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NOMURA ASSET MANAGEMENT U.K. LTD.

Stock Count and the Balance of Risk

A Case for Concentrated Portfolios

Technical Paper for Institutional Clients only

The Global Equity Team

by Nomura Asset Management U.K. Ltd.

This paper is aimed at institutional investors who are willing to adopt a more concentrated approach to portfolio management to achieve superior returns with an associated level of risk. Please refer to important risk disclosures at the back of this document for more information.

In this paper we explore the issue of optimising portfolio concentration. From our analysis we conclude that making an equity portfolio more concentrated does not ensure outperformance but can be a key element in facilitating it. It is important however to achieve the correct degree of concentration as too much exposes the portfolio to an undesirable negative skew in returns, whilst too little eliminates the potential for significant outperformance. Our analysis suggests that adding stocks to a portfolio does not necessarily provide greater benefit in risk-reduction and that a carefully selected concentrated approach can achieve a similar level of diversification. Risk mitigation should establish diversification based on fundamental drivers. We believe an optimal concentration of around 20 carefully selected stocks can retain the potential for superior returns whilst preserving the benefits of diversification.

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"A policy of portfolio concentration may well decrease risk if it raises both the intensity with which an investor thinks about a business and the comfort-level he must feel with its economic characteristics before buying into it."

Warren Buffett, Berkshire Hathaway Chairman's Letter, 1993

Summary

- Investment involves balancing a return objective with the chance that the objective is missed. Each investor has to determine their acceptable level of both desired return and risk tolerance.
- This paper explores how the stock count of equity portfolios impacts risk and return characteristics. Building upon a wealth of academic literature on this topic, we've used our own proprietary analysis which demonstrates that portfolios of just 10-40 stocks can provide an optimal risk/reward balance; creating the potential for above average returns whilst reducing the chance of failing to meet the investment objective.
- The starting point in portfolio construction is to identify the relevant objective, and then to select a strategy that provides the best opportunity to achieve it. If superior returns are required, 'unconventionality' in the investment process is a prerequisite. We would argue that more concentrated portfolios are 'unconventional' in the sense that over three quarters of conventional long-only equity funds hold in excess of 40 stocks[1].
- Portfolio theory uses historic asset price volatility as its sole measure for investment risk. However, as a proxy for risk, price volatility is controversial and more recent empirical studies have found almost no evidence of a relationship between portfolio returns and the variance of those returns. On the contrary, we view true investment risk as the uncertainty of attaining one's goals.
- In attempting to assess the optimum number of holdings in a portfolio required to achieve above average returns at acceptable risk levels, we analysed the historic returns of over 2000 stocks in the MSCI All Country World Index from 2004 to 2015 by creating randomly selected portfolios of differing stock counts. We make two key observations about the dispersion of their returns:
  i. Firstly, the dispersion of excess returns declines as the stock count rises, and beyond 40 stocks the dispersion in returns remains virtually unchanged. This pattern has persisted over the last two, three and ten years. This suggests the upper limit of portfolio stock count should be 40 stocks because beyond that the benefits of additional stocks is marginal.
  ii. Secondly, there is a marked downside skew for the portfolios of fewer than 10 stocks across all time periods; we observed that portfolios with very few stocks tend to underperform more often than they outperform. This downside skew is corroborated by a large body of analysis (Fama, 1965 and Hong and Stein, 2003) and supports the view that a crucially important element in successful investing is to avoid losing positions; in essence avoiding mistakes.
- In a theoretical context, it is therefore desirable to have more than 10 stocks in a portfolio. With less than 10, the impact of one or two mistakes will have an excessive negative impact on the overall investment return.
- The volatility of portfolio returns declines rapidly up to around 20 stocks but much more slowly beyond that. Therefore, large numbers of stocks are not required even considering commonly used risk measures such as volatility.

Notes:

1) Source: Nomura Asset Management U.K. Ltd., eVestment database, all equity funds with a noted number of holdings and 1 year returns as at 31 December 2015.

- In practice, the variance of returns also depends on the variance and covariance of the stocks held within it. If a portfolio of 20 stocks holds 10 that are highly correlated with each other, the equivalent number of uncorrelated portfolio stocks would be closer to 11 than to 20, thereby raising portfolio risk. To illustrate this point, owning a selection of 40 or even 100 oil exploration companies would be unlikely to result in a diversified portfolio for risk mitigation purposes as all would likely be impacted by movements in the oil price.
- Accordingly, effective portfolio diversification involves more than just increasing the number of stocks as the variance and covariance of the stocks in the portfolio is critical. In this respect, investors need to understand both the behaviour of an individual stock in a portfolio and how it interacts with the others.
- However, on a note of caution, historic return relationships between stocks can change over time. Consequently, prospective risk management strategies need to be supplemented with a thorough understanding of the underlying company's competitive positioning and economic drivers.

This paper explores the nature of risk and diversification and in doing so suggests a way to assess risk and the balance of risk in investment.

Investment Risk and the Return Objective

In establishing portfolios with the optimal risk/return profile, conventional portfolio theory uses historic asset price volatility as its sole measure, or proxy, for risk. For instance, the asset pricing models of Sharpe (1964) and Black and Scholes (1974) directly relate the change in price of an asset to its return. However, as a proxy for investment risk, we perceive asset price volatility to be controversial, and several empirical studies have found almost no evidence of a relationship between portfolio returns and the variance of those returns (Baillie and DeGennaro, 1990).

By contrast, we define risk as the probability of failing to meet an investment objective. For some investors this means the probability of failure to meet some future liability, such as pension or retirement costs, but this could also be the probability of failure to achieve as good a return as was possible. Implicit here is the concept that investing involves balancing the conflicting demands of having to take some risk to generate the required return, but in doing so, facing the potential of not realising it. Such an acceptable level, both of desired return and of associated risk tolerance is idiosyncratic to each investor.

Although it may be of limited use to solely use historic volatility of returns as a measure of investment risk, it should nevertheless be considered as part of a broader risk mitigation framework. Investors with a low return objective and a short time horizon would be well advised to create a low volatility portfolio irrespective of the loss of upside potential. On the other hand, for an investor with a long time horizon, volatility should be relatively unimportant.

Given our preferred definition of risk, first the investment return objective should be determined, followed by the construction of an appropriate strategy to achieve it.

Such a strategy should provide the potential to achieve the desired investment results without elevating excessively the chances that they will not be achieved. In 2006, Howard Marks (Oaktree Capital "Dare to be Great") published an insightful study which highlights *'unconventionality'* as the requisite mind-set for superior investment results.

	Conventional Behaviour	Unconventional Behaviour
Favourable Outcomes	Average good results	Above average good results
Unfavourable Outcomes	Average bad results	Below average bad results

Source: Howard Marks (2006)

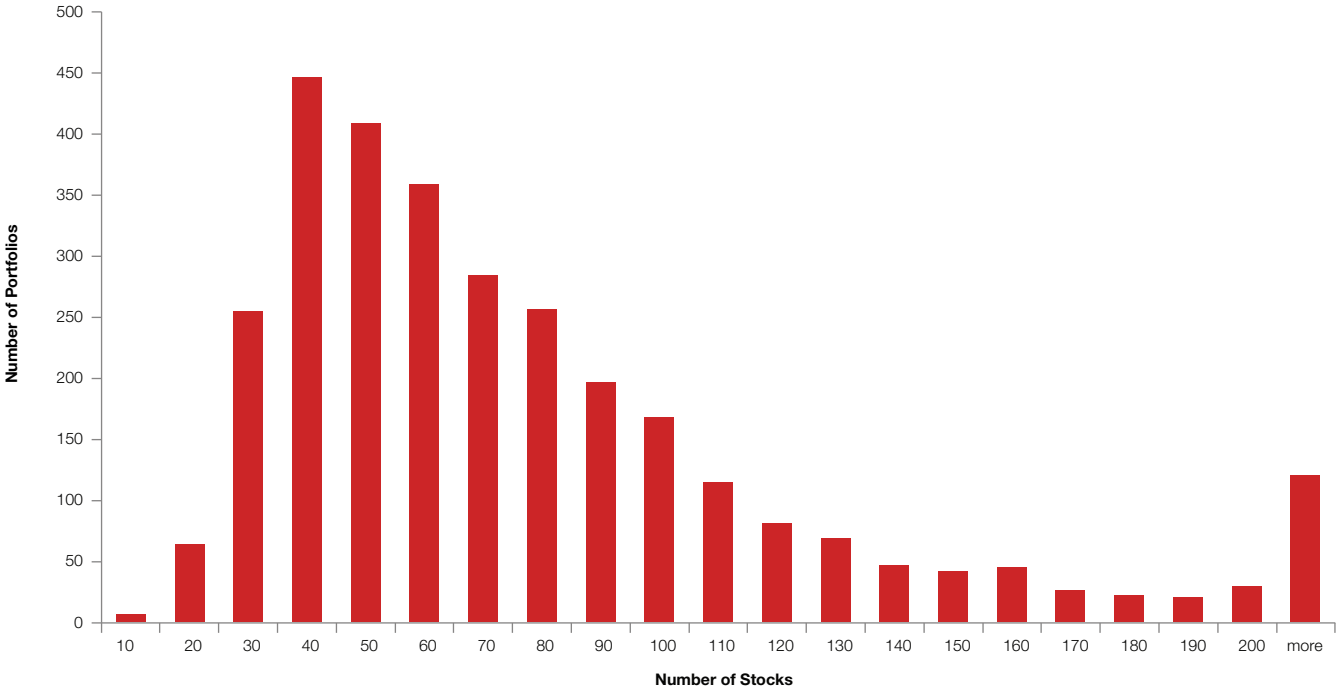
In his letter, Marks was referring to asset allocation but the concept can be applied to other aspects of investment, including investing teams and structure as well as for products and philosophies. In this paper we concentrate on its application to equity portfolio concentration.

In view of the above, the first question to address is what is 'unconventional' behaviour in the context of portfolio concentration?

There is no definitive answer to this since the relevant data required for the analysis on investors' strategies is somewhat limited. However, analysing the publicly available data, we observed that there are numerous highly diversified portfolios, suggesting that these are, at least somewhat conventional (Chart 1).

Conventionality

Chart 1: **Histogram of frequency of portfolio stock count**



Source: Nomura Asset Management U.K. Ltd., eVestment database, (All Equity funds with fewer than 300 holdings and at least 1 year return as at 31 December 2015).

Chart 1 demonstrates the frequency of the numbers of stocks held in equity portfolios in the eVestment database. Of the almost 3,050 funds in the eVestment database that have a stock count visible, 75% hold more than 40 stocks. When considered with the analysis that follows in this paper, it appears there is a diminished likelihood of achieving results significantly better than the benchmark once 40-50 or more stocks are held in the portfolio. This suggests that 'unconventional' behaviour in the context of portfolio concentration would therefore be to have a portfolio with less than 40 stocks.

In the analysis that follows, we demonstrate that concentrated portfolios can provide a good balance of achieving above average returns whilst avoiding a greater chance of failing to meet the investment objective.

Stock Count & Returns

We first analysed the effects of portfolio concentration on returns. Our aim was to determine the point of balance in portfolio construction, between the return objective and the probability of failure to achieve that return objective. This is the point where the potential to achieve above average returns remains as high as possible without introducing excessive exposure to the negative impact of investment mistakes.

Simulated results

To illustrate this, we analysed the historic returns of the more than 2000 stocks in the MSCI All Country World Index using returns data since 2004. We created portfolios of different numbers of stocks by randomly selecting stocks into 20 separate portfolios for various portfolio size (e.g. 20 x 1 stock portfolios, 20 x 2 stock portfolios, 20 x 4 stock portfolios, 20 x 6 stock portfolios, and so on). For simulation purposes we then calculated portfolio returns on a buy and hold basis (starting at equal weight) and compared that to the performance of the entire market, calculated in the same way. In reality, of course, there would be some index and portfolio turnover, and reweighting and indexes tend to be compiled on a market weight basis.

Chart 2: **Excess return simulation results since 2004 vs Stock count**

Source: Nomura Asset Management U.K. Ltd.

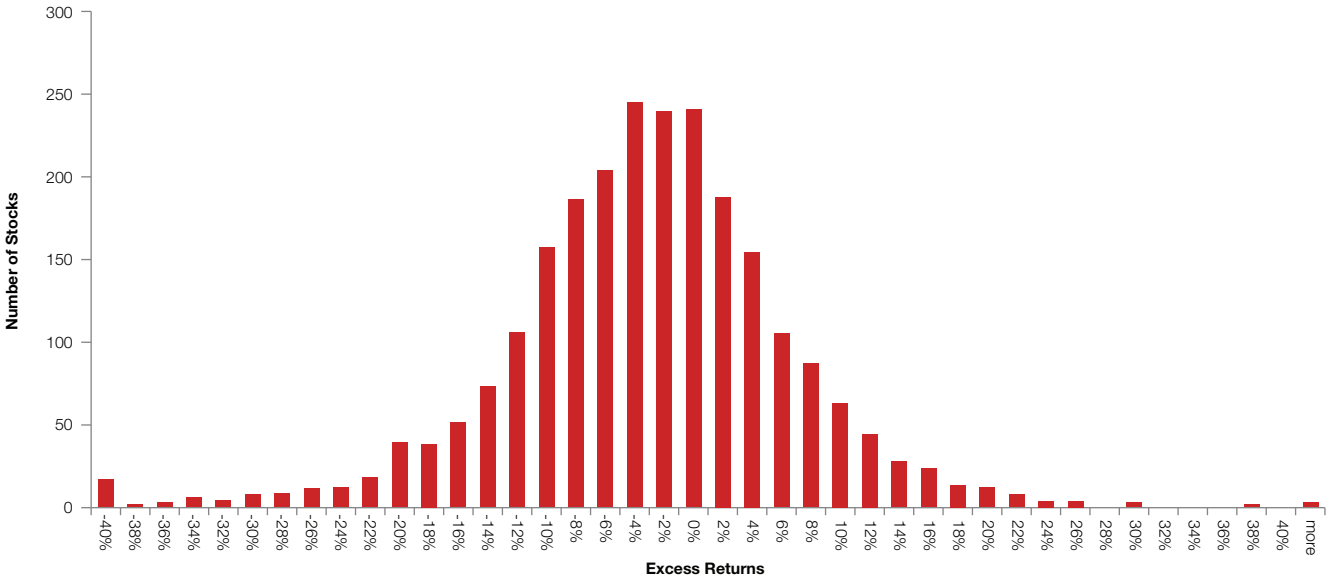
We can make two key observations about the dispersion of returns across the portfolios of each stock count. Firstly, the standard deviation of returns declines rapidly up to around 20 stocks but much more slowly beyond that—so beyond 40 stocks—the dispersion in returns remains more-or-less unchanged. We observed that the first 20 stocks reduced the standard deviation of excess returns of the portfolio groups by 75-85% of the maximum potential reduction (that is the standard deviation associated with the 150 stock portfolios)

with the decline in standard deviation of excess returns slowing from that point forward, such that approximately 90% of the maximum reduction is reached by the time you have 40 stocks.

This leaves an upper limit on optimal portfolio stock count of 40 stocks. This is a robust pattern over the last two, three and ten years. This suggests the upper limit of portfolio stock count should be 40 stocks because beyond that the potential to achieve above average investment returns has substantially diminished.

Secondly, there is a marked downside skew for the portfolios of fewer than around 10 stocks across all time periods. We observed that portfolios with very few stocks tend to underperform more than they outperform. This downside skew may seem counter-intuitive but the observation is corroborated by a large body of analysis (Fama, 1965 and Hong and Stein, 2003) and supports the view that a crucially important element in successful investing is to avoid losing positions; in essence avoiding mistakes. The negative returns skew (Chart 3) indicates that there is a higher probability of picking an underperforming stock than an outperforming stock.

Chart 3: **Frequency of annualised single stock buy and hold excess returns since 2004**



Source: Nomura Asset Management U.K. Ltd.

Coming back to our question of balance in investment strategy, what we have seen is that it is desirable to have more than 10 stocks in a portfolio because the impact of one or two mistakes will have an excessive impact on the overall investment return in a portfolio with fewer than 10 stocks.

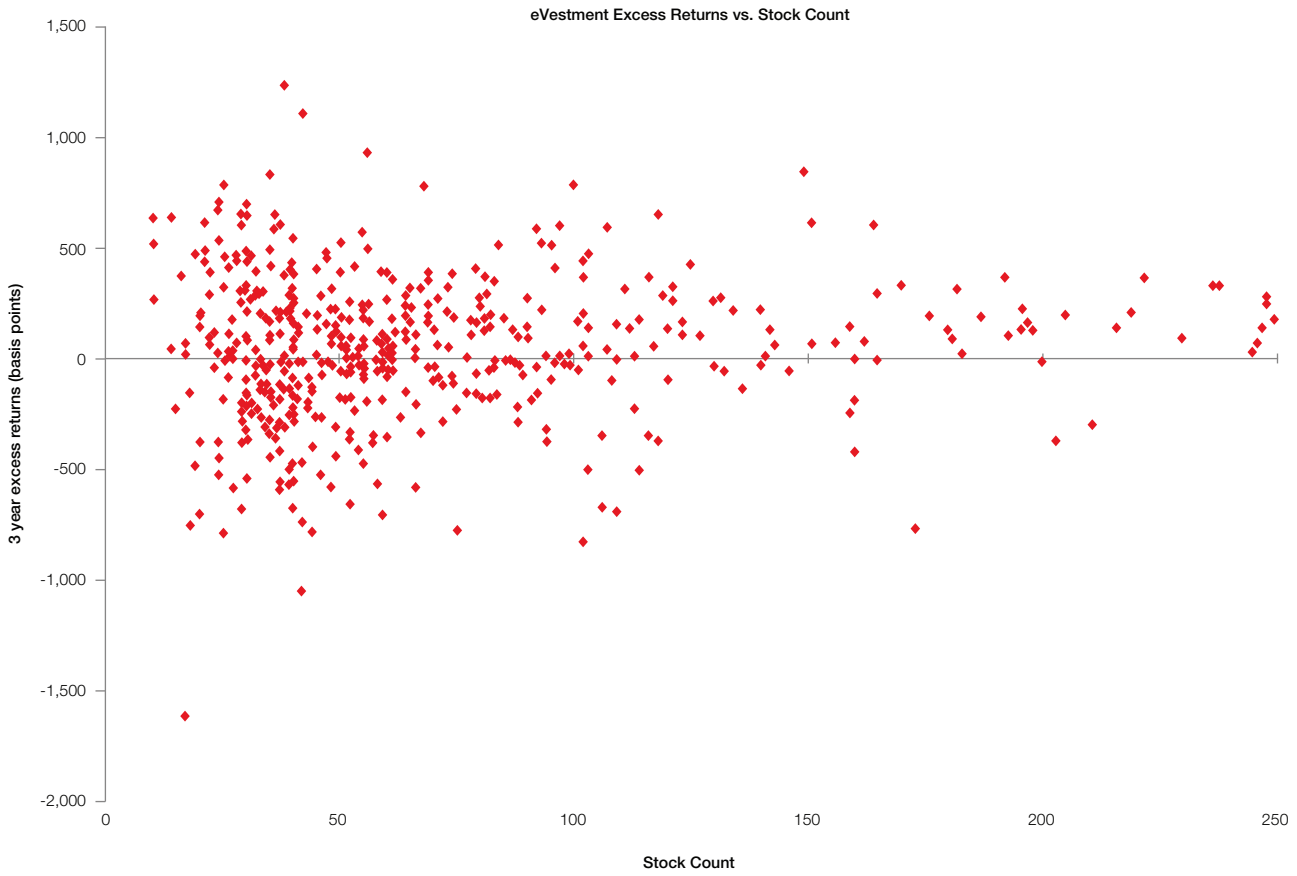
In summary, the impact of such an investment mistake in highly concentrated portfolios is not offset by the higher returns potential, but from 10 stocks and upwards, the negative skew in the returns distribution has dissipated. We combine this with our earlier conclusion, regarding the upper limit on stock count, to conclude that an optimum portfolio size should be between 10-40 stocks in order to achieve a balance between retaining the potential to achieve good investment returns and the chance of failing to do so.

Actual Fund Results

In order to assess the validity of our conclusion on the optimal portfolio size, we analysed actual fund performance data from the eVestment database (Chart 4). Here we make the assumption that the stock count reported to eVestment has remained more-or-less constant across the 3 year period of reported returns data and to reduce the impact of erroneous benchmarking, we took only those funds with a broad standard benchmark, such as the MSCI ACWI or S&P500 and eliminated any funds with clear sector biases (e.g. a Healthcare fund reporting performance vs. the S&P500).

Interestingly we notice that, particularly for the portfolios that hold a large number of stocks, there is evidence of 'survivorship bias'* in the data, which we advise the reader to bear in mind when examining Chart 4.

Chart 4: **Actual portfolio excess returns data over 3 years**



Source: Nomura Asset Management U.K. Ltd., eVestment (All Equity with fewer than 300 holdings, 3yr return and benchmarked against a standard benchmark).

*'Survivorship bias' - Funds may have closed due to poor performance and therefore would not be included in the dataset

Upper limit

Our simulation suggests that 90% of the potential reduction in the standard deviation of excess returns is achieved by just 40 stocks. Just from simple examination of chart 4 we can see that the actual portfolio data suggests a similar conclusion and, additionally, by calculation we find that from approximately 40 stocks to approximately 150 stocks there is almost no change in the standard deviation of excess returns. So from the perspective of investment balance our optimal upper limit does appear to have validity in real data with the potential for significantly better investment returns largely diminished by the time 40 stocks are in a portfolio.

Lower limit

Unfortunately, for our analysis, there is limited portfolio returns data at the lower end of the portfolio stock count range that is available publicly so we cannot empirically confirm the validity of our suggested lower stock count limit for prudent portfolio construction. However we are confident in the conclusion that fewer than 10 stocks provides an unfavourable return skew.

In summary, making an equity portfolio more concentrated does not ensure outperformance but can be a key element in facilitating it. However, it is important to achieve the correct degree of concentration as too much exposes the portfolio to an undesirable negative skew in returns, whilst too little eliminates the potential for outperformance. We propose an optimal concentration of around 20 stocks, which retains the potential for superior returns whilst preserving the benefits of diversification.

What about Volatility?

Despite our preferred definition of investment risk (the uncertainty of attaining one's goals) making no mention of volatility, we do not deem this to be unimportant and should be considered as part of a broader risk mitigation framework. However, we see volatility impact investment risk in the following two ways:

- Volatility is important as it pertains to the time horizon of the individual investor. The investor with a low investment return objective and a short time horizon would be well advised to create a low volatility portfolio irrespective of the loss of returns potential. On the other hand, for an investor with a very long time horizon volatility should be relatively unimportant.
- Volatility impacts behavioural biases of both the investor and manager. A substantial amount of volatility can introduce loss aversion bias and can ultimately cause an investor and/or portfolio manager to sell an investment at precisely the wrong time.

Diversifying Volatility – Theoretical Application

In deriving an optimal stock count for diversification we next look at the statistical relationship between the number of holdings in a portfolio and its overall volatility (Evans and Archer, 1968, Elton and Gruber, 1977, 2014)[1]. In the interests of brevity we use the derived mathematical relationship between portfolio volatility and number of stocks held within it (Appendix 1).

1.[2] $$\sigma_p{}^2 = \frac{1}{N}\overline{\sigma}_j{}^2 + \frac{N-1}{N}\overline{\sigma}_{jk}$$

Where:

$\sigma_p{}^2$ is portfolio variance (variance being the square of standard deviation)

$\overline{\sigma}_j{}^2$ is the average variance of portfolio constituents

$\overline{\sigma}_{jk}{}^2$ is the average covariance between each of the portfolio constituents

N is the number of stocks in the portfolio

Of course, the actual variance of portfolio returns depends on the variance and covariance of the stocks held within it, as well as the number stocks. Should a portfolio of 20 stocks hold 10 that are highly correlated with each other (strong covariance), then the 'equivalent' number of uncorrelated portfolio stocks would be closer to 11 than to 20 leading to significantly different portfolio volatility characteristics than predicted by the equation above. Nevertheless for the purposes of visual demonstration if we assume that stocks with index average variance and covariance are picked and that holds prospectively, then we can predict the variance of portfolios of different numbers of stocks. It is quite clear from the equation above that the relationship is of the approximate form 1/N + C so that as N increases the portfolio variance rapidly declines to the level of the constant C, which, as N becomes large, becomes the average covariance of the stocks from which the portfolio has been selected.

Calculation of the average covariance of monthly returns for all the stocks in the MSCI All Country World Index allows us to present a theoretical relationship between variance of portfolio monthly returns and number of portfolio stocks, assuming that the stocks selected have

Notes:

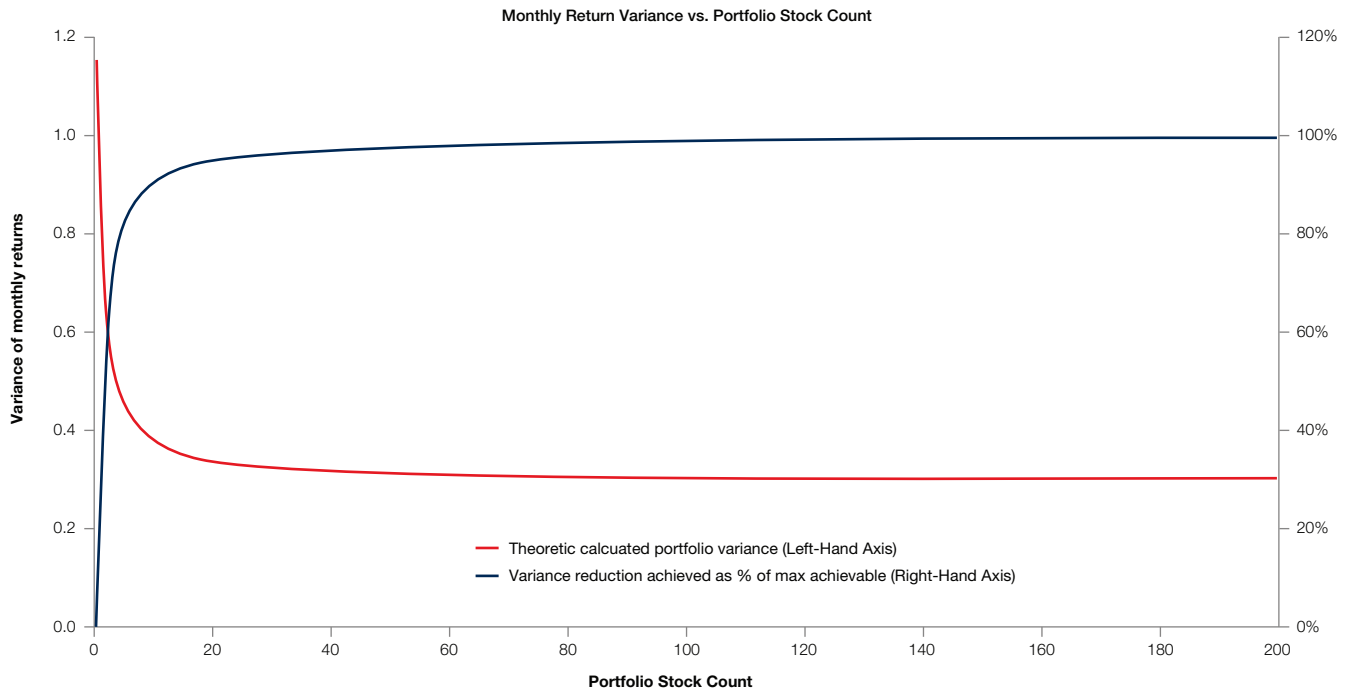
1)The analysis we have presented below is based on equal weighted portfolios and monthly returns volatility. However the statistical mathematics is appropriate for volatility all time periods and we could adjust the stock count in any portfolio to make it equivalent to equal weighted holdings.

2)In the interests of brevity we use the derived mathematical relationship between portfolio volatility and number of stocks held within it. For readers that desire more mathematical detail please refer to the appendix.


20
9
8
7
6

the average variance and the average covariance of all the stocks in the index. The relationship is shown in Chart 5, below. We have used monthly returns volatility, but the mathematical relationship makes no reference to the time horizon of the volatility so holds over longer and shorter periods.

Chart 5: **Theoretic relationship between portfolio variance and stock count**



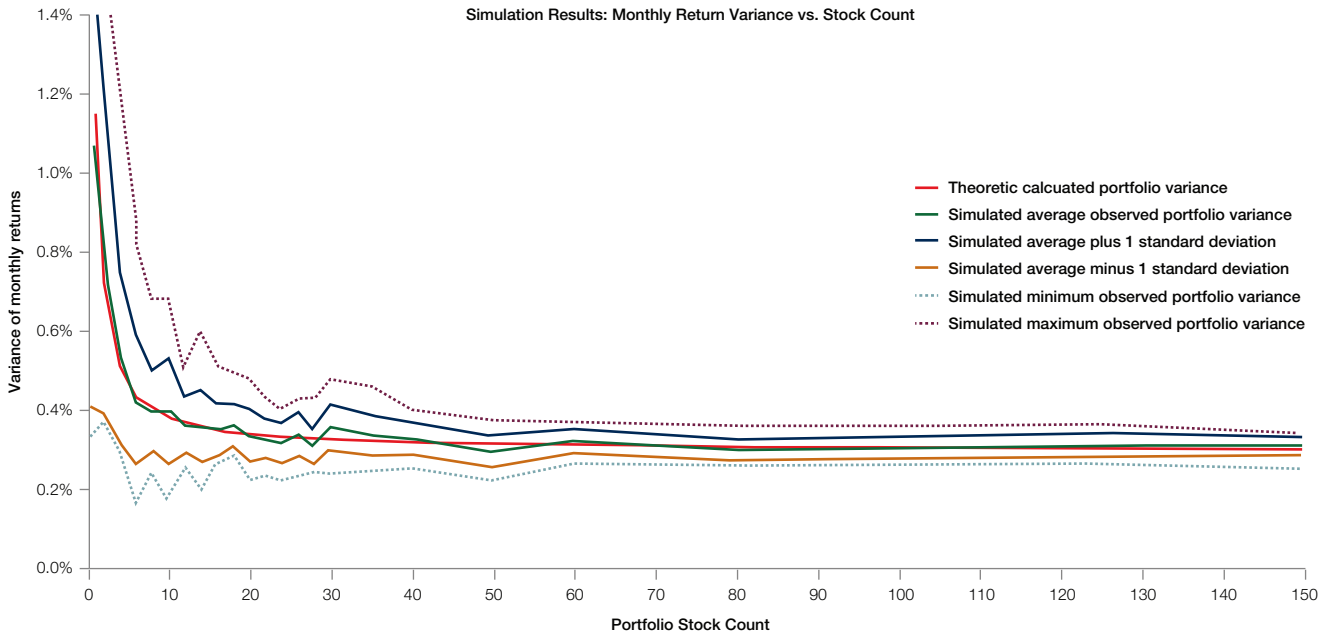
Source: Nomura Asset Management U.K. Ltd., monthly returns since 2004.

We find that the returns variance declines rapidly as portfolio stock count increases. However, at around 10 stocks in the portfolio the reduction in returns variance for each additional stock decreases rapidly with around 95% of the maximum available reduction achieved by the first 20 stocks.

Analysis of Historic Volatility

Using the same randomly created portfolios that we used earlier, we used simulation to analyse the mathematical relationship between stock count and portfolio volatility to possible real situations. In this simulation, for simplicity, we assumed a monthly re-weight of each portfolio back to equal weighting among the stocks. This enables one to observe the relationship between returns variance and stock count on average across each of the 20 portfolio groups and also analyse the variance in the monthly returns variances.

Chart 6: **Theoretic vs. simulated relationship between portfolio variance and stock count**



Source: Nomura Asset Management U.K. Ltd..

The analysis shows that the average portfolio return variance closely tracks the predicted theoretical level, validating the argument that the majority of systematic volatility can be diversified away with a relatively small number of stocks. Additionally we observe that the range of portfolio return variance reduces quite significantly as the stock count rises to around 20, with 20 stocks achieving around 99% of the maximum reduction in variance of the return variance across the simulation portfolios.

This analysis also highlights another very important point which the theoretical analysis does not. The diversification process is more involved than just increasing the number of stocks, the variance and covariance of the stocks in the portfolio is critical. If the diversification strategy has been particularly ineffective (i.e. many high covariance and variance stocks selected) or if specific effort has been made to lower volatility (many low covariance and variance stocks selected) then significantly higher or lower than theoretically expected portfolio returns variance will be experienced. Even a one-stock portfolio can have low returns variance if the stock is of particularly low volatility.

This analysis therefore highlights the importance of risk management in the construction of a concentrated portfolio. The manager needs to understand both the variance and covariance of individual stocks in their portfolio and manage these accordingly. This will limit the possibility of unintended outcomes for the portfolio which could impact the ability to achieve the investment objective.

Achieving Investment Balance

Ultimately the answer is idiosyncratic to the individual or institutional investor, but the framework we describe suggests a direction for practical implementation.

- The downside skew to returns for very low stock count portfolios suggests that holding below 10 stocks is probably not appropriate.
- The loss of returns potential from around 40 stocks and upwards suggests that holding 40 or more stocks is probably not necessary.
- Theoretical and simulation analysis suggests that whatever the time horizon volatility limit, more than 20 stocks is not really necessary to dampen portfolio volatility. But roughly 20 stocks will significantly reduce the chance that the portfolio manager will make a severe diversification error.

This leaves us with a range of 10-40 stocks as a possible strategy for the investor that wants to achieve above average investment results. That is not to say this strategy is right for all. An investor with a low investment return objective and a short personal time horizon for volatility purposes, may well wish to look primarily at volatility dampening strategies. That is to say, the personal benefit of dampening volatility may be greater than the return potential offered by investing in 10-40 stocks.

Conventional Diversification – how did we get here?

As our analysis suggests, a concentrated portfolio of between 10-40 stocks, with the optimal point being around 20 stocks, it is natural to wonder why this appears to be an unconventional approach.

The US mutual fund industry was created in the 1920s and grew rapidly from there. Funds were created to provide exposure to the market as well as to earn an excess return and all mutual funds were seen as being 'actively managed'. It wasn't until the early 1970s, when the first index funds became available, that investors even questioned a manager's ability to outperform the market. So the 'path of least resistance' for managers was to diversify heavily.

Since the 1950s Modern Portfolio Theory (MPT) has guided the investment community that for a given expected return, unsystematic portfolio risk can be reduced by holding more than one investment. According to MPT, the 'efficient portfolio' is one where risk is minimised for a given expected return, or expected return is maximised, for a given risk. Diversification is the process of achieving such a portfolio and has a strong intuitive logic, notwithstanding the questionable equating of returns volatility with investment risk. However, even here, there is scant theoretical support for highly diversified funds. It is likely the persistence of highly diversified funds has been driven by behavioural biases;

- *Status quo bias* – a preference for the current state of affairs. The fund industry had almost 50 years of selling diversified active products and investors buying these products before passive products became available. The industry therefore becomes familiar with diversified active products and this very large inertia is difficult to overcome as the products are deeply entrenched up and down the product development and supply chain.

- *Loss aversion* – refers to people's tendency to strongly prefer avoiding losses to acquiring gains. It is human nature to overemphasise the possibility of greater relative underperformance than the possibility of greater outperformance. Generally speaking investors are liable to give up the potential for larger outperformance to avoid the potential for smaller underperformance; hence portfolios are liable to drift towards over diversification.
- *Single stock loss effect* – For many investors the impact of a 'disaster stock' (like Volkswagen in 2015) on portfolio performance is a concern. However this fails to recognise the diversification effect that reduces the effect of such an event as the portfolio stock count moves above 10 stocks.
- *Commercial considerations* – Highly diversified funds need one investment team but have higher capacity than concentrated funds that also need one investment team. A fund of 20 equal weighted stocks limited to, say, 5% equity ownerships of investee companies would have a capacity of $4bn if the average market capitalisation investee company was $4bn market capitalisation. The capacity for a 100 stock portfolio would be $20bn, making the 100 stock portfolio a more attractive commercial proposition for the asset manager that has the capacity to gather such large assets.

Achieving True Diversification with Concentrated Portfolios

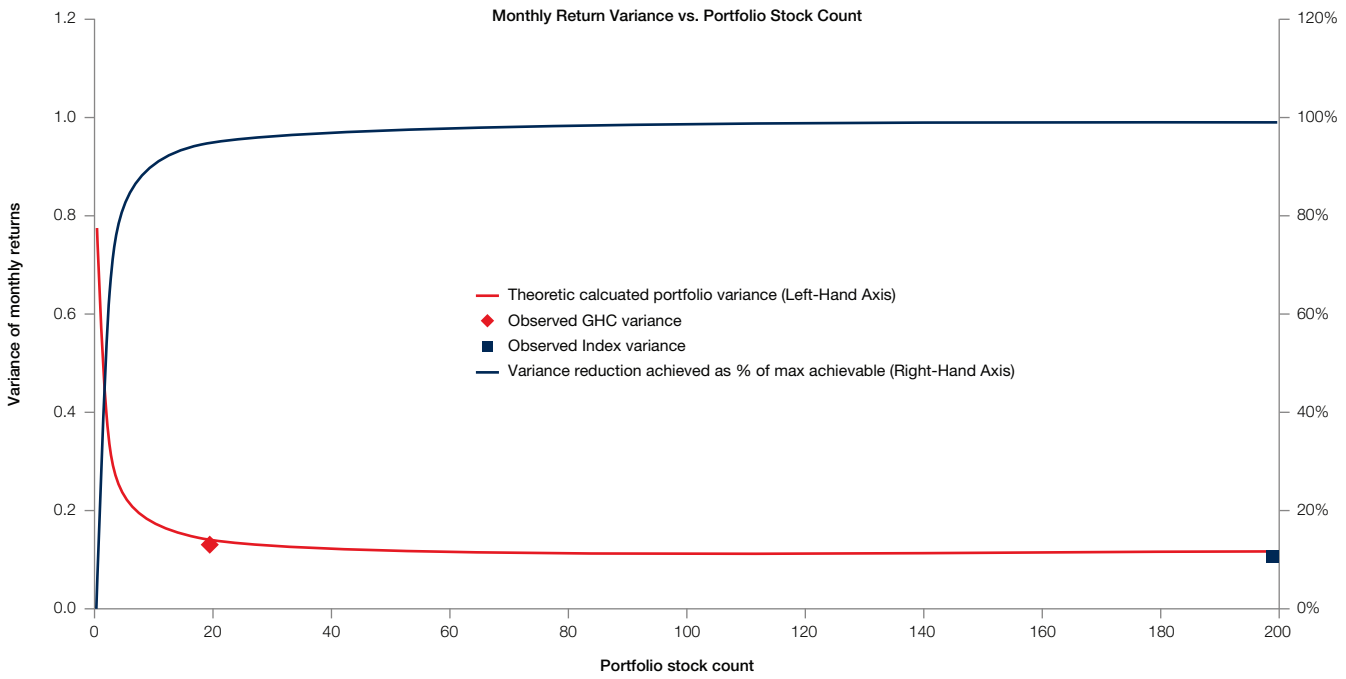
Diversification should achieve a balance of return potential whilst mitigating the impact of possible investment mistakes within the context of personal time horizon. Prudent portfolio construction is thus required to select stocks that behave together in a way that produces an expected balance of investment risk and expected return.

Ultimately the critical challenge of portfolio construction involves three components:

1. *Business model diversification* – Fundamental investment managers seek to understand the businesses in which they are invested. The business generates cash flow and from the cash flow derives the value. Certain business models are inherently attractive to us because of the tendency to strengthen over time (e.g. network effect businesses, bottleneck businesses, natural monopoly businesses), but we can still seek to diversify.
2. *Economic exposure diversification* – Conventionally economic exposure is assessed by active sector weight. However sectors are far from homogeneous and provide a poor substitute for analysis of the extent of the economic exposure of the portfolio as a whole. Glencore, LVMH and Daimler are in different sectors but all have significant economic exposure to the Chinese economy. Portfolio holdings, candidate stress analysis and equity return correlation analysis can help highlight areas of similar economic exposure, which could reduce the benefits of diversification.
3. *Economic scenario diversification* – It is well known that the historic relationship of the performance of different stocks can change dramatically during periods of market stress with correlations typically rising. Scenario analysis allows us to understand how the portfolio will likely behave as a result of the combined movement in a series of economic factors and therefore highlight areas of diversification concern.

Given this model and our own own Global High Conviction strategy performance since inception (1 January 2014)[1], it is apposite to assess the effectiveness of our own, fundamentally-driven diversification efforts. We have therefore recalculated the stock count and volatility relationship using the monthly returns variance and covariance since 31 Dec 2013. As Chart 7 shows the shape is very close to that expected, but the 'terminal' monthly returns variance is rather lower[2].

Chart 7: **Actual relationship between portfolio variance and stock count**



Source: Nomura Asset Management U.K. Ltd. Global High Conviction Strategy, monthly returns since 2013.

Aside from noticing the generally lower volatility, we can now assess our own portfolio construction effectiveness. The Global High Conviction strategy monthly returns variance was actually 9% lower than predicted, suggesting a successful effort at diversifying the portfolio. The index returns variance was around 3.5% lower than expected, which is well within the one standard deviation range.

Notes:

1)This strategy was managed as a 'paper portfolio' from inception on 1 January 2014 until the launch of the UCITS fund on 21 December 2015. The UCITS fund is a sub-fund of Nomura Funds Ireland plc, which is authorised by the Central Bank of Ireland as an open-ended umbrella investment company with variable capital and segregated liability between its sub-funds, established as an undertaking for Collective Investment in Transferable Securities under the European Communities (Undertakings for Collective Investment in Transferable Securities) Regulations 2011. The UCITS fund is not intended for distribution to or use by any person or entity in any jurisdiction or country where such distribution or use would be contrary to law or regulation.

2)The volatility of the equity market as a whole over the past two years has been lower than the average since 2004, see Appendix 2, so our own portfolio returns volatility has also been much lower than one might have expected from the longer term relationship.

A Way Forward

In conclusion, we define true investment risk as the chance of failing to attain one's goals. Within equity investing, the use of asset price volatility as the sole measure for risk has limited prognostic value and is only one component of investment risk. Our analysis suggests that adding stocks to a portfolio does not necessarily provide greater benefit in risk-reduction and that a carefully selected concentrated approach can achieve a similar level of diversification.
Our fundamental approach to risk management relies on a deep understanding of company fundamentals to gain portfolio-level risk mitigation through business and economic exposure diversification. Highly concentrated funds do not guarantee superior returns and poor stock selection could amplify losses in a portfolio. However, we believe when successfully deployed, such a strategy over a long-term investment horizon can offer the potential for superior returns whilst preserving the benefits of diversification.

Nomura's Experience in Global Equities

Our fund management capability was established over 50 years ago and we have a long and successful track record of active equity portfolios. Today we are one of Asia's largest global asset managers, managing over $120 billion in equities in total, including $2.7 billion in global, emerging and frontier strategies from our London office.

Our Global High Conviction strategy, which launched as a UCITS fund in December 2015, is managed by NAM UK's Global Equity Team and supported by a team of 18 investment professionals. It focuses on individual stock selection, with an emphasis on the timely purchase of a select number of high quality businesses trading below intrinsic value.

The management team actively manages the risk of unintended exposures and stock correlations of the concentrated portfolio comprising 17-25 stocks. In addition, the fund managers have access to both top-down risk analytics and bottom-up asset selection ideas through Nomura's global network of analysts. This enables the team to make investment decisions driven by individual company analysis whilst avoiding macro-economic, portfolio aggregate exposures.

- **True active global equity investing**
  97% active share
- **Highly concentrated**
  17-25 high conviction stocks
- **Rigorous 'bottom-up' analysis**
  Team approach to best stock holdings
- **Long-standing team**
  18 strong, spanning sector and geographic specialities with an average of 15 years' investment experience
- **Unconstrained**
  No limits on country or sector exposures
- **Quality & value bias**
  Integral to risk management

> *Our Global High Conviction Strategy aims to deliver superior compounding of returns through actively managing a highly-concentrated and unconstrained portfolio.*

The strategy is available on a pooled (UCITS) or segregated basis.

For more information please contact: info@nomura-asset.co.uk

Note: AUM data as at 31st December 2015.

Appendix 1

Theoretic relationship between portfolio returns variance and stock count

Firstly we use the basic calculation of variance of a population (we are dealing with all available data throughout this paper):

2. $$\sigma_p{}^2 = \sum_{i=1}^{N} \frac{(R_{pi} - \bar{R}_{pi})^2}{N}$$

Or for non-equal weighted portfolios this is equivalent to:

3. $$\sigma_p{}^2 = E\,(R_{pi} - \bar{R}_{pi})^2$$

Where E is the sum of the weighted expected returns of the portfolio constituents. We can expand equation 3 to derive equation 4 below:

4. $$\sigma_p{}^2 = E\left(X_1{}^2(R_{1i} - \bar{R}_1)^2 + 2X_1X_2(R_{1i} - \bar{R}_2)(R_{2i} - \bar{R}_2) + X_2{}^2(R_{2i} - \bar{R}_2)^2\right)$$

Which restated is equation 5:

5. $$\sigma_p{}^2 = X_1{}^2E(R_{1i} - \bar{R}_1)^2 + 2X_1X_2E((R_{1i} - \bar{R}_2)(R_{2i} - \bar{R}_2)) + X_2{}^2E(R_{2i} - \bar{R}_2)^2)$$

Which put simply is where the second term becomes the covariance of asset 1 with asset 2:

6. $$\sigma_p{}^2 = X_1{}^2\sigma_1{}^2 + 2X_1X_2\sigma_{12} + X_2{}^2\sigma_2{}^2$$

Now if we generalise this equation we can derive:

7. $$\sigma_p{}^2 = \sum_{i=1}^{N} X_i{}^2\sigma_i{}^2 + \sum_{\substack{i=1 \\ j=1 \\ j\neq i}}^{N} X_iX_j\sigma_{ij}$$

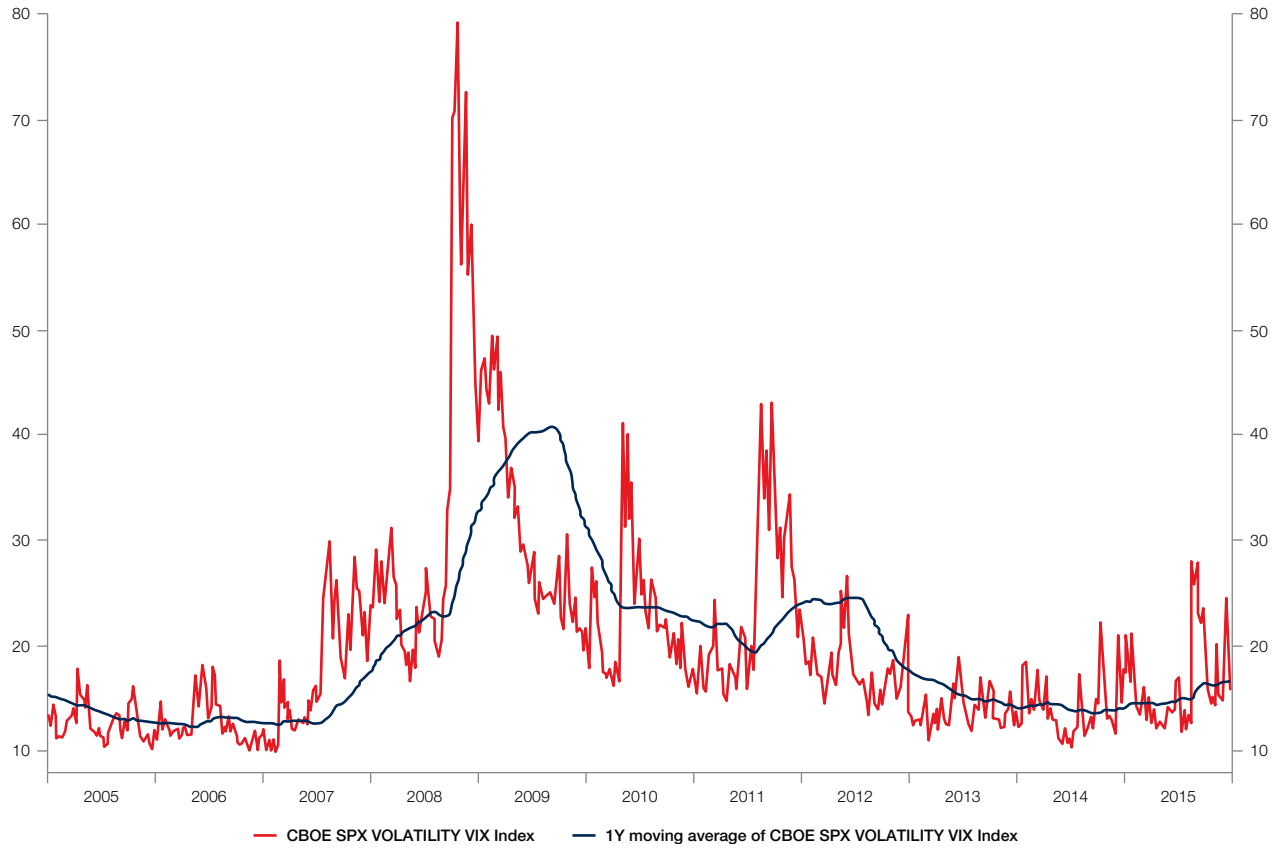
And if we assume an equal weighted portfolio then we can derive equation 1 where the variance and covariance of the i^{th} and j^{th} asset simply become average variance and covariance of the assets (stocks) in the portfolio:

1. $$\sigma_p{}^2 = \frac{1}{N}\bar{\sigma}_j{}^2 + \frac{N-1}{N}\bar{\sigma}_{jk}$$

Appendix 2

Vix volatility index over the past 10 years

Clearly the period since 2013 has been lower than the period since 2004 although the volatility over that period is dominated by the financial crisis.



Source: Thomson Reuters Datastream.

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Disclosures

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