NEUBERGER BERMAN

AJAY JAIN
Head of Multi-Asset Class
Portfolio Management

VANESSA ROSENTHAL
Portfolio Specialist,
Quantitative and Multi-Asset
Class Investment Team

WAI LEE
Global Head of
Quantitative Investments

OCTOBER 2016

RISK PARITY AND ALTERNATIVE RISK PREMIA: A HAPPY MARRIAGE

Decades of research into investment "factors," combined with improvements in investment technologies, has led to a proliferation of alternative risk premia investment products. That has left investors with a significant challenge: how should they select risk premia for their investment program; and how should they bring them together? In this paper we argue that much of the benefit of alternative risk premia can be accessed using a small but diversified selection of factors and asset classes. We also maintain that the low correlation between different risk premia makes a strong case for combining them as a single "asset class", and shows risk parity to be a compelling approach to constructing this portfolio—a "happy marriage" of two investment concepts. We then explore the impact of integrating this new "asset class" into a traditional 60/40 portfolio, as well as a portfolio with hedge fund allocations.

AT A GLANCE

- The efficacy of alternative risk premia is now widely-accepted, but that has led to a proliferation of "factors" and products.
- Investors need to select alternative risk premia, combine them into a portfolio, and integrate them into their investment programs.
- We argue that significant benefit can be accessed by pursuing just four factors across the four major asset classes.
- We argue for the benefit of combining the resulting risk premia to form a distinct "asset class", using risk parity weightings.
- We describe an active risk-budgeting approach to determining the size of allocation to this third "asset class", out of a traditional 60/40 equities-and-bonds portfolio.
- We show the results of a hypothetical backtest where increasing the allocation to alternative risk premia improved the risk-adjusted return of a traditional 60/40 portfolio between 2005 and 2016.
- We also show a hypothetical backtest with an improvement in risk-adjusted return when part of an allocation to hedge funds is replaced by alternative risk premia.

In September 2015 Neuberger Berman published a paper, "Beyond Beta", which introduced the concept of alternative risk premia and described how they "can potentially provide reliable long-term returns that are weakly correlated to traditional asset classes, and cheaper and easier to find than genuine alpha."[1] That paper focused on the two most well-researched premia—value and momentum in equity markets—to demonstrate their low correlation with a long-only equity exposure, and their appeal as a complement to, or partial replacement for, traditional hedge-fund or other absolute-return allocations.

The paper acknowledged the large number of alternative risk premia identified by academics and practitioners, and suggested a division into those that are factor-based (such as value) and those that are strategy-based (such as arbitrage risk premia). However, it did not expand on the challenge of selecting from that large number.

Neither did it consider the most efficient way to combine alternative risk premia once they have been selected (for simplicity, it tested value and momentum together by equally-weighting them); nor the impact that integrating the resulting combination of alternative risk premia could have on a multi-asset class portfolio (instead it showed how a value-plus-momentum allocation could improve the risk-return profile of a global equity allocation).

These questions were raised by the insights described in "Beyond Beta", and will be asked by any investor persuaded of the fundamental case for alternative risk premia strategies. In this paper we attempt to address them.

REVISITING ALTERNATIVE RISK PREMIA

Alternative risk premia represent return sources that compensate for bearing risks that are different from "traditional" investment risks. If you consider the return from a U.S. Treasury to be "risk free", the extra return you can get from investing in equities is the traditional "equity risk premium". The extra you can get for investing in a long-dated bond is the traditional "term premium". The extra return you can get from investing in a corporate bond is the traditional "credit risk premium".

By contrast, alternative risk premia are extracted, using long/short investment strategies, from "factors" such as value (securities with lower valuations tend to deliver higher long-term returns than those with higher valuations) and momentum (securities whose price has gone up recently tend to continue going up, and vice versa); or by using systematic investment strategies such as selling put options while shorting the underlying asset (for the volatility risk premium), or selling an acquiring company while holding the target in an acquisition (for the merger risk premium).

These risk premia have been described over decades, as academics and practitioners have researched systematic exceptions to the asset returns predicted by the Capital Asset Pricing Model (CAPM) put forward in the early 1960s. Beginning with the work of Fama and French, there are now literally thousands of published research articles examining and positing dozens of potential factors that can generate risk premia.

What are new are the investment products that package these alternative risk premia. They have launched in response to rapidly growing interest among institutional investors globally, who have recognized the appeal of their attractive return profiles and low correlation with traditional assets. This has been particularly true in recent years, as returns from "traditional alternative" investments such as hedge funds have struggled recently to deliver attractive absolute, non-correlated returns. The fact that alternative risk premia strategies tend to be simpler, more transparent, and often available with more attractive fee structures than traditional alternatives, has added to their appeal.

[1] See "Beyond Beta" by Erik Knutzen and Jeremy Deutsch (September 2015) at http://www.nb.com/pages/public/en-gb/insights/beyond-beta.aspx

SELECTING ALTERNATIVE RISK PREMIA

The existence of so many investable alternative risk premia clearly creates a new selection challenge for investors.

Ultimately, each individual investor can decide which risk premia to introduce to its portfolio based on investment beliefs, governance capacity and the cost and complexity of the strategies required to extract the premia. However, we believe a ready solution suggests itself for those with limited governance capacity, or those persuaded by the case for alternative risk premia but still in the early stages of implementation. Because it is simple and transparent, this solution may also serve as a good starting point for investors seeking to incorporate alternative risk premia into a traditional portfolio.

For this solution, we focus on four of the most thoroughly-researched factors rather than the more complex strategy-based risk premia. We seek them in the four major asset class groups of equities, fixed income, currencies and commodities.

In addition to value and momentum, described above, the four factors include carry (the tendency of higher-yielding assets to outperform lower-yielding assets) and liquidity (the tendency of less-liquid assets to outperform more-liquid assets).

That simple framework already gives us a matrix of 16 potential alternative risk premia, as shown in figure 1. Once we have selected those that are easy to trade, have a clear economic rationale, are of useful size, and have real diversification potential, we believe all except three are viable. We see no economic intuition in support of a persistent value premium in commodities; we do not consider the universe of off-the-run bonds necessary to extract a liquidity premium from fixed income to be large enough, without incurring excessive gross leverage; and the emerging markets exposure necessary to extract a liquidity premium from currencies would be too highly-correlated with traditional risky assets.

FIGURE 1: FOUR SIMPLE FACTORS ACROSS THE FOUR MAJOR ASSET CLASSES CAN DELIVER 13 VIABLE ALTERNATIVE RISK PREMIA

	Value	Momentum	Carry	Liquidity
Equities	Low price-to-market (book value) tends to outperform high price-to-market **Long value/ short growth**	Persistence in stock returns can be captured by following the trend **Long/short portfolio of equity index futures**	Dividend yielding stocks may outperform over the long run **Long/short portfolio of dividend-yielding and market cap indices**	Size premium may exist as compensation for liquidity risk **Long/short portfolio of large cap and small cap equity indices**
Fixed Income	Forward rate premium compensates buyer for risk of changes to future forward rate **Exposure to multiple interest rate markets**	Persistence in bond market returns can be captured by following the trend **Long/short portfolio of government bond futures**	Higher yielding bonds tend to outperform lower yielding bonds **Long/short portfolio of government bond future that prefers relatively steeper yield curves**	N/A
Currencies	Undervalued currencies as measured by PPP tend to outperform over time **Long/short portfolio of G10 currencies**	Persistence in currency returns can be captured by following the trend **Long/short portfolio of G10 currencies**	Currencies with higher carry tend to outperform **Long/short portfolio of G10 currencies**	N/A
Commodities	N/A	Persistence in commodity returns can be captured by following the trend **Long/short portfolio of commodity futures**	Backwardated commodities tend to outperform those in contango **Long/short portfolio of commodity futures based on backwardation or contango**	Liquidity premium for future months **Buy the spread between the Bloomberg Commodity Index and the forward index**

CREATING A PORTFOLIO OF ALTERNATIVE RISK PREMIA

Having identified our 13 alternative risk premia, we now need to think about an efficient way to package them together.

The first thing to note is that there is a clear benefit from doing so. In our "Beyond Beta" paper we showed the low correlation between the returns to value and momentum in global equities. That relationship holds across all 13 of our alternative risk premia: using a hypothetical backtest, based on returns since 2000, the highest correlation between any two risk premia was 0.65 (momentum in fixed income versus carry in fixed income, and carry in equities versus value in equities); while many pairs exhibited correlations as low as -0.18 to -0.20 (the lowest were seen in carry in currencies versus value in fixed income, and carry in equities versus liquidity in equities). Most notable, perhaps, is that the lowest correlation was found between two factors extracted from the same asset class.

When it comes to deciding how to weight these alternative risk premia, our choices are limited. Because they are return streams rather than asset classes or markets, the market-capitalization approach is not applicable, for example. The simplest and most obvious approach is to equally weight them—and that is an approach we will consider here. But because these return streams exhibit distinct and dispersed volatility patterns (from the very low variance in fixed-income value to the very high variance in commodities or equities momentum), they also lend themselves to the risk-parity approach to portfolio construction.

In its most common form, risk parity seeks to create an efficient allocation across multiple investments by weighting them roughly equally based on their relative risk contributions (as opposed to weighting them equally by capital allocation).

The theoretical assumption that justifies this approach is that, with no constraints on leverage and where Sharpe ratios and correlations are identical across different investments over the long term, a risk parity portfolio provides the most efficient asset allocation. The risk-parity portfolio can then be scaled higher—since leverage is not restricted—or lower, based on the target for overall-portfolio volatility.

In practice risk parity has most often been applied to multi-asset class portfolios, as an alternative to the traditional 60/40 method, following the growing recognition that the traditional approaches tend to be dominated by equity risk rather than being genuinely diversified. This is clear in the close correlation of performance between a 60/40 portfolio (60% MSCI World Index and 40% Barclays Global Aggregate Index) and a global equity index (MSCI World Index), which you can see in figure 4 below.

Solving that problem by equalizing the risk contribution from different portfolio components (by lowering the capital allocation to the more volatile equity component), and then applying leverage to bring overall portfolio risk back to the target of 10% (the portfolio-level volatility of a 60/40 mix), creates a portfolio that, when modelled for a long-term hypothetical backtest, outperformed 60/40 in terms of return, risk-adjusted return, and drawdowns.

Investors quickly recognized that the fundamental principle of risk parity can be applied to create portfolios of securities *within* asset classes as well as *across* asset classes: it is possible to weight a portfolio of equities or commodities, for example, according to the historical volatility of each one of those equities or commodities. The same applies to alternative risk premia: allocations to our 13 risk premia can be calibrated for equal risk contribution, with a high weighting going to a premium such as fixed-income carry and a lower weighting going to commodities momentum, for example. Leverage can be applied at portfolio level to achieve the target overall-portfolio volatility.

That is how the Credit Suisse Neuberger Berman Multi-Asset Risk Premia Index (Bloomberg: CSEANB1E Index, hereafter "CS NB MARP Index") is constructed, weighting the 13 alternative risk premia that we have described such that equal risk is expected to be contributed by each of the four styles of risk premia, as well as by each asset class within a given style. The CS NB MARP Index launched on January 29, 2016. The Credit Suisse Neuberger Berman Multi-Asset Risk Premia Proforma Index (Bloomberg: CSEANB0E Index, hereafter "CS NB MARP Proforma Index"), reflects the hypothetical backtested results of the CS NB MARP Index methodology for periods prior to the inception the CS NB MARP Index.[2]

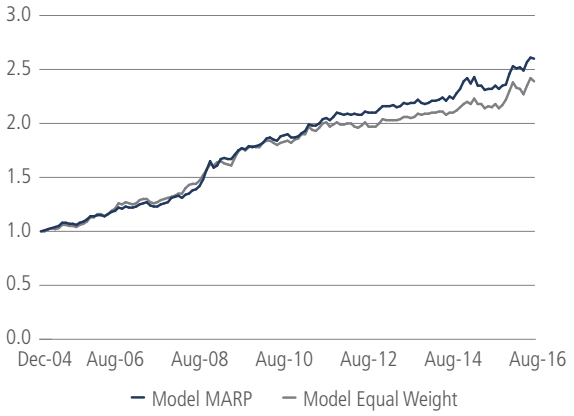
We created a "Model MARP" portfolio using the returns of both the CS NB MARP Index and the CS NB MARP Proforma Index; as well as a "Model Equal Weight" portfolio that equally weights the same premia used in the CS NB indices. When we compare the backtested results (gross of fees) of Model MARP with the Model Equal Weight portfolios, both scaled to a target volatility of 5%, we see that the risk-parity weighted Model MARP outperformed between 2005 and 2016, by 0.7 percentage points annualized (figure 2). Model MARP would have experienced a slightly higher maximum drawdown, however, between April and June 2015 (the maximum drawdown in the Model Equal Weight Portfolio came between March and May 2016).

[2] The Credit Suisse indexes are for informational purposes only. While the indexes are based upon a substantially similar investment methodology as used for Neuberger Berman investment strategies, the returns of the indexes are not the returns of any Neuberger Berman investment strategy and do not reflect the fees, transaction costs and other expenses associated with managing a portfolio. The returns of any Credit Suisse indexes may differ from the returns of a Neuberger Berman investment strategy managed using a similar methodology, including as a result of differences in timing and pricing methodologies (i.e., end-ofday pricing vs. intra-day pricing). Neuberger Berman currently does not manage any actual Multi-Asset Risk Premia Strategy accounts.

FIGURE 2: A MODEL RISK PARITY-WEIGHTED PORTFOLIO OF ALTERNATIVE RISK PREMIA OUTPERFORMED A MODEL EQUALLY-WEIGHTED PORTFOLIO SINCE 2005

GROWTH OF $1

(Hypothetical Backtested Analysis)



Source: Bloomberg, Neuberger Berman. Model MARP scaled to 5% target volatility.

Please see "Hypothetical Backtested Performance Disclosures" at the end of this material. Past performance is no guarantee of future results. The models shown reflect a combination of live index, backtested index, and/or backtested Neuberger Berman models. The results do not represent the performance of any Neuberger Berman strategies and do not reflect the fees and expenses associated with managing a portfolio. Hypothetical backtested performance has certain inherent limitations and reflects the retroactive application of models designed with the benefit of hindsight. Unlike actual investment performance, hypothetical backtested results do not represent actual trading and accordingly they may not reflect the impact that material economic and market factors might have had on decision making if assets were actually managed during the relevant period.

FIGURE 3: HYPOTHETICAL BACKTESTED ANALYSIS, 2005–2016

	Model Marp	Model Equal Weight
Annualized Return	8.5%	7.8%
Annualized Volatility	5.12%	5.12%
Sharpe (to 1M LIBOR)	1.35	1.21
Max Drawdown	-4.8%	-4.3%

Source: Bloomberg, Neuberger Berman. Model MARP scaled to 5% target volatility.

We believe that combining alternative risk premia using the risk parity approach to portfolio construction is a "happy marriage", and will use Model MARP as our proxy for the alternative risk premia "asset class" as we consider how to introduce them into an existing traditional portfolio.

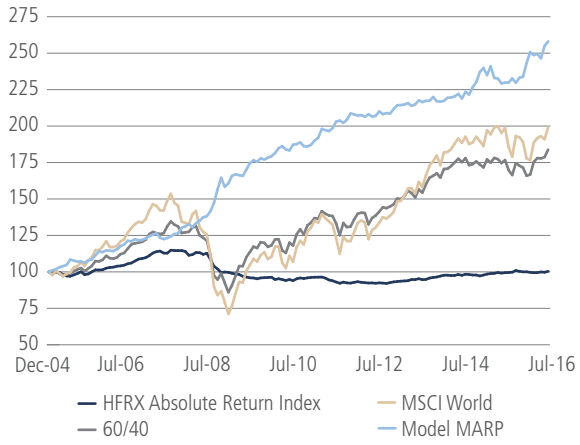
INTEGRATING A PORTFOLIO OF ALTERNATIVE RISK PREMIA

We believe that Model MARP can be considered as a separate asset class because alternative risk premia exhibit sufficient differentiation from other investments in their risk and return profiles, both individually and as a combined portfolio. Figures 4 and 5 shows this differentiation in hypothetical backtested performance, and historical downside risks, relative to the traditional 60/40 portfolio, global equities and hedge funds. The tracking error of the Model MARP was 17% compared to global equities, 12% compared to 60/40 and 7% compared to hedge funds—very high, and further evidence for our view that this is a distinct asset class.

FIGURE 4: ALTERNATIVE RISK PREMIA PERFORM DIFFERENTLY FROM GLOBAL EQUITIES, HEDGE FUNDS OR THE TRADITIONAL 60/40 PORTFOLIO

CUMULATIVE PERFORMANCE 2005 – 2016

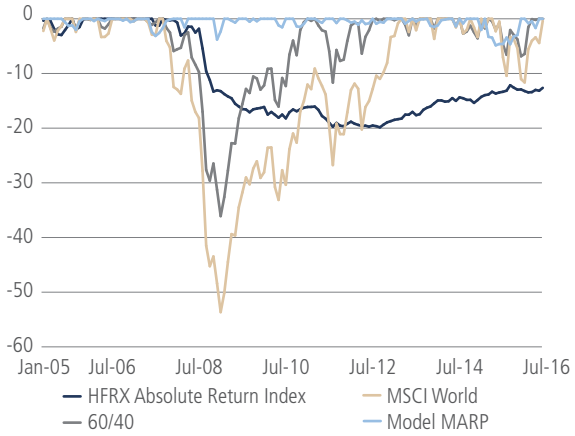
(Hypothetical Backtested Analysis)



Source: Bloomberg, Hedge Fund Research, Neuberger Berman. Model MARP scaled to 5% target volatility.

Please see "Hypothetical Backtested Performance Disclosures" at the end of this material. Past performance is no guarantee of future results. The models shown reflect a combination of live index, backtested index, and/or backtested Neuberger Berman models. The results do not represent the performance of any Neuberger Berman strategies and do not reflect the fees and expenses associated with managing a portfolio. Hypothetical backtested performance has certain inherent limitations and reflects the retroactive application of models designed with the benefit of hindsight. Unlike actual investment performance, hypothetical backtested results do not represent actual trading and accordingly they may not reflect the impact that material economic and market factors might have had on decision making if assets were actually managed during the relevant period.

FIGURE 5: DRAWDOWNS (HYPOTHETICAL BACKTESTED ANALYSIS)



Source: Bloomberg, Hedge Fund Research, Neuberger Berman. Model MARP scaled to 5% target volatility.

Please see "Hypothetical Backtested Performance Disclosures" at the end of this material. Past performance is no guarantee of future results. The models shown reflect a combination of live index, backtested index, and/or backtested Neuberger Berman models. The results do not represent the performance of any Neuberger Berman strategies and do not reflect the fees and expenses associated with managing a portfolio. Hypothetical backtested performance has certain inherent limitations and reflects the retroactive application of models designed with the benefit of hindsight. Unlike actual investment performance, hypothetical backtested results do not represent actual trading and accordingly they may not reflect the impact that material economic and market factors might have had on decision making if assets were actually managed during the relevant period.

This demonstrates some of the potential benefits from introducing a Model MARP allocation to a portfolio of global equities (as we showed for a value-and-momentum portfolio in the "Beyond Beta" paper); or to traditional multi-asset class portfolio (60/40-weighted or otherwise); or to a hedge fund allocation.

Let's begin by thinking about how to integrate Model MARP into a traditional 60/40 portfolio. One way to think about how much to allocate is in terms of expected tracking error: we believe 2% active risk is a reasonable objective *for the total investment program.*

This can actually be challenging to achieve, depending on how constrained the investor is in its allocation bands around asset classes, ability to short, ability to employ leverage, or other factors. Nonetheless, we can use the 2% active risk target as a guide to determine the maximum possible allocation to alternative risk premia before working backwards from there to determine the actual allocation.

Let's consider including Model MARP with a volatility of 5% into a 60/40 portfolio, which has had about 10% volatility, historically. This is the assumption used for the backtested analysis shown in figure 5. For now, let's also assume that the investor does not take active risk anywhere in the portfolio.

In seeking to achieve 2% active risk at the whole-portfolio level, one would need to invest 40% into the alternative risk premia strategy. This is because a 40% allocation to an alternative risk premia strategy with 5% volatility would have contributed 2% active risk (that is, 5% of 40%, ignoring the low correlation between 60/40 and alternative risk premia). From this analysis, a 40% allocation to alternative risk premia would be the upper bound.

If that feels like an excessive capital allocation, an investor without constraints on leverage could scale the Model MARP to a volatility of, say, 10%, roughly equal to that of the traditional 60/40 portfolio. Then a Model MARP allocation of 20% would contribute 2% active risk at the whole portfolio level (that is, 10% of 20%).

Now let us revisit our assumptions with the potential diversification benefits to a portfolio with a hedge fund allocation in mind. Before, we worked on the assumption that active risk was not being taken elsewhere in the portfolio. This is not likely to be the case in reality, as portfolios often include some allocations to active investment strategies, whether traditional long-only or non-traditional—alternatives, hedge funds, opportunistic, diversifiers, and other categories.

We do not argue that alternative risk premia strategies are hedge fund replication strategies or straightforward substitutes for hedge funds. In fact, as we have already seen, the exposure of Model MARP to hedge fund factors is typically quite low—correlation and beta with the HFRX Absolute Return Index is -0.28 and -0.46, respectively. However, alternative risk premia strategies and hedge funds do tend to share high-level objectives such as absolute return and low correlation with traditional assets. With that in mind, we believe investors may want to re-examine performance expectations for both their traditional active management and their non-traditional investments when considering what role alternative risk premia strategies might play as an addition to or partial replacement for such allocations

In short, where active strategies are pursued, some of the 2% total active risk budget allocated to these active managers could be re-allocated to the new Model MARP allocation with the aim of improving efficiency based on the fact that these active managers will likely have had exposure to some or all of the factors that generate these risk premia. Re-assigning the risk budget to a Model MARP-style implementation of these factors (that is, long/short instead of long-only) may provide for more upside potential given its "purer" exposure to the factors.

Figure 6 is a hypothetical backtested analysis that shows the impact of integrating Model MARP, at its unleveraged volatility of 5%, with a traditional 60/40 portfolio. First we show the impact of adding 10%, 20% and 30% Model MARP allocations to a traditional 60/40 portfolio. Then we look at a

FIGURE 6: INCREASING THE ALTERNATIVE RISK PREMIA ALLOCATION IMPROVED RISK-ADJUSTED RETURN AND DRAWDOWNS
Hypothetical Backtested Analysis, 2005 – 2016

	These portfolios show the effect of adding increasing amounts of Model MARP into the traditional 60/40				These portfolios show the effect of replacing half of a 20% hedge fund allocation with Model MARP	
	60% global equities/40% global bonds	55%/35% + 10% Model MARP	50%/30% + 20% Model MARP	40%/30% + 30% Model MARP	50%/30% + 20% HFRX	50%/30% + 10% HFRX + 10% Model MARP
Annualized Return	5.3%	5.8%	6.2%	6.4%	4.4%	5.3%
Annualized Volatility	10.42%	9.5%	8.5%	7.1%	8.9%	8.7%
Sharpe (to 1M LIBOR)	0.36	0.44	0.53	0.68	0.31	0.42
Max Drawdown	-36.1%	-31.7%	-27.1%	-19.7%	-32.9%	-30.1%
Correlation to MSCI World	0.98	0.98	0.97	0.94	0.98	0.98

Source: Bloomberg, Hedge Fund Research, Neuberger Berman. Model MARP scaled to 5% target volatility.

Please see "Hypothetical Backtested Performance Disclosures" at the end of this material. Past performance is no guarantee of future results. The models shown reflect a combination of live index, backtested index, and/or backtested Neuberger Berman models. The results do not represent the performance of any Neuberger Berman strategies and do not reflect the fees and expenses associated with managing a portfolio. Hypothetical backtested performance has certain inherent limitations and reflects the retroactive application of models designed with the benefit of hindsight. Unlike actual investment performance, hypothetical backtested results do not represent actual trading and accordingly they may not reflect the impact that material economic and market factors might have had on decision making if assets were actually managed during the relevant period.

portfolio with a 20% hedge fund allocation (50% equities / 30% fixed income / 20% hedge funds) and show the effect of replacing half of the 20% hedge fund allocation with Model MARP. In both cases, increasing the allocation Model MARP improved returns and reduced volatility, and significantly reduced maximum drawdown.

CONCLUSION

The combination of decades of academic and practitioner research into investment factors with improvements in investing and trading technologies has led to wide acceptance of the efficacy of allocating to alternative risk premia on the one hand and a proliferation of investment products on the other.

Investors face three challenging decisions: first, which alternative risk premia to allocate to; second, whether and how to combine them to form an alternative risk premia "asset class"; and third, how to integrate alternative risk premia into the broader multi-asset class portfolio.

As investors become more familiar with the space, they will make their own decisions about which risk premia fit with their investment beliefs and their governance constraints. Portfolio efficiency could be improved further by exploring additional alternative risk premia to those we have covered here. However, we believe a significant part of the benefit of alternative risk premia investing can be accessed by pursuing the four factors of value, momentum, carry and liquidity across the four asset classes of equities, fixed income, currencies and commodities. We also believe that the low historical correlation between different alternative risk premia makes a strong case for combining them as a single "asset class"; and that, consistent with our backtested analyses which demonstrated improved efficiency of portfolios constructed on a risk-parity basis, this may be an ideal methodology for doing so.

The selection and combination of alternative risk premia can certainly be done in a more sophisticated way, but even this simple, transparent and systematic approach highlighted in our backtested analysis improved the risk-adjusted return profile of a traditional 60/40 portfolio over the past decade, as well as a portfolio that included a hedge fund allocation. What is more, risk-adjusted return improved with every additional allocation to alternative risk premia, suggesting that these improvements may be limited only by the size of active risk budget that the investor has to deploy.

HYPOTHETICAL BACKTESTED PERFORMANCE DISCLOSURES

This material included hypothetical backtested performance of model portfolios that reflect the blended performance of live and backtested Credit Suisse indexes and backtested Neuberger Berman quantitative models. While the backtested models and indexes (live and backtested) are generally based upon a substantially similar investment methodology, the backtested model and index returns (live and backtested) shown herein are not the returns of any Neuberger Berman investment strategy and do not reflect the fees, transaction costs and other expenses associated with managing a portfolio. The returns of any backtested models and indexes (live and backtested) shown may differ from the returns of a Neuberger Berman investment strategy managed using a similar methodology, including as a result of differences in timing and pricing methodologies (i.e., end-of-day pricing vs. intra-day pricing). Neuberger Berman currently does not manage any actual Multi-Asset Risk Premia (MARP) Strategy accounts.

The following is a description of the backtested models shown herein and the methodology used in constructing backtested indexes and backtested Neuberger Berman quantitative models.

Models Presented:
Model Multi-Asset Risk Premia ("Model Marp"): Reflects the blended performance of: (a) the Credit Suisse Neuberger Berman Multi-Asset Risk Premia Index ("CS NB MARP Index") for periods after the launch of the index on January 29, 2016; and (b) the Credit Suisse Neuberger Berman Multi-Asset Risk Premia Proforma Index ("CS NB MARP Proforma Index") for periods prior to the launch of CS NB MARP Index on January 29, 2016. The CS NB MARP Proforma Index reflects the hypothetical backtested results of the index methodology prior to the inception of the CS NB MARP Index.

Model Equally-Weighted Alternative Risk Premia ("Model Equal Weight"): Reflects a hypothetical backtested model portfolio that blends the performance of the individual risk premia that comprise the CS NB MARP Index with a weighting assigned to each of the 13 alternative risk premia. The returns are then scaled by a constant so that the annualized volatility of the return series is equal to that of the Model MARP portfolio, i.e. 5%. For certain periods of time the backtested data may be constructed utilizing the return data of the CS NB MARP Index and CS NB MARP Proforma Index.

Backtesting Methodologies.
The methodologies used for backtested models and backtested indexes (collectively, "backtested portfolios") are substantially similar. The backtested portfolios generally assume a minimum $25 million investment with no cash allocations and monthly rebalancing. Backtested portfolios are constructed by determining a risk budget for the underlying assets and then applying a risk balanced framework to determine portfolio weights. The risk budget is determined by identifying common risk premia from multiple assets, then bundling "similar" strategies into respective risk premia buckets. Risk budgeting is then applied at both the risk premia level as well as within each bucket, at the strategy level. The risk of each constituent asset is defined using historical data with more weight assigned to recent data (i.e. exponentially weighted with 1 year half life). To calculate the covariance matrix, an expanding data set is used with at least 5 years of data. Data for individual risk premia begins in January 2000. Some shrinkage methods are also applied at this stage. The correlation matrix is a combination of 1) a standard correlation matrix and 2) a correlation matrix that averages correlations both within the asset classes and also across asset classes. The backtested portfolio weights are derived by allocating equal risk to each asset class and to each asset within the asset class, and subsequently determining the portfolio weights to each asset that would provide for such a distribution of risk budget. After forming the portfolio, the next period's asset returns obtained from Bloomberg are multiplied by the respective portfolio weights to get the next period's portfolio return. There may be differences in the weighting and other methodologies described here between the Neuberger Berman models and the live and backtested indexes that use a substantially similar methodology, including the treatment of cash and timing of execution prices. Neuberger Berman simulated models generally use intra-day execution prices whereas live and backtested indexes generally use end-of-day pricing.

There may be material differences between the hypothetical backtested performance results and actual results achieved by actual accounts. Backtested model performance is hypothetical and does not represent the performance of actual accounts. Hypothetical performance has certain inherent limitations. Unlike actual investment performance, hypothetical results do not represent actual trading and accordingly the performance results may have under- or over-compensated for the impact, if any, that certain economic or other market factors, such as lack of liquidity or price fluctuations, might have had on the investment decision-making process or results if assets were actually being managed. Hypothetical performance may also not accurately reflect the impact, if any, of other material economic and market factors, or the impact of financial risk and the ability to withstand losses. Hypothetical performance results are also subject to the fact that they are generally designed with the benefit of hindsight. As a result, the backtested models theoretically may be changed from time to time to obtain more favorable performance results. In addition, the results are based, in part, on hypothetical assumptions. Certain of the assumptions have been made for modeling purposes and may not have been realized in the actual management of accounts. No representation or warranty is made as to the reasonableness of the assumptions made or that all assumptions used in achieving the hypothetical results have been stated or fully considered. Changes in the model assumptions may have a material impact on the hypothetical returns presented. There are frequently material differences between hypothetical performance results and actual results achieved by any investment strategy. Neuberger Berman did not manage any accounts in the manner reflected in the models during the backtested time periods shown.

Unless otherwise indicated, results shown reflect reinvestment of any dividends and distributions. Backtested portfolios are shown gross of fees or other expenses. If such fees and expenses were reflected, returns referenced would be lower. Model returns reflect the deduction of estimated transactions costs.

ADDITIONAL DISCLOSURES

This material is presented solely for informational purposes and nothing herein constitutes investment, legal, accounting or tax advice, or a recommendation to buy, sell or hold a security. No recommendation or advice is being given as to whether any investment or strategy is suitable for a particular investor. It should not be assumed that any investments in securities, companies, sectors or markets identified and described were or will be profitable. Information is obtained from sources deemed reliable, but there is no representation or warranty as to its accuracy, completeness or reliability. All information is current as of the date of this material and is subject to change without notice. Any views or opinions expressed may not reflect those of the firm as a whole. Third-party economic or market estimates discussed herein may or may not be realized and no opinion or representation is being given regarding such estimates. Certain products and services may not be available in all jurisdictions or to all client types. Unless otherwise indicated, returns shown reflect reinvestment of dividends and distributions. Indexes are unmanaged and are not available for direct investment. The use of tools cannot guarantee performance. Diversification does not guarantee profit or protect against loss in declining markets. Investing entails risks, including possible loss of principal. **Past performance is no guarantee of future results.**

CS Index Disclaimer: This disclaimer extends to Credit Suisse Securities (Europe) Limited ("CS"), its affiliates or its designate in any of its capacities and relates to the Credit Suisse Neuberger Berman Multi-Asset Risk Premia Index (the "Index"). CS is described as "Index Sponsor" under the rules relating to the Index, as prepared by CS (the "Index Rules") and Credit Suisse International ("CSI") is described as the "Index Calculation Agent". The Index may, in accordance with the Index Rules, be subject to change at any time by the CS but subject to consultation with the Index Committee (as described in the Index Rules). None of CS, CSI or any of their respective affiliates makes any warranty or representation whatsoever, express or implied, as to the results to be obtained from the use of the Index, or as to the performance and/or the value thereof at any time (past, present or future). CS as Index Sponsor does not warrant or guarantee the accuracy or timeliness of calculations of Index Values or the availability of an Index Value on any particular date or at any particular time. The Neuberger Berman Multi-Asset Risk Premia strategy is not in any way sponsored, endorsed, sold or promoted by CS, CSI or any of their respective affiliates. None of CS, CSI or any of their respective affiliates have prepared, reviewed or approved this document. Neither CS, CSI nor any of its affiliates shall have any responsibility to monitor whether Neuberger Berman Europe Limited ("NBEL") as the "Index Rebalancing Entity" in respect of the Index, is acting in compliance with the rules relating to the Index. "Credit Suisse", the Credit Suisse logo and "Credit Suisse Actively Rebalanced Indices" are trademarks or service marks or registered trademarks or registered trademarks or registered service marks of Credit Suisse Group AG or one of its affiliates. The "Credit Suisse Neuberger Berman Multi-Asset Risk Premia Index" contains trademarks or service marks or registered trademarks or registered service marks of (i) Credit Suisse Group AG or one of its affiliates and (ii) Neuberger Berman Europe Limited or one of its affiliates.

The MSCI World Index: is a free float-adjusted market capitalization weighted index that is designed to measure the equity market performance of developed markets. As of November 27, 2013, the MSCI World Index consists of the following 23 developed market country indices: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

Barclays U.S. Aggregate Index: represents securities that are SEC-registered, taxable, and dollar denominated. The index covers the U.S. investment grade fixed rate bond market, with index components for government and corporate securities, mortgage pass-through securities, and asset-backed securities.

Hedge Fund Research, Inc.: (HFRI) is the global leader in the alternative investment industry. Established in 1992, HFRI specializes in the areas of indexation and analysis of hedge funds. HFRI produces over 100 indices of hedge fund performance ranging from industry-aggregate levels down to specific, niche areas of sub-strategy and regional investment focus, with performance dating back to 1990, and is the industry's most widely used standard benchmark of hedge fund performance globally. The HFRI Equity Hedge Index is comprised of managers typically maintaining at least 50%, and in some cases is substantially entirely invested in equities and equity derivatives, both long and short. Strategies can be broadly diversified or narrowly focused on specific sectors and can range broadly in terms of levels of net exposure, leverage employed, holding period, concentrations of market capitalizations and valuation ranges of typical portfolios. The HFRI Emerging Markets Index is comprised of strategies according to their regional investment focus only. There are no investment strategy criteria for inclusion in these indices.

For traditional portfolios referenced herein, equities are represented by the MSCI World Index and fixed income is represented by the Barclays Global Aggregate Index.

This material is being issued on a limited basis through various global subsidiaries and affiliates of Neuberger Berman Group LLC. Please visit www.nb.com/disclosure-global-communications for the specific entities and jurisdictional limitations and restrictions. The "Neuberger Berman" name and logo are registered service marks of Neuberger Berman Group LLC. a

NEUBERGER | BERMAN

Neuberger Berman
605 Third Avenue
New York, NY 10158-3698

www.nb.com