

Active is: Dynamic diversification with managed futures

**For fund distributors and
professional investors only.**



Michael Rothstein,
FRM, CAIA
Co-Head of Product
Specialists Multi Asset US

Executive summary

Managed futures have historically delivered equity-like returns over time, but with high diversification to traditional asset classes. This unique return profile has become well known for the potential of delivering positive returns in times of sustained market stress, an attribute popularised as 'crisis alpha'. Due to these differentiated return characteristics, managed futures stand out as truly diversifying exposures in traditional portfolios.

Due to the diversifying attributes of managed futures and despite having an equity-like volatility, a well dosed allocation to managed futures can even be used to reduce an overall portfolio's volatility. For this and other reasons, managed futures can be considered essential long-term exposures in otherwise traditional portfolios.



Thomas J. Zimmerer,
PhD
Global Head of Product
Specialists Multi Asset

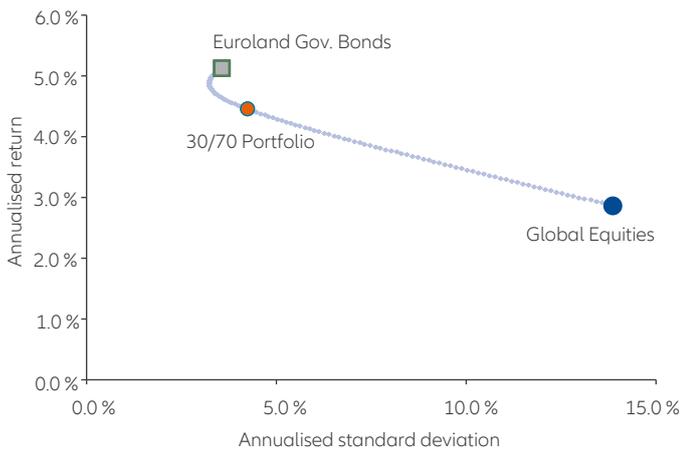
Managed futures strategies can be incorporated in existing portfolios to align with investment objectives of risk mitigation, return enhancement or both. Depending on the funding source and weighting, their portfolio impact is different. Most importantly, they can be added in a risk-reducing or risk-neutral way to the portfolio.

Diversifying portfolios with managed futures

Risk mitigation and return enhancement are desirable attributes for portfolio diversifiers. However, achieving the former typically implies a tradeoff of the latter. Return enhancement is typically pursued through equity exposure, whilst risk mitigation often requires a reduction of this exposure in favour of high quality fixed income, typically government bonds. As government bonds have a lower volatility than equities, their expected return is also naturally lower. This is especially true in the prevailing low interest rate environment.

Assessing the realised diversification benefits of two representative indices since the turn of the century, we see that global equities ended up trailing over the period while fixed income conversely benefited from falling yields. As a result, the risk-return combinations between Euroland government bonds and global equities result in an anomaly: rather than a concave and upward sloping risk-return combination, the historic return combinations manifested in a convex, downward sloping line (see Exhibit 1).

Exhibit 1: Portfolio choice with standard indices

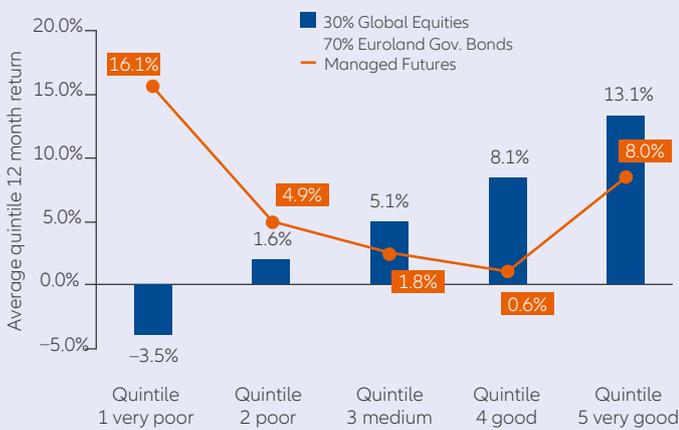


Source: Allianz Global Investors. Euroland Government Bonds are represented by the JP Morgan EMU EUR Total Return Index (JPM EMU). Global Equities are represented by the MSCI World Index Net Return Index in Euro (MSCI World). 30/70-portfolio is represented by 30% Global Equities and 70% Euroland Government Bonds. Calculations are based on monthly returns between January 2000 and December 2017 for illustration purposes and not meant to be an indication for future results.

In response, investors can consider the diversification benefits of managed futures which have delivered a uniquely dynamic return profile over time. Sorting historic trailing 12-month returns of a 30/70 portfolio (30% global equities vs 70% Euroland government bonds) portfolio by size and comparing its average quintile returns with the corresponding managed futures returns, illustrates how managed futures performed in different market environments. Exhibit 2 demonstrates strong returns in periods of persistent market stress (Quintile 1), while having delivered positive returns across a broad range of market environments (Quintiles 2 to 5).

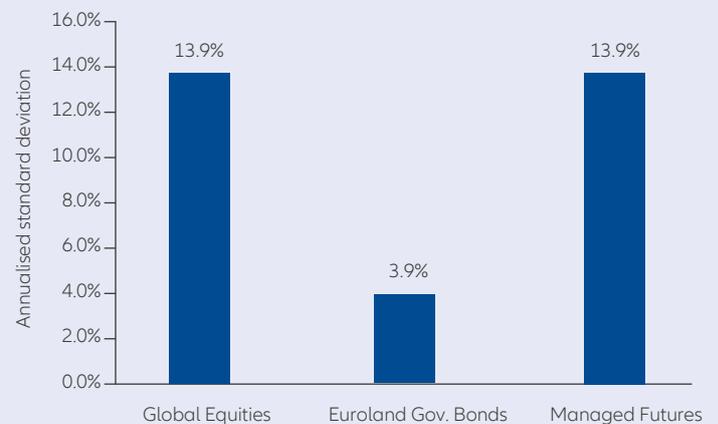
It is the realisation of positive returns in times of sustained market stress (crisis alpha) that make managed futures a particularly attractive component in an equity/fixed income portfolio. Since the return pattern they produced was very different from traditional beta, they offer a unique diversification benefit reflected by a low average correlation to equities and fixed income. This unique benefit can be incorporated to even lower a portfolio's volatility despite having a stand-alone volatility that is comparable to that of equities (see Exhibit 3).

Exhibit 2: Average returns in different market environments



Source: Allianz Global Investors. Euroland Government Bonds are represented by the JP Morgan EMU EUR Total Return Index (JPM EMU). Global Equities are represented by the MSCI World Index Net Return Index in Euro (MSCI World). 30/70-Portfolio is represented by 30% Global Equities and 70% Euroland Government Bonds. Managed futures are represented by the SG Trend Index, hedged in Euro (SG Trend). The numbers in the chart are the arithmetic average returns of the SG Trend Index and the correspondent arithmetic average returns in the relevant quintiles sorted according to the 30% Global Equity/70% Euroland Government Bonds portfolio. Calculations are based on monthly returns between January 2000 and December 2017 for illustration purposes and not meant to be an indication for future results.

Exhibit 3: Comparison of historic volatilities



Source: Allianz Global Investors. Euroland Government Bonds are represented by the JP Morgan EMU EUR Total Return Index (JPM EMU). Global Equities are represented by the MSCI World Index Net Return Index in Euro (MSCI World). Managed Futures are represented by the SG Trend Index, hedged in Euro (SG Trend). Calculations are based on monthly returns between January 2000 and December 2017 for illustration purposes and not meant to be an indication for future results.

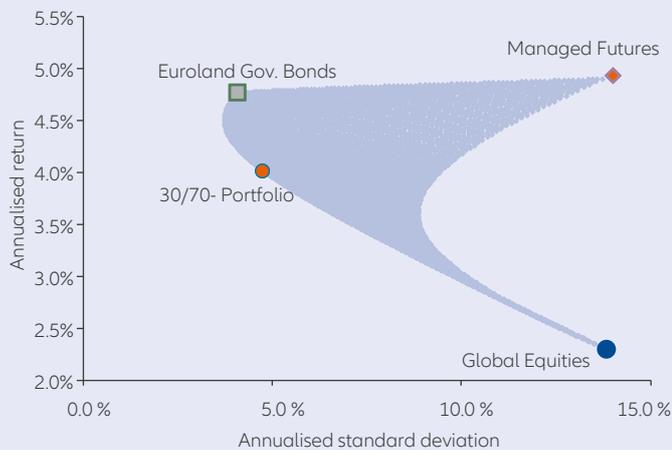
When adding managed futures as a third asset to the opportunity set, we can plot the constellation of different allocations in risk/return space. This illustrates the diversification benefit of adding an asset with similar risk level to traditional beta (see Exhibit 4).

The driving force behind the diversification potential is the attractive long-term low correlation of managed futures to global equities and Euroland government bonds.

Over the analysis period between 2000 and 2017, managed futures delivered a modestly negative/positive correlation to equities/fixed income respectively (see Exhibit 5). Even though their volatility is equity-like over time, their low correlation to traditional asset classes is a desirable attribute to add to a 30/70 portfolio. If well dosed, the overall portfolio volatility can even go down.

Exhibit 4 already indicates that there is a broad set of portfolio choices different than 30/70 which lead to higher diversification, i.e. more return for the same level of risk, less risk for the same level of return or even more return and less risk. The question is to what extent managed futures should be added and how to fund them: purely from equities, from fixed income or from both.

Exhibit 4: Portfolio choice with managed futures



Source: Allianz Global Investors. Euroland Government Bonds are represented by the JP Morgan EMU EUR Total Return Index (JPM EMU). Global Equities are represented by the MSCI World Index Net Return Index in Euro (MSCI World). 30/70-portfolio is represented by 30% Global Equities and 70% Euroland Government Bonds. Managed futures are represented by the SG Trend Index, hedged in Euro (SG Trend). The cloud of portfolios represents all possible combinations of the three assets varied by 1% increments. Calculations are based on monthly returns between January 2000 and December 2017 for illustration purposes and not meant to be an indication for future results.

Exhibit 5: Correlation matrix

| | Global Equities | Euroland Gov. Bonds | Managed Futures |
|---------------------|-----------------|---------------------|-----------------|
| Global Equities | 1.00 | -0.17 | -0.20 |
| Euroland Gov. Bonds | -0.17 | 1.00 | 0.30 |
| Managed Futures | -0.20 | 0.30 | 1.00 |

Source: Allianz Global Investors. Euroland Government Bonds are represented by the JP Morgan EMU EUR Total Return Index (JPM EMU). Global Equities are represented by the MSCI World Index Net Return Index in Euro (MSCI World). Managed Futures are represented by the SG Trend Index, hedged in Euro (SG Trend). Calculations are based on monthly returns between January 2000 and December 2017 for illustration purposes and not meant to be an indication for future results.

Decomposition of diversification benefit into volatility effect and correlation effect

The concept of portfolio diversification is well known and relatively straight-forward, at least on the surface. To illustrate, we consider a portfolio which starts as purely focused on growth potential and therefore consists of global equities only. However, shorter term risk considerations don't allow for a 100% global equity portfolio so an allocation to Euroland government bonds is considered. Even in this most basic two-asset example, the question arises of how much of the reduction in portfolio volatility comes from adding a less risky asset (volatility effect) vs adding an asset with low correlation to the other asset (correlation effect). Both effects together will deliver the desired diversification benefit which investors are looking for when adding additional candidates into a portfolio. By decomposing the diversification benefit into the pure volatility effect and pure correlation effect, we can analyse how the sizing and funding of an additional portfolio candidate impacts total portfolio risk.

To analyse these impacts we must delve beneath the surface. Fortunately modern portfolio theory's equation for portfolio volatility provides a framework for quantifying both the volatility effect and correlation effect. The equation considers both the volatilities and importantly the correlations of the underlying portfolio components.

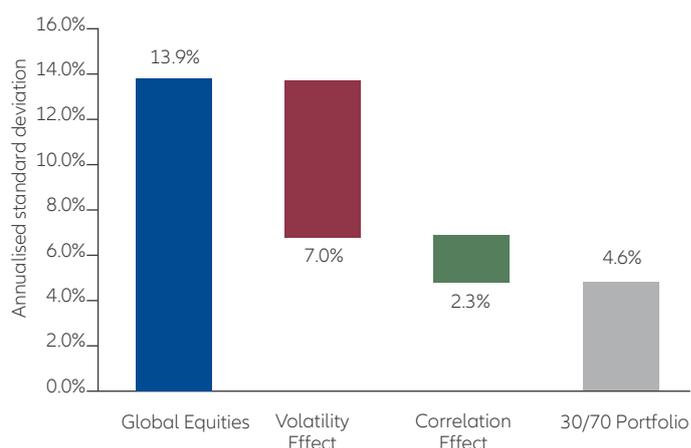
Exhibit 6:

$$\sigma_P = \sqrt{\underbrace{w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2}_{\text{Volatility Effect}} + \underbrace{2w_1 w_2 \sigma_1 \sigma_2 \rho_{1,2}}_{\text{Correlation Effect}}}$$

The formula allows us to sequentially determine the volatility effect and correlation effect when adding potentially new candidates to an existing portfolio and/or changing its composition. We do so, by simply calculating the difference in portfolio risk before and after addition/change by suppressing the correlation effect first and modeling it thereafter. The isolated volatility effect can be calculated by the difference of portfolio risk assuming a correlation of 1, i.e. adding up the weighted volatilities before and after. The isolated correlation effect is then determined as the additional difference of portfolio risk due to setting correlations to the real (typically lower than 1) value of correlation.

The below deconstruction illustrates the sequential decomposition of the diversification benefit: starting from the volatility of global equities, we see that the risk reduction is primarily driven by the volatility effect and less notably so by the correlation effect. As one would expect, the diversification benefit from adding defensive fixed income to an aggressive equity portfolio is mainly driven by its lower volatility than by the isolated correlation feature.

Exhibit 7: Static diversification



Source: Allianz Global Investors. Euroland Government Bonds are represented by the JP Morgan EMU EUR Total Return Index (JPM EMU). Global Equities are represented by the MSCI World Index Net Return Index in Euro (MSCI World). 30/70 portfolio is represented by 30% Global Equities and 70% Euroland Government Bonds. The Volatility Effect reflects the difference in portfolio volatility between the starting portfolio (100% MSCI World) and the intermediate blended 30/70 portfolio assuming a correlation coefficient of 1 between Global Equities and Euroland Government Bonds. The Correlation Effect is the difference in portfolio volatility between the intermediate blended 30/70 portfolio with an assumed correlation coefficient of 1 and the actual blended 30/70 portfolio with the realised correlation coefficient between Global Equities and Euroland Government Bonds. Calculations are based on monthly returns between January 2000 and December 2017 for illustration purposes and not meant to be an indication for future results.

Adding managed futures: Sizing and funding

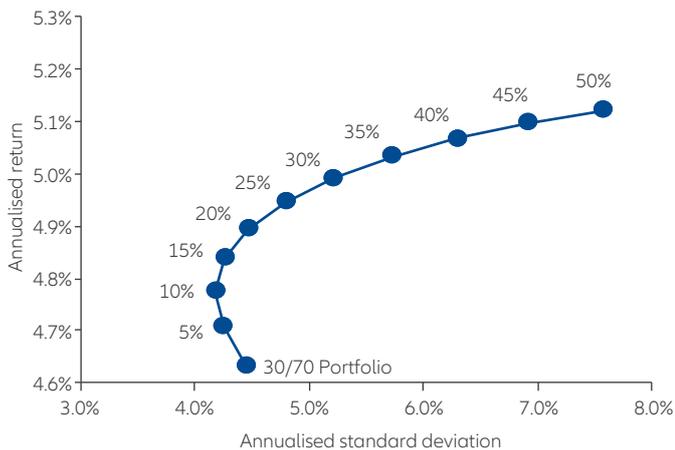
Isolating the volatility effect vs correlation effect allows for a better understanding of portfolio diversification benefits when changing the portfolio composition and/or adding new constituents. When adding a diversifying asset to existing portfolios, the diversification benefit is not only influenced by the properties of the diversifying asset alone: it is influenced by the current composition of the portfolio and very much so by the funding source for the addition of the diversifier. What follows is a consideration of the two effects as it relates to funding an allocation to managed futures.

Funding pro-rata: Risk mitigator and return enhancer

When adding asset classes to a portfolio, a common desire is to maintain the current strategic asset allocation (say 30/70) by proportionally scaling back these exposures in order to fund the additional portfolio candidate. To assess this approach we fund the allocation to managed futures from 0-50% in 5% increments. Since managed futures exhibited higher volatility than the 30/70 portfolio over this period, one might think that the overall volatility should go up from adding a more volatile asset to the portfolio. However, the correlation effect can overcompensate the volatility effect up to certain allocations leading to an overall volatility reduction and only beyond certain allocations leads to an overall increase in portfolio volatility.

To understand how adding a more volatile exposure can reduce the overall portfolio volatility, we again decompose the portfolio volatility into the volatility effect (reflecting correlations of 1) next to correlation effect (reflecting realised correlations) and plot this for 5% allocation steps. We can see that due to the low correlation of managed futures to a 30/70 portfolio, up to a 10% allocation to managed futures, pro-rata funded from equities and fixed income, the overall portfolio volatility goes down, before it starts to increase for any bigger allocation beyond 10%.

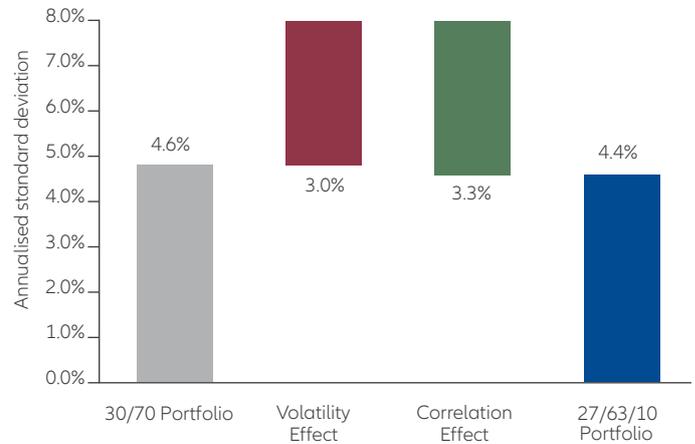
Exhibit 8: Enhancing traditional allocations with dynamic diversification – fund pro-rata



Source: Allianz Global Investors. Euroland Government Bonds are represented by the JP Morgan EMU EUR Total Return Index (JPM EMU). Global Equities are represented by the MSCI World Index Net Return Index in Euro (MSCI World). 30/70-Portfolio is represented by 30% Global Equities and 70% Euroland Government Bonds. Managed futures are represented by the SG Trend Index, hedged in Euro (SG Trend). Calculations are based on monthly returns between January 2000 and December 2017 for illustration purposes and not meant to be an indication for future results. See data tables in appendix (Exhibit 18) for additional details and performance statistics.

Below we see the decomposition of the diversification benefit for a 10% allocation to managed futures.

Exhibit 9: Dynamic diversification (fund pro-rata) 27/63/10

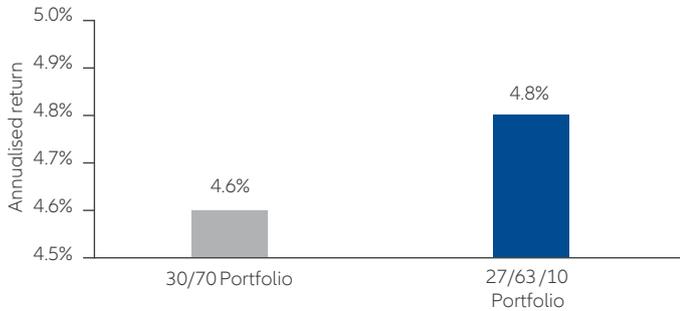


Source: Allianz Global Investors. Euroland Government Bonds are represented by the JP Morgan EMU EUR Total Return Index (JPM EMU). Global Equities are represented by the MSCI World Index Net Return Index in Euro (MSCI World). 30/70-Portfolio is represented by 30% Global Equities and 70% Euroland Government Bonds. Managed Futures are represented by the SG Trend Index, hedged in Euro (SG Trend). The Volatility Effect reflects the difference in portfolio volatility between the starting portfolio (30/70) and the intermediate blended 27/63/10-portfolio (27% Global Equities, 63% Euroland Government Bonds and 10% Managed Futures) assuming a correlation coefficient of 1 between between the three assets in the blended portfolio. The Correlation Effect is the difference in portfolio volatility between the intermediate blended portfolio with an assumed correlation coefficient of 1 and the actual blended 27/63/10-portfolio with the realised correlation coefficient between Global Equities, Euroland Government Bonds and Managed Futures. Calculations are based on monthly returns between January 2000 and December 2017 for illustration purposes and not meant to be an indication for future results.

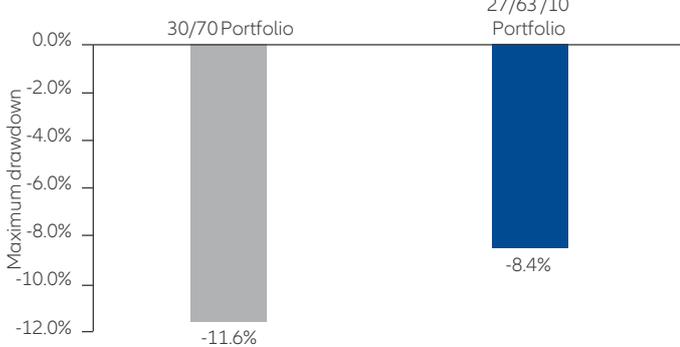
We can see that while managed futures add stand-alone risk to the portfolio, they reduce the overall combined risk due to the correlation effect overcompensating the volatility effect.

Another way to express diversification benefits is by comparing the realised maximum drawdowns before and after the portfolio change: the maximum drawdown is notably reduced while long-term returns were enhanced.

Exhibit 10: Return enhancement



Risk mitigation

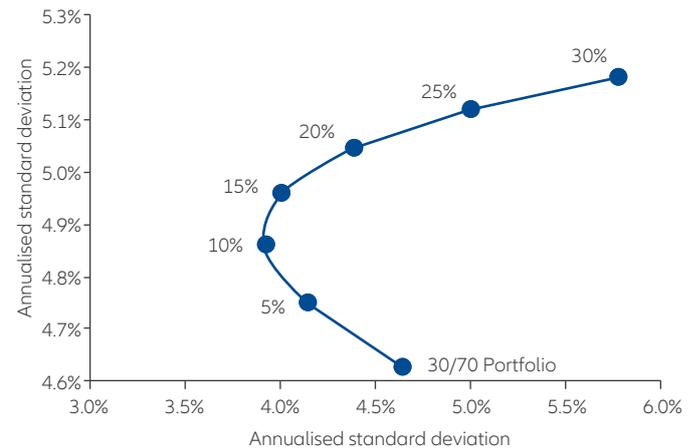


Source: Allianz Global Investors. Euroland Government Bonds are represented by the JP Morgan EMU EUR Total Return Index (JPM EMU). Global Equities are represented by the MSCI World Index Net Return Index in Euro (MSCI World). 30/70-Portfolio is represented by 30% Global Equities and 70% Euroland Government Bonds. Managed Futures are represented by the SG Trend Index, hedged in Euro (SG Trend). 27/63/10-Portfolio is represented by 27 % Global Equities, 63% Euroland Government Bonds and 10% Managed Futures.

Funding from equity: Risk mitigator

Another common approach is to focus on limiting risks associated with equity returns. To assess this approach we fund the allocation to managed futures from 0-50% in 5% increments from the portfolio's equity exposure. Since managed futures exhibited similar volatility as global equities over this period, one might think that the overall volatility should stay the same or go up by replacing equities with an asset with similar volatility exposure. However, the diversification benefit of managed futures results again in an overall lower standard deviation for certain allocation sizes before it starts to rise. If we consider managed futures as an equity substitute, then a replacement up to 10% can lead to an overall risk reduction.

Exhibit 11: Enhancing traditional allocations with dynamic diversification – fund from equity

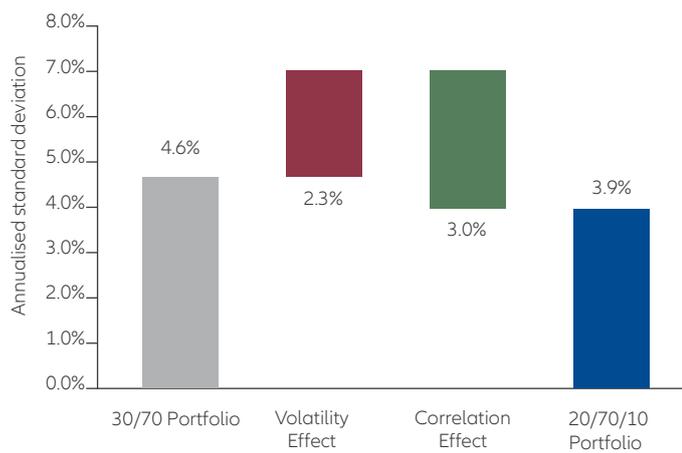


Source: Allianz Global Investors. Euroland Government Bonds are represented by the JP Morgan EMU EUR Total Return Index (JPM EMU). Global Equities are represented by the MSCI World Index Net Return Index in Euro (MSCI World). 30/70-Portfolio is represented by 30% Global Equities and 70% Euroland Government Bonds. Managed Futures are represented by the SG Trend Index, hedged in Euro (SG Trend). Calculations are based on monthly returns between January 2000 and December 2017 for illustration purposes and not meant to be an indication for future results. See data tables in appendix (Exhibit 18) for additional details and performance statistics.

While the risk/return profile shows a similar curvature as in the pro-rata example earlier, the decomposition of the total impact of the blend on portfolio volatility is slightly different: while funding managed futures from equities, the pure volatility effect adds additional stand-alone risk to the portfolio. Taking correlations into account though, shows that while the volatility level of managed futures is similar to global equities, it still is different in terms of the return pattern that managed futures offer: the potential to perform positively in periods of negative equity markets – due to the ability to go short – results in the long-term correlation to equities being low or even negative. This correlation effect can again overcompensate for the pure volatility effect, which leads to a lower long-term portfolio volatility when substituting global equities with managed futures (see Exhibit 12).

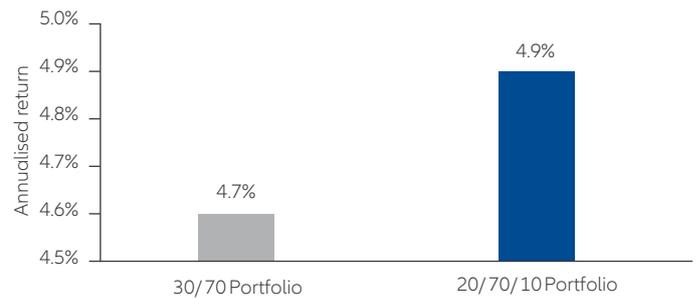
It has to be noted that these considerations are based on long-term average calculations: in times of rising market volatility and changing correlations, total portfolio volatility can go up when adding managed futures funded from global equities. The strongest impact of an equity replacement by managed futures is its drawdown mitigation effect: below we outline the improvement in maximum drawdown before and after equity replacement. While the maximum drawdown was improved by more than 50%, average returns were also increased (see Exhibit 13).

Exhibit 12: Dynamic diversification (fund from equity) 20/70/10

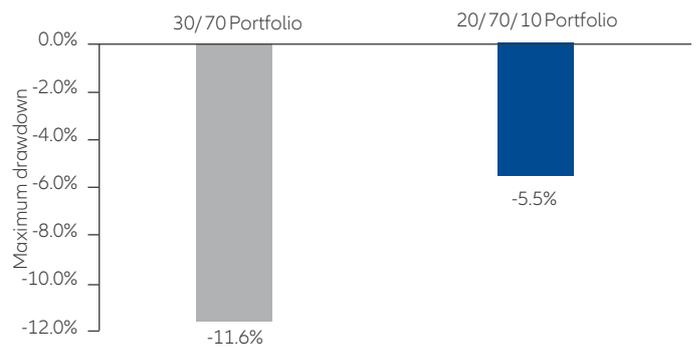


Source: Allianz Global Investors. Euroland Government Bonds are represented by the JP Morgan EMU EUR Total Return Index (JPM EMU). Global Equities are represented by the MSCI World Index Net Return Index in Euro (MSCI World). 30/70-Portfolio is represented by 30% Global Equities and 70% Euroland Government Bonds. Managed Futures are represented by the SG Trend Index, hedged in Euro (SG Trend). The Volatility Effect reflects the difference in portfolio volatility between the starting portfolio (30/70) and the intermediate blended 20/70/10-portfolio (20% Global Equities, 70% Euroland Government Bonds and 10% Managed Futures) assuming a correlation coefficient of 1 between between the three assets in the blended portfolio. The Correlation Effect is the difference in portfolio volatility between the intermediate blended portfolio with an assumed correlation coefficient of 1 and the actual blended 20/70/10-portfolio with the realised correlation coefficient between Global Equities, Euroland Government Bonds and Managed Futures. Calculations are based on monthly returns between January 2000 and December 2017 for illustration purposes and not meant to be an indication for future results.

Exhibit 13: Return enhancement



Risk mitigation



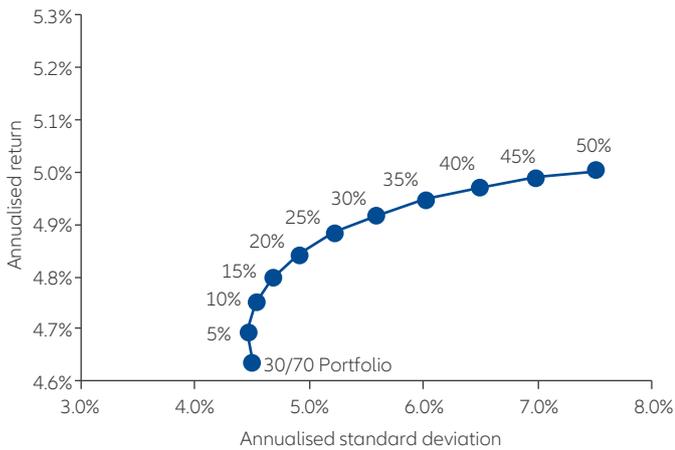
Source: Allianz Global Investors. Euroland Government Bonds are represented by the JP Morgan EMU EUR Total Return Index (JPM EMU). Global Equities are represented by the MSCI World Index Net Return Index in Euro (MSCI World). 30/70-Portfolio is represented by 30% Global Equities and 70% Euroland Government Bonds. Managed Futures are represented by the SG Trend Index, hedged in Euro (SG Trend). 20/70/10-Portfolio is represented by 20% Global Equities, 70% Euroland Government Bonds and 10% Managed Futures.

Funding from bonds: Return enhancer

A common problem investors face is the prevailing low interest rate environment. As this challenges the return potential from fixed income, investors are frequently looking for alternative methods to achieve both the risk mitigation they were looking for with their fixed income allocation, along with the potential for a superior long-term return potential.

To assess this approach we fund the allocation to managed futures from 0-50% in 5% increments from the portfolio's fixed income exposure. Since managed futures exhibited roughly three times the volatility of the Euroland government bonds over this period, the overall volatilities could be expected to rise significantly. However, the power of diversification unfolds and the diversification benefit of managed futures results in an overall lower standard deviation for blends below 10% before aligning and then exceeding that of the initial portfolio when higher allocations are included.

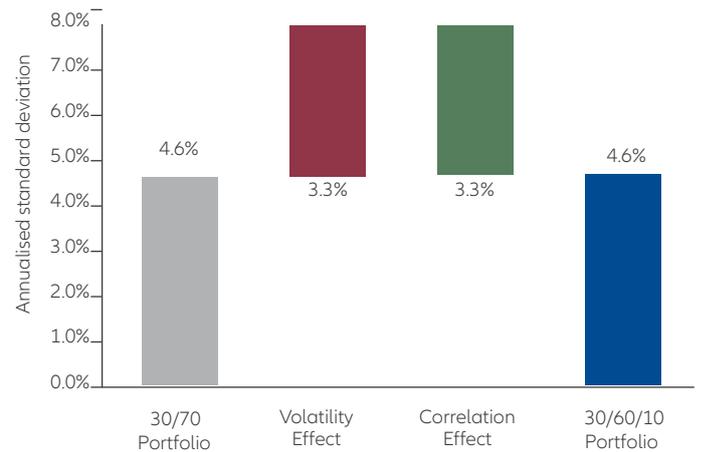
Exhibit 14: Enhancing traditional allocations with dynamic diversification – fund from bonds



Source: Allianz Global Investors. Euroland Government Bonds are represented by the JP Morgan EMU EUR Total Return Index (JPM EMU). Global Equities are represented by the MSCI World Index Net Return Index in Euro (MSCI World). 30/70-Portfolio is represented by 30% Global Equities and 70% Euroland Government Bonds. Managed Futures are represented by the SG Trend Index, hedged in Euro (SG Trend). Calculations are based on monthly returns between January 2000 and December 2017 for illustration purposes and not meant to be an indication for future results. See data tables in appendix (Exhibit 18) for additional details and performance statistics.

Again, when decomposing the diversification effect of a 10% allocation to managed futures funded from Euroland government bonds, the to be expected rise in volatility is fully offset by the correlation effect. The bond substitute by managed futures therefore was overall risk-neutral.

Exhibit 15: Dynamic diversification (fund from bonds) 30/60/10

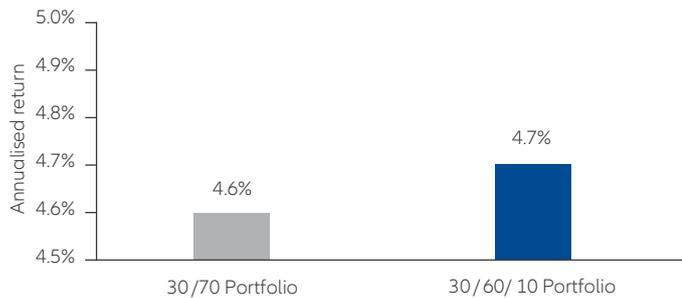


Source: Allianz Global Investors. Euroland Government Bonds are represented by the JP Morgan EMU EUR Total Return Index (JPM EMU). Global Equities are represented by the MSCI World Index Net Return Index in Euro (MSCI World). 30/70-Portfolio is represented by 30% Global Equities and 70% Euroland Government Bonds. Managed Futures are represented by the SG Trend Index, hedged in Euro (SG Trend). The Volatility Effect reflects the difference in portfolio volatility between the starting portfolio (30/70) and the intermediate blended 30/60/10-portfolio (30% Global Equities, 60% Euroland Government Bonds and 10% Managed Futures) assuming a correlation coefficient of 1 between between the three assets in the blended portfolio. The Correlation Effect is the difference in portfolio volatility between the intermediate blended portfolio with an assumed correlation coefficient of 1 and the actual blended 30/60/10-portfolio with the realised correlation coefficient between Global Equities, Euroland Government Bonds and Managed Futures. Calculations are based on monthly returns between January 2000 and December 2017 for illustration purposes and not meant to be an indication for future results.

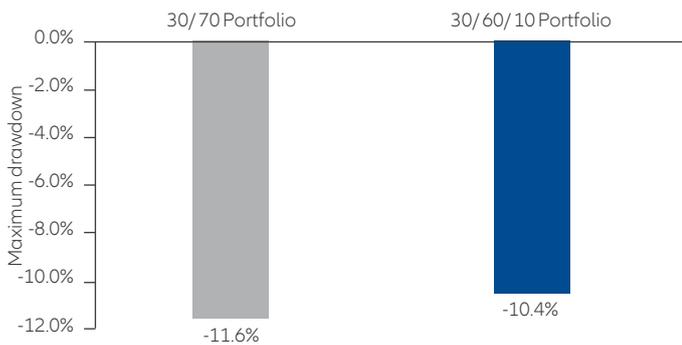
While managed futures typically are positioned as an equity substitute, aiming to deliver equity-like return outcomes with more diversification and to offer risk mitigation in times of sustained equity market stress, a funding from fixed income can also be motivated in order to boost returns without necessarily increasing portfolio volatility or draw down risk. In fact, the maximum drawdown for a 10% bond substitute was even improved, while the returns were enhanced over the period (see Exhibit 16).

These findings may be of particular interest for those concerned with the return potential offered by fixed income in the current environment.

Exhibit 16: Return enhancement



Risk mitigation



Source: Allianz Global Investors. Euroland Government Bonds are represented by the JP Morgan EMU EUR Total Return Index (JPM EMU). Global Equities are represented by the MSCI World Index Net Return Index in Euro (MSCI World). 30/70-Portfolio is represented by 30% Global Equities and 70% Euroland Government Bonds. Managed Futures are represented by the SG Trend Index, hedged in Euro (SG Trend). 30/60/10-Portfolio is represented by 30% Global Equities, 60% Euroland Government Bonds and 10% Managed Futures.

What is the optimum?

Managed futures offer unique diversification benefits over time, making them a helpful tool for investors in the current environment of low fixed income yields and stretched equity market valuations. Depending on the investor's objectives a variety of uses and funding sources can be considered.

When determining the optimal allocations under portfolio constraints (e.g. maximum 70% to a single asset), we observe the funding source is critical. When maximising Sharpe Ratio¹ ((Expected Portfolio Return – Cash)/Portfolio Standard Deviation), equities are the preferred funding source. Given the historically strong performance of fixed income, an unconstrained optimisation would favour fixed income up to an 88% weight, which is unlikely desired in the current low yield environment. By considering the maximum 70% constraint, the max Sharpe Ratio portfolio would lead to 70% fixed income, a 13.2% allocation to managed futures and the remainder in equities. As a general statement, if investors take a risk-adjusted view on portfolios and do not want to overpronounce defensive fixed income holdings relative to equities and constrain it to max 70%, the most efficient portfolio is to split the remaining allocation between equities and managed futures roughly equally.

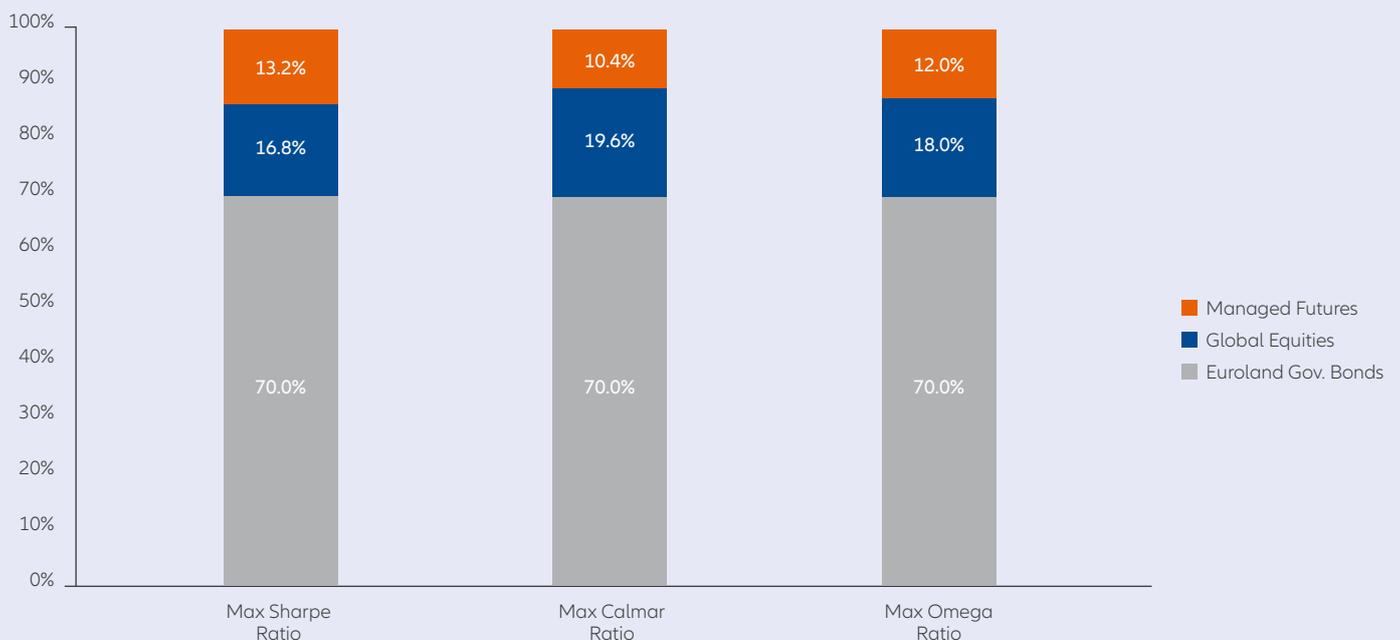
When drawdown risk management is a greater priority, the Calmar Ratio² ((Expected Portfolio Return – Cash)/ Maximum Portfolio Drawdown) can be used as optimisation criterion.

Here, drawdowns are considered the measure of risk which may be more intuitive for some investors, as well better aligned with their perception of risk. Taking a drawdown risk-adjusted view on the portfolio, the max Calmar Ratio portfolio under portfolio constraints (limiting 70% to a single asset) leads to 70% in fixed income and the remainder of the portfolio is to split the allocation between equities and managed futures by roughly two thirds vs one third, respectively.

Finally, to move beyond mean/variance-based performance measures and incorporate higher moments of a return distribution, the Omega Ratio³ (Omega is the probability-weighted ratio of gains over losses) can be utilised to capture the higher moments of a of the distribution (i.e. skewness, kurtosis). The allocation to managed futures in the max Omega Ratio portfolio (12%) is between the max Sharpe Ratio portfolio and max Calmar Ratio portfolio under the same max 70% single holding constraint. Taking a view that optimises the chance of gains vs the risk of loss, managed futures again have their place in the portfolio by splitting between equities and managed futures by roughly two thirds vs one third respectively.

In summary, whatever risk-adjusted view investors take on portfolios, be it by measuring risk as volatility, drawdown or the likelihood of losses vs gains, managed futures are a must-have component in a traditional 30/70 portfolio. Anything below 10% makes a difference already, whereas 10% maximises diversification.

Exhibit 17: Ratio maximisation under portfolio constraints



Appendix data tables

Exhibit 18:

| Analytics | Max Sharpe Ratio | Max Calmar Ratio | Max Omega Ratio |
|-------------------------------|------------------|------------------|-----------------|
| Annualised Return | 4,94% | 4,88% | 4,92% |
| Annualised Standard Deviation | 3,93% | 3,91% | 3,92% |
| Maximum Drawdown | -5,6% | -5,5% | -5,6% |
| Sharpe Ratio | 0,80 | 0,79 | 0,80 |
| Calmar Ratio | 0,56 | 0,57 | 0,56 |
| Omega Ratio | 2,48 | 2,48 | 2,49 |
| Risk Contribution | | | |
| Global Equities | 23% | 35% | 28% |
| Euroland Gov. Bonds | 51% | 49% | 50% |
| Managed Futures | 26% | 16% | 22% |

Exhibit 19:

| | Annualised Return | Annualised Standard Deviation | Max Drawdown | Sharpe Ratio | Calmar Ratio | Omega Ratio | Diversification Benefit | Risk Weights | | |
|---------------------------------|-------------------|-------------------------------|--------------|--------------|--------------|-------------|-------------------------|-----------------|---------------------|-----------------|
| | | | | | | | | Global Equities | Euroland Gov. Bonds | Managed Futures |
| Fund pro-rata | | | | | | | | | | |
| Equity / Bond / Managed Futures | | | | | | | | | | |
| 30% / 70% / 00% | 4,65% | 4,58% | -11,6% | 0,62 | 0,25 | 2,09 | 2,32% | 73% | 27% | 0% |
| 29% / 67% / 05% | 4,72% | 4,41% | -10,0% | 0,66 | 0,29 | 2,18 | 2,85% | 69% | 29% | 2% |
| 27% / 63% / 10% | 4,79% | 4,35% | -8,4% | 0,69 | 0,36 | 2,24 | 3,25% | 60% | 29% | 10% |
| 26% / 60% / 15% | 4,85% | 4,42% | -6,8% | 0,69 | 0,45 | 2,23 | 3,54% | 50% | 28% | 22% |
| 24% / 56% / 20% | 4,91% | 4,60% | -6,0% | 0,68 | 0,52 | 2,16 | 3,71% | 38% | 26% | 37% |
| 23% / 53% / 25% | 4,96% | 4,89% | -6,1% | 0,65 | 0,52 | 2,07 | 3,77% | 27% | 22% | 51% |
| 21% / 49% / 30% | 5,01% | 5,26% | -6,2% | 0,61 | 0,52 | 1,97 | 3,74% | 19% | 19% | 63% |
| 20% / 46% / 35% | 5,05% | 5,71% | -6,4% | 0,57 | 0,51 | 1,88 | 3,65% | 12% | 15% | 73% |
| 18% / 42% / 40% | 5,08% | 6,21% | -6,8% | 0,53 | 0,48 | 1,80 | 3,50% | 8% | 24% | 69% |
| 17% / 39% / 45% | 5,11% | 6,75% | -7,7% | 0,49 | 0,43 | 1,72 | 3,31% | 11% | 20% | 69% |
| 15% / 35% / 50% | 5,14% | 7,32% | -8,6% | 0,46 | 0,39 | 1,66 | 3,09% | 15% | 17% | 68% |
| Fund from equity | | | | | | | | | | |
| Equity / Bond / Managed Futures | | | | | | | | | | |
| 30% / 70% / 00% | 4,65% | 4,58% | -11,6% | 0,62 | 0,25 | 2,09 | 2,32% | 73% | 27% | 0% |
| 25% / 70% / 05% | 4,77% | 4,13% | -7,7% | 0,72 | 0,38 | 2,33 | 2,78% | 58% | 38% | 3% |
| 20% / 70% / 10% | 4,88% | 3,92% | -5,5% | 0,79 | 0,56 | 2,48 | 2,99% | 37% | 48% | 15% |
| 15% / 70% / 15% | 4,97% | 4,00% | -5,7% | 0,79 | 0,55 | 2,46 | 2,91% | 16% | 52% | 33% |
| 10% / 70% / 20% | 5,06% | 4,35% | -6,0% | 0,75 | 0,54 | 2,34 | 2,56% | 3% | 48% | 49% |
| 05% / 70% / 25% | 5,13% | 4,92% | -6,3% | 0,68 | 0,53 | 2,19 | 2,00% | -1% | 41% | 60% |
| 00% / 70% / 30% | 5,19% | 5,63% | -7,6% | 0,60 | 0,45 | 2,04 | 1,28% | 0% | 34% | 66% |
| Fund from bonds | | | | | | | | | | |
| Equity / Bond / Managed Futures | | | | | | | | | | |
| 30% / 70% / 00% | 4,65% | 4,58% | -11,6% | 0,62 | 0,25 | 2,09 | 2,32% | 73% | 27% | 0% |
| 30% / 65% / 05% | 4,70% | 4,54% | -11,0% | 0,64 | 0,26 | 2,13 | 2,86% | 73% | 25% | 2% |
| 30% / 60% / 10% | 4,75% | 4,60% | -10,4% | 0,64 | 0,28 | 2,12 | 3,30% | 69% | 23% | 8% |
| 30% / 55% / 15% | 4,79% | 4,75% | -9,7% | 0,63 | 0,31 | 2,09 | 3,65% | 63% | 20% | 18% |
| 30% / 50% / 20% | 4,83% | 4,98% | -9,1% | 0,61 | 0,33 | 2,02 | 3,92% | 55% | 16% | 29% |
| 30% / 45% / 25% | 4,87% | 5,29% | -8,5% | 0,58 | 0,36 | 1,93 | 4,11% | 47% | 13% | 40% |
| 30% / 40% / 30% | 4,90% | 5,66% | -7,9% | 0,55 | 0,39 | 1,85 | 4,24% | 40% | 10% | 50% |
| 30% / 35% / 35% | 4,93% | 6,08% | -7,3% | 0,51 | 0,43 | 1,77 | 4,32% | 33% | 8% | 59% |
| 30% / 30% / 40% | 4,95% | 6,54% | -6,9% | 0,48 | 0,46 | 1,71 | 4,36% | 8% | 24% | 69% |
| 30% / 25% / 45% | 4,96% | 7,04% | -7,8% | 0,45 | 0,40 | 1,65 | 4,37% | 11% | 20% | 69% |
| 30% / 20% / 50% | 4,98% | 7,56% | -8,7% | 0,42 | 0,36 | 1,60 | 4,35% | 15% | 16% | 68% |

Source: Allianz Global Investors as at December 2017. This is for guidance only, not an indication of future results.

About the authors

Michael Rothstein, FRM, CAIA

Vice President, Co-Head of Product Specialists Multi Asset US

Mr. Rothstein is a Co-Head of Product Specialists Multi Asset US with Allianz Global Investors, which he joined in 2007. He is a member of the Multi Asset US portfolio management team, and is responsible for the Firm's Dynamic Multi Asset and Multi Asset Liquid Alternative strategies managed in the United States. Previously with the firm, Mr. Rothstein was an investment analyst in the product development and monitoring group; before that, he was an investment specialist. Mr. Rothstein has 12 years of investment-industry experience. Earlier in his career, he was a financial advisor with A.G. Edwards. Mr. Rothstein has a B.S. in finance and business administration from Ramapo College, and an M.B.A. in statistics from Baruch College. He holds the Financial Risk Manager and Chartered Alternative Investment Analyst designations, and the FINRA series 7 and 66 licenses.

Thomas J. Zimmerer, Ph.D.

Managing Director, Global Head of Product Specialists Multi Asset

Dr. Thomas Zimmerer is Managing Director and Global Head of Product Specialists Multi Asset with Allianz Global Investors, which he joined in 2014. As a member of the Multi Asset U.S. portfolio-management team, he focusses on the Firm's dynamic multi-asset strategies. Mr. Zimmerer has 21 years of industry-experience. Before joining Allianz Global Investors, he was a professor of Finance and Investments at the University of Applied Science in Ansbach, Germany, and served as senior consultant for Alpha Portfolio Advisors, a German-based consulting firm, advising institutional investors. Prior, Mr. Zimmerer was a portfolio manager with Allianz Asset Management on active bond strategies and active protection strategies. He has a master's degree in Economics and Finance and a Ph.D. in Econometrics from the University of Regensburg, Germany.

Indices utilised :

MSCI World Index NR EUR

JPM EMU TR EUR

SG Trend Index USD – Hedged to EUR (H-EUR)

The hypothetical monthly currency hedge is based on calculated currency forwards reflecting the yield differential between one month EURIBOR and one month US-LIBOR rates and the observed historical bid/offer spread.

¹ Sharpe, W. F., 1994, The Sharpe ratio, *Journal of Portfolio Management*, 21 (1): 49–58.

² Young, Terry W., 1991, Calmar ratio: a smoother tool, *Futures (magazine)*.

³ Con Keating, William F. Shadwick, A Universal Performance Measure, *Journal of Performance Measurement* vol. 6, no. 3, 2002: 59–84.

August 2018

Investing involves risk. The value of an investment and the income from it may fall as well as rise and investors might not get back the full amount invested. Investing in fixed income instruments may expose investors to various risks, including but not limited to creditworthiness, interest rate, liquidity and restricted flexibility risks. Changes to the economic environment and market conditions may affect these risks, resulting in an adverse effect to the value of the investment. During periods of rising nominal interest rates, the values of fixed income instruments (including short positions with respect to fixed income instruments) are generally expected to decline. Conversely, during periods of declining interest rates, the values of these instruments are generally expected to rise. Liquidity risk may possibly delay or prevent account withdrawals or redemptions. Past performance is not a reliable indicator of future results. If the currency in which the past performance is displayed differs from the currency of the country in which the investor resides, then the investor should be aware that due to the exchange rate fluctuations the performance shown may be higher or lower if converted into the investor's local currency. The views and opinions expressed herein, which are subject to change without notice, are those of the issuer companies at the time of publication. The data used is derived from various sources, and assumed to be correct and reliable, but it has not been independently verified; its accuracy or completeness is not guaranteed and no liability is assumed for any direct or consequential losses arising from its use, unless caused by gross negligence or wilful misconduct. The conditions of any underlying offer or contract that may have been, or will be, made or concluded, shall prevail. This is a marketing communication issued by Allianz Global Investors GmbH, www.allianzgi.com, an investment company with limited liability, incorporated in Germany, with its registered office at Bockenheimer Landstrasse 42–44, 60323 Frankfurt/M, registered with the local court Frankfurt/M under HRB 9340, authorised by Bundesanstalt für Finanzdienstleistungsaufsicht (www.bafin.de). The duplication, publication, or transmission of the contents, irrespective of the form, is not permitted; except for the case of explicit permission by Allianz Global Investors GmbH.