Benchmark concentration: value weights versus equal weights in the FTSE 100 Index

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Abstract

Defining the characteristics of a suitable portfolio benchmark continues to attract the attention of both academic researchers and investment professionals. Concern that increased domination of certain stock indices by a few large firms will lead to inefficient portfolio diversification has prompted some in the investment industry to argue that index providers should adjust their weighting methods to limit concentration. This article demonstrates that concentration in capitalization weighted indices does not necessarily represent an additional source of risk. On the contrary, during large shocks, the capitalization weighted FTSE 100 Index exhibited lower risk and higher returns than an equally weighted portfolio of the same constituents.

1. INTRODUCTION

This study examines the effects of concentration in the FTSE 100 Index upon the risk and returns of the index portfolio. Concentration is shown to have increased over the study period. However, evidence is presented which indicates that, on balance, the concentration arising from capitalisation weighting has provided investors with lower risk and higher returns than an alternative equally weighted portfolio of the same constituents.

Stock indices have long been used by professional investors to gauge the performance of the market as a whole, and hence the sentiment of other investors. They have also become increasingly important as model portfolios for passive investors and as benchmarks against which the added value or alpha of active investors can be measured. The characteristics of a good benchmark portfolio are defined comprehensively by (Bailey (1992a) and Bailey (1992b)). These include the requirement to be transparent, unambiguous, easy to replicate and measurable. A working paper by Haberle and Ranaldo (2005) suggests that many so called passive benchmark portfolios represented by major indices such as the S&P 500 actually have more in common with an actively managed portfolio than a purely passive benchmark, or proxy for their respective sections of the market portfolio.

Capitalisation weighted country, global and regional market indices have also been used extensively as proxies for the market portfolio in studies examining the efficient market hypothesis (EMH) and the Capital Asset Pricing Model (CAPM). This is because the capitalisation weights of the theoretical mean variance efficient market equilibrium portfolio are said to be determined by informed investors who arbitrage away pricing anomalies that would result in deviations from the optimal state of mean variance efficiency. However, (Roll (1977) and Roll (1978)) pointed out that the best available stock market indices are still incomplete and ambiguous proxies for the market portfolio. Roll’s findings led to the realisation that tests of the

CAPM and EMH that use stock indices as proxies for the market portfolio are liable to produce inconclusive results.

As well as having their ability to provide adequate proxies for the market portfolio evaluated by researchers such as Roll and Bailey, the effectiveness of standard capitalisation weighted indices as benchmarks against which the performance of active managers can be measured has also been questioned by Daniel et al (1997) who suggest a method for evaluating investment performance based on characteristic based benchmark portfolios. Arnott et al (2005 p 93) also argue that standard capitalisation weighted stock indices are inefficient measures of overall market performance and go so far as to express the view that capitalisation weighted benchmarks are fundamentally flawed when they state that

"…through the 1962 – 2004 period; we experienced bubbles in which cap weighting caused severe destruction of investor wealth…"

Instead of capitalisation weights, Arnott et al (2005), propose a fundamental weighting system based on characteristics such as net earnings, number of employees and total sales of index constituent firms.

Concern among professional investors in the UK with regard to increases in concentration of the capitalisation weighted FTSE 100 Index and indeed, the UK market as a whole, has continued to be reported in the financial press since the turn of the century.[1] Concentration exists when weightings are distributed unevenly among index portfolio constituents so that a minority of large firms account for the majority of the total market value of an index. During early 2000, Vodafone Air-Touch merged with its European rival Mannesmann. Soon afterwards, on the 31st May 2000, Vodafone had a weight in the FTSE 100 Index of 13% and, at that time, the ten largest firms in the FTSE 100 Index accounted for more

[1] Searches through Lexis Nexis over the period yield numerous examples in addition to those referenced later in this paragraph.

than 52% of its value. Vodafone also accounted for more than 10% of the equity value of all firms listed on the London Stock Exchange, while the ten largest firms accounted for 41%.[2] Contemporary reports in the financial press, such as Riley (2000), highlighted concerns that the concentration of the UK's leading market index into just a few sectors (namely banks, oils, telecommunications and pharmaceuticals) may have meant that investors tracking the index were poorly diversified. More recently, Coggan (2005) reported similar concerns about the consequences of further increases in concentration due to the pending consolidation of Shell Transport and Trading in the UK and Royal Dutch Shell in the Netherlands into a single entity listed in Amsterdam and London.

Much of the concern voiced about stock market, and index, concentration seems to stem from the naive diversification principles of Evans and Archer (1968), namely that investors should spread their portfolio between eight to ten randomly selected firms to reduce stock specific risk. A study by Bloomfield et al (1977) raised the number to around twenty firms. This then increased to between fifty and one hundred (Campbell et al 2001), and to more than three hundred (Statman 2004). The mean variance optimisation principles of Markowitz (1952) are also frequently cited by investors concerned that the levels of concentration in many national stock markets are beyond levels that would be implied in a world of mean variance optimisation.[3] Such concerns may be fuelled, at least in part, by the fact that in the three years following the rapid concentration increases of the NASDAQ and the UK markets during 1999 and early 2000, World markets experienced some of the most volatile and predominantly negative returns in recent history. Such conditions appear to have led some commentators to

[2] Figures calculated using the London Stock Exchange file of all listed firms published monthly.

[3] For instance, Troughton in the forward to Stowe et al (2002).

blame the volatility on excessive exposure to the idiosyncratic (stock specific) risk of the largest firms and sectors of the market portfolios and their respective benchmark indices.[4]

Table 1, reports that the share of the FTSE 100 Index that is accounted for by the ten largest firms and sectors has increased from 37% and 58%, respectively in January 1984 to 51% and 72% in January 2005. Table 2, demonstrates that concentration is not limited to the UK market and its associated indices because it shows that in January 2005, 55% of the value of the NASDAQ 100 Index and 28% of the NASDAQ Composite Index were accounted for by the ten largest firms. The top ten firms by market value also accounted for 40% of the S&P 100 Index and 19% of the Russell 1,000 Index. Indeed, high levels of concentration can be found in other major developed market country and regional indices such as the Dow Jones FTSE Global Indices, and the Topix Japanese market indices.

During 1999 and 2000, partial divestiture of subsidiaries by a number of large parent firms resulted in new index constituent firms arising from the divestitures. Substantial portions of the new firms' equity were unavailable for trade by outside investors because they were retained by the parent firms. This phenomena, referred to as free float restrictions led to pricing distortions as funds tracking the index tried to replicate their benchmark weights even though free float restrictions meant that sufficient stock was not available to meet demand. This is because the existing index weighting system, in effect, double counted the weights of partial divestitures. In order to eliminate this problem, between September 2000 and June 2001, FTSE International begun to adjust the capitalisation weights of its indices to take into account the percentage of free float available. Around this time, high levels of concentration also prompted FTSE International to prepare an alternative version of the FTSE 100 and FTSE Allshare Index in which constituent weights were capped at 5% to, *"allow for a more diversified index"*.

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[4] The author can provide an extensive list of newspaper comments if requested, although typing "FTSE Constituent Weights" into the search function on FT.com for the period January 1999 – December 2004 will yield a substantial list of press articles in which such views are expressed.

Furthermore, an editorial in the Financial Times (2000) observes that Merrill Lynch Investment Management created an equally weighted version of the FTSE 100 as a benchmark because it *"should show lower volatility, thanks to better diversification."* Unfortunately, the equally weighted version of the FTSE 100 index calculated by Merrill Lynch and the capped weighting schemes used by FTSE International also have their drawbacks when evaluated by the criteria of suitable benchmarks described by Bailey et al (1992) or Haberle and Ranaldo (2005). For instance the greater frequency of re-balancing required to maintain capped or equal weights will result in higher portfolio transaction costs.

Empirical tests of different portfolio weighting schemes, such as those of Bloomfield et al (1977) demonstrate that naive diversification eliminates a substantial amount of risk without the application of more elaborate portfolio optimisation strategies. In a more recent study, DeMiguel et al (2004) have found that naive structures, such as capitalization weights, or equal weights are not significantly less efficient than a variety of more complex methods tested in their study. Naive methods of calculating benchmark indices are likely to be more transparent, less ambiguous and in the case of capitalisation weighted indices, less costly to replicate with a passive tracking portfolio, compared to arbitrarily capped weights, or other more sophisticated methods, such as the fundamental weighting scheme of Arnott et al (2005). Transparency is important if indices are to be used as benchmarks for measuring the performance of actively managed portfolios (Bailey et al 1992 a and b). With regards to portfolio concentration, equally weighted indices are effectively indices with constituent weights capped at 1/n and thus have the lowest possible level of concentration for a given number of constituents. By contrast, concentration in capitalisation weighted indices is allowed to vary with the value of the dominant firms and in the hypothetical extreme case, one firm could have a weight approaching 100% while all the other firms each had a weight that was infinitesimally small.

Some analogy may be drawn between investing in value weighted indices and a buy and hold strategy, whereas a more broad-based portfolio with constituent weights closer to those of an equally weighted index can be compared with a contrarian strategy of selling winners, i.e. growing firms whose size has increased in relation to other firms in the investment universe and buying losers, firms whose weights have fallen in relation their peers.[5] However, when new money is committed, or new large firms are added to an index, perhaps due to mergers, the value weighted strategy might be argued to have more in common with a momentum strategy of buying winners and selling losers. In addition, equally weighted indices give a greater relative weight to small firms compared to a value weighted index. Hence, they will perform better than value weighted indices when small firms are doing relatively well compared to large firms.

Although some argue that capitalization weighted indices could be more risky when concentration levels rise, due to the idiosyncratic risk of the largest constituents countering the naive diversification principles of Evans and Archer (1968), the reverse effect, i.e. a fall in risk, could also be consistent with the principles of modern portfolio theory. For example, it is possible to imagine a situation in which a single large firm is, in effect, a portfolio of subsidiary firms whose investment returns are not perfectly correlated. It is, therefore, theoretically possible to imagine a situation where all the firms in the market portfolio merge into one. If such a hypothetical situation existed in an efficient market, the optimal mean variance efficient portfolio would contain the stock of the single firm that would, by definition, represent the market index portfolio. Without going to such hypothetical extremes, it is possible to imagine that the large multinational 'mega' firms in a concentrated stock index, such as the FTSE 100 may contain a diverse collection of income streams that have a low correlation with each other and with other large firms in the index.

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[5] Henceforth in this thesis portfolio weights are based on the equity market values in relation to the total equity market value of the index portfolio; therefore, there are two types of portfolio – value-weighted and equally weighted.

Studies such as (Wei and Zhang (2006), Campbell et al (2001) and Goyal and Santa-Clara (2003)) indicate that average idiosyncratic volatility of stock market constituent firms appears to have increased in recent years. They suggest that this may be due to decreases in the average return on equity and increases in the volatility of the average return on equity. Campbell et al (2001) also note that firms entered the equity market earlier in their life cycle and had lower earnings quality during the inflation of the technology bubble than previously and suggest that this is another factor that might explain increases in average firm volatility. However, rising idiosyncratic volatility coupled with rising concentration will not lead to greater systematic volatility so long as, firm, or industry specific risk is no more correlated across firms, or industries, than previously. Notwithstanding the last observation, Roll (1992), in a cross sectional analysis of different market indices, reached the conclusion that levels of concentration in national market indices are positively associated with the volatility of index returns.

While it may initially seem counterintuitive to reconcile the concentration of the NASDAQ 100 equity market into technology firms, or the rapid increase in UK equity market concentration during the latter part of the 1990s, with the principles of portfolio diversification, this article demonstrates that the concentrated value weighted FTSE 100 Index portfolio has had lower risk and higher returns than an equally weighted portfolio of the same constituents. Furthermore, such a finding is consistent with modern portfolio theory if any of the following conditions hold. Either, the variances of the largest firms' returns are lower than the average variance of all firms in the portfolio, the covariances of the returns for the largest constituent firms' with each other and the market as a whole is below the average covariances of returns between all other firms in the portfolio, or the returns of the largest firms are greater than the average returns of all firms in the portfolio. The findings reaffirm the principles of modern portfolio theory. Namely that investors should concentrate first on expected returns and covariance of constituent firms when building portfolios, or evaluating passive benchmarks. Even if some firms seem very large and have a relatively high weight in the portfolio, or benchmark, their individual stock return volatility should only be a cause for concern if it is not mitigated by the primary considerations of modern portfolio theory, i.e. expected returns, expected variance and expected covariances.

2. DERIVATION AND SELECTION OF THE DATA SAMPLE

In a time series study of stock index concentration such as this, it is necessary to measure the weights of constituent firms in order to measure the concentration of an index portfolio. Therefore, the choice of index is limited by the availability of data identifying not only current constituents but historic index constituents and the original base constituents. These conditions are necessary in order to allow recreation of the historic index portfolio enabling historic levels of concentration to be evaluated using financial databases, such as Thomson Financial Datastream. As a value weighted index of the 100 largest firms listed on the London Stock Exchange the FTSE 100 Index meets all of the above criteria. It has a history from inception in January 1984 through to the present, while the original constituent list together with the names and dates of subsequent additions and deletions is publicly available. In addition, the constituent selection procedures and calculation methods appear to be more transparent than those of competing index providers. Furthermore, the concentration of the FTSE 100 Index increased, and by some measures doubled, over the last ten years, to the extent that at the time of writing more than 50% of the index value is accounted for by the ten largest firms. These characteristics combined with the depth and liquidity of the constituents, and size of the London Stock Exchange as a whole, justify the selection of the FTSE 100 for this study.

The UK FTSE 100 Index is re created over the period from its inception in January 1984 through December 2004 using historic constituent lists supplied by FTSE International together with prices and market values from Thomson Financial Datastream. This enables time series of index concentration levels, volatility levels and returns of the actual index and an equally weighted portfolio of the same constituents to be measured. In addition, incremental volatility and incremental returns are calculated by subtracting the standard deviation and returns of the equally weighted portfolio of FTSE 100 Index constituents from those of the value weighted FTSE 100 index.[6]

Concentration

A key feature of the analysis is the idea that an index of concentration or diversity can be used to measure the distribution of constituent weights within a stock index portfolio. Based on the analysis of a range of different concentration metrics by Clarke (1993), the Hirschman Herfindahl Index *(H)* of concentration and the variance of the logarithm of firm size are calculated using the equity market values of FTSE 100 constituents.

Values of the *H* index are calculated at twenty trading day intervals as follows:

$$H_1 = \sum_{i=1}^{N} (x_i / x)^2 = \sum_{i=1}^{N} w_i^2 \qquad (1)$$

where w_i is the weight of an individual company in a sample, x_i is the value of firm *i* and *x* is the total value of all *N* firms. The *H* index is influenced more by the biggest firms in a portfolio as it is the sum of the squared weights of all the portfolio firms. *H* has an upper limit of unity in the hypothetical scenario in which the entire market is represented by just one firm. It has a minimum value of $1/N \rightarrow 0$ in the case of many small equally sized firms.

In the situation where firm values have an approximately log normal distribution, the variance of the logarithm of firm weights (V^2) provides an unambiguous ranking of firm size inequality (Clarke 1993). The distribution of FTSE 100 Index constituent firm size and firm weights was found to be approximately log-normal; therefore, daily values of the variance of the logarithms of firm weights sampled at twenty trading day intervals are calculated as follows:

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[6]From September 20th 2000, FTSE International began to phase in a free float adjusted weighting method. The analysis presented here is based upon a recreation of the Index using the original weighting method up until the 20th September 2000 and the free float adjusted method post September 2000.

$$V^2 = \frac{1}{N}\sum_{i=1}^{N}\left[\log\left(w_i / \overline{w}_g\right)\right]^2 \qquad (2)$$

where $\overline{w}_g$ is equal to the geometric mean of firm weights.

A range of other concentration metrics were also calculated for the FTSE 100 Index constituents. However, the time series path of many of these appeared very similar to the *H* index, which is influenced relatively more by large firms than other concentration metrics. In contrast, the V^2 index that is influenced by a more even range of firm sizes in the distribution. Therefore, the decision was made to report only the *H* index and the V^2 index. The latter adds value to the analysis by confirming that concentration has increased over time, regardless of which part of the distribution is emphasised.

Value weighted FTSE 100 Index and equally weighted constituent portfolio returns

The Datastream total return index and market value data for all FTSE 100 Index constituents, past and present, are used to calculate the dividend-inclusive geometric returns for the FTSE 100 Index constituents over the entire study period. Geometric equally weighted and value weighted returns are used to calculate FTSE 100 Index portfolio returns and the returns of the equally weighted portfolio of constituents. However, once the cross section of constituent returns is aggregated to form the respective index, or portfolio, they are then converted to logarithmic returns for time series analysis. The incremental monthly return is then derived by subtracting the equally weighted return from the value weighted return.

Incremental standard deviation

None overlapping monthly data for the realised value weighted and equally weighted monthly variance are derived by taking the sum of squared daily value and equally weighted returns over twenty trading days. The assumption of an expected return of zero for estimating realised volatility was proposed by Figlewski (1997) and has been adopted more recently by Goyal and Santa-Clara (2003). Alternatives such as the contemporaneous risk free rate plus a long term average premium, such as that adopted by Campbell et al (2001), could also be adopted; however, when equity returns are measured at daily frequencies, or less, a mean return of zero is a reasonable assumption, given that the realised variance, over periods of up to one month, is large in relation to estimates of the mean return. The square roots of each variance series then proxy as the realised value and equally weighted monthly standard deviations. The incremental monthly standard deviation, like the incremental return, is simply derived by subtracting the equally weighted standard deviation from the value weighted standard deviation.

3. RESULTS AND ANALYSIS OF THE DATA

Concentration in the FTSE 100 Index

Figure I, plots the levels of both the Hirschman-Herfindahl Index and the Variance of the Logarithm of Firm Size. From 1997 onwards, concentration increased rapidly, reaching current levels around March 2000 when there was a structural break resulting from the Vodafone-Mannessmann merger event, after which concentration levels remained high until the end of the study period.

Figure II indicates that relatively low levels of concentration observable in Figure I during the early to the mid 1990s correspond with the fall in the number of mergers and an increase in the number of divestitures. The rapid increase in concentration in the late 1990s coincided with an increase in the value of both domestic and foreign mergers. Throughout the 1980s, both before and after the 1987 crash, the number and value of mergers between UK firms increased to a peak in 1989. However, Figure II also reveals that the recession of the early 1990s was characterised by a fall in the number of mergers and an increase in the number of divestitures, resulting in a trend towards more ‘focussed’ firms. Many of the UK mergers in the 1990s resulted in the creation of multinational firms, often leading specific industry sectors, such as pharmaceuticals, telecommunications, software development and oil production. The increased importance of international mergers is evident from the greater percentage of the total value of mergers accounted for by foreign firms through much of the 1990s, apart from the dips in 1995 and 1996, which are followed by a rise to the peak in 1999. Notable examples include the merger of BP with Amoco Oil, Vodafone with Mannesmann and Glaxo-Welcome with Smith-Kline and Beecham to form Glaxo-Smithkline. These firms have expanded overseas to such an extent that the majority of their revenues are now generated outside of the UK. In fact, Orton (2001) cites Michael Hughes of Baring Asset Management

"More than half of the constituents of the FTSE 100 Index,.....now derive the majority of their earnings from international activities."

Examination of the financial statements of the larger index constituent firms provides plenty of supporting evidence for the above statement.

In addition to merger activity, concentration in the FTSE 100 Index may also have increased as a result of large foreign multinational firms such as HSBC, BHP Billiton and South African Breweries taking a London listing. Thus, while the majority of firms listed on the London market are relatively small and domestically-orientated, the majority of the market value of the UK market and the FTSE 100 Index is accounted for by a few large global industry leaders.

Descriptive Statistics of the data series

Incremental returns and standard deviations arise as a result of concentration of capitalisation weights in the index. Positive incremental returns indicate that the value weighted FTSE 100 Index portfolio return is greater than the equally weighted portfolio of constituents, while negative values of the incremental standard deviation indicate that the value weighted portfolio is less risky than the equally weighted counterpart. The objective of this study is achieved by examining whether, on balance, the incremental returns and standard deviation benefit or harm investors’ wealth.

Panel A. of Table 3, reports the descriptive statistics for the annualised discrete non-overlapping sequences of monthly return and volatility data. It is immediately apparent that none of the data series conform to the characteristics of a normal distribution because they all exhibit skewness and kurtosis values outside the defining range of the Jarque-Bera Test. However, the relative skewness of the incremental standard deviation has a lower absolute value than either its capitalisation weighted or its equally weighted counterpart. Indeed, the skewness of the incremental return is positive, unlike the equally weighted and value weighted returns. It is generally believed that investors prefer positive skewness to negative skewness in returns. Therefore, this result indicates potential benefits of the market value weighted FTSE 100 Index portfolio, as compared to the equally weighted portfolio of FTSE 100 Index constituents. The value weighted standard deviation has a lower kurtosis of 19 than the equally weighted standard deviation of 22, indicating that extreme variations are more likely to occur in the equally weighted series. At 0.1 and 0.2 standard deviations from zero, respectively, the annualised mean and median of the incremental standard deviation indicates that for the majority of the time, the value weighted FTSE 100 Index portfolio is not significantly more risky than the equally weighted portfolio. The range of the annualised incremental standard deviation from -5.8% to a maximum of 5.4% is of greater economic interest, as it shows that historically market value weights have reduced portfolio risk at the extremes more than they increased it at the extremes, when compared to an equally weighted portfolio of the same constituents.[7]

The contribution of market value weights to total returns, shown by the incremental return, is impressive. Both the mean and the median annualised incremental returns positive at 3.9% and 2.34% respectively. The maximum value is an annualised contribution of 146% to

[7] Such extremes correspond to the October 1987 crash and subsequent economic and political events such as Saddam Hussein's invasion of Kuwait in August 1990, uncertainty surrounding Britain's exit from the Exchange Rate Mechanism (ERM) in 1992, Russia's sovereign debt default in August/September 1998, the terrorist attacks of September 2001 and the lead up to the invasion of Iraq by US led forces in March 2003.

total portfolio return, while the minimum is – 37%. This is 30 and 8 standard deviations away from zero respectively. Taken together with the positive skewness this indicates that during extreme market conditions, the contribution of the incremental return to the total FTSE 100 Index returns are larger during positive extremes than they are during negative extremes. These findings imply that very large firms with a greater weight in the index have higher returns on average than the smaller firms and that their returns are less volatile during periods of market crisis.[8] This is not entirely surprising given that many large firms are multinationals with more diverse revenue streams than their smaller counterparts.

Correlation between the variables

The previous section determined whether concentration benefits or harms investors overall. This section searches for associations between the monthly variables incremental standard deviation, incremental return and the total value weighted return and standard deviation of the FTSE 100 Index over the study period. The objective here is to determine when, or under what market conditions the incremental return and standard deviation is most likely to benefit, or harm investors' wealth.

Panel B of Table 3, provides a matrix of correlation coefficients for each variable. A positive correlation is evident between the incremental return and both the capitalisation and the equally weighted standard deviation. This indicates that as volatility increases the incremental returns increase and vice versa. Thus the capitalisation weights in the concentrated FTSE100 Index result in investors being compensated better for increases in market risk than they would be if they were to hold an equally weighted portfolio of the same constituents.

[8] Note that smaller firms in the FTSE 100 Index are still large firms when compared to the market as a whole and that for much of the 1990s large cap growth firms out-performed the small cap value firms reversing the pattern documented in many studies published during the later 1980s and early 1990s (Dimson et al 2003).

There is also a positive correlation coefficient between the incremental monthly standard deviation and both the capitalisation weighted and equally weighted index return. This suggests that when average firm returns are positive, the variability of returns due to capitalisation weights is greater than the variability due to capitalisation weights when average firm returns are negative. In other words, the incremental standard deviation is likely to be negative when FTSE 100 Index returns are negative and positive when returns are positive. This would imply that a value weighted portfolio exhibits less downside risk than an equally weighted portfolio of the same constituents but more 'upside risk'. Further support for this idea is provided by the negative correlation between the incremental standard deviation and both value and equally weighted standard deviations. The negative correlation indicates that as the average volatility of all firms in the index increases, incremental standard deviation is likely to decrease and may turn negative. Thus, capitalization weights appear to reduce overall portfolio volatility at a time when the market generally is becoming more risky for investors.

Both the differenced Hirschman-Herfindahl Index and the differenced variance of the logarithm of firm weights have a negative correlation coefficient with value and equally weighted returns. This indicates that concentration tends to increase when average firm returns fall and vice versa. However, it is not possible to establish negative causality between portfolio returns and changes in concentration because the incremental return, i.e. the portfolio return component that is directly attributable to constituent weights, has a positive correlation with changes in concentration. This is illustrated by correlation coefficients of 0.53 and 0.63 between the incremental returns and the differenced Hirschman-Herfindahl Index and the Variance of the Logarithm of Firm Weights, respectively. In other words, the contribution to portfolio returns resulting in constituents weights being concentrated away from the lower limit of an equally weighted portfolio tends to increase as concentration increases. This could be interpreted to mean that when average firm returns are lower, investors concentrate their assets into firms with the highest expected returns with the result that the incremental return increases.

The results in Table 3 demonstrate that passive and semi-passive investors in the UK equity market are better off holding a value weighted portfolio than trying to distribute their assets more evenly among the universe of listed companies, even if the levels of concentration in the market indices are high enough to lead some financial journalists and members of the investing community to worry that the market is poorly diversified. This article argues that although such worries may appear intuitive from the naive diversification principles of Evans and Archer (1968), they fail to take account of the richness of the variance covariance matrix structure in the manner advocated by Markowitz (1952). Thus, when the return, risk and covariance dynamics are accounted for it makes sense to hold the concentrated market capitalization weighted portfolio.

Evolution of the data sample

The time series charts presented in this section illustrate the evolution of the data series over the period. A number of key events that have influenced the data series and are reflected in the charts are discussed.

From examination of Figure III, it is evident that on many occasions when the equally weighted average returns of FTSE 100 Index constituents exhibit the largest negative values, namely October 1987, September 1990, September 1998 and September 2001, the incremental realised return has been positive. In other words, during the periods when overall volatility has been highest and market returns have had their largest negative shocks, concentration in the FTSE 100 Index has reduced the magnitude of those negative shocks. It has also increased positive returns over much of the period when equally weighted average returns have been positive. Thus the data suggest that far from reducing investors' risk to reward profiles, allowing FTSE 100 Index trackers and the index itself to reflect market value weights of constituents actually had the effect of improving investors' risk to reward profiles as compared to an equally weighted portfolio of the same constituents.

Although much smaller in magnitude than the equally weighted standard deviations, negative spikes of the incremental standard deviation, plotted in Figure IV, have often occurred simultaneously with positive spikes in the equally weighted standard deviations, revealing that during volatility peaks, the monthly equally weighted standard deviation is greater than the monthly value weighted standard deviation of FTSE 100 Index returns. This effect is particularly evident during the 19th October 1987 crash, the period preceding the ERM crisis on the 16th September 1992, the Russian sovereign debt default in August 1998, the terrorist attacks in September 2001 and the period leading up to the coalition operation in Iraq during March 2003. Therefore, Figure IV provides further visual evidence that a value weighted portfolio is less risky than an equally weighted portfolio during times of market stress. This finding is consistent with the idea that large firms are generally less risky than smaller firms, perhaps because they tend to have more stable cash flows from a more diverse range of markets.

Figure V plots the incremental realised monthly return and the value weighted standard deviation of the FTSE 100 Index returns. It can be seen that during large shocks, such as those indicated by the vertical lines in Figure V, the incremental realised return is usually positive and the value weighted standard deviation appears to be correlated with the incremental return. Hence the value weighted portfolio returns are greater than an equally weighted portfolio containing the same constituents, during these extreme events.

4. CONCLUSION

Investors in the FTSE 100 Index are concentrating more of their assets into fewer firms than they were twenty years ago. However, by concentrating their assets into just a few relatively large firms, investors have not increased the risk of their portfolios. This is evident from the fact that the incremental standard deviation, defined as the difference between the standard deviation of the value weighted FTSE 100 Index and an equally weighted portfolio of the same constituents, is frequently negative and was very negative during the times of greatest market volatility, namely the 1987 crash, the 1992 ERM crisis, the Russian sovereign debt default in 1998 and for a significant period following the collapse of the TMT bubble during 2000 – 2002.

The findings reported here for the FTSE 100 Index are consistent with the argument that the returns of small firms' stocks are more risky, particularly during periods of market stress, thus providing an explanation as to why a concentrated portfolio of large liquid multinational firms is less risky than an equally weighted portfolio in which smaller firms have a disproportionate influence. In fact, contrary to popular perception, the evidence presented from the FTSE 100 Index indicates that historically high levels of concentration in value weighted indices may actually benefit passive investors because of the increased exposure to negative incremental realised volatility and positive incremental returns during market shocks. In other words, large firms may come to dominate an index such as the FTSE 100 for a reason, namely that their expected return and covariance characteristics with the rest of the index are favourable from a portfolio diversification perspective. This presumably means that they are able to issue more equity to satisfy investors' demands so that their relative size increases compared to other firms in the index. Therefore, concentration of the index evolves due to the efficient allocation of capital to firms that are able to provide investment opportunities whose return and covariance characteristics meet investors' needs. Hence the creation of benchmark indices with capped weights may actually increase risk for a given level of return if dominant firms whose weights are capped have, an above average expected return, a below average variance or a below average covariance with the rest of the index or market constituents.

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Table 1

Concentration of the top ten firms and industries in the FTSE 100 Index in January 1984 and January 2005

Panel A: Top 10 Firms and Industries in the FTSE 100 Index in January 2005					
Firm Name	*Weight*	*Cumulative weight*	*Industry*	*Weight*	*Cumulative weight*
BP	10%	10%	*Banks*	23%	23%
HSBC Holdings	8%	18%	*Oil integrated*	15%	37%
Vodafone Group	7%	25%	*Pharmaceuticals*	9%	47%
Glaxosmithkline	6%	31%	*Telephone wireless*	8%	55%
Royal Bank of Scotland	5%	36%	*Mining*	5%	60%
Shell Transport and Trading.	4%	40%	*Food retailers*	3%	63%
Barclays	3%	43%	*Food producers*	3%	65%
Astrazeneca	3%	46%	*Tobacco*	3%	68%
HBOS	3%	49%	*Distilleries and Vintners*	2%	70%
Lloyds TSB Group	2%	51%	*Retailers and department stores*	2%	72%
Panel B: Top 10 Firms and Industries in the FTSE 100 Index at Base January 1984					
Firm Name	*Weight*	*Cumulative Weight*	*Industry*	*Weight*	*Cumulative weight*
British Petroleum	7%	7%	*Speciality chemicals*	10%	10%
Shell Transport And Trading.	6%	14%	*Food retailers*	8%	18%
GEC (now Marconi)	5%	19%	*Diversified industrials*	8%	25%
Imperial Chemical Industries	4%	23%	*Banks*	6%	32%
Marks And Spencer	3%	25%	*Food producers*	6%	38%
British American Tobacco	3%	28%	*Insurance brokers*	6%	44%
Glaxo Holdings	3%	31%	*Life insurance*	4%	49%
BTR	2%	33%	*Tobacco*	4%	53%
Beecham Group	2%	35%	*Auto parts*	3%	55%
Grand Metropolitan	2%	37%	*Builders' merchants*	3%	58%

Notes:

Source: Thomson Financial Datastream. Note that constituent weights in the actual index may vary from those above due to different free float adjustments applied by the index providers. Firms and industries are listed in decreasing order of weight. Industry identifies the Thomson Financial Datastream level six industry sub-group mnemonic.

Table 2

Concentration of the top ten firms and industries in a global, regional and some market indices: January 2005

Country/Region	***Index name***	***% of value in top ten firms***	***% of value in top ten industries***
World	Dow Jones FTSE Global 100	88	98
Europe	Dow Jones FTSE Eurotop 100	35	83
US	Russell 1,000	19	43
US	S&P 100	40	43
US	Nasdaq Composite	28	63
US	Nasdaq 100	55	87
Japan	Topix 1,000	19	49
Japan	Topix 100	34	64
UK	UK Equity Market	40	59
UK	FTSE 100	51	72

Notes:
Source: Thomson Financial Datastream and for the UK Equity Market the London Stock Exchange Files of Listed Firms. Industries refer to Thomson Financial Datastream Level Six Industry Sub-Groups.

Table 3

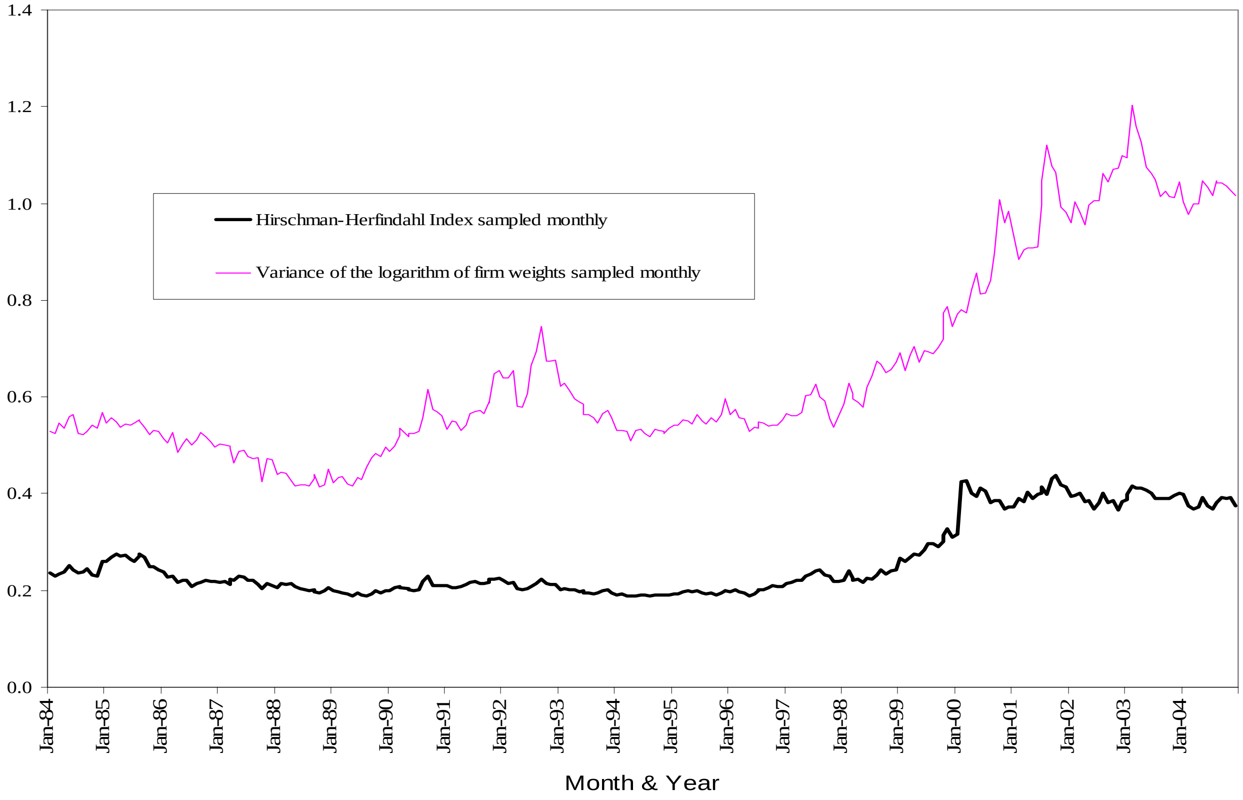
Descriptive statistics and cross correlations of FTSE 100 Index data series observed over the study period: January 1984 – December 2004

Panel A: Descriptive Statistics of Annualised Monthly Data Series											
	μ	**Med**	**Max**	**Min**	**σ**	**Skew**	**Kurt**	**μ/σ**	**Med/ σ**	**Max/ σ**	**Min/σ**
VWSD	15.0%	13.1%	72%	6.9%	7.3%	3.13	19	2.0	1.8	9.8	0.9
EWSD	14.8%	12.9%	77%	6.0%	7.6%	3.31	22	2.0	1.7	10.2	0.8
ISD	0.23%	0.25%	5.4%	-5.8%	1.6%	0.01	5	0.1	0.2	3.3	-3.5
VWR	15.1%	18.0%	318.6 %	-92%	17%	-0.69	4	0.9	1.1	19.1	-5.5
EWR	10.8%	15.8%	301.6 %	-96%	18%	-1.02	6	0.6	0.9	16.5	-5.2
IR	3.9%	2.3%	145.7 %	-37%	4.9%	0.83	6	0.8	0.5	29.7	-7.6

Panel B: Matrix of Correlation Coefficients for each Data Series							
	VWR	***EWR***	***IR***	***VWSD***	***EWSD***	***ISD***	***DH***
EWR	0.9648						
IR	-0.1989	-0.4495					
VWSD	-0.2701	-0.3212	0.2795				
EWSD	-0.2912	-0.3345	0.2574	0.9759			
ISD	0.1321	0.1031	0.0647	-0.0204	-0.2381		
DH	-0.1230	-0.2536	0.5274	0.1519	0.1340	0.0620	
DV	-0.1465	-0.3034	0.6331	0.0332	0.0124	0.0912	0.3271

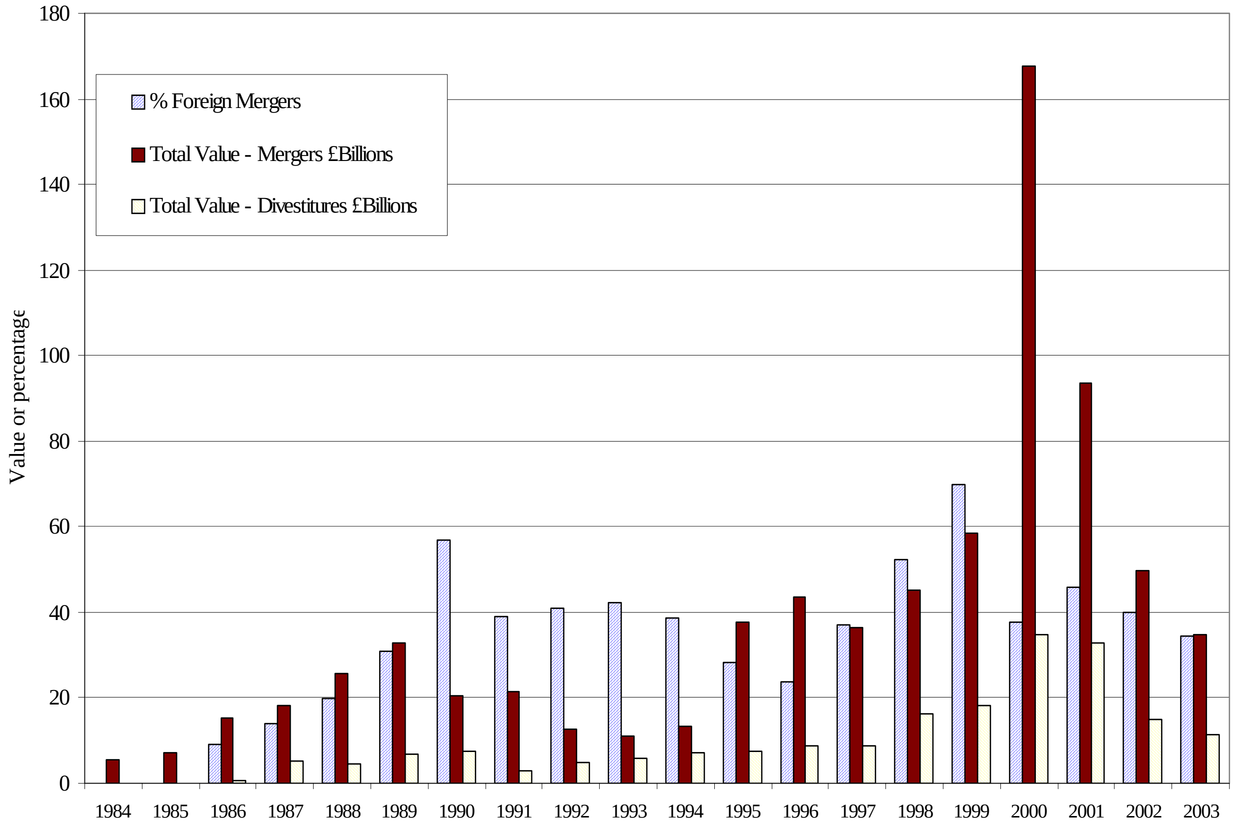
Notes:

In panel A, the acronyms VWSD, EWSD, ISD, VWR, EWR and IR abbreviate the monthly – value weighted standard deviation, equally weighted standard deviation, incremental standard deviation, value weighted return, equally weighted return and the monthly incremental return respectively. All monthly data series are estimated using twenty trading days of data as detailed in the text. The number of observations for each variable in the reported sequences of non-overlapping data is 265, μ is the mean, Med is the median, Max is the largest value, Min is the smallest, σ is the sample standard deviation, Skew is the skewness and Kurt is the kurtosis. The last four columns report the mean, median, largest value and smallest value, respectively, divided by the standard deviation. The Jarque-Bera Test Statistic rejects the null hypothesis of a normal distribution at the $\alpha < 5\%$ level for all data series. Each series is annualised based on an assumption of 253 trading days per year. Therefore, a value weighted mean twenty trading-day logarithmic return of 1.1139% is annualised to 14.09% when multiplied by 12.65, i.e. a multiplication factor of 253/20. This converts into a discrete geometric return of 15.1% per year if we take $e^{-3.12} - 1$. Standard deviations are multiplied by the square root of 12.65. However, skewness and kurtosis values relate to raw monthly, i.e. not annualised data. Panel B reports correlation coefficients between the study variables. The additional acronyms DH and DV abbreviate the monthly – differenced Hirschman-Herfindahl Index and monthly differenced variance of the logarithm of firm size respectively. All monthly data series are estimated using twenty trading days of daily data as detailed in the text.



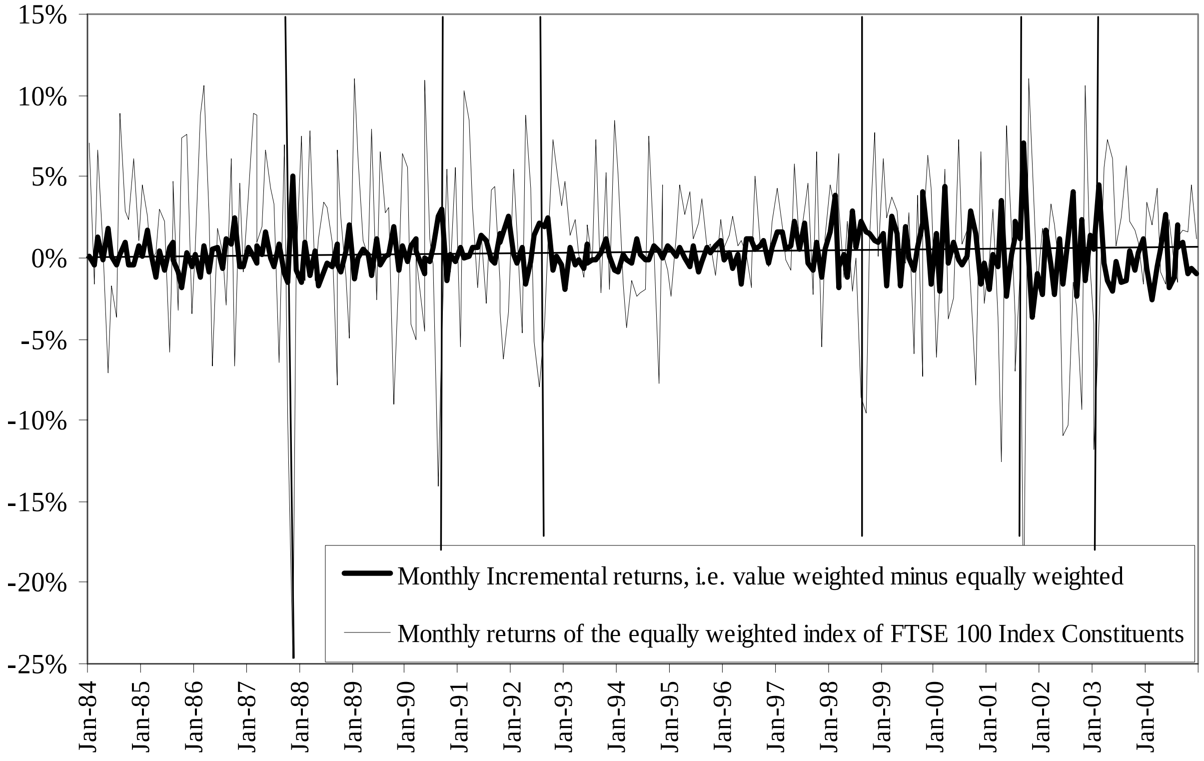
Notes:
The level concentration metrics, sampled at twenty trading day intervals, are plotted over the entire study period. In order to fit the two series onto the same chart, the Hirschman-Herfindahl Index has been scaled up by a factor of ten, while the variance of the logarithm of firm weights remains unchanged.

Figure I. Level concentration metrics (scaled)



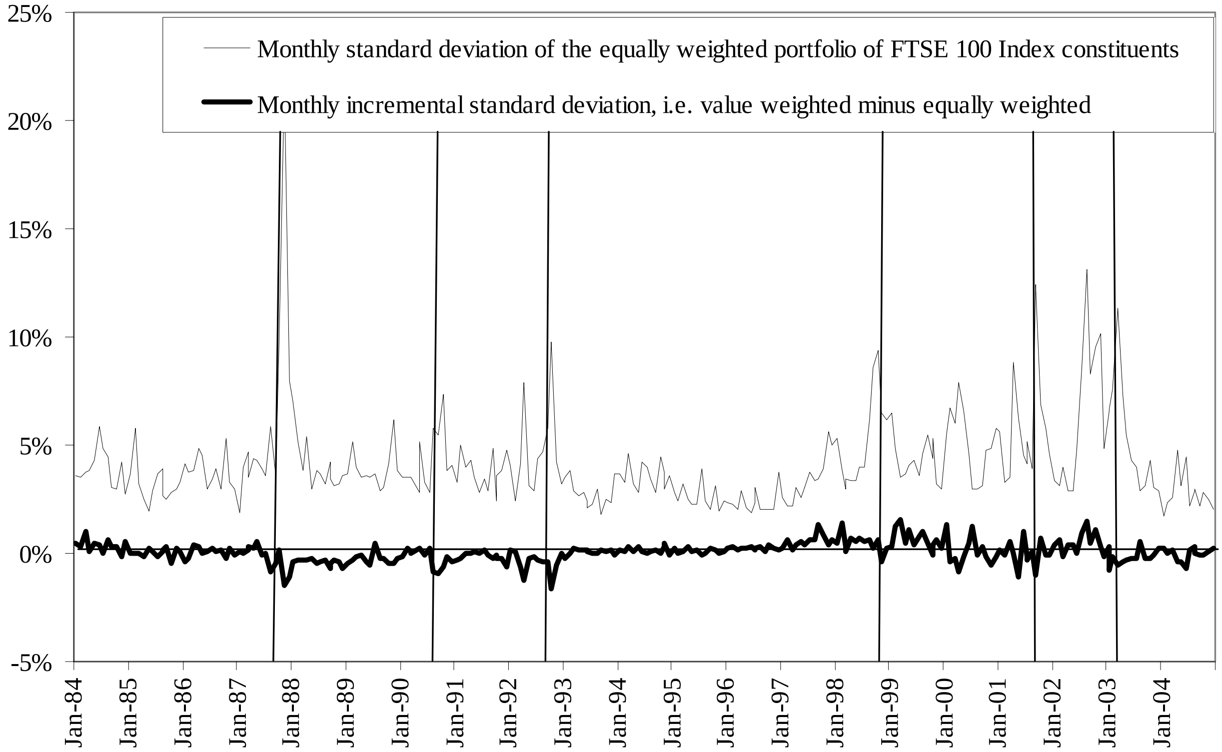
Source: Office for National Statistics data. Note: total value includes mergers between UK and foreign and UK and UK firms. The % foreign refers to the proportion of UK firms acquired by, or merging with, foreign firms.

Figure II. Value of mergers and divestitures involving UK firms



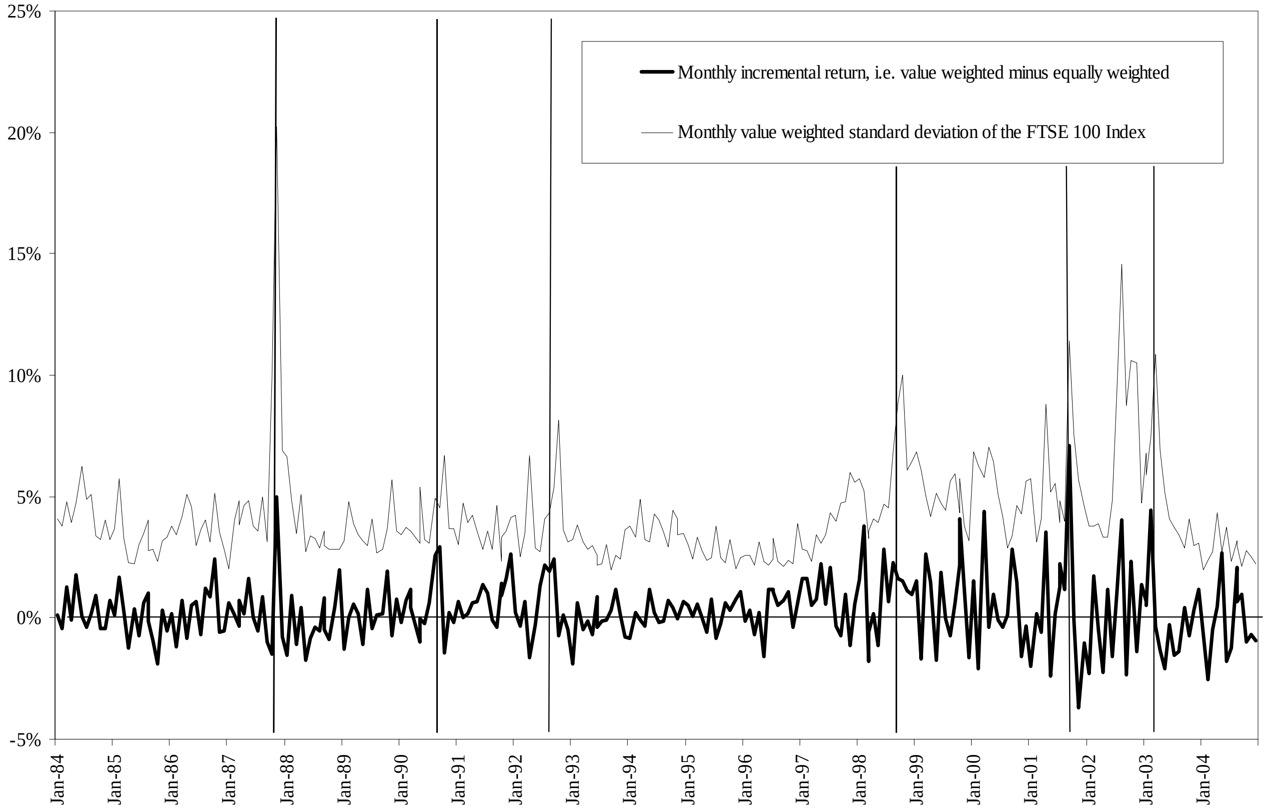
Notes:
Monthly equally weighted returns (thin line) and incremental returns (bold line) are estimated as the sum of logarithmic daily returns over twenty trading days. Vertical lines identify the 1987 market crash, Saddam Hussein's invasion of Kuwait in August 1990, uncertainty surrounding Britain's exit from the Exchange Rate Mechanism (ERM) in 1992, Russia's sovereign debt default in August/September 1998, the terrorist attacks of September 2001 and the lead up to the coalition operation in Iraq during March 2003.

Figure III. Monthly equally weighted and incremental returns of the FTSE 100 Index



Note: both the time monthly series of monthly incremental standard deviation (bold line) and standard deviation of the equally weighted portfolio of FTSE 100 Index constituents (thin line) comprises discrete non-overlapping estimates each generated using twenty trading days of index and constituent total return data. Vertical lines are as for Figure III.

Figure IV. Monthly equally weighted and incremental standard deviation



Note: both the monthly incremental return (bold line) and the monthly value weighted standard deviation of the FTSE 100 Index, comprise non overlapping observation in the series is estimated using twenty trading days of daily data. Vertical lines are as for Figure III.

Figure V. Incremental return and value weighted standard deviation