

Brian Hurst
Principal

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Bryan W. Johnson, CFA
Regional Director

Yao Hua Ooi
Vice President

Understanding Risk Parity

So, You Think You're Diversified...

The outperformance of Risk Parity strategies during the recent credit crisis has provided evidence of the benefits of a truly diversified portfolio. Traditional diversification focuses on dollar allocation; but because equities have disproportionate risk, a traditional portfolio's overall risk is often dominated by its equity portion. Risk Parity diversification focuses on risk allocation. We find that by making significant investments in non-equity asset classes, investors can achieve true diversification – and expect more consistent performance across the spectrum of potential economic environments.

First, the paper highlights the concentration risk embedded in traditional portfolios, and explains the intuition behind Risk Parity. Next, we describe a Simple Risk Parity Strategy and demonstrate its consistent outperformance over nearly 40 years of historical data. Finally, we delve into the more advanced portfolio construction and risk management techniques used to implement actual Risk Parity portfolios.

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PART 1: INTRODUCTION — THE NEED FOR TRUE DIVERSIFICATION

Risk Parity strategies have received increasing attention over the past several years for a few reasons. First, the strategy has shown more consistent long-term performance than traditional portfolios.¹ Second, after significant market declines in 2008, many investors are concerned about the tail risk in their portfolios.² Finally, despite the common view that diversification failed during the recent credit crisis, Risk Parity strategies passed an acid test in 2008 by performing well relative to traditional portfolios.

Today, portfolio allocations to equities are typically 60% or higher. Because equities have approximately three to four times the risk of bonds, this allocation leads to a portfolio that has roughly 90% of its risk budget dedicated to equities.³ In other words, when viewed through the lens of risk, traditional asset allocations are highly concentrated in the equity markets — and not actually diversified at all. The concentration risk of traditional portfolios leads to lower risk-adjusted returns, less consistent performance across economic environments and higher tail risk.

Exhibit 1 shows a typical portfolio broken down by both capital (dollar) allocation and risk allocation. Clearly, this traditional

portfolio is dominated by equity risk, meaning that its performance over time will largely be dictated by the equity markets. The bond market can have a miserable year or an extraordinary year, commodity prices can soar or plummet, but the effect on the portfolio will nonetheless be small. Traditional portfolios give the illusion of diversification when in fact they have concentrated exposure to the equity markets.

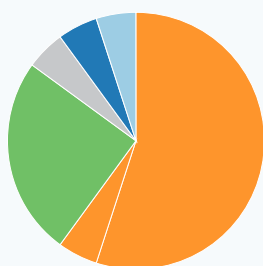
PART 2: WHAT IS THE CONCEPT BEHIND RISK PARITY?

Risk Parity portfolios rely on risk-based diversification, seeking to generate both higher and more consistent returns. (More diversified portfolios have higher Sharpe Ratios.) The typical Risk Parity portfolio begins with a much lower exposure to equities relative to traditional portfolios, and invests significantly more in other asset classes. As a result, the risk budget of the portfolio is not concentrated in equities, but spread more evenly across other asset classes.

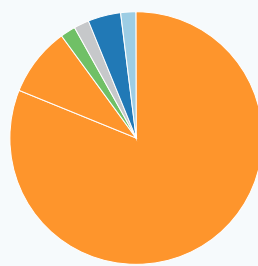
The key to Risk Parity is to diversify across asset classes that behave differently across economic environments. In general, equities do well in high growth and low inflation environments, bonds do well in deflationary or recessionary environments, and commodities tend to perform best during inflationary

Exhibit 1: Traditional Portfolios are Heavily Concentrated in Equity Risk.

Traditional Dollar Allocation



Traditional Risk Allocation



- Public and Private Equity
- Fixed Income
- Real Estate
- Commodities
- Hedge Funds

Source: AQR. "Dollar Allocation" and "Risk Allocation" charts are for illustrative purposes only and are intended to illustrate an asset class allocation and corresponding risk allocation/exposure of the typical multi-asset class, or "traditional" portfolio. "Risk Allocations" are calculated based on AQR volatility and correlation estimates. Certain of the assumptions have been made for modeling purposes and are unlikely to be realized. No representation or warranty is made as to the reasonableness of the assumptions made or that all assumptions used in calculating risk allocations have been stated or fully considered.

¹ Comparing the simulated returns of a "Simple Risk Parity" portfolio versus the simulated returns of a 60% S&P 500 / 40% Barclays US Aggregate balanced portfolio from January 1971 through December 2009.

² Tail risk is defined as the risk of portfolio returns that are more than three standard deviations below the mean of a normal distribution. In other words, a very large, unexpected and rapid drawdown of capital.

³ A portfolio's "risk budget" is defined as the amount of risk that a portfolio manager is willing to take on, in order to pursue her target return. Volatility is not the same as risk, but it's an important input in determining the risk of an asset. Throughout this paper, "risk" is measured as the volatility (standard deviation) of returns. However, the concepts presented extend to other measures of risk such as marginal risk contribution, value-at-risk (VaR), stress test based loss estimates, and other measures of risk. These risk exposures are based on AQR volatility and correlation estimates and are for illustrative purposes only.

environments. Having balanced exposure to these three main asset classes can produce more consistent long-term results. While there can be material differences among Risk Parity strategies, such as the breadth of asset classes used and portfolio construction methodologies employed, the concept that binds them all is a more balanced approach to risk allocation.

Exhibit 2 shows the Sharpe Ratios of these three asset classes over the thirty-nine years from 1971 to 2009.⁴ Over the long term, the risk-adjusted returns are nearly identical, although there has been performance dispersion over shorter time periods. Regardless of asset class, investors have been paid, on average, about the same amount to bear risk — which is why a portfolio constructed to weight the risk of each asset class similarly makes sense in the long term. In contrast, the more common equity risk concentrated portfolio is consistent with the idea that risk-adjusted returns of equities are far greater than that of the other asset classes, despite many decades of evidence suggesting otherwise.

To illustrate this point, we present a stylized “Simple Risk Parity Strategy” which invests in only three asset classes (Exhibit 3). The intuition is straightforward: instead of

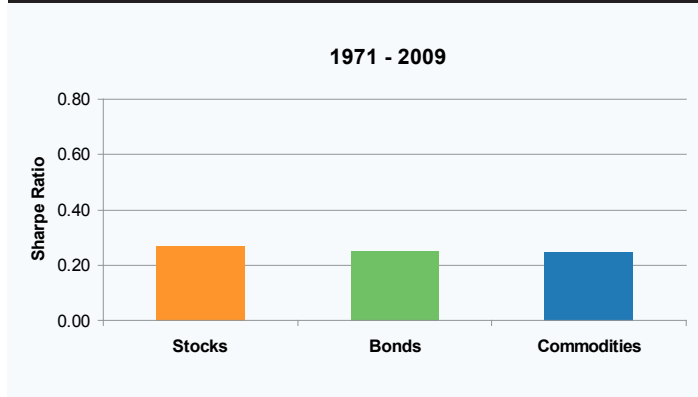
taking a single large concentrated risk in equities, investors should diversify with several more balanced risks and expect more consistent returns with lower tail risk.

PART 3: CONSTRUCTING AND TESTING A SIMPLE RISK PARITY STRATEGY

To demonstrate how these strategies work, we construct a “Simple Risk Parity Strategy” (or “Strategy”) and compare this simulated portfolio to a typical 60/40 simulated portfolio.⁵ In practice, many Risk Parity strategies provide exposure to a wider range of asset classes. Here, for simplicity, we construct the Strategy using only three widely available commercial indices: the MSCI World Index, the Barclays U.S. Aggregate Government Index,⁶ and the S&P GSCI Index, representing exposures to equities, bonds, and commodities, respectively. Using these three indices allows us to analyze Risk Parity from as early as 1971, examining the historical performance characteristics through a number of different business cycles and market environments.

“Risk Parity” by definition aims for equal risk across asset classes, and for this study we will target a similar amount of volatility from each asset class every month.⁷ In order to do this, we begin

Exhibit 2: Risk-Adjusted Performance is Similar Across Asset Classes from 1971 to 2009.



Source: AQR. MSCI World Index (stocks), Barclays Capital U.S. Government Index and Ibbotson U.S. Intermediate Government Bond Index (before 1976) [bonds] and the S&P GSCI Total Return Index (commodities). Past performance is not a guarantee of future performance.

Exhibit 3: The “Simple Risk Parity Strategy” Offers a Balanced Allocation Across Asset Classes.



Source: AQR. For illustrative purposes only.

⁴ These are the realized Sharpe Ratios based on monthly returns in excess of the 3 month T-bill returns for the MSCI World Index (stocks), the Barclays U.S. Aggregate Government Bond Index (bonds), and the S&P GSCI Index (commodities). We begin in 1971, as that is when all three data series are available.

⁵ 60% S&P 500 Index and 40% Barclays Aggregate Bond Index portfolio, rebalanced monthly. While a “60/40” portfolio is clearly more basic than most portfolios today, it does represent a similar risk exposure as today’s broader portfolios and gives more history to use in the analysis.

⁶ Prior to the inception of the Barclays U.S. Aggregate Index, we use the Ibbotson U.S. Intermediate Government Total Return Index to calculate bond returns until January 1976.

⁷ In actual Risk Parity portfolio implementations, the targeted risk will generally factor in correlation assumptions across the asset classes as well as other measures of risk beyond volatility.

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by determining an expected volatility for each asset class.⁸ The position weight calculated at the beginning of each month then is simply the targeted annualized volatility for each asset class divided by the forecasted volatility for that asset class. We repeat this process each month and rebalance to the new weights. For comparison purposes, we scale the portfolio so that the average annualized volatility of this portfolio matches the volatility of the 60/40 portfolio over the period.⁹

This methodology ensures that a lot less capital is allocated to high volatility asset classes (e.g., equities). As a result, these risks will not dominate the portfolio since exposures to lower volatility assets are increased to balance risks. As volatility estimates change, the holdings of Risky Parity portfolios also shift accordingly to maintain the desired diversification. We think targeting and controlling the overall portfolio volatility can also lead to more consistent returns. As the volatility of an asset increases (decreases), the position size in the portfolio will be decreased (increased) accordingly. This is in stark contrast to traditional portfolios which are typically rebalanced to a constant capital allocation percentage. This means the volatility of a traditional

portfolio may vary significantly over time, mainly due to changes in market volatility.

Exhibit 4 compares the historical performance of the Strategy to a traditional 60/40 portfolio. The Strategy has delivered higher returns (an additional 1.7% per year) at the same annualized volatility over the past 39 years, resulting in a Sharpe Ratio that is more than 60% higher. This significant increase in risk-adjusted returns is due to superior portfolio construction techniques and improved risk diversification.

The Strategy would have delivered more consistent performance and reduced drawdowns due to improved diversification, but it wouldn't have outperformed in every environment. Exhibit 4 indicates how the Simple Risk Parity Strategy may have performed through specific historical scenarios. In the early 1970s, inflation was out of control, leading President Nixon to impose wage and price controls on August 15, 1971. While inflation dipped initially, commodity prices continued climbing, accentuated by the 1973 OPEC oil embargo. This scenario shows the power of having material investments in assets which benefit from inflation, such

Exhibit 4: The “Simple Risk Parity Strategy” Has Offered Higher Simulated Risk-Adjusted Returns and More Consistent Performance over the Past 39 Years.

| January 1971 through December 2009 | Simple Risk Parity Strategy | 60/40 S&P/Barclays Agg | Outperformance of Simple Risk Parity Strategy Over 60/40 * |
|---|-----------------------------|------------------------|--|
| Annualized Return | 11.2% | 9.6% | 1.7% |
| Annualized Standard Deviation | 10.1% | 10.1% | |
| Sharpe Ratio | 0.45 | 0.28 | 63% improvement |
| Select Periods: Cumulative Returns | | | |
| Nixon Price Controls (8/71 - 4/74) | 53.5% | 8.1% | 45.5% |
| 1982 Bull Market (9/82 - 3/84) | 38.0% | 48.0% | -10.0% |
| 1987 Market Crash (10/87) | -1.8% | -11.5% | 9.7% |
| Surprise Fed Rate Hike (2/94 - 3/94) | -9.0% | -5.8% | -3.2% |
| Tech Bubble (1/99 - 3/00) | 16.4% | 14.7% | 1.7% |
| Tech Bust (4/00 - 2/03) | 22.5% | -17.6% | 40.1% |
| Easy Credit (8/02 - 3/04) | 28.7% | 21.8% | 6.9% |
| Credit Crisis (7/07 - 3/09) | -0.5% | -26.0% | 25.5% |

* Outperformance may differ slightly from the simple difference due to rounding.

Source: AQR. The US 60/40 portfolio consists of a 60% allocation to S&P 500 Index and a 40% allocation to Barclays Capital U.S. Government Index and Ibbotson U.S. Intermediate Government Bond Index (before 1976) [bonds]. The simulated Simple Risk Parity Strategy is based on a hypothetical portfolio. This analysis has been provided for illustrative purposes only and is not based on an actual portfolio AQR manages. Past performance is not a guarantee of future performance.

⁸ Specifically, for the Simple Risk Parity Strategy, our volatility forecast is the annualized prior rolling 12 month standard deviation of monthly returns for each index.

⁹ The 60/40 portfolio from 1971 to 2009 realized an average of 10.1% annualized volatility.

as commodities. The Simple Risk Parity portfolio would have outperformed the 60/40 portfolio by over 45% during this period.

The 1982 bull market is an example where the 60/40 portfolio would have outperformed the Simple Risk Parity Strategy. This is to be expected, as during this period equities were the best performing asset class on a risk-adjusted basis. While underperforming 60/40, the Simple Risk Parity Strategy still would have performed well on an absolute basis in this type of environment. Importantly, the Simple Risk Parity Strategy doesn't necessarily underperform in bull markets, as evidenced by the results over the Tech Bubble and during the Easy Credit years in the mid 2000s.

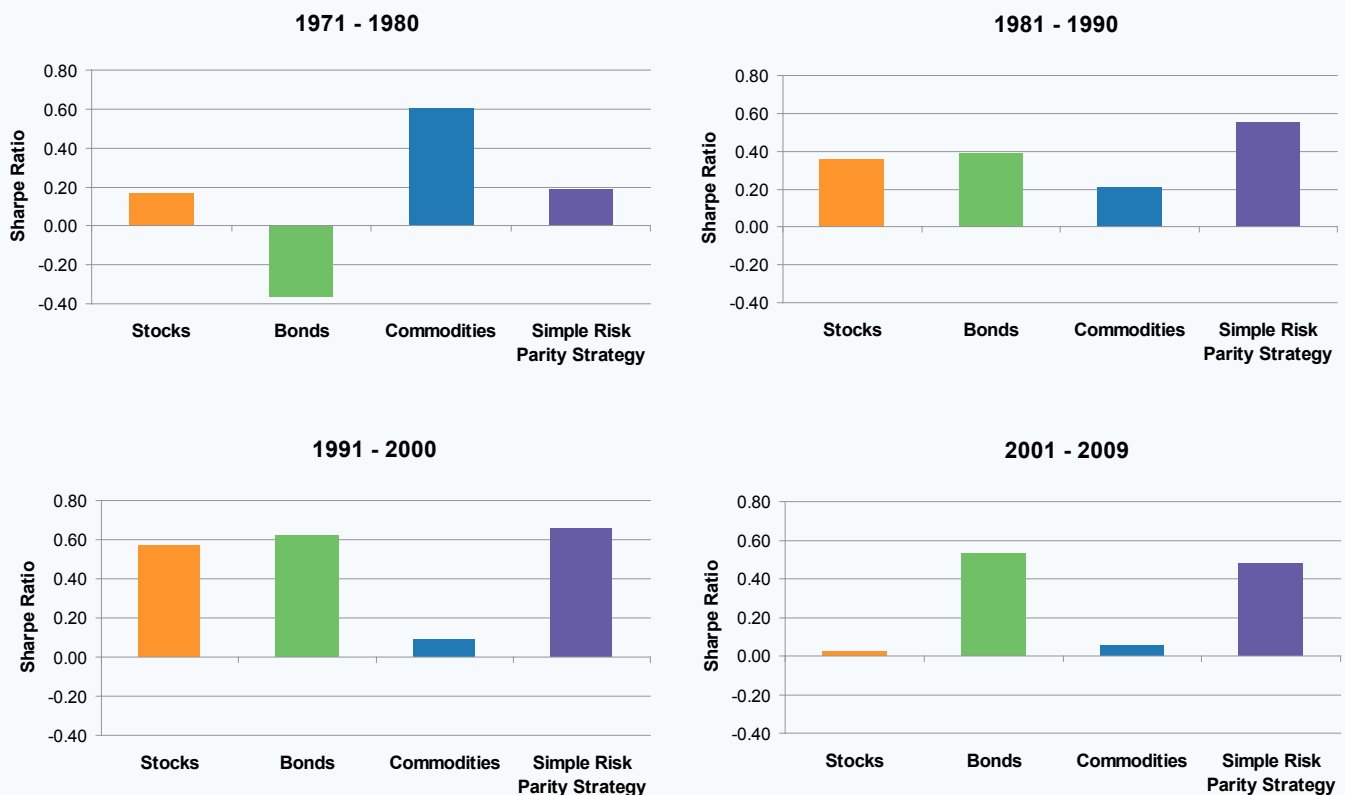
The surprise hike of the Fed Funds rate in February 1994 is an example of an environment that was tough for most portfolios. This is also an example where Risk Parity may underperform more

traditional asset allocations as fixed income suffered relatively more than equities on a risk-adjusted basis.

Equity bear markets like the 1987 Market Crash, the Tech Bust and the recent Credit Crisis are all environments where Risk Parity has significantly outperformed more traditional asset allocations. By having material exposure to assets that perform well in these environments, such as government bonds, Risk Parity portfolios would have managed to largely preserve and in some cases grow capital during equity bear markets.

In addition to providing better risk-adjusted returns, the Risk Parity approach is more resilient to different economic environments than a traditional 60/40 portfolio. Exhibit 5 shows Sharpe Ratios for exposures to equities, bonds and commodities over the thirty-nine years from 1971 to 2009 broken down by decade. When looking over the medium-term (periods as long as

Exhibit 5: The "Simple Risk Parity Strategy" Has Delivered More Consistent Risk-Adjusted Returns Than Individual Asset Classes in a Wide Range of Economic Environments.



Source: AQR. MSCI World Index (stocks), Barclays Capital U.S. Government Index and Ibbotson U.S. Intermediate Government Bond Index (before 1976) [bonds] and the S&P GSCI Total Return Index (commodities). The simulated Simple Risk Parity Strategy is based on a hypothetical portfolio. This analysis has been provided for illustrative purposes only and is not based on an actual portfolio AQR manages. Past performance is not a guarantee of future performance.

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a decade), the returns to these asset classes can be very different.

A portfolio that concentrates in just one of these risk sources is subject to significant concentration risk. If that asset class generates low or negative returns over an extended period of time, the concentrated portfolio will suffer.

For example, during the inflationary decade of the 1970s, commodities were the best-performing asset class. The 1980s was a decade where all three asset classes performed generally well. During the deflationary period of the 1990s, both stocks and bonds performed well while commodities offered little. Over the last decade, marred by two large recessions with an asset and credit bubble in between, only bonds have given investors healthy returns. Through all of this, returns to the Simple Risk Parity Strategy have been consistently positive due to the broad risk diversification.

PART 4: IMPLEMENTING ACTUAL RISK PARITY PORTFOLIOS

Thus far, we have only described a simplified approach to Risk Parity. In this section, we begin by revisiting the theory behind why Risk Parity should outperform more concentrated portfolios, and we conclude with a discussion of more advanced portfolio construction and risk management techniques commonly used in the actual implementation of Risk Parity strategies.

Unlevered Risk Parity portfolios may be attractive due to their high risk-adjusted returns and reduced tail risk, but the nominal expected returns may be too low to meet an investor's desired return. To address this concern, the diversified Risk Parity portfolio can be scaled to match an investor's expected return.

Exhibit 6: Risk Parity Portfolios can Offer Higher Returns with Less Concentration Risk.

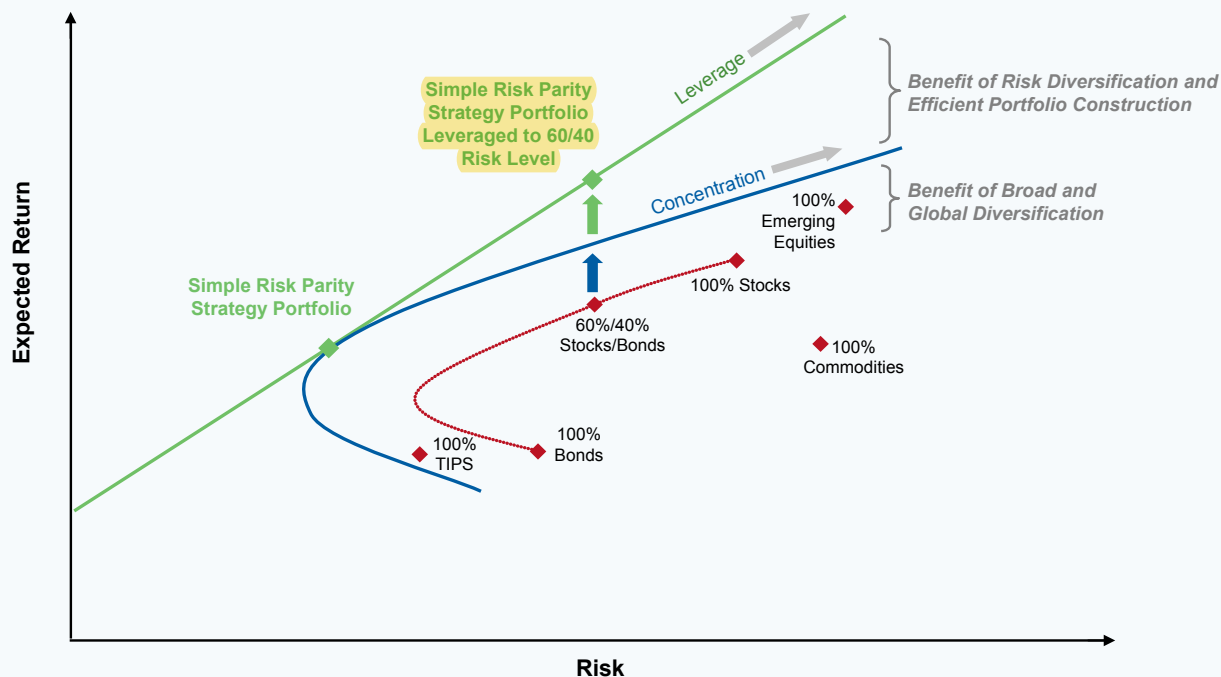


Chart is for illustrative purposes only and not based on an actual portfolio AQR manages.

This idea took root starting in the 1950s, when Harry Markowitz¹⁰ first described the concept of allocating to different mixtures of assets to form the efficient frontiers as shown in the red and blue lines in Exhibit 6. James Tobin¹¹ then demonstrated that all investors should hold some combination of a diversified portfolio (the portfolio that lies where the green line meets the blue efficient frontier line, or the “tangent portfolio”) and cash. Borrowing and leverage have existed for a very long time, but the advent of liquid futures markets and increased access to low cost financing has allowed Risk Parity portfolios to extend these concepts by moving up the green capital market line. This enables the investor to maintain the higher Sharpe Ratio and other benefits of a diversified portfolio as the investor seeks higher returns.

In this illustration, let’s assume the Risk Parity portfolio is the tangency point between the blue and green lines.¹² This unlevered Risk Parity portfolio has significantly less risk than the traditional 60/40 portfolio but a problem is that it also has a lower expected return. The solution is to use leverage to increase the expected return of the Risk Parity portfolio while matching the volatility of the 60/40 portfolio. The resulting Risk Parity portfolio has much higher expected returns due to the more efficient portfolio construction.¹³

In order for investors to seek higher returns, they must take on higher risk. The question is how to take that risk. The traditional approach is to concentrate in riskier assets, in particular equities. In contrast, the Risk Parity approach is to start with a diversified lower-risk portfolio and then use leverage to raise the expected return. (The use of leverage introduces its own risks, of course, particularly when investments are illiquid. To mitigate this, Risk Parity portfolios tend to invest in liquid instruments such as financial futures contracts.) Risk Parity investors believe that some leveraging of a more diversified liquid portfolio is a fundamentally better way to achieve higher returns than the traditional approach of concentrating in the riskiest assets.

Next, we review the more advanced portfolio construction and risk management techniques used to manage Risk Parity portfolios.

Breadth of instruments used. While the Simple Risk Parity Strategy invests in only three asset classes, actual Risk Parity portfolios can incorporate additional asset classes. Since these instruments are not perfectly correlated with each other, this further enhances the level of risk diversification and the efficiency of the total portfolio.

Correlation and volatility forecasting. While the Simple Risk Parity Strategy targets an equal amount of risk in each asset class, a real-life implementation would incorporate correlations across different asset classes in order to equalize risk contributions. In addition, proprietary risk models can be utilized to improve volatility forecasts, which can help maintain the risk balance across asset classes and more consistent portfolio level volatility over time.

Tactical over/underweights. The Simple Risk Parity approach described so far was based on an equal allocation of risk to each of three major risk categories. Indeed, some practical implementations use this “passive” approach to budgeting risk across these categories. However, it is also possible to use the “equal risk across categories” portfolio as the neutral allocation, and then over- or under-weight the risk allocations based on the manager’s tactical views.

Different volatility targets. In the exposition above, we used an annualized volatility target of about 10%, which corresponds to the approximate average volatility of a 60/40 portfolio. However, by changing the amount of leverage used, it is easy to construct portfolios of an arbitrary level of volatility — e.g. that of a 70/30 portfolio, 80/20 portfolio, or even a 100% equity portfolio.¹⁴ We believe that Risk Parity is a far superior approach to building “target risk” portfolios than those conventionally used.

Trading systems and risk control. Managers can also use proprietary algorithmic trading systems in order to trade passively and reduce trading costs or market impact while adjusting position sizes. Finally, systematic portfolio level drawdown control systems can be used in order to minimize portfolio losses during challenging periods for the strategy.

¹⁰ “Portfolio Selection.” Harry Markowitz, *The Journal of Finance*, Vol. 7, No. 1 (1952), pp. 77-91.

¹¹ “Liquidity Preference as Behavior Towards Risk”. James Tobin, *Review of Economic Studies* 25.1: 65–86. (1958). ¹² The Risk Parity portfolio isn’t actually the true tangent portfolio, but given the aim of maximizing diversification, it’s likely close to the true tangent portfolio. This distinction has been omitted to make the exposition simpler.

¹³ It is easy to see that the green line provides the opportunity to provide greater return at equal risk (shown on the graph), or lower risk at equal return, or some combination of the two. There are risks associated with using leverage. Please read important disclosures at the end this paper.

¹⁴ It is worth noting that a risk parity portfolio that targets the same level of volatility as a 100% equity portfolio would still have only 25% of its risk derived from equity risk if four asset classes are used.

PART 5: INVESTING IN RISK PARITY

In this section, we explore how a Risk Parity portfolio fits into an investor's overall portfolio. We also examine funding sources and the various “buckets” investors use to place a Risk Parity investment.

When investors ask which source to use to fund an investment in Risk Parity, the natural answer is part of the existing equity allocation. The rationale for using equities as the source for funding is that most portfolios are overly exposed to equity risk and one of the main benefits of Risk Parity is that it helps to reduce equity concentration risk while still maintaining a more balanced exposure to general market risk.

Here is a list of the various approaches institutions have used in determining how Risk Parity fits within their investment scheme:

Core/Satellite Approach. The risk/return characteristics of Risk Parity could qualify it to be the core holding of an investment portfolio. The “green line versus blue line” in **Exhibit 6** makes a compelling argument that no matter what an investor's risk appetite or return target is, a Risk Parity portfolio with the appropriate level of leverage should provide better expected risk-adjusted returns. This core portfolio can also be supplemented by other uncorrelated strategies, such as alternative investments. Some large institutions have moved in the direction of this “core/satellite” approach to building their portfolios.

Alternative investments. The use of leverage and derivative instruments, as well as the novel approach to portfolio construction leads a number of investors to classify Risk Parity in the “alternatives” bucket. It should be noted that Risk Parity portfolios, which have approximately a 0.5 correlation to equities, would be classified as a “directional” alternative rather than a zero beta, non-directional alternative strategy.

Opportunistic or Flexible Allocation. Some investors have a bucket for opportunistic or flexible investments and it is not uncommon to see Risk Parity portfolios placed in this classification.

Global Tactical Asset Allocation (GTAA). Because of the wide range of global asset classes used as well as the dynamic shifting of weights among different asset classes, GTAA portfolios are generally the most similar peer group. Indeed, some institutional consultants have even created a Risk Parity sub-category of GTAA. However, most investors do not currently have asset allocation buckets at such fine granularity.

Our view is that, regardless of how Risk Parity is classified, it can be a useful tool for improving the risk/return characteristics of an overall portfolio.

CONCLUSION

The theory and practice behind Risk Parity strategies have gained increasing ground with investors because of:

- reduced equity concentration and reduced tail risk,
- more meaningful diversification than traditional approaches,
- a portfolio that is more robust in different economic environments, and
- an opportunity to improve the risk/return characteristics of an overall portfolio, by either enhancing return, reducing risk, or a combination of both.

These potential advantages of Risk Parity have led to increased acceptance of the approach among large institutional investors. As the approach becomes more widely available, it deserves consideration by any investor seeking to build more efficient portfolios.

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The white papers discussed herein can be provided upon request.

