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Are you taking enough risk? How do you know?

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Risk & Reward

Research and investment strategies

Are you taking enough risk? How do you know?

By Michael Marshall

In brief
In a world of low volatility and low interest rates, it becomes increasingly important to understand the level of risk in an investment portfolio. Standard measures such as statistical volatility are often misleading. We propose using a different metric, Internal Portfolio Risk, which we think provides a far more accurate picture of the level of an investment portfolio's true risk.

A low volatility and low interest rate world has prompted a reassessment of the appropriate level of risk required to achieve a specified return outcome. As investors seek returns in this anaemic world, absolute return funds come under the spotlight because they are typically structured to deliver an attractive return with lower than equity-level risk. This dual focus on return and risk can also bring scrutiny, as many critics are concerned, about the promise of a "free lunch" – can one achieve a long-term, risk asset-like return and deliver it with a low standard deviation. In other words, are you taking enough risk to achieve a return target and, importantly, how do you know?

We believe that high information ratios – high returns for a given level of ex-post volatility – are possible if a manager can achieve a positive and persistent hit rate and a positive return skew, provided the risks interact in such a manner as to achieve low portfolio volatility.

Standard deviation, VaR, tracking error and other risk metrics have become synonyms, or even direct substitutes, for risk. But, fundamentally, they are not the same thing.

A volatility target put in place to limit downside exposure does not equate to the risk required to achieve a desired level of return. Low day-to-day volatility achieved through high levels of diversification allows portfolio managers to manage and limit short-term downside risk (drawdowns). However, it is the amount of internal risk – the risk associated with the individual positions or ideas – that allows the portfolio manager to achieve return targets.

Put another way, portfolio returns are not an outcome of the level of assumed volatility but rather of the skill of the manager in selecting positions and combining these in portfolios – volatility is merely an outcome of how the assumed risks behave.

Targets and targets

Any asset or portfolio generates returns in two ways: capital returns and yield (or carry).

Yields can be thought of as premia paid to investors bearing the risk of a position, e.g. dividends on stocks, bond coupons and the carry in currency, to name a few. If a market were to stand still, the yield would equal the total return.

The portfolio yield can be estimated ex-ante with some degree of certainty – for example, an investor can be confident of the yield to be received from a sovereign bond and, at an index level, we have some degree of certainty of the dividend yield.

Capital returns, on the other hand, require forward estimation: How far can the S&P 500 rally or the euro fall? Where will five-year US inflation be trading in a year's time? By how much will share A outperform share B?

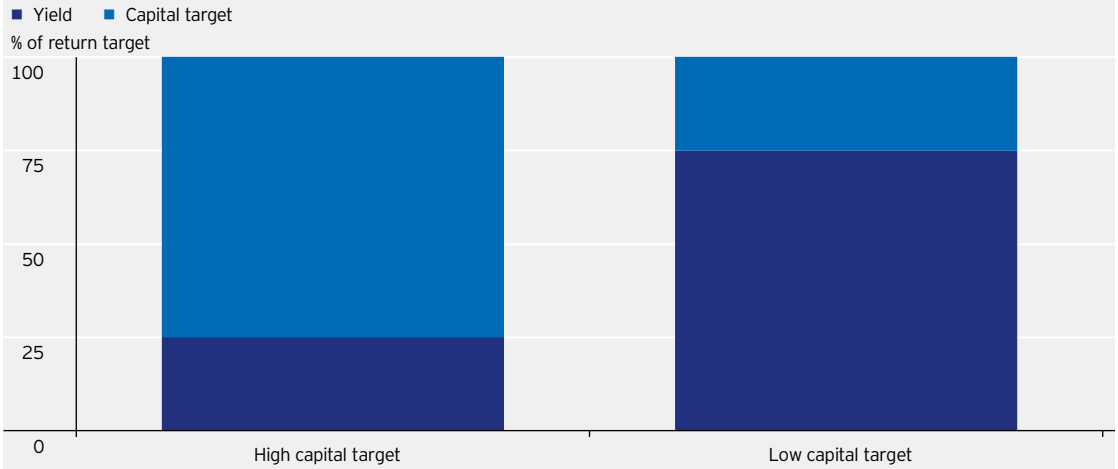
How these capital returns play out, both idiosyncratically and combined, will, ex post, determine a portfolio's volatility. In other words: volatility is only concerned with the capital movements of positions.

Of course, nothing is certain, and some yields are more guaranteed than others – there is clearly a feedback loop between yield and capital risk. However, that risk is incorporated into thinking about what size position is appropriate for, say, a high yield credit market or low risk sovereign bond. Fortunately, in a world of derivatives and leverage, it is relatively easy to scale the volatility contribution of a particular asset, enabling flexibility in the asset's contribution to the portfolio of (post funding) yield and expected return.

Using this, we can define the capital target as the target return less expected portfolio yield. This gives us the amount of return the portfolio must generate from its capital moves – or the amount of return the capital risks must generate (figure 1).

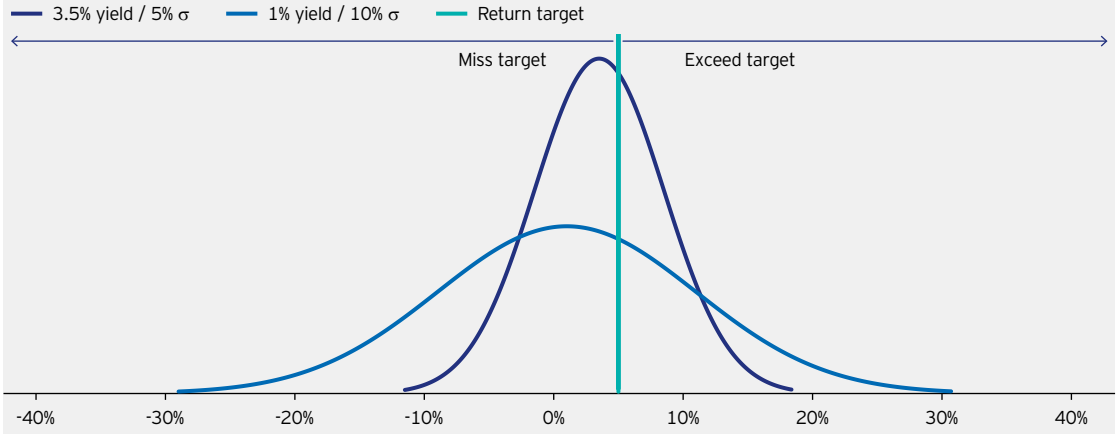
It follows that, when trying to achieve a return target, the closer the portfolio yield is to the required return, the less capital risk is required to achieve or exceed that target.

Figure 1
The higher the yield, the less capital return is necessary
Effect of yield on return target



Source: Invesco. For illustrative purposes only.

Figure 2
Adding risk widens the potential return distribution
Gaussian return distributions for different levels of yield and volatility



Source: Invesco. For illustrative purposes only.

To illustrate this in absolute terms: if risk-free cash rates are equivalent to the return target, then there is no need to take capital risk to achieve it. Adding risk will only increase the possible distribution of returns around the target and in doing so, increase the potential overshoot in both directions (figure 2).

Normally, however, the target return will exceed the expected portfolio yield, and some capital risk will have to be taken to achieve the target. Knowing this, we are still left with the problem of determining just how much risk is necessary to give us a good chance of generating capital returns at least equal to our capital target while minimising the chance that capital losses cause a target miss.

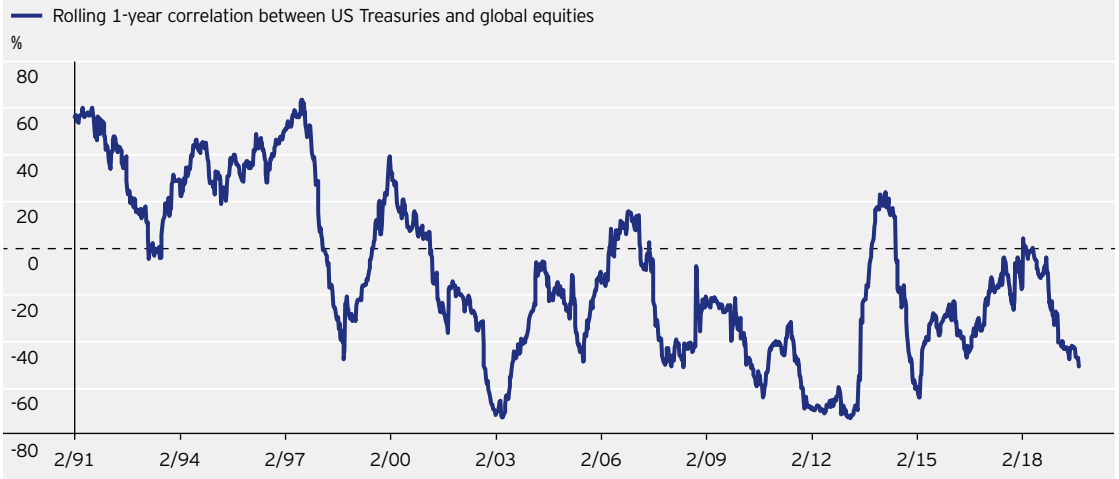
Focusing solely on standard deviation can be misleading.

Volatility ≠ Risk
Focusing solely on standard deviation can be misleading. The observable dynamic of a portfolio is driven by the level of volatility of each underlying investment combined with the correlation between those investments. However, these relationships do not remain static through time. Even using a simple asset allocation example of a stock/bond portfolio, the correlation between these two assets is not stable. This becomes increasingly true when you expand to more complex strategies, like those that look to isolate and reflect independent risks across idiosyncratic investment ideas.

Figure 3 shows that the correlation between equities and bonds has been both positive and negative at different times. In figure 4, we can also see that the standard deviation of both asset classes has evolved over time and, at times, has been at very similar levels.

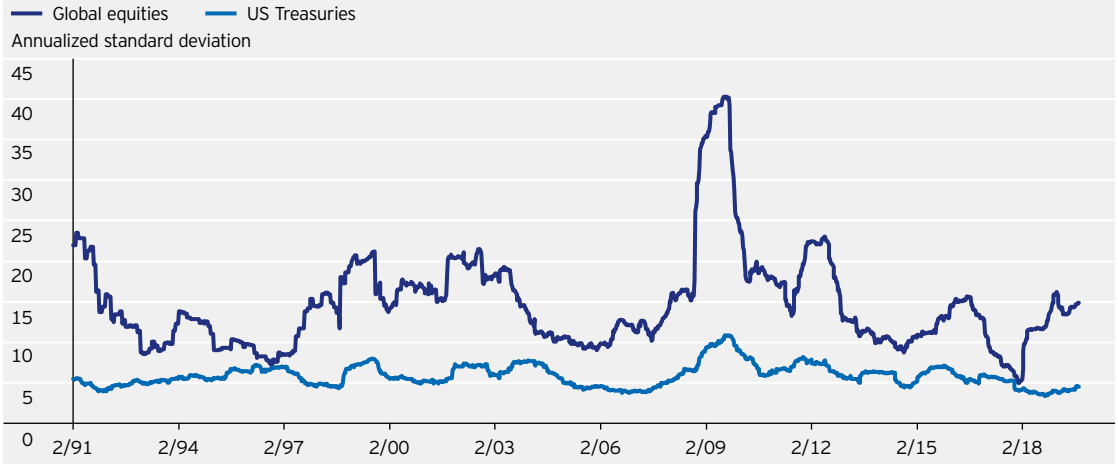
This could lead to sub-optimal investment choices based on how much observable volatility is embedded

Figure 3
Correlations: sometimes positive, sometimes negative



Source: Bloomberg. Data as at 6 September 2019. For illustrative purposes only. Treasuries represented by 10-year US Treasuries. Global equities represented by MSCI World Index.

Figure 4
The standard deviation of returns is far from constant



Source: Bloomberg. Data as at 6 September 2019. For illustrative purposes only.

in the portfolio relative to the return outcome for each asset class.

Figure 5 highlights the lack of relationship between backward-looking observable risk metrics, such as ex-ante standard deviation, and subsequent returns. Comparing December 1995 with March 2009, both delivered subsequent annualized returns of around 12% over the next few years but, in 1995, the observable standard deviation was 5.5% and in March 2009 it was 9.3%.

We therefore need to look at a broader set of metrics to determine whether the underlying risk embedded within the portfolio is sufficient to achieve the portfolio return target.

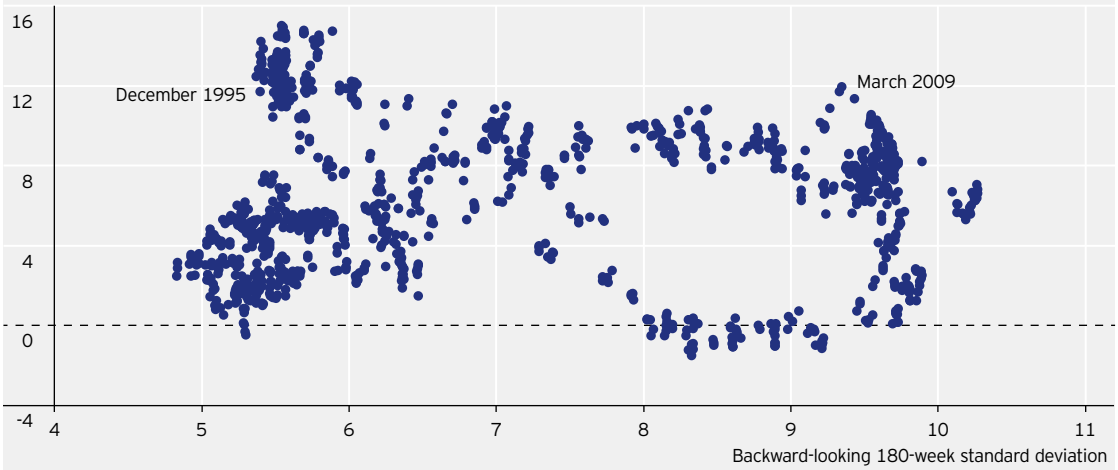
The 'required information ratio'

In the textbook Gaussian world, where returns are normally distributed (clearly not the case in the real world), one can imply the probability of achieving a given capital return by dividing the capital target by the expected portfolio standard deviation (the 'required information ratio') and inferring the outcome from the Gaussian distribution (figure 6). We use the after-yield or capital target for this because, as we have mentioned before, volatility is largely concerned with the capital moves of the assets – not the yield.

For example, if the required information ratio is 1, we can estimate that this portfolio has a 16% chance of reaching or exceeding its objectives, as 16% of the normal distribution lies to the right of one standard deviation. These are not great odds!

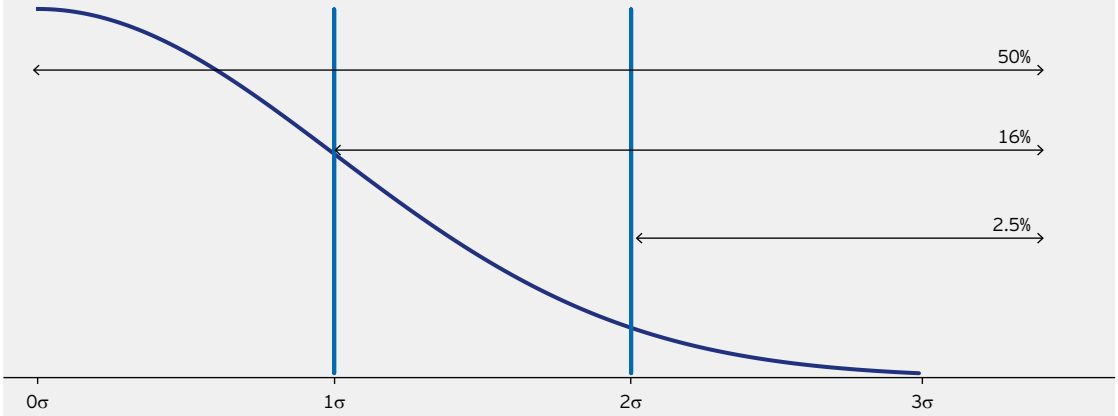
Likewise, if the expected yield equals the targeted return, the capital target and required information ratio is 0, so, regardless of the level of volatility (under this rationale), there is a 50% chance of exceeding the target, because 50% of the distribution lies to the right of zero.

Figure 5
Standard deviation is a poor predictor of returns



Source: Bloomberg, data as at 6 September 2019. The data points represent the standard deviation and returns of a 50-50 portfolio of the MSCI World and the S&P US Treasury bond 7-10 year total return index.

Figure 6
Risk and return in a Gaussian world
Probability of positive return outcome (normal distribution)



Source: Invesco. For illustrative purposes only.

Although this may be an easy heuristic to apply, it is extremely flawed in practice. Standard deviation is not necessarily a good estimator of risk as financial asset returns are not normally distributed and correlations and volatilities can evolve, as previously discussed. This thinking also completely ignores manager skill and, most importantly, it penalises diversification.

Through mathematical construct, more diversification equals less volatility and a higher required information ratio (ex-ante) for a given target. This implies that more manager skill would be required to achieve the desired return outcome.

Take the example of an illustrative multi-asset portfolio targeting a return of 3-month GBP LIBOR plus 5%, with a current ex-ante standard deviation of 3.5% and 2.5% expected yield. This implies a required information ratio of around 1. It seems fairly optimistic to expect the managers to be able to achieve that kind of ratio consistently over time but, as we have shown, this thinking is flawed.

When portfolios exhibit high levels of diversification – where the returns are driven by many truly independent factors – standard deviation can be extremely misleading and could prompt managers to understate the probability of achieving their targets, leading them to take on excessive levels of risk.

In other words, low volatility does not necessarily mean low risk.

Volatility – diversification – risk

Volatility

For any portfolio, there are many ways to calculate its variance, but the simplest is using parametric ex-post variance determined as:

$$\sigma_p^2 = W^T \cdot \nu \cdot W$$

where W is the vector of holdings' weights and ν is the covariance matrix of the holdings' returns, itself being a function of the holdings' volatilities and their correlations.

It clearly follows that the parameters which increase or reduce portfolio variance are (a) the holding weights or mix, (b) the volatility of those holdings and (c) the correlation between the holdings.

> Volatilities and correlations are notoriously unstable, which leads to unstable portfolio volatilities through time.

Ex-ante, the manager only controls the holding weights; volatilities and correlations can only be estimated. Both of these parameters are notoriously unstable, which leads to unstable portfolio volatilities through time. This can be seen in figure 7, which shows the rolling 1-year standard deviations for three static illustrative portfolios.

De-risking by allocating to lower volatility assets will reduce portfolio variance, as will diversification. But what does this mean for risk and our original problem of defining how much we are taking? And is it enough to achieve our targets? We first need to understand the effects of diversification.

Diversification

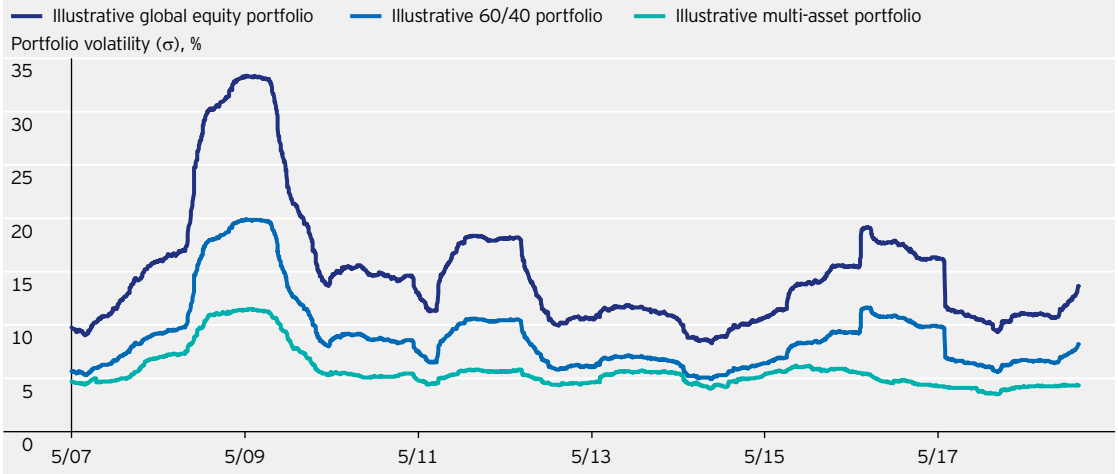
Principal component analysis (PCA) is a useful tool when investigating the level of portfolio diversification. We can expand PCA using a metric called the 'number of equally weighted independent factors' (NEWIF) to investigate the extent to which independent components have driven a portfolio's returns in the past.

$$NEWIF = e^{\sum\left(p \cdot \ln\left(p\right)\right)}$$

where

$$p = \frac{eigenvector\left(\nu_w\right)}{\sum eigenvector\left(\nu_w\right)}$$

Figure 7
Volatilities are notoriously unstable



Source: Invesco. For illustrative purposes only. Data as at 31 December 2018. Illustrative global equities portfolio represented by MSCI World Index, 60/40 = 60% MSCI World and 40% Barclays global bond indices, and the multi-asset portfolio is an illustrative portfolio targeting an annual return of 3-month GBP LIBOR plus 5%.

ν_w is the covariance matrix of the weighted holdings' returns, which can be calculated as $W_d \cdot \nu \cdot W_d$ with W_d being the diagonal matrix of the holding weights.

Simplistically, this number can be interpreted as how many purely uncorrelated factors were driving portfolio returns in a given period. We are effectively calculating the number of equally-weighted, statistically independent positions that the diversification prevalent in the portfolio during that period would have implied.

For the same three static illustrative portfolios in figure 7, we have calculated the NEWIF for the same rolling one-year periods (figure 8). Clearly, there is more going on in the illustrative multi-asset portfolio, as shown by the persistently greater number of independent factors at play. Also visible is the effect of unstable diversification, where markets can – and do – provide greater or lesser levels of diversification in different periods.

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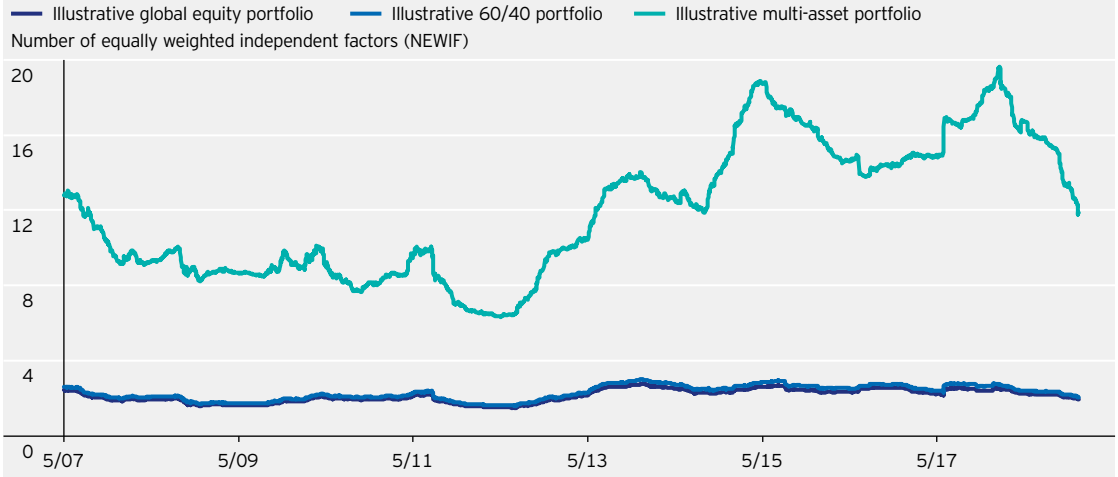
Risk

Our goal is to know whether we are holding enough risk in the portfolio to give us a good chance of reaching our return objectives. If we are right in our views, will we be able to achieve our capital targets?

Figure 8
How many equally weighted independent factors are in your portfolio?



Source: Invesco. For illustrative purposes only. Data as at 31 December 2018.

Knowing the portfolio variance and the NEWIF enables us to calculate the pre-diversification or 'internal risk' of the portfolio.

If all the holdings in a portfolio are uncorrelated the portfolio variance is merely the sum of the holdings' weighted variances. So, if the portfolio variance is known and all holdings are of equal weight and variance, we can solve for the volatility of each factor:

$$\sigma_f = \sqrt{\frac{\sigma_p^2}{NEWIF}}$$

The Internal Portfolio Risk can then be calculated as the sum of the independent factors' volatilities:

$$Internal\ Portfolio\ Risk = NEWIF \cdot \sigma_f$$

By normalising the diversification effect through PCA and calculating the Internal Portfolio Risk, we get an idea of how much risk we have in the portfolio – something diversified volatility might be hiding. We can then compare this to our capital target and model or assess whether we have enough risk to meet it.

The rolling calculation for our three illustrative portfolios is shown in figure 9, and figure 10 compares the volatility and Internal Portfolio Risk of all three sample portfolios as at 31 December 2018. The low levels of historic portfolio volatility of the illustrative multi-asset portfolio mask near equity-like levels of Internal Portfolio Risk.

If we hold only one asset in a portfolio, the Internal Portfolio Risk is equal to its volatility. But this risk has only one outcome driver. By holding the same amount of internal risk but split across multiple outcome drivers (the NEWIF), we can facilitate portfolio-level volatility reduction without compromising the level of risk.

Nevertheless, the manager still needs to be right about the positions to generate the returns, but their opportunity set – the things he or she can be right about – is larger.

We have now effectively estimated the risk implicit in the portfolio. While volatility (or standard deviation) can give us an idea of how the portfolio may behave in the short term, the internal risk allows us to look through the effects of short-run diversification and assess how much risk there is to generate capital returns.

If managers are right in their position selection, it is the level of Internal Portfolio Risk that will determine the size of long-run portfolio outcomes.

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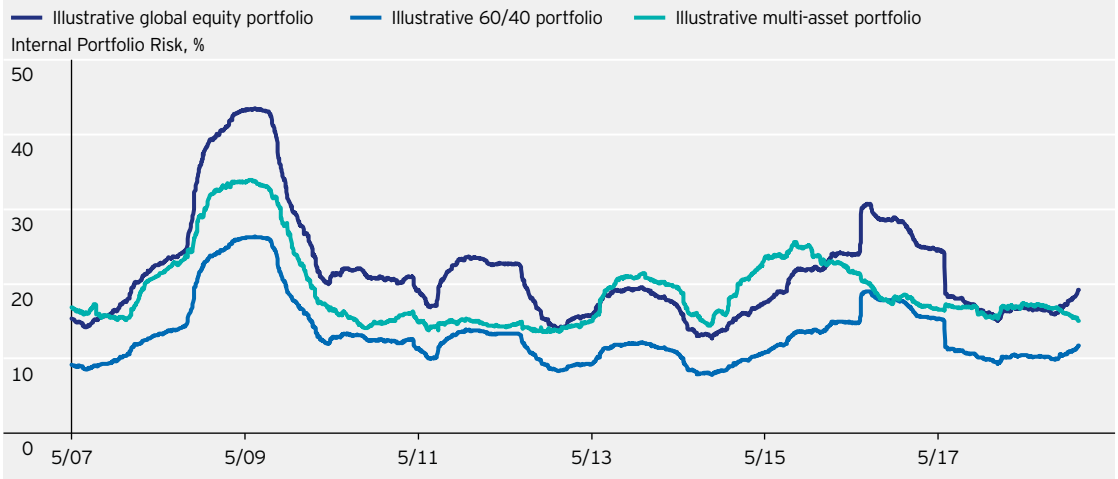
Conclusion

When trying to assess the level of risk embedded in a portfolio, we propose that considering a portfolio's statistical volatility metrics alone can be misleading when used to infer return potential.

We show that longer-term returns are not an outcome of the level of assumed volatility, but rather a by-product of the skill of the manager in selecting positions and the combination of these positions in the portfolio. Volatility (or standard deviation) is only an outcome of how the assumed risks behave.

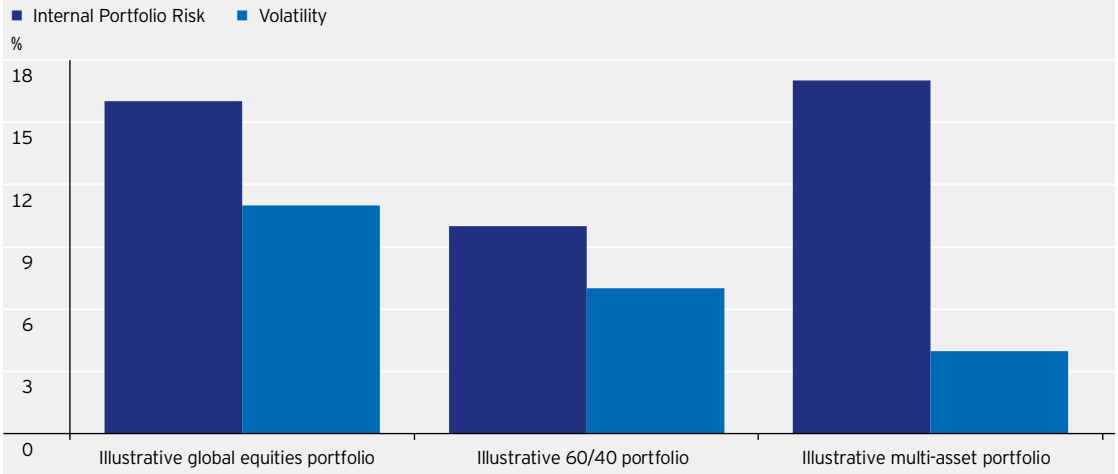
As such, we believe the return potential of a portfolio is reflected most accurately through analyzing its embedded risk (Internal Portfolio Risk) - determining this requires an assessment of how diverse the drivers of a portfolio's returns truly are.

Figure 9
Internal Portfolio Risk: a better reflection of the portfolio's risk



Source: Invesco. For illustrative purposes only. Data as at 31 December 2018.

Figure 10
Volatility and risk are not the same thing



Source: Invesco. For illustrative purposes only.

A manager should, therefore, be able to reduce portfolio-level volatility without compromising the level of actual risk if a given level of internal risk is split across many truly independent factors. Using this approach in a portfolio context, it is fully possible to achieve high information ratios – high returns for a given level of ex-post volatility – provided the manager achieves a positive and persistent hit rate, positive return skew and if the portfolio risks interact so as to achieve low net day-to-day volatility.

A manager should be able to reduce portfolio-level volatility without compromising the level of actual risk if a given level of internal risk is split across many truly independent factors.

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Michael Marshall assists with the construction and risk management of our multi-asset portfolios.

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