June 2014

PANAGORA

Investment Insight: "Upside Participation and Downside Protection" and Risk Parity Portfolios

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The New Holy Grail

"Upside participation and downside protection" has always been one of the qualitative or otherwise loosely defined goals of active investing. With the global financial crisis of 2008 "permanently" etched on the psyche of the investment community, this goal, especially the latter half of it, has taken on much more significance in recent years. To many investors and managers, this has become the new Holy Grail of investing.

In the pursuit of this Holy Grail, there are two important questions we need to address. The first is how we quantitatively define "upside participation and downside protection". The second question is how we achieve it, and more importantly, how we achieve it without sacrificing long-term returns.

In a recent paper[i], we offered some answers to the first question by providing an analytic framework in which we define the upside and downside participation ratios of an active strategy relative to a market benchmark. We also use the participation ratio difference (PRD) as a statistics measure for the efficacy of "upside participation and downside protection". We show that a positive PRD is an indicator of "upside participation and downside protection" for a positive PRD implies that the degree with which the active strategy goes down in a falling market is less than the degree with which it goes up in a rising market. We also proved in the paper that the PRD measure is directly related to the alpha of the strategy versus the benchmark with respect to a one-factor CAPM model. In other words, a strategy with a positive PRD is also one with positive alpha and vice versa.

Three Ways to the Holy Grail

We shall give a brief description of participation ratios and PRD shortly. However, the focus of this research note is about the second question of how to achieve "upside participation and downside protection". In our view, there are at least three approaches to it.

One is to invest in low volatility and/or low beta strategies, such as minimum variance or defensive equity strategies. These strategies drastically reduce portfolio risk and beta so downside participation ratios are quite low. On the other hand, they have historically relied heavily on the low volatility anomaly to deliver enough alpha to outperform capitalization-weighted benchmarks. The potential risk to this approach is if the low volatility anomaly fails to deliver in the future, these strategies will have very low upside participation ratios as well and consequently, low alpha and negative excess returns relative to their benchmarks.

The second approach is to design strategies with built-in tail-risk hedging based on portfolio insurance schemes, offered by either derivatives such as options and swaps, or stop-loss policies using trend based signals traditionally utilized by CTA managers. These strategies became quite popular after the 2008 financial crisis, because with hindsight they worked very well during the crisis for the obvious reason that the type of portfolio insurance offered by these strategies was exactly what the doctor would have ordered.

However, many stop-loss investment policies have actually detracted value over the long run due to explicit or implicit costs associated with these strategies[ii] and they have since stopped working in the last several years. In addition, whether they would provide needed insurance in future financial crises remains an open question.

The third category of investment strategies to deliver "upside participation and downside protection" is through the true diversification offered by Risk Parity portfolios. Compared to the previous two approaches, the investment objective of Risk Parity is not explicitly about downside protection. Rather it is intended to capture asset returns or risk premiums in the most diversified way. But in the process of doing so, as we shall see in this note, it proves to be a very efficient way to deliver "upside participation and downside protection".

How does this happen? To answer this question, one has to take a deep look at traditional market indices. Almost none of the traditional market indices are truly diversified, due to various embedded risk concentrations. For example, equity indices have risk concentration in countries, sectors, and stocks. Beyond equity indices, fixed income indices are typically concentrated across the term structure (maturities) and credit ratings. Finally, commodity indices have risk concentrations in sectors and individual commodities. These risk concentrations cause high volatility in market indices, characterized by unnecessarily sharp upturns and deep drawdowns. By diversifying away these risk concentrations, which are in total contradiction with the "passive" labeling of market-weighted indices, Risk Parity portfolios avoid sharp moves in both up and down markets resulting in positive participation ratio differences. In addition, since volatilities and betas of Risk Parity portfolios are only slightly lower than that of market indices, Risk Parity portfolios typically outperform market indices in the long run.

Participation Ratios and PRD

We define participation ratio as the ratio of the conditional mean or average of a strategy versus the conditional mean or average of the corresponding index, conditioned on the sign of the index return relative to cash.

Suppose the index excess return is denoted by r_x and the strategy excess return[iii] is denoted by r_y. Then the upside participation ratio is

$$P_+ = \frac{E(r_y | r_x > 0)}{E(r_x | r_x > 0)}.$$

The notation $E()$ in the equation denotes expectation or average. Similarly we define the downside participation as

$$P_- = \frac{E(r_y | r_x < 0)}{E(r_x | r_x < 0)}.$$

With both participation ratios defined, we denote the participation ratio difference as

$$\text{PRD} = P_+ - P_-.$$

When the upside participation ratio is greater than the downside participation ratio, PRD is positive. Naturally, all else equal, one would prefer a strategy with a positive PRD and a positive alpha to one with a negative PRD and a negative alpha. By definition, only strategies with positive PRDs qualify as strategies that provide "upside participation and downside protection".

Participation Ratios of Risk Parity Portfolios

We now study the participations ratios and PRDs of Risk Parity portfolios in two parts. The first part will be focused on Risk Parity portfolios at the asset class level. In the next section, we will move on to Risk Parity multi asset portfolios.

Exhibit 1 provides the list of nine asset classes and their corresponding market-weighted indices. For each asset class, we shall construct a Risk Parity portfolio based on our proprietary risk budgeting methodology with either futures or physical securities. With portfolios using futures, we target Risk Parity volatility to be consistent with the volatility of the indices. With portfolios of physical securities, we have portfolios that are fully invested without leverage. The backtest returns of all Risk Parity portfolios span from January 1995 to December 2013 on a monthly basis. Based on the monthly returns of the Risk Parity portfolios and their corresponding indices[iv], we calculated upside and downside participation ratios conditioned on monthly returns of individual indices and the resulting PRDs[v].

Exhibit 1 Asset classes with corresponding benchmark indices

Asset Class	Index
Commodity	GSCI
US Treasury	BarCap US Tsy
US Credit	BarCap Credit
World ILB	BarCap ILB
World non US Bond	WGBI x US
US Large Cap	S&P 500
US Small Cap	R2000
World non US Equity	MSCI x US
EM Equity	MSCI EM

For illustrative purposes only. Source: PanAgora.

Exhibit 2 shows the participation ratios and PRDs for the nine asset classes, together with beta-adjusted alphas and excess returns versus the indices. The upside participation ratios range from 0.85 to 1.02 with an average of 0.92. The downside participation ratios range from 0.54 to 1.01 with an average of 0.79. Finally, the PRDs are all positive except that of the World ex US Government Bond Index. They range from -0.12 to 0.36 with an average of 0.13.

We make several remarks about these results. First, the upside participation ratios are, in general, below and close to one. This is consistent with the fact that Risk Parity portfolios are not necessarily low volatility strategies so they can have strong upside participation.

Second, the downside protection is quite strong except for the World ex US bond portfolio. This exception was the result of outstanding performance of the WGBI ex US index whose largest allocation was to Japanese government bonds. Japanese government bonds were one of the best performing sovereign bonds during this period due to the disinflation and often outright deflation in Japan. While risk concentration embedded in traditional indices generally does not pay, it can be rewarded in rare occasions.

Exhibit 2 Participation ratios, PRDs, alphas and excess returns of Risk Parity asset class portfolios

Asset Class	P_+	P_-	PRD	Alpha	Excess Return
Commodity	0.88	0.54	0.34	0.73%	0.61%
US Treasury	1.02	0.94	0.08	0.05%	0.04%
US Credit	0.85	0.84	0.01	0.01%	-0.04%
World ILB	0.95	0.86	0.09	0.04%	0.02%
World x US Bond	0.89	1.01	-0.12	-0.04%	-0.05%
US Large Cap	0.94	0.80	0.15	0.25%	0.17%
US Small Cap	0.90	0.84	0.06	0.16%	0.06%
World non US Equity	0.99	0.62	0.36	0.60%	0.57%
EM Equity	0.87	0.67	0.20	0.52%	0.41%
Average	**0.92**	**0.79**	**0.13**	**0.26%**	**0.20%**

For illustrative purposes only. Source: PanAgora.

Some aspects of alpha and excess return are also worth noting. First, there is strong correlation between PRD and alpha, as we have shown theoretically in the aforementioned paper. For example, the monthly alpha is positive 73 bps for the Risk Parity commodity portfolio and negative 4 bps for the World ex US bond portfolio. The average monthly alpha across asset classes is 26 bps, or close to 3% on an annual basis.

The excess returns, on the other hand, are slightly lower than alpha, because the Risk Parity portfolios' betas to their indices are less than one and excess returns assume they have a beta of one. As a result, the commodity portfolio's excess return is 61 bps and the World ex US bond's excess return is -5 bps instead of -4 bps. We also note that the excess return of the Risk Parity credit portfolio is now -4 bps. Compared to the index, the Risk Parity credit portfolio is higher in credit rating but lower in duration. Given its flat PRD, the relative short duration position largely explains the underperformance. However, excess returns are positive for the other seven asset classes and the average is 20 bps per month. Overall, we can also conclude that in seven out of nine cases, the Risk Parity portfolio succeeded in achieving the goal of "upside participation and downside protection."

Participation Ratios of Risk Parity Multi Asset Portfolios

Risk Parity multi asset portfolios utilizing underlying Risk Parity asset class portfolios achieve "upside participation and downside protection" from both a top-down and bottom-up perspective. On the other hand, Risk Parity multi asset portfolios utilizing traditional market indices can only rely on the top-down approach. In this section, we derive the participation ratios of Risk Parity multi asset portfolios based on backtest results from January 1995 to December 2013 and compare the two implementations. In addition, we shall also construct a third Risk Parity multi asset portfolio which incorporates a dynamic risk allocation (DRA) approach and demonstrate that it further improves its ability to provide "upside participation and downside protection."

We must first choose a benchmark for the multi asset portfolios. Traditional asset allocation based on notional allocation rather than risk allocation must have significant equity and equity-like assets to generate sufficient long term returns. Many institutional investors have created policy portfolios that resemble a 60/40 portfolio with 60% in equity and 40% in fixed income. Even though institutional investors have diversified away from 60/40 into other alternative investments such as private equity, real estate, and hedge funds, it can be argued that their portfolios still mirrors that of 60/40 from the perspective of aggregated risk allocation. For instance, their portfolio returns during the 2008 financial crisis are a case in point.

We thus construct a 60/40 portfolio based on the equity and fixed income asset classes listed in Exhibit 1. The 60% equity allocation consists of a 25% allocation to both the S&P 500 index and MSCI ex US index, as well as a 5% allocation to both the Russell 2000 index and the MSCI EM index. The 40% fixed income allocation consists of a 15% allocation to both the US Treasury index and the WGBI ex US index, and a 5% allocation to both the credit index and the inflation-linked bond index.

Exhibit 3 displays the annualized return statistics of the 60/40 benchmark as well as the three Risk Parity multi asset portfolios. The annualized return volatilities are all around 9% while the returns exhibit significant differences. The biggest return improvement is from 60/40 to RPMA I, which is a Risk Parity portfolio constructed using traditional market indices. The return almost doubled from 4.15% to 8.02%. The other two incremental improvements are also meaningful. RPMA II, which applies the Risk Parity principle both across as well as within asset classes, improves the return by almost 150 bps per year. Lastly, the portfolio that incorporates dynamic risk allocation (DRA) by applying tactical shifts to the portfolio's strategic risk allocation (RPMA II DRA) enhances return by an additional 200 bps over RPMA II. How did Risk Parity multi asset deliver such strong performance relative to the 60/40 portfolios? The participation ratios help to answer this question.

Exhibit 4 Annualized average excess return, standard deviation, and Sharpe ratio of multi asset portfolios

	Average Return	Standard Deviation	Sharpe ratio
60/40	4.15%	8.99%	0.46
RPMA I	8.02%	9.24%	0.87
RPMA II	9.46%	8.94%	1.06
RPMA II DRA	11.49%	8.67%	1.33

For illustrative purposes only. Source: PanAgora.

Exhibit 3 Participation ratios, PRDs, alphas and excess returns of Risk Parity multi asset portfolios

	P_+	P_-	PRD	Alpha	Excess Return
60/40	1.00	1.00	0.00		
RPMA I	0.94	0.53	0.41	0.42%	0.32%
RPMA II	0.93	0.37	0.56	0.57%	0.44%
RPMA II DRA	0.98	0.24	0.73	0.76%	0.61%

For illustrative purposes only. Source: PanAgora.

Exhibit 4 shows the participation ratios and PRDs of the three Risk Parity multi asset portfolios, together with beta-adjusted alphas and excess returns. The upside participation ratios are all close to one while the downside participation ratios are much less than one. Hence the answer to the performance question is that Risk Parity portfolios had strong downside protection in bad times while keeping up with the 60/40 portfolio in good times.

Intuitively, it is easy to understand why this is the case. When the 60/40 portfolio has a positive return, it is mostly due to a positive equity return since the 60/40 portfolio is dominated by equity risk. Risk Parity

portfolios have significant exposure to equity risk, so they will participate strongly in an equity rally. However, despite having significant equity exposure, it is much less than that of an equity centric 60/40 portfolio. As a result, periods of concentrated equity rallies are likely to leave large return gaps between the Risk Parity portfolios and the 60/40 portfolio. During these periods, exposure to commodities within Risk Parity portfolios helps to minimize the return gap and thus raise the upside participation ratios close to one.

When the 60/40 portfolio has a negative return, it is mostly due to negative equity market performance. In this case, the significant exposure to high quality fixed income provides true diversification which offsets the loss contribution from equities. This offset either reduces the portfolio losses or turns a profit for Risk Parity portfolios. The aggregated effect is a much smaller loss for the Risk Parity portfolios, i.e., strong downside protection.

Another important feature of Exhibit 4 is that the downside participation ratios get progressively smaller as we move from RPMA I, to RPMA II, to RPMA II DRA. The improvement of RPMA II over RPMA I is due to the increased downside protection attributable to the underlying Risk Parity asset class exposures. For example, all four Risk Parity equity portfolios have downside participation ratios less than one (see Exhibit 2). In the case of World ex US and EM equity, the ratios are significantly less than one. When equity markets are down, causing losses for the 60/40 portfolio, these Risk Parity equity portfolios provide additional downside protection for RPMA II and RPMA II DRA.

The effect of DRA is two-fold. Not only does it improve downside protection, but it also improves upside participation. Comparing RPMA II DRA to RPMA II, we see the upside participation ratio goes up from 0.93 to 0.98 and the downside participation ratio goes down from 0.37 to 0.24. This is also intuitive since a valuable tactical process is supposed to add value in both up and down markets.

The participation ratios result in significant positive PRD for the Risk Parity portfolios and significant alphas and excess returns versus the 60/40 portfolio. In Exhibit 4, the alphas and excess returns are expressed on a monthly basis for consistency with participation ratios. On an annualized basis, the excess returns are 3.9%, 5.3% and 7.3% respectively for RPMA I, RPMA II, and RPMA II DRA.

Conclusion

"Upside participation and downside protection" is neither an elusive goal nor a mere marketing slogan. It can be rigorously defined in terms of quantitative return and risk measures. In this paper, we have shown that one concrete approach to achieve this goal is through true diversification.. Risk Parity, both across and within asset classes provides significant downside protection without forgoing much upside participation relative to a 60/40 benchmark. The combination of both Risk Parity applications results in a major participation ratio difference and a higher excess return over the 60/40 portfolio. We also point out that a dynamic risk allocation process can further improve both upside participation and downside protection.

Risk Parity accomplishes "upside participation and downside protection" through a unified theme of true diversification. Unlike other approaches such as minimum variance, and stop-loss policies, the success of Risk Parity does not rely on any particular factor or forecasting signal, whose efficacy can disappear with

changing market conditions and changing investor behavior. Rather, the real strength of Risk Parity lies in its simplicity, true passivity, and indifference to the crowds, i.e., the traditional market indices.

Index Descriptions

The Citigroup World Government Bond Index (formerly Salomon Smith Barney World Government Bond Index (WGBI)) is a market-capitalization-weighted benchmark that tracks the performance of 23 government bond markets including Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Malaysia, Mexico, the Netherlands, Norway, Poland, Portugal, Singapore, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

The Morgan Stanley Capital International (MSCI) World Index is an unmanaged list of securities from developed and emerging markets, with all values expressed in U.S. dollars.

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[i] Qian, Edward, On the Holy Grail of "Upside Participation and Downside Protection", to appear in the *Journal of Portfolio Management*, 2015

[ii] Qian, Edward, The "Value" of Stop-Loss Investment Policies, PanAgora Investment Insight, July 2013

[iii] The use of excess return instead of actual return is to make both participation ratios of cash equal to zero, as they should be since it really does not participate in any way.

[iv] We use 3-month US Treasury bill return as cash return.

[v] The detailed calculation for each pair of Risk Parity portfolio and its corresponding market index, based on monthly excess returns is as follows. First we identify all the months during which the index returns were positive. Then we calculate the average returns of both the index and the Risk Parity portfolio in those months and take the ratio of two averages to obtain the upside participation ratio. Second, we repeat the process for the downside participation ratio by using average returns during the months when the index return is negative.