Risk Parity – Rewards, Risks and Research Opportunities

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Barry Schachter
Research Associate, EDHEC-Risk Institute
Chief Risk officer, Woodbine Capital Advisors

S. Ramu Thiagarajan
Professor of Finance, Tulane University
Abstract
Mean-Variance optimisation has come under great criticism recently, based on the poor performance experienced by asset managers during the global financial crisis. In response, an alternative approach, called Risk Parity, which proceeds by equalising risk contributions, has garnered much interest. In this paper we summarise the work of a group of leading researchers on Risk Parity chosen for this special issue. We also survey more generally what is known about this approach. While Risk Parity has intuitive appeal and has performed well over some historical time periods, it is premature to claim the superiority of Risk Parity over other asset allocation approaches. We raise several conceptual and practical questions about Risk Parity, which we think are worthy of additional research.

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EDHEC is one of the top five business schools in France. Its reputation is built on the high quality of its faculty and the privileged relationship with professionals that the school has cultivated since its establishment in 1906. EDHEC Business School has decided to draw on its extensive knowledge of the professional environment and has therefore focused its research on themes that satisfy the needs of professionals.

EDHEC pursues an active research policy in the field of finance. EDHEC-Risk Institute carries out numerous research programmes in the areas of asset allocation and risk management in both the traditional and alternative investment universes.
Carl Mahler stood before a group of fellow financial advisers recently and voiced frustration and fear that a fundamental tenet of investing had been proved wrong. "Hi. My name is Carl, and I'm a recovering asset-allocationist," the Raymond James Financial adviser quipped (WSJ) after the failure of asset allocation in 2008 (Lauricella).

"The only thing that went up during the crisis is the correlation between 'diversified' assets" (Frequently heard remark among consultants after the crisis)

**Introduction**

The rational reaction to any crisis is to take a closer look at what went wrong and question traditional ways of doing things. This reaction is healthy – up to a point. This reaction also has a dark side, given our general tendency, through our cognitive biases, to attribute, ex post, "causes" to momentous events, such as the recent Global Financial Crisis. For this reason, we must temper our reactions with careful reasoning and analysis. As Samuel Clemens (Mark Twain) put it, "We should be careful to get out of an experience only the wisdom that is in it – and stop there."  

The management of investment portfolios, particularly on the institutional side, has not been left out of the post-crisis self-analysis. As allocators painfully noted, the risk contribution of equities far exceeded their forecast limits in a year when global equities were down significantly. Part of this surprise can be explained by the jump in realised equity correlation beginning around the time of the Lehman bankruptcy. The increased equity correlations, along with the high realised volatility of equities compared to debt, resulted in equities contributing more than 90% of the risk in a typical 60/40 policy portfolio. Some have argued that the increased availability and use of equity ETFs has permanently increased the baseline level of equity correlations.

Looking beyond just equities, during the crisis latent correlations to other asset classes (e.g., corporate bonds and the US dollar) became evident, significantly affecting portfolio return dynamics and returns. Many placed the blame for this "failure" of asset allocation on mean variance optimisation (MVO), claiming that MVO resulted in under-diversified strategies. The call for a suitable alternative asset allocation paradigm has never been louder.

One alternative approach that has gained a lot of attention recently is 'Risk Parity' – the strategy of equalising portfolio risk contributions from different asset classes. The idea itself is not new and has been in use for some time in managing global, multi-asset portfolios. Booth & Fama (1992) may have been the first to mention the risk contribution of an asset in the context of a multi-class allocation.

The new popularity of Risk Parity brings to the fore important conceptual and practical questions. Examples of some of the practical questions are: can Risk Parity be used to guide the articulation of policy portfolios? And, since implementing Risk Parity "typically" involves levering up bonds, is the time for adoption of this strategy wrong? Will the recovery result in a 'new normal' which makes application of usual paradigms challenging? Basic conceptual questions requiring attention are the following: How can Risk Parity coexist with the dominant paradigms of decision making under risk? Can heuristics for decision making, such as Risk Parity, provide clues as to how those paradigms might evolve to better reflect the nature of uncertainty facing decision makers? Finally, can a study of such heuristics help us learn more about those aspects of human nature that gave rise to these heuristics for portfolio decision making.

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1. Clemens (1898).
2. Bogle (2003) defined a policy portfolio as "...the portfolio that reflects the long-term views of [a fund's] trustees and advisers about expected risks and returns in the various asset classes." Policy portfolios are tailored to meet the cash flow and growth needs determined by the pension liabilities.
3. Policy portfolios with a typical 60/40 stock/bond allocation have been shown to have nearly 90% of the risk coming from equities even during normal (non-crisis) periods. During the crisis, correlations of other assets with equity increased further. This resulted in equities contributing even more than 90% to the risk of the portfolio during the time of crisis.
4. See, for example, White (2010), and Greene, (2010).
5. An asset's risk contribution is equal to the product of the asset's weight in the portfolio and its marginal contribution to portfolio risk.
We have heard many of these questions from plan sponsors, consultants and investors repeatedly over the last 24 months. This special issue presents a collection of very insightful research from some of the leading researchers in the country on this important topic. It is our belief that these papers will greatly add to the understanding of this important topic and help address/resolve some of the key questions raised. The rest of this paper provides an overview of the key issues in Risk Parity, summarises the research findings of the contributors and provides some thoughts for future research.

**Risk Parity**

Risk Parity (RP) is a relatively simple idea. Very loosely defined, RP attempts to create a portfolio in which the various asset classes contribute equally to the overall risk of the portfolio. Despite the quantitative underpinning, Risk Parity is a heuristic allocation approach. The justification is intuitive (not theoretical) and is driven by portfolio managers’ dissatisfaction with the realised performance characteristics of multi-asset class portfolios. As noted above, in a typical policy portfolio, 60/40, equity contributes more than 90% of the risk of the overall portfolio. In most pension plan investment portfolios, the typical allocation to equities is quite high. Figure 1, reproduced from Ruban & Melas (2011), shows the average pension plan allocation to the different asset classes in many countries. Other than Japan and Germany, the allocation to equities has been quite high in most countries. As noted in the introduction, this high allocation to equities resulted in high realised portfolio volatility and huge drawdowns during the crisis.

Macro risks dominated asset markets following the crisis making any estimation of expected returns very difficult. The sensitivity to estimation errors of MVO portfolios, has led to them being characterised as “maximum error” portfolios. The challenge, then, is to identify and adopt a multi-asset class allocation strategy that, in practice will exhibit performance characteristics expected from greater risk diversification.

In seeking to find out whether Risk Parity can meet this challenge, we must first enquire into the theoretical basis for Risk Parity and its relation to mean variance optimisation. A formal model of expected returns with Risk Parity as the optimal portfolio solution is yet to be developed and should provide a fruitful area for future research.

Edward Qian (2011) starts the discussion for the special issue with a pedagogical piece on the definition of Risk Parity and what it means for diversification. Using a simple two-asset example, he compares the 60/40 portfolio to a Risk Parity portfolio which allocates 25% to equities and 75%...
to bonds. This portfolio has a higher Sharpe ratio but lower returns. So, the solution is to lever the entire 25/75 portfolio. To get the same risk as the 60/40 portfolio, the RP portfolio would have a higher allocation in both bonds and stocks. In his example it turns out to be 41% stocks and 124% in bonds. Qian examines the diversification benefits of RP using three metrics—correlations to stocks and bonds, beta to underlying assets and loss contribution. Risk Parity portfolios exhibit lower risk and better diversification. He notes appropriately that Risk Parity is an application of age-old views on diversification and not the other way around. He also notes that RP portfolios may involve timing risks and since these portfolios typically involve leveraging sovereigns there is no guarantee that they will outperform the way they had in the last decade. He also cautions that while Risk Parity solutions can be enhanced to incorporate active views on risk-adjusted returns, such an exercise is not easy. The caution comes from the fact that forecasting asset returns is a difficult exercise and big adjustments to risk allocations can make the portfolio unbalanced.

Risk Parity and Models of Expected Returns
Risk Parity is not based on any formal model of expected returns. Rather it is a heuristic born of the view that capital diversification is best achieved in practice by risk diversification in portfolio construction. Frequently researchers ‘reverse engineer’ the Risk Parity result in order to benchmark it with portfolios based on either mean-variance optimisation or the CAPM.

Risk Parity may be thought of as a particular instance of a policy portfolio, with portfolio weights such that the ratio of the contributions from any pair of asset classes is equal to 1. In this view, then, Risk Parity is member of a class of policy portfolios in which the portfolio weights are such that the relative risk contributions from each pair of asset classes are positive, real valued constants, not necessarily equal for each pair. This last point is alluded to by Lee (2011). It would be helpful to our understanding of Risk Parity as a policy portfolio to attempt to characterise conditions under which an investor would select a portfolio based on risk contribution, ignoring return contribution, and within that set of conditions identify the special cases under which equal risk contribution would be optimal.

Qian (2005) relates the Risk Parity portfolio to the basic CAPM model, showing that the Risk Parity portfolio will also be the MVO portfolio when the portfolio components have equal Sharpe ratios and uncorrelated returns. Lee (2011) also notes this comparing Risk Parity and MVO in a mean-variance framework, and examines the characteristics of Risk Parity portfolios. Generalising this insight to broader classes of asset pricing models would be helpful for placing the Risk Parity portfolio on sound theoretical ground. Similarly, exploring the relation between risk contribution portfolios and stochastic dominance principles would be helpful. Platen and Rendick (2010) argue that well diversified portfolios may proxy for the long-run growth optimal portfolio. Their analysis examined the market portfolio and the 1/n portfolio only, but their results suggest that an investigation of the long-run properties of the RP portfolio might be fruitful.

Finally, because Risk Parity is a heuristic approach to asset allocation, it may be that the Risk Parity approach can be justified by evaluating it in a context where a heuristic approach is optimal. For example, Risk Parity may be compared to portfolio solutions obtained by modeling decision making with “fuzzy” probabilities. Behavioural finance research also justifies heuristics (or rules of thumb) as efficient decision making rules in uncertain environments. A behavioural interpretation of Risk Parity may aid in a deeper understanding of its usefulness.

Two Concepts of Risk Parity
Variants of two conceptual approaches to uncertainty are found in Risk Parity portfolio construction. In the first, information about uncertainty is embedded in estimates of asset
(class) variances and covariances derived from historical return data. At the risk of stirring up an epistemological debate, we will call this first conceptual approach objectivist. The resulting estimates are subject to estimation error, the significance of which may be analysed and addressed with various error reduction methods. We discuss estimation error issues further below. Risk contributions are equated across asset classes based on estimated asset class correlations and variances. These may be derived either bottom-up from the same underlying data used to estimate individual asset level variances and correlations or top-down from variances and covariances for benchmark portfolios representing the various asset classes.

In the second approach, which we will call subjectivist, uncertainty is embodied in the different ensembles of variances and covariances across a discrete set of economic scenarios (or regimes) specified by the manager. These scenarios may be identified with the aid of statistical tools or are entirely dependent on the manager’s subjective evaluation.

As this second approach may be less familiar, an example may help to illustrate. At a high level, the two engines of nominal returns are real economic growth and inflation. The manager may then assume four possible scenarios, related to combinations of high/low inflation/growth and express an opinion (however derived) on the performance of each asset class in each scenario. Based on this set of potential outcomes (or states of the world), the manager can select risk contributions that are (approximately) equal.

The subjectivist approach faces challenges in estimating the number of scenarios and, importantly, in the probabilities for the regimes, as these probabilities are integral to determining portfolio weighting. Another challenge is estimating the scenario-contingent variances and correlation across different assets. For example, in a low growth/low inflation regime, gold and nominal bonds may outperform whereas equities and commodities work well in a high inflation/high growth regime. Identifying suitable econometric models to address some of the estimation challenges of the subjectivist approach would likely add significant value.

This description above of the two main conceptual approaches is embedded in a one-period framework. If we extend this to a more realistic multiperiod framework, additional challenges arise. For example, the subjective approach must now allow for multiple scenarios within the investment horizon, and develop some concept of a transition matrix. The objective approach must make allowance for non-constant parameters and potentially incorporate a model of market dynamics. In each case, the estimation challenges increase pari passu.

Risk Parity/Risk Premia and Portfolio Timing
Risk Parity exploits risk premia in the different asset classes while trying to keep the risk balanced. In this issue, Ben Inker (2011) raises many questions both about the Risk Parity paradigm including the existence of risk premia in some asset classes, the use of standard deviation as a measure of volatility and timing risks. As an example of the difficulty in using historical volatility as a measure of risk, Inker notes that the spread (to Libor) of AAA credit card ABS had a standard deviation of about 1 basis point for several years starting in 2005. Any researcher relying on this would have been greatly misled during the crisis, as the standard deviation increased by a factor of 200 during this period. Clearly, standard deviation is not the best (or only) measure of volatility used in RP implementation, but it is an important one.

Inker also questions whether risk premia can be assumed to be positive for certain asset classes such as commodities. Looking at the pure roll yield (i.e. ignoring any cash returns on the underlying collateral) of the S&P/GSCI Reduced Energy Index, he shows that positive roll yield of 3.4%/year in the period from 1970-1992 turned into a staggering 8.9%/year loss in the period
starting 2003. In the case of commodities, he attributes the decline (at least partially) to huge inflows into commodity ETFs that have wiped out the roll yield. More generally, his paper raises the issue of the impact of structural shifts in the different asset markets and the implications of those shifts on risk premia.

If risk premia is not the primary driver of investment in different assets, it has to be risk reduction, thus correlation of the diversifying assets can be an important reason for inclusion of assets such as commodities. If correlation is the driver, the manager should be careful to assess and monitor correlations (including latent correlation) and shifts in them.

Importantly, Inker brings up the issue of timing in implementing RP portfolios. We comment on issues related to implementation of RP portfolios later in this paper. Since RP portfolios typically involve leveraging bonds, Inker cautions readers that leveraging bonds at a time when yields are historically low can lead to performance challenges. There are two concerns with the use of leverage in general. Whenever an asset needs to be levered, one has to assess the cost of leverage with the expected returns on the stub (levered component). The second concern is timing risk, as taking on leverage in a low-risk class can hurt the portfolio if, as Inker says, leverage is assumed after a period of abnormally high returns in such assets. Thus, both timing as well as the noisiness of expected return estimates become very important in implementing RP portfolios. The final risk with respect to leverage is tail risk. During crises, the markets become macro-driven, introducing significant volatility in the changes to slope yield. Thus, it is important to consider these effects in implementing RP portfolios.

Exposure to assets implies capturing risk premia from these assets. For example, Briand, Nielsen and Stefek (2009) show that the correlation of the ML Domestic Master Index with term spread is 0.91 and the correlation of the MSCI EAFE Index with high yield spread is 0.59. However, RP portfolios provide exposure to assets through a portfolio process constructed with the goal of achieving parity and not maximising returns. Because exposure to assets implies exposure to risk premia, it will be interesting to see what RP means in terms of systematic exposure to risk premia. It will then, be important to study if such premia can be sustained in the future.

Risk Parity and Estimation Error

An important motivation behind the Risk Parity approach is that forecasting asset returns is difficult and noisy. Mean variance optimisation is very sensitive to input parameter estimates. Small changes in expected returns can lead to significant changes in the portfolio (Merton, 1980), which is why managers use various methods to mitigate this problem. As Risk Parity does not employ explicit forecasts of asset returns, it is relevant that estimation errors in the mean are more critical in MVO portfolio weight determination.

As noted above, estimation errors play a big role in criticisms of MVO and motivate the use of econometric fixes, such as a shrinkage estimator, and alternatives, such as Risk Parity. DeMiguel, Garlappi and Uppal (DGU, 2009) argue that estimation errors in the MV strategy are such that the loss from sub-optimal diversification is more than offset by the elimination of estimation error under the $1/n$ strategy. In explaining the apparent superior performance of the $1/n$ portfolio, Tu and Zhou (2008) note the interplay between the impact of estimation errors and the difference between the “true” weights of the MV optimal portfolio and the $1/n$ portfolio. Tu and Zhou point out that the trade-off between reducing estimation error and efficiency loss from choosing a suboptimal portfolio, improves for the $1/n$ portfolio, the smaller the differences between the weights of the $1/n$ portfolio and the MVO portfolio. This suggests that, to the extent that the RP portfolio weights vector lies somewhere intermediate between the MV and $1/n$ portfolios, RP
may display a superior trade-off between estimation error and sub-optimality. This, however, is an open question and worthy of some research energy. Fugazza, Guidolin and Nicodano (2010) argue that the empirical results of DeMiguel, Garlappi and Uppal (2009) do not carry over to tests with longer investment horizons and growth-optimal investors, suggesting that in other contexts estimation errors may not dominate this trade-off.

Also of interest would be a comparative analysis of the sensitivity to estimation errors of the RP and MVO weights. In particular, a question meriting research attention is the impact on estimation error arising from non-linearity in the transformation of estimated individual asset and asset class variances and covariances into RP risk weights.

**Risk Parity Portfolio Construction and Trading Costs**

While the statement of the Risk Parity approach is straightforward, implementation involves many challenges. Ruban and Melas (2011) contribute to this aspect of the discussion in this issue by noting that there are two ways of constructing a Risk Parity portfolio. One approach is to rebalance the portfolio. Related to the Qian paper, a 60/40 portfolio with unbalanced risks can be rebalanced to achieve Risk Parity by shifting more to bonds from equities. This results in a portfolio with a higher Sharpe ratio but lower returns. They rightly note "the consistency of higher risk-reward ratios for the Risk Parity strategy seems impressive, however, it is worth keeping in mind that higher risk-reward ratios do not put money in the bank—returns do".

Using leverage to achieve Risk Parity, it is possible to leverage up the bond piece alone, keeping the equity component constant. Ruban and Melas (2011) show that for a two asset class Risk Parity portfolio, leverage ($k$, [adjusted for cost]) can be expressed as follows:

$$k = \frac{\sigma_s \hat{w}_E}{\sigma_E (1 - \hat{w}_E)},$$

where $\hat{w}_E$ is the weight of equity in the levered portfolio. Thus, the amount of leverage is a function of the relative volatilities of stocks and bonds. They show that adding leverage can reduce portfolio volatility only if the correlation between asset classes is sufficiently negative. The correlation between bonds and equities needs to become more negative as the amount of leverage in the portfolio rises, the equity weight in the portfolio falls and the ratio of equity to bond volatility rises. This paper is an interesting follow-up to their earlier paper (Ruban & Melas, 2010), which shows that although adding leverage can reduce portfolio risk, the conditions needed for this to occur are quite restrictive.

A third and popular way to achieve Risk Parity is to combine, rebalance and leverage. Thus, you can have combinations of $k$ and $\hat{w}_E$. Clearly, there is no unique combination of $k$ and $\hat{w}_E$ that will achieve Risk Parity. Portfolio managers attempt to get that combination of $k$ and $\hat{w}_E$ that will achieve either the same volatility or the same return as their target portfolio (which can be policy portfolio). The paper derives the conditions for either of these constraints to be satisfied and provides a useful guide to the researchers and portfolio managers in constructing Risk Parity portfolios. One of the key inferences from the Ruban and Melas paper is that one cannot assume that the Sharpe ratio is linear in leverage. If the Sharpe ratio for the stub component is lower than the unlevered component, then the RP solution will be inferior to what is normally assumed in RP discussions.

Strictly speaking, the Risk Parity concept is agnostic on the question of leverage, as is MVO. Perhaps this is why proponents of Risk Parity articulate the use of leverage in different, and not necessarily consistent, ways. As noted, the most frequently articulated approach to meet a return objective is to take a levered position in the lower risk asset classes. However, an alternative is to first determine the relative risk contributions and subsequently lever the entire portfolio to
achieve the return objective. In the context of the leverage discussion, some authors (as noted above), make reference to the “Risk Parity Line.” The analogy to the capital market line of the CAPM is obvious and intended. However, it is only for the second approach to leverage above that this analogy is warranted. Nevertheless, some authors do not make a distinction between the particular leveraged-Risk Parity approach employed and the analogy to the CAPM capital market line.

The discussion of leverage also introduces questions about trading costs into the examination of the Risk Parity approach. From an operational perspective, funding costs may differ depending on how the borrowing program is implemented, for example, shorting governments (thereby enabling a levering of the entire portfolio) versus buying corporates on margin (thereby levering the debt asset class), reflects differences in counterparty risk and liquidity risk. At this level of granularity, it is more difficult to separate the question of degree of leverage from the portfolio construction process itself.

Other trading costs will also affect the relative attractiveness of the Risk Parity approach. For example, more research needs to be done to assess turnover cost in RP implementation, particularly when leverage increases significantly. Some preliminary investigation of turnover has been done by Maillard, Roncalli and Teiletche (2010). In an empirical study, they measure turnover as the sum of the absolute value of the differences in individual asset weights at consecutive (monthly) portfolio rebalancing points. They find significantly lower turnover for the RP portfolio than for a benchmark MV portfolio, and the result is consistent across experiments using several different asset universes. This result is only suggestive, however, as their measure does not focus on the quantity traded or the cost of trading. Given the very different levels of concentration in MV and RP portfolios, and the wide variation in trading cost across asset classes, their results may not hold in the space of transactions costs. A full analysis of turnover cost should include trading impact cost estimates, as RP portfolios may have bigger allocations to less liquid assets (typically with low measured volatility and low measured correlation).

**Risk Parity as a Policy Portfolio**

Can Risk Parity become the dominant paradigm for policy portfolios, or can it be shown that alternative policy portfolio paradigms do not dominate the RP approach? The general goal of policy portfolio construction is to manage funding and cash flow realities through the allocation of wealth among asset classes based on a robust (and, one hopes, theoretically sound) framework. We have already mentioned many of the alternatives to Risk Parity used to specify policy portfolios.

Other alternative constructions, such as portfolio resampling, have not become popular as they are computationally burdensome and have poor out-of-sample performance (Scherer, 2007(a)). Also employed in practice, though not in wide use, are the Minimum Variance portfolio, the Maximum Diversification portfolio (a concept related to Risk Parity), and portfolios that reflect policies articulated in terms of controlling portfolio loss, where a downside risk measure is used or a constraint on downside risk is used.

While many different approaches exist both in theory and practice, policy portfolios have been dominated by equity-centric portfolio construction heuristics. Central to the asset allocation process in many of these policy portfolios has been some variation of a mean variance framework with all its attendant issues. Allocators who advocate these policy portfolios are not blind to the equity risk. As noted earlier, they assume that risk in order to meet return targets to fund the liabilities.

We can speculate, in certain areas, about how the Risk Parity portfolio’s characteristics relate to other approaches. For example, policy portfolios that embody downside risk mitigation may share...
some performance attributes with the RP portfolio, which, through lower risk concentration, would be expected to be more resistant to drawdowns. Moreover, Risk Parity, Minimum Variance, 1/n and Maximum Diversification portfolios may all be more robust to estimation error than MVO portfolios. Apart from the 1/n portfolio, which does not rely on parameter estimates in determining the portfolio weights, how the others fare in this regard relative to each other is not clear. The Minimum Variance and an 1/n portfolios likely exhibit worse diversification benefits than the Risk Parity portfolio (see also, Bernartzi & Thaler [2001], DeMiguel, Garlappi and Uppal [2009]).

Allocators using RP as a policy portfolio paradigm are giving up the higher return of equities in favour of levered low-risk assets. Assness, Frazzini and Pedersen (2010) provide some insights in this respect. Based on Frazzini & Pedersen (2010), they show that leverage aversion might be the key theoretical link that would result in the RP portfolios being optimal. The intuition runs like this: The market has many investors who are averse to leverage (most mutual funds and a typical plan sponsor may fall into this group). Thus, in order to meet return targets, they choose to hold riskier assets instead of levering the low-risk assets. As a result, the expected return is reduced on these risky assets and the underweighted low-risk assets trade at lower prices offering higher return. Thus, investors who are able to apply leverage are able to get higher return on these low risk assets. Frazzini & Pedersen (2010) show that in the presence of these constraints, the tangency portfolio or weighs safer assets. Assness et al. (2010) use this to justify a role for RP within a formal theory of expected return. It is important to remember that leverage aversion, as pioneered by Black (1972), did not yield the RP portfolio as the optimal solution to a portfolio problem. In other words, leverage aversion is being used as a justification for a portfolio construction problem characteristic of RP portfolios.

If leverage is a deterrent that results in a risk premium for levering low-risk assets, it will be interesting to investigate the conditions under which this does not persist. This, of course, assumes that the leverage constraint is binding on some participants and cannot be avoided in other ways (e.g. through the use of derivatives). One interesting way to study this effect would be to examine leverage aversion and its implications for RP portfolios during times of shocks to leverage in the system, i.e. when leverage becomes very cheap or very expensive.

Risk Parity and Mean Variance Approaches – The Empirical Evidence
It is not entirely clear that the RP approach will dominate the MV approach. MRT compare the performance of a “globally diversified portfolio” using RP, MV and a 1/n portfolio. With monthly rebalancing and a sample period from January 1995 through December 2008, they found the RP portfolio to have the highest Sharpe ratio and the greatest average monthly return. Interestingly, MRT found that the maximum drawdown of the RP portfolio exceeded the MV portfolio (though it was far less than the 1/n portfolio). This result would likely be reversed for a period focused on the financial crisis. A detailed examination of the drawdown characteristics of RP portfolios would be helpful. In an environment with constant volatilities and correlations, RP portfolios should provide superior protection against drawdown. That may not be the case in a world with multiple volatility regimes, if the portfolio cannot be revised at the regime switching points.

In this special issue Ruban & Melas (2011) compare the performance of a simple Risk Parity strategy with two assets stocks and bonds (wherein the weights are a function of the volatilities)- and a static 60/40 approach. Figure 2 (reproduced from their paper) compares the returns of these two approaches.

It is clear that during the tech bubble, this simple heuristic portfolio with 60/40 weights on stocks/bonds significantly outperformed the simple RP strategy. Since the tech bubble burst, the outperformance of bonds, hence the RP strategy which levered bonds, has been quite impressive.
While we recognize that most RP programs are more complex and involve multiple asset classes, this simple comparison provides a key insight that RP can and will underperform other policy portfolios in certain market settings. We include two papers in this special section that run a horserace between a “policy portfolio” and RP and variations of RP.

Figure 2: Difference in rolling returns (5 year, annualised) between US Risk Parity and 60/40 portfolios

Chaves, Shu, Li & Shakernia (2011) compare representative RP portfolios with four different types of popular asset allocation strategies – equal weighting, minimum variance, mean-variance optimisation and the 60/40 portfolio. They look at performance, consistency and diversification. While the mean-variance optimisation and 60/40 portfolios are well known options as policy portfolios, they also include equal weighting and minimum variance due to their growing popularity. Equal-weighting is a naïve portfolio that is mean variance optimal only under restrictive conditions, but it is an easy one to construct. Minimum variance can be constructed using just the covariance information and is MVO only if all the expected returns are the same.

Using nine asset classes and data over a 30-year period (from January 1980–June 2010), the authors show that their RP portfolio does not consistently outperform either a 60/40 or an equal-weighted portfolio. However RP does outperform minimum variance and mean variance strategies. Even though RP does not outperform the equally-weighted strategy, the authors show that they provide better diversification based on an analysis of the attribution of portfolio variance.

The authors raise an important question about the definition of an ”asset class” for inclusion in RP portfolios. For example, do all equities come under one asset class or do we put domestic, emerging and frontier equities in different asset classes? They note, rightly, that the RP research process can potentially lead to date mining and look-ahead bias. Chaves, et al. (2011) show that the results of their horse-race are sensitive to how the assets are grouped in the different asset classes. Thus, the results vary when Risk Parity portfolio is constructed using five asset groups versus nine-asset groups. Furthermore, the inclusion (or lack) of the subsequently BarCap Aggregate Bond Index (which has a historical Sharpe ratio of .82 over the last 30 years) makes a big difference in their results. This issue is echoed in the arguments of Bhansali (2001) below discussed.

Empirical comparisons of portfolio performance are tricky as the results can be very sensitive to inputs, operational definitions, time periods chosen and the metrics used to define the race. This concern is not unique to the RP debate but it is escalated in this debate because of the availability of many asset classes and any one of multiple instruments may be selected to define each asset class.
Further highlighting the challenges in the empirical horse-race is a paper by Edgar Peters (2011) included in this special issue. Peters looks at the validity of a popular response (by plan sponsors) to the failure of the policy portfolio during the crisis – namely part immunization of the plan. Plan sponsors have attempted to limit the risk to the plan by partially immunizing the plan and allocating the rest to growth assets. This hybrid approach combines liability hedging and growth investment. To mimic this practice, Peters sets up a hypothetical portfolio wherein 45% of the liabilities are hedged using the Citi Liability Index and the rest of the assets are invested in a combination of growth assets/cash in a 45/10 split. He compares the performance of this hypothetical portfolio with a static policy portfolio using the asset classification specified in Leibowitz and Bova (2008) which has roughly 50% equities, 25% bonds and the rest in alternatives (private equity and real estate). All of these portfolios are compared to the Citi Liability Index which is used as a proxy for the liability in a defined-benefit program. The RP portfolio dynamically balances risks between asset classes, within asset classes and over time. Unfortunately this empirical experiment is limited to the time period going back only about 15 years as the Citi Liability Index against which the funded status is evaluated starts only in 1995. Not surprisingly, Peters finds that the RP portfolio wins over the other static policy portfolios irrespective of the metric used.

The more interesting aspect of the paper is in evaluating the reasons for the success of the RP portfolio. Peters shows that RP portfolios dynamically shift weights as a function of volatility. In particular, the RP portfolio is able to add value because it shifts more/less weight to equities in low/high volatility regimes. Given that bonds typically do better than equities in high volatility regimes, this result, while not surprising, highlights the source of additional value from RP strategies. Recall, from our earlier discussion of MRT that during the period from 1995 to 2008 (like Peters), they found RP portfolios outperformed 1/n portfolios.

All of the aforementioned empirical papers highlight the difficulty of relying on observed performance characteristics for evaluating dominance of any particular asset allocation approach. For example, most of the underperformance of the Risk Parity portfolio in Chaves et al. (2011) comes from 1980 –1999, a sample period largely outside that of the Peters paper. The Chaves et al. analysis has significantly lower allocation towards pro-cyclical assets (REITS, PE, etc.) in their policy portfolio compared to the Peters analysis. These high-beta assets did significantly worse during market downturns, worsening the impact on the policy portfolios. The Peters paper does not use the BarCap Aggregate Bond Index which is included in some iterations in the Chaves et al. paper. Thus, we can see that the choice of the time period and the composition of the basket in the construction of RP can significantly affect the results in the empirical analysis. More work on the robustness to different sample universes and sample intervals is needed. As noted earlier, having a theory which yields RP as the optimal solution will help with this exercise as well.

**Risk Parity in a Risk Factor Framework**

Assets are complex packages of risks. Understanding and modelling these risks is critical for any investment process. Return estimates can be noisy and it is the premise of Risk Parity that risks are easier to model than expected returns, hence the focus should be on risks. However, it will be important to think of a comprehensive model of risk so that the investor can understand the different sources of risk. In a very interesting paper, Bhansali (2011) discusses sources of risk from a factor-modelling perspective. He stresses the importance of looking at assets through the risk lens rather than the lens of expected returns. As an illustration of the importance of this view, he demonstrates that a portfolio that would be deemed highly diversified, with allocations to nine different classes (of which only 3 with about 35% capital allocation are in equities), has a huge equity risk factor exposure (nearly 81% of the risk, in his sample). Using principal component analysis he infers that popular indices such as the Emerging Market Bond Index and High Yield Bond Index (some of which are likely levered in RP implementations) have high equity risk factor exposure.
The risk factors themselves are shown to exhibit long-term stability and mean-reversion, thus allowing them to be modeled as a function of factor risk premia. In this way, when risk premia is high/low for certain factors, exposure can be increased/decreased.

Vineer also shows that while asset returns can be highly correlated, risk factors are not likely to be nearly as highly correlated (based on the work of Page and Taborsk (2010) suggesting that investing in modelling of factor risk is a fruitful endeavour for asset managers and plan sponsors.

He cautions that measurement of factor exposures requires sophisticated modelling as the said estimates should be robust and withstand stress shocks. He also points out that a factor-based approach ignores security-specific risk, which reduces the advantage of this approach for market neutral and arbitrage type portfolios. Vineer also argues that it is critical to consider the non-linear cost function of leverage and its impact on RP portfolios, to the extent that they rely on the availability of leverage in lower risk securities.

We concur with Vineer on the importance of modelling risk. The first task for the researcher is in defining risk. Risk is more comprehensive than any measure of volatility. Particularly in a levered portfolio, there are many facets of risk – kurtosis (fat tails), illiquidity, counter-party, contagion, etc. The second task is the cataloguing of the different sources of risk and development of a covariance structure for the different sources of risk. Some risks are systemic and cannot be controlled – these are the ones that the PM has to learn to live it. Others can be controlled, diversified, and hedged in different ways. We believe this is important.

One of the fascinating aspects of this discussion is the renewed focus on understanding risk. While a huge amount of research energy has been focused on modelling expected returns over the years, the bull market had relegated risk to a service task and not an integral part of the investment function. As with anything, there is a risk of overreacting in our response to the effects of the crisis. In particular, some of the discussions are vehement about discarding any insights on expected returns. We believe that this is wrong. Any investment policy that totally ignores insights on expected returns is wrong and runs the risk of discarding potentially very valuable information in constructing portfolios. In a world dominated by macro moves, it is important to have a balanced investment policy where attention to risk is given appropriate weight.

**Summary**

The attractiveness of RP does not lie in the fact that it would have outperformed MVO during the crisis. Ex post, we could design any number of strategies that would have outperformed MVO during the crisis. The attractiveness of RP is not its simplicity. The 1/n strategy is far simpler to implement (and explain) and does not require a numerical search to find the portfolio weights. However, RP strongly appeals to our intuition that risk diversification is the central goal in portfolio decision making, and equalising estimated risk contributions is probably a good way to try to approach that goal. RP is also appealing in that the resulting portfolio does not depend on the thing we have the least confidence in being able to accurately estimate, namely expected returns.

As we have tried to clarify in this paper, these sources of appeal represent only a starting point in evaluating the utility of the RP concept. We have noted where questions of theory, need for further empirical work and need for more clarification of appropriate implementation remain. The papers in this volume provide much that is helpful along these lines. More importantly, perhaps, we hope that this compendium generates meaningful discussion and leads to additional fruitful innovations in research.
References


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