracking error of 3% pa we will see how the number of stocks required to maintain this level needs to be adjusted as underlying market volatility changes over time. So there is a question of how to define risk appetite. Using stock numbers as a proxy for risk measurement and management does not appear to be a consistent measure.

FIGURE 2: RELATIONSHIP BETWEEN NUMBER OF STOCKS AND EX-ANTE TRACKING ERROR (S&P 500) AS AT 31 DECEMBER 2014



S&P500 Index constituents only. All ex-ante risk data is from Barra multi-factor equity models, dated 31 December 2014. Each simulation has been run 100 times. Active portfolios hold from 20 to 480 stocks.

Source: S&P 500 Index constituents, MSCI Barra, SICM analysis

> As market volatility varies over time, the relationship between stock numbers and tracking error changes

As noted above, as market volatility varies over time, the relationship between stock numbers and tracking error changes. To illustrate this point, compare the same analysis using March 30, 2009 data (*Figure 3*) when ex-ante total risk of the S&P 500 peaked at 42.4% pa. We also show the December 31, 2014 data repeated in *Figure 4* with the vertical scale set to be the same as in *Figure 3*, when market volatility was highest.

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What is obvious in *Figure 3* are the much higher levels of tracking error in March 2009, where we now experience a median tracking error of 16% pa when holding 40 stocks. To generate a median tracking error of 3% pa in March 2009 the active portfolio would have had to hold 350 stocks.

When considering the number of stocks as a measure of diversification and hence risk control, suppose we construct a portfolio that holds 100 stocks. If we compare tracking error levels in March 2009 (11% pa) and December 2014 (2% pa), can we claim to be equally diversified in both instances?

Using a simple measure like the number of stocks held in a portfolio is an inadequate measure of portfolio active risk.

For example, the range of the tracking error when holding 50 stocks in December 2014 was 2.4% pa to 3.2% pa, whilst in March 2009 a 50 stock portfolio produced tracking errors in the range 13% pa to 17% pa. Would an asset owner be satisfied that they are equivalently diversified in these cases? It appears that using a simple measure like the number of stocks held in a portfolio is an inadequate measure of portfolio active risk.

FIGURE 3: RELATIONSHIP BETWEEN NUMBER OF STOCKS AND TRACKING ERROR (S&P 500) IN MARCH 2009

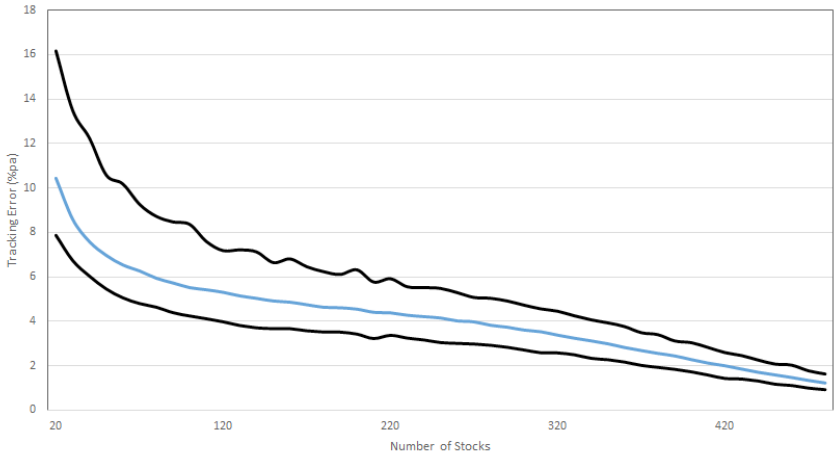
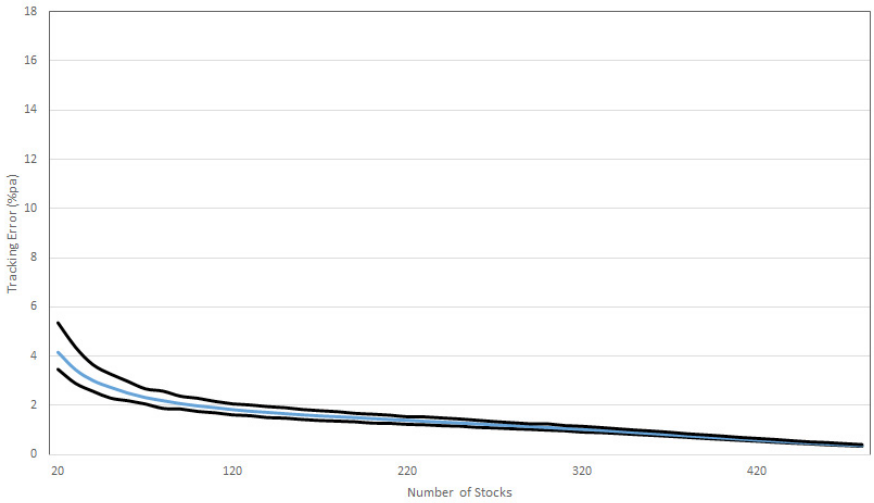


FIGURE 4: RELATIONSHIP BETWEEN NUMBER OF STOCKS AND TRACKING ERROR (S&P 500) IN DECEMBER 2014 ON SAME SCALE AS MARCH 2009 RESULTS



Note in both figures the blue line is the median value, the upper black line the maximum values and the lower black line the minimum values. Analysis uses S&P500 Index constituents only. All risk data is from Barra multi-factor equity models, date as indicated in the figure title . Each simulation has been run 100 times

Source for Figure 3, 4: S&P 500 Index constituents, MSCI Barra, SICM analysis

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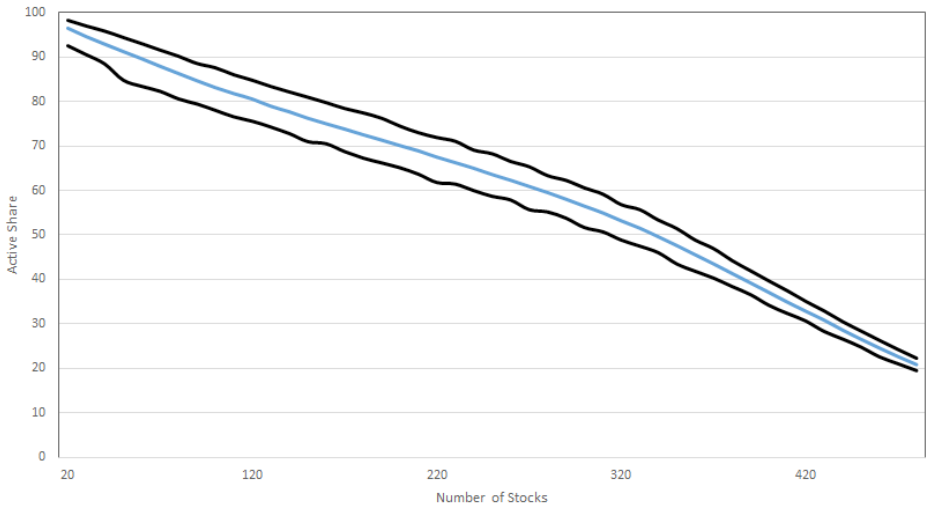
Risk Measure 2: Active share

Next, consider the relationship between the number of stocks held in the portfolio and the active share of the portfolio. In *Figure 5* we show the relationship between the number of stocks on the horizontal axis and active share on the vertical axis. As fewer stocks are held in the portfolio, the active share rises towards 100%.

It is immediately noticeable that the relationship between number of stocks held in the portfolio and the active share is more linear in nature than observed for stock numbers and tracking errors in *Figure 2*. At 40 stocks in the active portfolio, the median active share achieved is 93%, and the range of active share values is 87% to 96%. This would indicate the asset manager is managing the portfolio in a highly active way.

Note that the active share calculation is time independent and also independent of market volatility. These facts closely relate active share and stock numbers as risk measurements and results in both measures to suffering from similar limitations in terms of accurately depicting the volatility environment which the asset owner and manager find themselves.

FIGURE 5: RELATIONSHIP BETWEEN NUMBER OF STOCKS AND ACTIVE SHARE (S&P 500)



Note the blue line is the median value, the upper black line the maximum values and the lower black line the minimum values. Analysis uses S&P500 Index constituents only. Each simulation has been run 100 times

Source: S&P 500 Index constituents, MSCI Barra, SICM analysis

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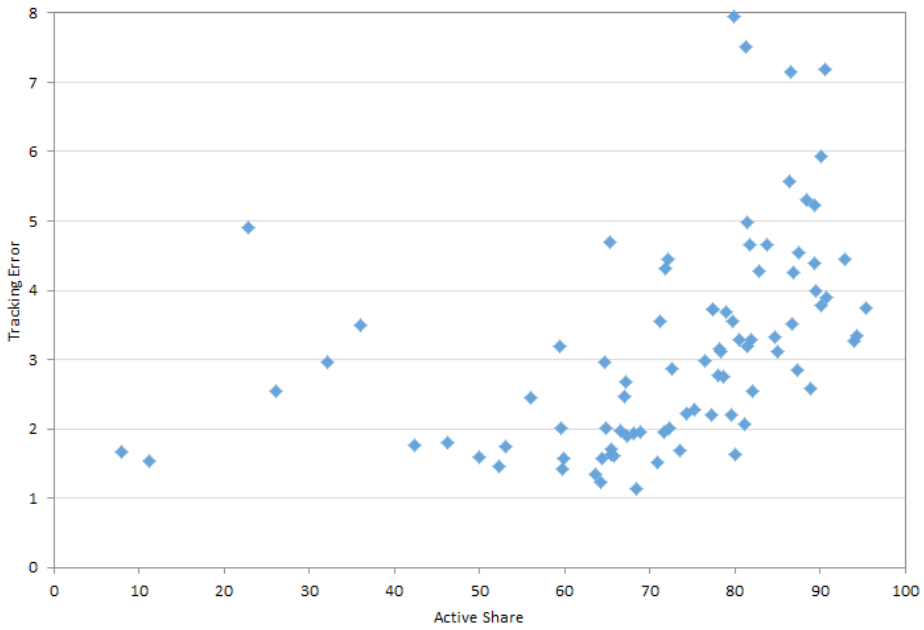
Non-simulated data results

Switching the discussion now to actual fund numbers, *Figure 6* shows results generated using data drawn from eVestment.[3] The values displayed are for US Large Cap Core Equity Funds as of end December 2014. Tracking error is shown against the manager-preferred benchmark, and we note that the tracking error values displayed are ex-post estimates based on two years of monthly data to the end of December 2014. Although the data is more widely spread than in the simulation results we can identify the same broad trend, higher levels of tracking error are linked to higher levels of active share.

We note that there are a number of outliers present in this non-simulated data. For example, high values of tracking error for what appear to be low values of active share. These outliers may be due to the way active share is calculated – technically, cash holdings are not included. The same is not true in the calculation of tracking error and from an active risk viewpoint, cash increases tracking error when measured against an equity benchmark.

FIGURE 6: RELATIONSHIP BETWEEN THE TRACKING ERROR AND ACTIVE SHARE (US LARGE CAP CORE EQUITY)



Note that each plot represents a US Large Cap Core Equity Funds as defined by eVestments as of end December 2014. Tracking error is calculated from the last two years of returns (ending 30 September 2014).

Source: eVestment, SICM analysis

> We note that there are a number of outliers present in this non-simulated data

Also, we note that active share is calculated at one point in time whilst realized tracking error is estimated over two years in our example. If the active manager has made large changes to the portfolio over the preceding two years this will not be accounted for in the active share calculation. Therefore we might expect to see bias in the real data compared to the simulated data as no cash assets were included in the simulations and tracking error estimates were calculated as ex-ante estimates, consistent with the data used to calculate active share.

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3 www.evestment.com/

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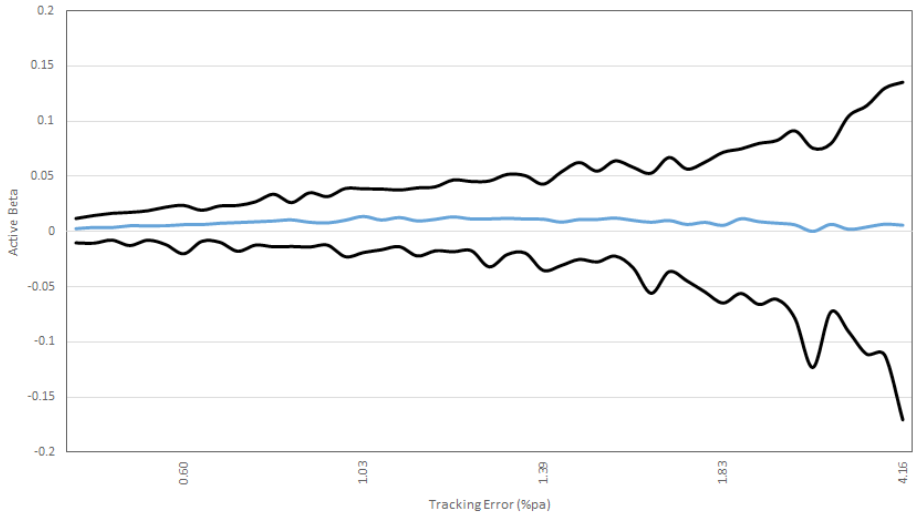
FIGURE 7: RELATIONSHIP BETWEEN ACTIVE BETA AND TRACKING ERROR AT 31 DECEMBER 2014



Note the blue line is the median value, the upper black line the maximum values and the lower black line the minimum values. Analysis uses S&P500 Index constituents only. All risk data is from Barra multi-factor equity models, dated 31 December 2014. Each simulation has been run 100 times. Sources : SICM analysis

Source: SICM analysis

Another important point to consider is the effect that market leverage has on the results, measured using active beta (how far beta is away from a value of 1.00). *Figure 7* shows the relationship between active beta and tracking error.

From *Figure 7* we observe that portfolios with large tracking errors display a wide range of active betas. This is not surprising as a large active beta implies a large exposure to systematic risk and therefore a higher chance of the portfolio showing a return deviation from the benchmark. For portfolios with tracking errors well below 1, the range of active beta narrows substantially.

Portfolios with large tracking errors display a wide range of active betas.

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Conclusions

In this paper we have considered commonly used measures of, or proxies for, portfolio risk estimation. Each measure has strengths and limitations. We have viewed the risk estimation problem from the perspective of an active portfolio manager and have therefore been primarily concerned with active risk. We wanted to investigate and understand the interrelationships between tracking error, active share, and the number of stocks in a portfolio.

Of the three measures we investigated, the number of stocks in a portfolio is in some way the odd one out as a measure of active risk. Nonetheless it is a measure that is commonly used, particularly as a proxy for the level of diversification in a portfolio. Tracking error and more recently active share, are well known measures of active risk in a portfolio.

We found that the relationships amongst the three measures are in general terms easily understood. For example a high active share value relates to a high tracking error value, while high stock numbers result in low tracking errors. These relationships are well documented in other publications. Of greater interest is how these relationships vary through time, in particular, as the underlying volatility of the market changes.

Although the general relationships mentioned above hold, there are large variations in the values obtained for tracking error estimates. This has implications for rules of thumb type rules that asset owners and asset managers may use. For example, for a fixed value of tracking error the value of active share and number of stocks required to generate the tracking error vary greatly over time. Used in isolation, stock numbers might leave the investor very disappointed – leading either to too little active risk or too much active risk depending on the current investment environment.

The active share measure has received an increasing level of coverage over the last few years. Its growing popularity is due to ease of calculation and ease of interpretation. Our results show that active share is non-linearly related to tracking error and as in the case of number of stocks in the portfolio, it is insensitive to the volatility environment the asset owner and asset manager find themselves in.

In our opinion tracking error is a robust measure of the active risk of an actively managed portfolio. The other alternatives may be valuable as secondary measures, used in conjunction with tracking error. Used in isolation the simpler measures do not provide precise estimates.

Although not discussed in this paper, we believe that making use of multi-factor risk models that partition risk into its various sub-components is the best way to measure, decompose and analyze active risk. The ability to decompose active risk alleviates the need to use simpler measures like active share that have been applied to the problem of identifying managers as active, index-hugger, stock picker, or market timer.

The most important point in all of the discussion is that risk measurement is an important component of any investment process. Having the ability to look at portfolio risk from multiple angles will in the end lead to portfolios that are better constructed and hopefully correctly reflect the abilities and skills of the portfolio management team.

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