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The Quest for Diversification

Why Does It Make Sense to Mix Risk Parity, Carry and Momentum Risk Premia?

RESEARCH STRATEGY & ANALYSIS

The Quest for Diversification

Why Does It Make Sense to Mix Risk Parity, Carry and Momentum Risk Premia?

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Summary

Diversification should be the first objective of any large institutions because managing risk is a key source of long-term performance. However, building a diversified portfolio cannot only be reduced to the allocation policy between asset classes, such as stocks and bonds. Diversification can be improved by using alternative risk premia, in particular carry and momentum. Mixing traditional and alternative risk premia will then become the standard of diversified management in the near future.

The traditional diversification approach consists in optimising the volatility of a portfolio. This approach is inadequate for managing diversification because it focuses on arbitrage risk factors and not on common risk factors. When considering traditional risk premia, the standard approach today is to use the risk parity model.

With an enlarged investment universe of traditional and alternative risk premia, the "correlation diversification approach" must be replaced by the "payoff diversification approach" because the relationships between assets are non-linear. Indeed, correlation models are not able to take into account the convexity characteristics of these assets, which is not the case of payoff models.

The payoff approach implies mixing concave and convex strategies in order to diversify the skewness risk of diversified portfolios. This is why it makes sense to allocate between traditional, carry and momentum

risk premia. Nevertheless, this approach recognises that diversification cannot be obtained in every state of nature, and must mainly focus on the adverse states instead of the positive ones. In this case, budgeting the skewness risk is the right way to manage diversification and reduce the residual tail risk.

Key Points

- Investors don't need diversification at all times, they primarily need diversification in bad economic times and stressed markets.
- The traditional diversification approach assumes a linear Gaussian world. It cannot take into account non-linearity between assets, and the asymmetric behaviour between good and bad times.
- The payoff diversification approach assumes a non-linear, non-Gaussian world. It can take into account non-linearity between assets, in particular the fact that the behaviour of assets may be different in stressed markets than in normal markets.
- Correlation diversification is not time-consistent. This is why it is difficult to assess tail risk in this framework.
- Payoff diversification is a better approach for building a diversified allocation and understanding the risk/return profile of the portfolio.
- Risk parity is the optimal method for capturing traditional risk premia, because it focuses on the performance contribution of assets and not on their hedging properties.
- Carry and momentum are the two most important alternative risk premia. Mixing concave and convex payoffs is key for managing the skewness risk in bad times.
- While volatility risk can be fully diversified, hedging skewness risk can only be partial. This is why skewness risk must be risk-budgeted from an ex-ante point of view.
- Diversification is multifaceted: across asset classes, across risk premia strategies, across payoff functions and across time.
- Combining the traditional multi-asset class approach of balanced funds with the alternative multi-strategy approach of hedge funds helps to improve the risk/return profile of a diversified portfolio.

The traditional diversification approach

The notion of diversification is generally associated with many topics that are ultimately centred on two main concepts:

- the concept of risk optimisation;
- the concept of multi-asset classes.

Most institutional investors focus on these concepts in order to build their long-term investment policy, especially their strategic asset allocation.

The modern portfolio theory was formulated by Harry Markowitz fifty years ago. This framework places greater emphasis on the trade-off between expected return and risk. For Markowitz, expected return is "a desirable thing" while risk is "an undesirable thing". By using volatility as the risk measure, Markowitz formulates the theory of portfolio optimisation, where the investor maximises the expected return or minimises the volatility of the portfolio. As noted by Markowitz, the two metrics are, however, not of the same nature. The expected return of a portfolio is a linear combination of expected returns of assets that compose the portfolio. By contrast, the portfolio's volatility is a convex combination of asset volatilities. Said differently, the risk of the portfolio is lower than the sum of individual risks.

Because of this asymmetry, volatility optimisation holds a prominent place in the construction of investment portfolios. For a long time, the concept of volatility diversification has been reduced to the concept of volatility optimisation. This explains why correlation is the central tool in this traditional approach: it serves as the degree of freedom or the selection variable whereas volatilities are assumed to be given. The emergence of diversified funds has its roots in this framework. Indeed, the traditional portfolio construction of these investment vehicles consists generally in finding assets that are lowly or negatively correlated.

Figure 1: Correlation matrix between asset classes (2000-2016)

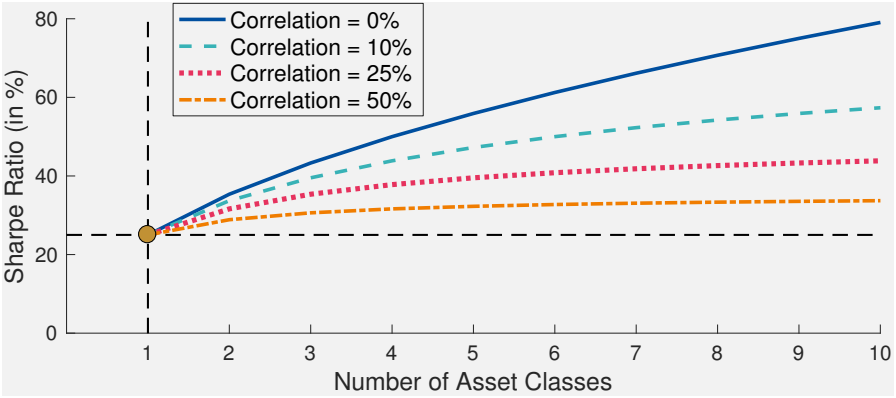
		Equity				Bond			
		US	Euro	UK	Japan	US	Euro	UK	Japan
Equity	US	100%							
	Euro	78%	100%						
	UK	79%	87%	100%					
	Japan	53%	57%	55%	100%				
Bond	US	-35%	-39%	-32%	-29%	100%			
	Euro	-17%	-16%	-16%	-16%	58%	100%		
	UK	-31%	-37%	-30%	-31%	72%	63%	100%	
	Japan	-17%	-18%	-16%	-33%	37%	31%	36%	100%

Source: Amundi Research

In this context, it makes sense to shape the allocation using two layers of decision: across asset classes and within asset classes. Since the first level of diversification dominates the second level, the search for diversification is mainly driven by the search for uncorrelated asset classes[1]. In Figure 1, we report the correlation of weekly returns between equities and sovereign bonds for the period from January 2000 to December 2016[2]. The average correlation is equal to 10%. This low level of correlation is mainly due to the negative correlation between stocks and bonds. Nevertheless, using a large universe of equity and bond indices is more relevant than using only an equity index and a bond index.

In Figure 2, we have reported the relationship between the asset class correlation and the Sharpe ratio of the portfolio. We assume that the Sharpe ratio of asset classes is equal to 0.25, the correlation is uniform across asset classes and the portfolio is equally-weighted. We notice that the improvement in the Sharpe ratio is limited when the correlation is equal to 50%. In order to have a real benefit on the Sharpe ratio, the correlation must be lower than 25%. In this case, we can reach a Sharpe ratio larger than 0.40 or 0.50. However, the best case is the one of uniform correlations. As shown in Figure 1, the correlation matrix is more a bloc structure with high cross-correlations within equities or bonds and negative cross-correlation between equities and bonds. In this case, the Sharpe ratio of the portfolio is unlikely to exceed 0.50[3].

Figure 2: Impact of the uniform correlation on the Sharpe ratio



Source: Amundi Research

[1] *Brinson, G.P., Hood, L.R. and Beebower, G.L. (1986), Determinants of Portfolio Performance, Financial Analysts Journal, 42(4), pp. 39-44.*

[2] *We use the following equity indices S&P 500, Eurostoxx 50, FTSE 100 and Nikkei. For bonds, we use generic bond indices with a 10-year duration. All the indices are hedged in USD.*

[3] *For instance, if the inter-group correlation is -20% and the intra-group correlation is 70%, the Sharpe ratio is bounded by 0.50 even if the number of asset classes tends to infinity.*

Therefore, the previous results show that one of the challenges when building a well-diversified portfolio is to define the right diversification universe of asset classes. For a long time, a universe of large cap stocks and sovereign bonds was sufficient. In the recent years, this has not been the case, not necessarily because the diversification has been reduced[4] but because yields are low. This is why investment universes have increased and now include corporate bonds, high-yield bonds, commodities, real assets and even currencies[5].

When building diversified funds, the allocation process is the second challenge: how to mix these different asset classes? The answer is generally naive and is mainly based on the constant-mix strategy. This approach consists of defining fixed asset class weightings and rebalancing the portfolio when the current allocation drifts too far away from the target allocation. For instance, calendar rebalancing, in particular monthly rebalancing, is generally the most used rebalancing strategy. The constant-mix method is backed by the results of Merton[6], who showed that this is the optimal strategy across a multi-period investment horizon under some conditions[7]. The development of balanced funds is structured around three risk-aversion profiles or three asset-mix policies:

- the conservative investor should invest in a defensive fund (20% of stocks and 80% of bonds);
- the moderate investor should invest in a balanced fund (50% of stocks and 50% of bonds);
- the aggressive investor should invest in a dynamic fund (80% of stocks and 20% of bonds).

This type of investment approach is not restricted to individual investors, but is also used by many institutional investors to define their strategic asset allocation. In particular, the 60/40 constant-mix allocation in equity and fixed income has been adopted by many pension funds and sovereign wealth funds[8]. In Figure 3, we show the risk decomposition of constant-mix allocations between equities and bonds[9]. For the defensive 20/80 allocation, we notice

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[4] *Ilmanen, A., and Kizer, J. (2012), The Death of Diversification Has Been Greatly Exaggerated, Journal of Portfolio Management, 38(3), pp. 15-27.*

[5] *The enlargement of the investment universe is mainly motivated by the search for asset classes with higher performance rather than by the search for asset classes with higher diversification power.*

[6] *Merton, R.C. (1969), Lifetime Portfolio Selection under Uncertainty: The Continuous-Time Case, Review of Economics and Statistics, 51(3), pp. 247-257.*

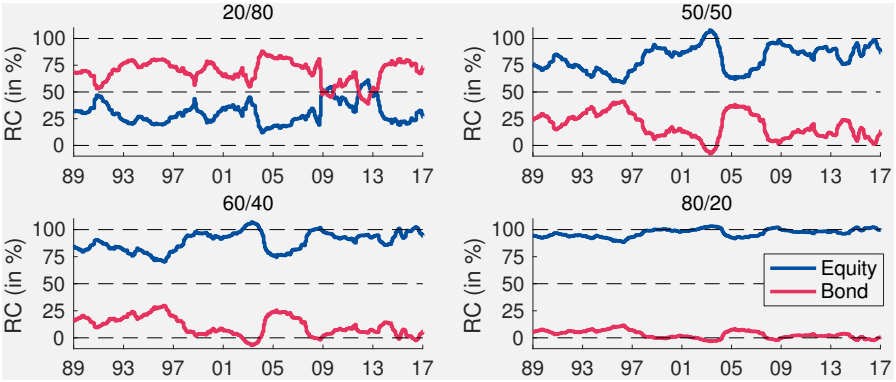
[7] *Asset prices follow geometric Brownian motions, investors have a CRRA utility function and there are no transaction costs.*

[8] *Sharpe, W. F. (2010), Adaptive Asset Allocation Policies, Financial Analysts Journal, 66(3), pp. 45-59.*

[9] *They are respectively represented by the MSCI World Index and the J.P. Morgan Global Aggregate Bond Index.*

that the risk contribution of bonds is higher than the risk contribution of equities. For the other allocations, we observe the contrary. For instance, 97% of the 80/20 portfolio's volatility is explained by equities. We face a paradox here. When the proportion of equities is high, equities are the main contributor to the portfolio's risk whereas bonds only explain a residual part[10]. In this case, we do not obtain a diversified portfolio, but we have a deleveraged equity portfolio. Indeed, bonds are used in order to hedge a (small) part of the equity exposure, but their diversification property has little impact.

Figure 3: Risk decomposition of constant-mix allocations



Source: Amundi Research

The payoff diversification approach

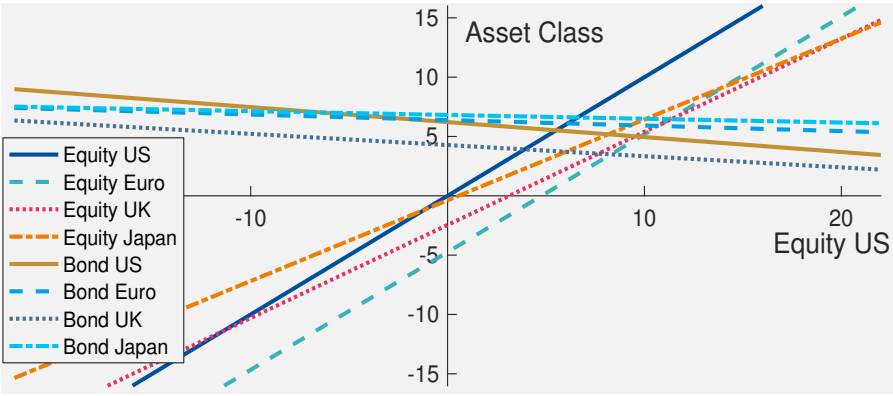
We now turn to the payoff diversification approach, which is more general than the correlation approach. The underlying idea is to consider the option analysis framework. In this case, the dependence function between the underlying asset and the option is represented by the payoff. This tool is particularly interesting because options introduce non-linearity, and this type of dependence cannot be captured by a correlation analysis. Indeed, we know that correlation is a valid dependence measure only if the joint distribution of asset returns is Gaussian. This assumption is difficult to satisfy, because it implies that the assets are related to each other by a linear relationship. This is why this correlation statistic is called the linear correlation measure.

Let us come back to the previous example with the 8 asset classes. In Figure 4, we have represented the payoff function of each asset class by considering that the reference asset is the S&P 500 index. The payoff function has been

[10] *The risk contribution may also be negative.*

estimated for the period from January 2000 to December 2016 by assuming that asset returns are Gaussian. In this case, the payoff function is an affine function. We obtain an important result here: using correlation for building diversified portfolios is equivalent to considering that payoff functions between asset classes are linear. This is a strong assumption. Indeed, investors know that the cross-sensitivity between two asset classes may change depending on the economic cycle or the regime of the reference asset. For instance, we know that the behaviour of corporate bonds is different when the equity market is in bull or bear mode.

Figure 4: Associated payoff functions to asset classes



Source: Amundi Research

The issue is that correlation is not always time-consistent. For instance, some assets may present a low correlation in a normal regime, and a high correlation in a stressed regime. In this case, the payoff is non-linear. An example is given in Figure 5, which shows the typical payoff of a pure short volatility strategy. We recognise the payoff of a short put option[11].

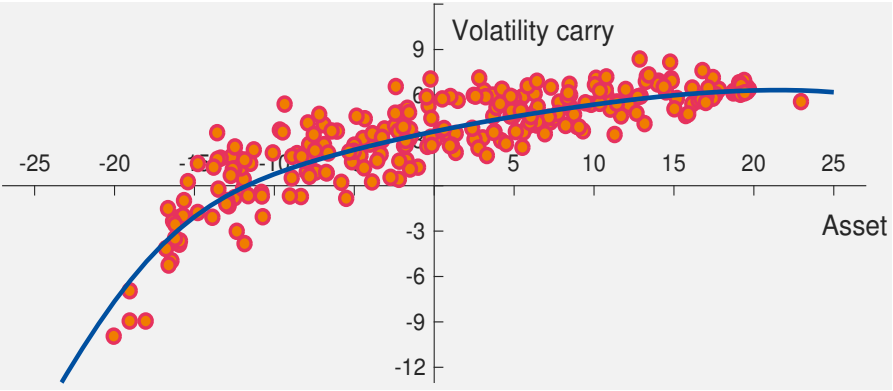
For investors, diversification is crucial, because they hope that it will help them during market crises. There is then an asymmetry between normal and stressed markets, since investors particularly need diversification in a period of stress. This raises an issue as historical correlations are generally estimated using recent periods. The investor may then be myopic, in particular if the recent period does not incorporate stressed events. In this case, diversification may be over-estimated.

The payoff approach is a framework that solves the previous puzzle. Indeed, asset returns may present non-linear relationships, meaning that the risk cannot be fully assessed with the volatility measure. Non-linear payoffs

[11] *Hamdan, R, Pavlowsky, F., Roncalli T., and Zheng, B (2016), A Primer on Alternative Risk Premia, SSRN, 2766850.*

generate a skewness risk that may be dramatic in a stressed period. A typical example is the behaviour of the short volatility strategy during the 2008 global financial crisis.

Figure 5: Payoff of the short volatility strategy



Source: Amundi Research

Since the payoff approach is more time-consistent than the correlation approach, it is suited to build long-term diversified portfolios. Firstly, it allows us to know if some assets can be partly hedged in a stressed period, and what the residual risk is. Secondly, knowing the theory of options, a hedging strategy always generates a cost, and this cost depends on the relative position of the reference asset. The aggregation of payoff functions is therefore not straightforward, implying that we have to do some arbitrages. The correlation approach suggests that we can dramatically reduce the risk by accumulating various asset classes in a diversified portfolio. The payoff approach shows that there is a limit to diversification, because the range of available linear payoff functions is limited. This is also linked to the limit of skewness diversification observed by Roncalli (2017)[12].

How to build a diversified portfolio in 2017?

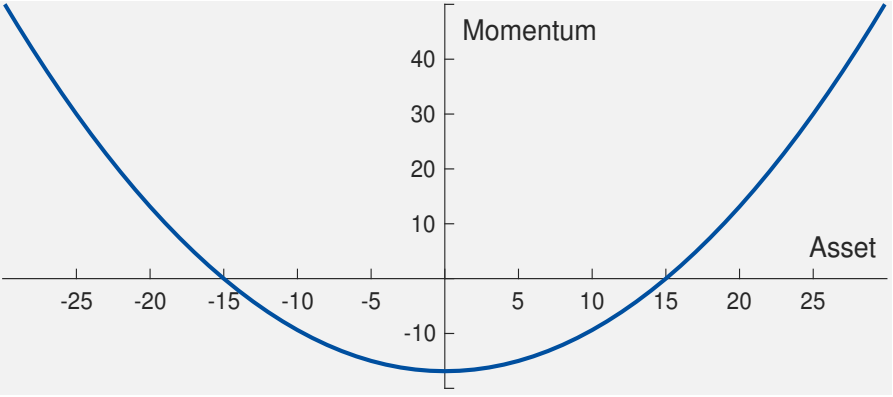
Expanding the universe of asset classes is not the unique and most efficient way to gain diversification, especially because the number of asset classes is limited. Moreover, this approach implies moving towards less liquid assets, which is not such a bad idea, but not always compatible with daily liquidity constraints. Another approach is to mix traditional and alternative risk premia. The advantage of such an approach is that the portfolio contains the same assets,

[12] *Roncalli, T. (2017), Alternative Risk Premia: What Do We Know?, Chapter 10 in Jurczenko, E. (Ed.), Factor Investing and Alternative Risk Premia, ISTE-Elsevier.*

but they are grouped in different ways in order to produce different payoffs.

The search for yield is driving investors to increase the use of carry strategies. This is a good thing for diversifying traditional risk premia, since carry strategies exhibit a different payoff than those of equities and bonds. As noted by Koijen *et al.* (2017)[13], there are different forms of carry risk premia, and they are present in most asset classes. Moreover, these strategies, which are considered as income strategies, are particularly attractive in a low yield environment.

Figure 6: Payoff of the time-series momentum strategy



Source: Amundi Research

However, accumulating carry risk premia does not only improve the performance of diversified portfolios. This also has a negative impact on the risk of the portfolio, not on the volatility risk but on the skewness risk. The reason is that the payoff of such strategies is generally a short put. This is why we have to manage the carry strategy in order to reduce its high convexity in bad times. We can also mix carry risk premia with momentum risk premia in order to partly hedge the residual skewness risk. Indeed, we can show that a time-series momentum risk premium theoretically exhibits a long straddle payoff (see Figure 6). This result has been exhibited on CTA trend-followers for a long time[14].

It is a great opportunity that carry and momentum strategies are the two most important alternative risk premia and also the two most complementary payoff functions. How to explain it? Roncalli (2017) notices that there are many alternative risk premia, but most of them are mainly located in the equities universe (for example low beta or quality). In contrast, carry and

[13] *Koijen, R.S.J., Moskowitz, T.J., Pedersen, L.H., and Vrugt, E.B. (2017), Carry, Journal of Financial Economics, forthcoming.*

[14] *Fung, W., and Hsieh, D.A. (2001), The Risk in Hedge Fund Strategies: Theory and Evidence from Trend Followers, Review of Financial studies, 14(2), pp. 313-341.*

momentum are present in all asset classes. Investors are more puzzled with the value premium, because it is more a long-term mean-reverting strategy, except in the case of stocks, for which the mean-reverting frequency is shorter. This is why the payoff of the value strategy is more heterogeneous across asset classes. Nevertheless, carry and momentum risk premia are sufficient to improve the diversification of traditional portfolios. The main reason is that carry is a skewness risk premium and momentum is a market anomaly. Combining convex payoff strategies with concave payoff strategies therefore mitigates the risk of the portfolio and improves its risk/return profile.

As indicated in the introduction, portfolio allocation is the other issue with the investment universe when building a diversified portfolio. Recent literature has shown that the constant-mix allocation is not necessarily optimal because it does not take into account the risk dynamics of assets. A better model is the risk-budgeting approach, which has become the standard of portfolio allocation when dealing with risk factors[15]. The advantage of risk budgeting is that risk contributions are decided from an ex-ante point of view. Building a risk-parity portfolio of stocks and bonds is therefore a good way to capture traditional risk premia in a balanced way. By adding alternative risk premia, we can again use the risk-budgeting approach but it cannot be based on the volatility risk measure. Indeed, the payoff approach tells us that diversification differs with respect to the state of nature. In good states, diversification helps to smooth volatility, but is not crucial for managing performance. In bad states, it is essential for managing the drawdown or skewness risk. With such non-linear strategies, the risk-budgeting approach must therefore be based on asymmetric risk measures such as the expected shortfall. Contrary to Gaussian risk models, it implies focusing mainly on bad times in order to reduce the skewness risk of the carry risk premium and tail risk of equities.

What about risk factor analysis of investment portfolios?

The standard approach for analysing the risk of a portfolio is to define a set of risk factors and regress the returns of the portfolio on the returns of the risk factors. Therefore, we can split the portfolio risk into two main components: a part which is explained by the common risk factors (also called the 'beta' component) and a residual component (also called the 'idiosyncratic' or 'alpha' component). Contrary to the return-based style analysis, the holding-based style analysis estimates the sensitivity of each risk factor at the security level. Sensitivities are then aggregated in order to obtain the risk

[15] *Roncalli, T. (2013), Introduction to Risk Parity and Budgeting, Chapman & Hall/CRC Financial Mathematics Series.*

factor analysis at the portfolio level. Even if the two approaches seems to be different, they share the main assumption: the relationships between assets and common risk factors are linear, or said differently, they jointly follow a multivariate Gaussian distribution. In this framework, correlation is the appropriate statistical tool to describe the dependence between assets and common risk factors, and the linear regression is the relevant statistical tool to estimate these linear relationships. In the case where we use alternative risk premia as common risk factors, the previous framework estimates the 'average' sensitivities, since the payoff approach shows that the sensitivity is state- and time-dependent. This result is already known in equities. Indeed, size, value, low beta, and momentum risk factors exhibit non-linear payoffs. We face the same issue when analysing the risk of a multi-asset portfolio. Therefore, the payoff approach can help to perform more robust risk factor analysis.

The convergence of traditional and alternative asset management

In a previous Amundi viewpoint entitled "Alternative Risk Premia: What Do We Know?", we have already indicated that the development of alternative risk premia highlights the growing convergence between traditional active management and alternative management. The emergence of new diversified funds that mix risk parity, traditional risk premia, carry and momentum also contributes to this asset management shift. Indeed, these new funds combine the traditional multi-asset class approach of balanced funds with the multi-strategy approach of hedge funds. This recognises that diversification is multifaceted: across asset classes, across risk premia strategies, across payoff functions and across time. We believe that such diversification framework will become the standard in the asset management industry in the coming years.

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