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(Not So) Modern Portfolio Theory

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Author

Gavin Duckett
Director / Investment Adviser

Gavin is a Director and Investment Adviser at Newport Asset Management. Gavin is responsible for quantitative research, global asset allocation strategies, model portfolio construction and portfolio management. As well as co-investment adviser to the Newport Core Fund, Gavin is the manager of Newport's global multi-asset model portfolios (both domestic and international) and the Newport Global Absolute Return SMA Model Portfolio that is accessible via the Praemium SMA platform.

Gavin has 15 years of experience in the financial services industry having worked in Sydney, London, Kuala Lumpur, Singapore and now Melbourne. Gavin earned a Bachelor's degree in Economics/Banking & Finance and a Master's degree in Commerce/Financial Planning from the University of Western Sydney.

Newport Asset Management

Level 2, Professional Chambers
120 Collins Street
Melbourne VIC 3000
Australia

t : +613 9069 5870
e : enquiries@newportpw.com

www.newportam.com

ABN 16 166 931 960
AFSL 451 820

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Introduction

It's often said that **"diversification is the only free lunch in finance"**. This remark is attributable to Harry Markowitz, the godfather of modern portfolio theory, and is one that gets tossed around fairly indiscriminately in the investment community – often in product pitches. The thought is that by resting on simple diversification across asset classes, an investor gets the benefit of reduced risk while sacrificing little in expected returns over the long run. We are of the opinion that simply relying on diversification in order to manage risk isn't "free" at all and in actual fact it can, and has often, come at great cost. Here we re-issue a short paper (with updated figures) that looks at the foundational theory underpinning strategic asset allocation (i.e. Modern Portfolio Theory) and why the theory leads to a practice that might not be the "free lunch" that most believe it is.

(Not So) Modern Portfolio Theory

Strategic Asset Allocation ("SAA") is the name given to the process of assigning weightings to various asset classes within a portfolio or model based on the risk and return profile of the investor. SAA will assign a larger weighting to growth type asset classes if the portfolio has a higher allowance for risk and more to defensive asset classes as the risk allowance decreases. SAA portfolios are strategic in the sense that they are fixed recommended asset allocations that rarely change over time and are therefore supposedly suitable for investors with a reasonably long investment timeframe, typically 5 years or more. Weightings against the SAA benchmark are allowed to drift with the relative performance of the various allocations i.e. allocations performing well will naturally see an increase in their percentage weightings relative to the other allocations, but the weightings are generally rebalanced back to the SAA benchmark at least annually.

The importance of asset allocation in determining the variability of portfolio returns has been established in research literature by Brinson, Singer & Beebower[i] and Ibbotson & Kaplan[ii]. Much of the theoretical framework behind SAA lies with Modern Portfolio Theory (Markowitz)[iii]. Markowitz showed how the combination of assets or asset classes in a portfolio could reduce total portfolio variance and, in so doing, provided the theoretical rationale for diversification. Diversification lies at the heart of MPT as it

attempts to maximise a portfolio's expected return for a given amount of portfolio risk by calculating the proportions that should be afforded to each of the various assets; this is known as Mean-Variance Optimisation (MVO). Investing is a trade-off between risk and return and, in general, assets with higher expected returns are thought to be riskier. For a given amount of risk, MPT describes how to construct a portfolio with the highest possible expected return. Or, for a given expected return, MPT describes how to construct a portfolio with the lowest possible risk. One of the fundamental concepts behind MPT is the importance of considering how each asset changes in price relative to how every other asset in the portfolio changes in price i.e. how correlated they are.

MPT and MVO, therefore, provide the foundation with which an investor can build an efficient frontier. Every possible combination of risky assets (without including any holdings of the risk-free asset) can be plotted in the risk/expected return space, and the collection of all such possible portfolios defines a region in this space. A combination of assets, i.e. a portfolio, is referred to as "efficient" if it has the best possible expected level of return for its level of risk.

Figure 1: An Efficient Frontier Curve

Figure 1 is a simple illustration of what an efficient frontier might look like (in reality the bottom left of the curve would turn back in on itself). The upward-sloped boundary, or curve, is called the "efficient frontier". The efficient frontier, is the portion of the opportunity set that offers the highest expected return for a given level of risk and lies at the top of the opportunity set. An efficient frontier curve such as this might be produced using allocations to just equities and bonds or may include other asset classes like property securities or commodities. Portfolios further down the curve (to the left of "balanced") would be considered lower risk/lower return portfolios consisting of heavier weightings to say bonds. And portfolios further up the curve (to the right of "balanced) would be considered higher risk/higher return portfolios consisting of heavier weightings towards say equities.

In practice, proponents of SAA would measure an asset's rate of return and systematic risk (volatility as measured by standard deviation) over some historical time period. Using these historical risk and return measures, as well as covariance, a mean-variance optimisation program or calculation would reveal what the most efficient allocation would have been amongst the assets in question. It is then inferred that this would be the most efficient allocation and would provide the same risk and return profile going forward.

Tactical Asset Allocation ("TAA") builds on SAA by taking a somewhat active approach to the strategic asset allocations themselves and adjusting these long-term target weights for a short period of time to capitalise on market opportunities. Domestic equities that might have a 30% allocation in the SAA for example, might be underweighted to 25% for a short period of time if the outlook for domestic equities is not positive. Given that SAA & TAA are generally benchmark relative, the tactical weightings do not often deviate too far away from the SAA.

The MPT framework is useful in determining how to introduce or reduce risk in a portfolio through the weightings to various asset classes and what the most efficient allocation to particular asset classes would have been in the past as it generally uses the historical risk, return and covariance characteristics of asset

classes to build portfolios (SAAs) that sit on, or as close as possible to, the efficient frontier.

However, and herein lies the problem, the MPT framework makes a number of implicit and explicit assumptions about investors and markets and these assumptions not only compromise the theory but weaken the effectiveness of its real-world application. Without listing them all, here are just some of the assumptions that are particularly troublesome:

i) Markets are efficient and all investors have access to the same information at the same time.
ii) All investors are rational and risk averse.
iii) All investors are price takers, i.e. their actions do not influence prices.
iv) Any investor can lend and borrow an unlimited amount at the risk-free rate.
v) Asset returns are normally distributed and known in advance.
vi) Investors have an accurate conception of possible returns (forecasts match the true distribution)
vii) Correlations (or covariance) between assets are fixed and stable over time.
viii) The risk (volatility) of all assets is known in advance and is stable over time.
ix) Investors seek to control risk only through diversification.

These assumptions (amongst others) allow for the creation of optimised portfolios over some specific historical period. But creating optimal portfolios and remaining on the efficient frontier over some future time period is next to impossible and future outcomes will be vastly different than models would suggest. Accurately estimating forward the required MVO inputs strikes us as virtually impossible. The MPT framework explicitly assumes that risk/returns are known in advance and are constant and that correlation between asset classes are fixed and stable over time. Obviously, the future is unknowable and, as previously mentioned, this is dealt with through the generally accepted approach of looking at $\mathcal{X}$ years of historical data and assuming that the risk/return/co-variance numbers are a reasonable estimate of what the next $\mathcal{X}$ months or years will deliver. Let's now look at whether or not the use of long term historical data as an estimate of future outcomes is reasonable.

Expected Return & Expected Volatility Estimates

Figure 2 shows the returns of various asset classes over 12 month rolling periods using monthly data. Visually you can see that the 12-month returns for various traditional asset classes are anything but stable.[iv] For the S&P 500 alone, between January of 1993 and June of 2020, the worst 12-month return was in excess of -40% and the best 12-month return was in excess of +50%. The annualised return for the S&P 500 for the 20 years to 31 December 2007 was 11.63% p.a. In the following 12 months the S&P 500 returned -37.00% and 1.66% p.a. annualised over the 5 years from 31 December 2007.

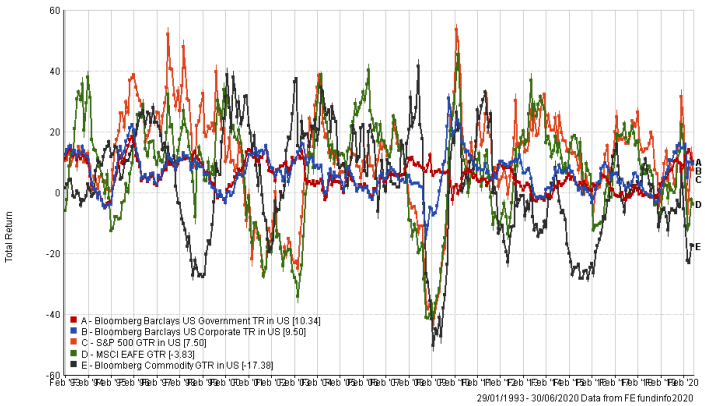


Figure 2: Rolling 12-month gross total returns (monthly data in local currency terms)

Expected returns are especially susceptible to estimation error because returns are harder to predict than volatilities and correlations. Combine this with the fact that the optimisation output (portfolio weights) is especially sensitive to expected return inputs and we have a significant problem.

The same variability can be seen risk (volatility) as measured by the standard deviation of returns. Figure 3 shows the standard deviation of returns over 12 month rolling periods for the same asset classes in the previous example.[v]

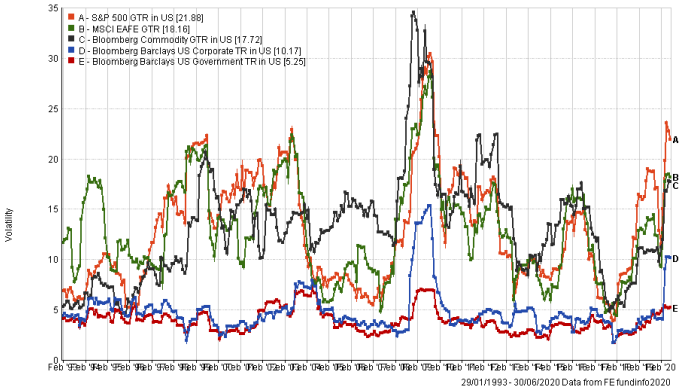


Figure 3: Rolling 12-month standard deviation of returns (monthly data in local currency terms)

Visually you can see that it's not uncommon for all asset classes to experience periods in which their annualised volatility doubles or triples. In the 10-year period to June of 2000, the annualised volatility for the S&P 500 was 13.43. Over the course of the next 3 years, that figure increased by 40% to an annualised volatility of 18.69. During the global financial crisis, the annualised volatility of the investment grade corporate bond index went from a 20-year historical average of 4.68 to 15.34 for the 12-month period ending 31 August 2009.

Using historic annualised returns and standard deviation of returns as the estimation and input for future expected return and volatility is a fools errand.

Asset Co-Variance (Correlation)

Correlation is a statistical measure of the degree to which the returns of one asset move in relation to those of another asset. If two assets are said to be highly correlated they would display a linear relationship between their returns over time and would have a tendency to always move in the same direction. If two assets are said to have a low (or no) correlation to each other, it means that their movements show little or no relationship to each other. If two assets are said to be negatively correlated, it means that they display an inverse relationship to each other i.e. they tend to move in opposite directions. Correlation is expressed as a number between +1 and -1; +1 being perfect positive correlation, zero being no correlation and -1 being perfect negative correlation.

Why Is Correlation Important?

Along with expected returns and expected volatility, correlation is one of the primary building blocks in portfolio construction and arguably the most important. The reason for this is that the primary purpose of asset allocation and diversification is to lower total portfolio risk (standard deviation) and the effectiveness of diversification relies on this relationship. We can illustrate how important correlation is to the portfolio construction process using the following two assets as an example.

	Asset A	Asset B
Expected Return	15%	20%
Expected Standard Deviation	10%	10%

Expected Return & Risk for a One Asset Portfolio

If we allocated 100% of our portfolio to Asset A, our portfolio's expected return would simply be 15% and the expected standard deviation (risk) would be 10%. Fairly straight forward.

Expected Return & Risk for a Two Asset Portfolio

Let's now imagine that we have identified Asset B as a potential allocation for the portfolio. It has a slightly higher expected return of 20% with the same expected volatility or standard deviation. And we will look at allocating an equal 50% to each of the assets.

To calculate the expected return for the portfolio we use the following formula:

$R_p = w_1R_1 + w_2R_2$

Where:

R_p = expected return for the portfolio
w_1 = proportion of the portfolio invested in asset 1
R_1 = expected return of asset 1

In order to calculate the expected standard deviation or volatility (risk) of a portfolio we must introduce correlation. We first calculate the portfolio's expected variance using the following formula:

$$\sigma_p^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\,\rho_{1,2}\sigma_1\sigma_2$$

Where:

σ_p = expected variance for the portfolio
w_1 = proportion of the portfolio invested in asset 1
σ_1 = expected standard deviation of asset 1
ρ = correlation of the two assets

The square root of the variance will then give us standard deviation or portfolio volatility (risk).

Table 1 at the back of this paper presents the expected return and expected standard deviation for the two-asset portfolio for various expected correlation measurements between the two assets.
At a perfect positive correlation (+1) you can see that by adding Asset B we have diversified the portfolio and increased the expected return but the volatility has not changed i.e. the level of risk is still the same as it was for the one asset portfolio. However, as the correlation starts to fall away from +1 you can see that the volatility also starts to decrease. By the time we get to zero correlation, the portfolio volatility has fallen from 10% to 7.07%, a 29.3% reduction in risk. As we move into negative correlation the reduction in risk continues because the assets move in opposite directions to each other so they effectively start to cancel each other out. At a correlation of -0.25, the portfolios volatility has nearly halved.

The Problem with Correlation

In order to illustrate the importance of correlation in the portfolio construction process we have used somewhat unrealistic numbers; the assumption that expected return is still the same as we move into negative correlation for example. In the real world very few asset classes have a perfect positive correlation (+1) or zero correlation and as correlation moves closer to perfectly negative the returns start to cancel each other out. The vast majority of investments will have some correlation (between 0 and +1). The goal is to find low or somewhat negatively correlated assets. The fact that most investments are positively correlated is a problem and means that finding the right mix of assets is a challenge.

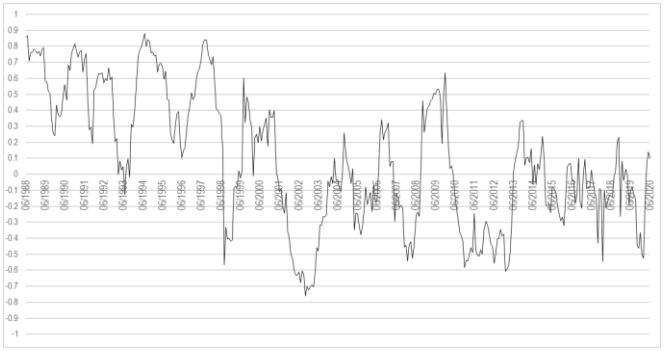


Figure 4: S&P 500 Index & Barclays US Aggregate Index – Rolling 12-month correlation (monthly data)

Like return and volatility, correlation is also difficult to estimate reliably and can change drastically. Figure 4 shows that, between June 1988 and June 2020 (over 30 years), the correlation between the S&P 500 Index and the Barclays US Aggregate Index changed sign over 40 times and ranged from +0.87 to -0.76.[vi] In 2007, the 12 months preceding the global financial crisis, the correlation between the two indexes was -0.44. In 2008, the height of the GFC, the correlation shifted to +0.35. When the correlation between assets in a portfolio moves from negative (or zero) to positive, it reduces the effectiveness of diversification and means that sticking with a fixed set-and-forget strategic asset allocation will

not result in a fixed risk/return profile but rather a wildly varying one.

Carefully examining correlation is critical to the process of portfolio construction. However, correlation is a statistical measure that is subject to estimation error and correlation among assets can vary over time and in different market conditions. History has shown that many risky assets do tend to perform similarly during periods characterised by risk aversion and a general flight to safety.

Constrained vs. Unconstrained MVO

Assumptions aside, a further complication arises in the practical application of MPT. An MVO run as unconstrained means that there are no minimum or maximum constraints placed on the asset weights. The MVO is allowed to freely find the most efficient allocation across the asset classes regardless of the outcome. An MVO that is run with constraints means that minimum or maximum constraints are placed on the optimisation's outputs. For example, an MVO might be run stating that it must allocate at least 20% to domestic equities as part of its outputs for each risk level even if it otherwise wouldn't have. Or the MVO might be told that it can only allocate a maximum of 20% to fixed income for example. The issue that arises here is that an unconstrained MVO will often produce unrealistic allocations for given levels of risk. It might, for example, make very large allocations to one particular asset based on that asset's risk/return and correlation data and leave you with very concentrated (not well diversified) portfolios that aren't realistic or suitable for clients/investors. If, on the other hand, constraints are placed on the optimisation's allocations it will certainly produce more suitably diversified portfolios, however the MVO is now compromised as it is no longer producing the most efficient allocations for each given level of risk i.e. the portfolios are no longer on the efficient frontier. Placing constraints on the MVO process to produce more diversified portfolios is common practice but, again, it compromises the outcome.

Consequence - Drawdown & Recovery

The consequence of adhering to MPT i.e. relying solely on diversification across asset classes to manage risk, is that of extreme variability in outcomes for investors and portfolios with susceptibility to higher volatility and larger drawdown than models would predict.

According to Ned Davis Research Inc., between June of 1901 and January 2016, the Dow Jones Industrial Average spent 34.5% of that time in drawdown (falling/bear market), 41.9% of that time recovering from drawdown and only 23.6% of that time generating new capital growth. The point to be made here is that it's not unreasonable to think that an asset class like U.S large-cap equities could make up a reasonable portion of any portfolio aimed at capital growth and a long look back suggests that it's an asset that could potentially spend three quarters of its time either falling in value or recovering from a fall in value. And while MPT/diversification suggests that you can lessen the risk associated with a portfolio holding such as this by allocating to other asset classes, it does not entirely remove the potential negative impact that the remaining allocation could have on portfolio performance.

The Financial Express FCA[vii] Recognised Offshore Mixed Asset Balanced Fund sector is made up of 164 funds that have, on average, approximately 50% of their portfolios allocated to growth (higher return/higher risk) type assets (like equities for example) and 50% of their portfolios allocated to defensive (lower return/lower risk) type assets (like bonds for example). Looking at figure 5 we can see that, between September of 2000 and March of 2003, the sector went through a drawdown of -21.76% and took the best part of 2 years to recover. Between November 2007 and March 2009, the same

sector went through a -30.31% drawdown and took over 4 years to recover. These figures are in nominal terms, in real terms i.e. accounting for the effect of inflation, the recovery would be even longer.[viii]

Figure 5: Financial Express FCA Recognised Offshore Mixed Asset Balanced fund sector (Cumulative return)

Chart 1 at the back of this paper illustrates the investment gains (recovery) required for certain levels of incurred loss (drawdown) in order to break even. If you start with an investment of say $100,000 and incur a 50% loss you are left with $50,000. In order to get back to where you started and break even ($100,000) a gain of 100% is required from your $50,000. Some might say this is misleading because the monetary loss and gain is the same i.e. $50,000 but the mathematics is clear; a 50% loss will require a 100% gain to get you back to where you started. What this chart shows is that recouping losses always requires a larger percentage gain than the loss itself, and the difference between the two gets more dramatic as the losses get larger.

The sorts of drawdowns historically experienced in equity markets and traditional multi-asset funds are toxic to the sustainable compounding of capital and not only have a dramatic and negative impact on risk/adjusted returns but also introduce another risk that we have not yet touched on, sequence risk.

Consequence - Sequence Risk

It is not just long-term average returns that impact your capital accumulation, but the timing of those returns. Sequence risk is the risk that the order and timing of your investment returns are unfavourable, resulting in less capital precisely when you need to sell or withdraw from an investment. Imagine, for a moment, an investor approaching retirement or an investor who needed to redeem an investment to cover a capital expenditure in say March of 2009; having just lost 30 or 40% (or more) of their portfolio value with little or no time to recover it. Or take, for example, the following two 7-year investments. Option A, figure 6, was a 7-year investment with annualised volatility of 15.20%, a maximum drawdown of -50.95%, an annualised return of -3.85% p.a. and a gross total return of -24.02%.

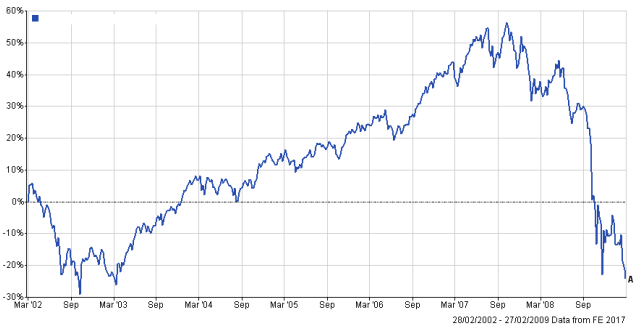


Figure 6: Option A

Option B, figure 7, was a 7-year investment with annualised volatility of 13.69%, a maximum drawdown of -16.26%, an annualised return of +17.52% p.a. and a gross total return of +207.56%

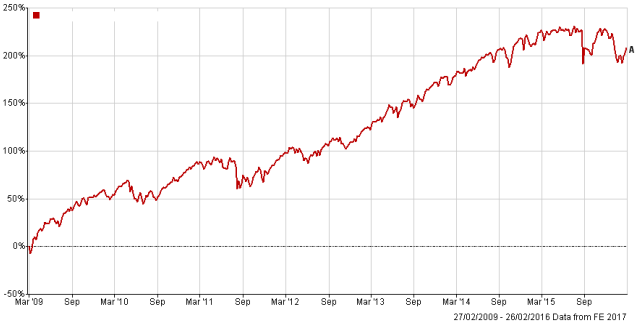


Figure 7: Option B

Option A lost 24% of the initial investment while option B doubled the initial investment. Obviously any investor would have hoped that they had chosen option B. But it isn't actually a choice between two different investments at all. Options A and B both represent 7-year investment holding periods in the S&P 500 Index of equities. The period covered by Option A starts in March of 2002 and finishes in February of 2009. The period covered by Option B commences immediately after and finishes in February of 2016. 7-years is a significant period of time in the life of any investor and this example (although extreme) simply serves to illustrate that timing can play a crucial role in determining whether or not the outcome for an investor is spectacular or abysmal.

If, as a multi-asset portfolio manager, we can avoid drawdown in individual asset classes and reduce the propensity for deep and prolonged drawdowns in the overall portfolio, we have the potential to maintain a much more consistent risk/return profile and significantly diminish sequence risk.

Summary

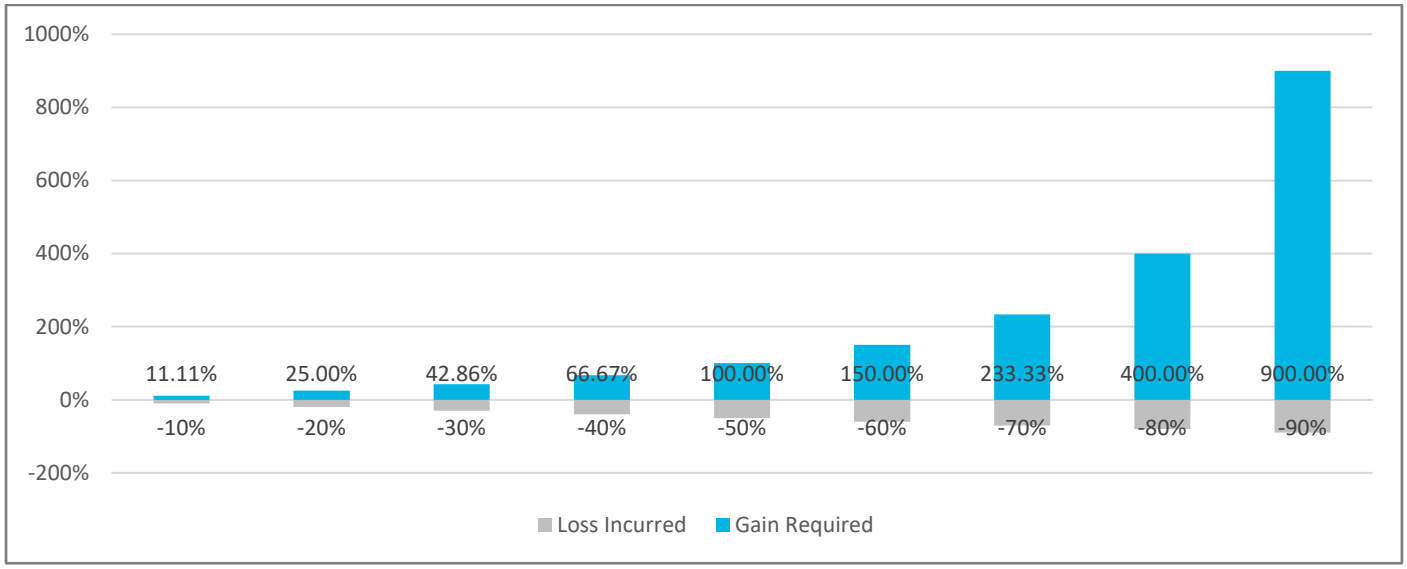
The assumptions that historical risk premiums, volatility and correlations across asset classes are predictable and stable over time and that strategic asset allocation can sufficiently control systematic (or market) risk simply through diversification are dangerous ones. The mean-variance optimisation output is reliant on, and extremely sensitive to, what goes in. Without a highly accurate forecasting model, strategic asset allocation is not forward looking and does little to react to rapidly changing market conditions. Strategic asset allocation will not provide continually optimised (or efficient) portfolios and investor outcomes will differ greatly from those suggested by models using historic data. Diversification, as Warren Buffet has put it, "is protection against ignorance". The notion that one must always be diversified and have some exposure to all asset classes at all times (albeit in varying percentages) in an attempt to reduce portfolio risk is a flawed one. There is a trade-off between diversification and knowledge. If you know something that gives you an edge then, holding an asset simply because diversification says you should, comprimises and dilutes that edge. Portfolios need to have the right asset class exposures at the right time and have the ability to completely avoid asset classes or markets that are showing signs of decline e.g. a bear market in equities. As the risk premia of asset classes are conditional, asset classes trend up and down with economic cycles and valuation levels of asset classes become expensive or cheap, it's hard to understand why an investor should remain exposed to all asset classes at all times. We believe that, in order to be more effective, asset allocation needs to more flexible, more dynamic, than strategic asset allocation and even tactical asset allocation would suggest is necessary. The asset allocation framework needs to move away from the "traditional" and evolve with significant changes in global markets and global economic cycles. Individual capital markets are now more globally connected than they have ever been. Distorted fundamentals and central bank policy mean that the bubble and bust market cycles we have seen in recent years are the new normal. This will mean that sticking with a fixed set-and-forget asset allocation will not result in a fixed risk/return profile but rather a wildly varying one. Under a fixed asset allocation the potential to really manage systematic (or market) risk, rather than just diversify it, is blindly ignored. We believe that an actively managed asset allocation program that is highly flexible can run portfolios that produce superior risk adjusted returns. We believe this approach allows asset managers to be more flexible and opportunistic and addresses some of the shortcomings of traditional asset allocation and performance that may fall far short of expectations. There is a commonly used investment adage that states, *'It's time in the market not timing the market that's important'*. This is one observation that we find it very hard to agree with.

Table 1

	Asset A	Asset B				
Expected Return	15%	20%				
Expected Standard Deviation	10%	10%				
Portfolio Weighting	50%	50%				
Correlation	**1.00**	**0.75**	**0.50**	**0.25**	**0.00**	**-0.25**
Expected Return	17.50%	17.50%	17.50%	17.50%	17.50%	17.50%
Expected Standard Deviation	10.00%	9.35%	8.66%	7.91%	7.07%	6.12%
Reduction in Risk (Volatility)	0.00%	-6.50%	-13.40%	-20.90%	-29.30%	-38.80%

Source: Newport Private Wealth calculations

Chart 1



Source: Newport Private Wealth calculations

[i] Brinson G, Hood L and Beebower G "Determinants of Portfolio Performance," Financial Analysts Journal, July/August 1986
[ii] Ibbotson RG and Kaplan PD, 'Does Asset Allocation Policy Explain 40, 90, or 100 Percent of Performance?' Financial Analysts Journal, vol.56, no.1 2000
[iii] Markowitz H, 'Portfolio Selection', Journal of Finance, vol.7, no.1 1952
[iv] Data source: FE fundinfo Limited
[v] Data source: FE fundinfo Limited
[vi] Data source: FE fundinfo Limited
[vii]" FCA = the UK Financial Conduct Authority
[viii] FCA Recognised Offshore Mixed Asset Balanced Fund" is an FE sector comprising of UK Financial Conduct Authority recognised offshore funds