Portfolio Construction Theory Series - Part 2

Sharpe Ratios, Correlation, and Putting It All Together

In Part 1, we introduced a puzzle: a hedge fund with a lower standalone Sharpe ratio can be the better addition to a portfolio. We began answering that puzzle by examining how volatility affects diversification. The key insight was the "Diversification Sweet Spot" — allocations where each asset contributes equal risk to the portfolio, achieved by weighting assets inversely to their volatilities.

But volatility is only one of three levers. Now we turn to the other two: Sharpe ratio and correlation.

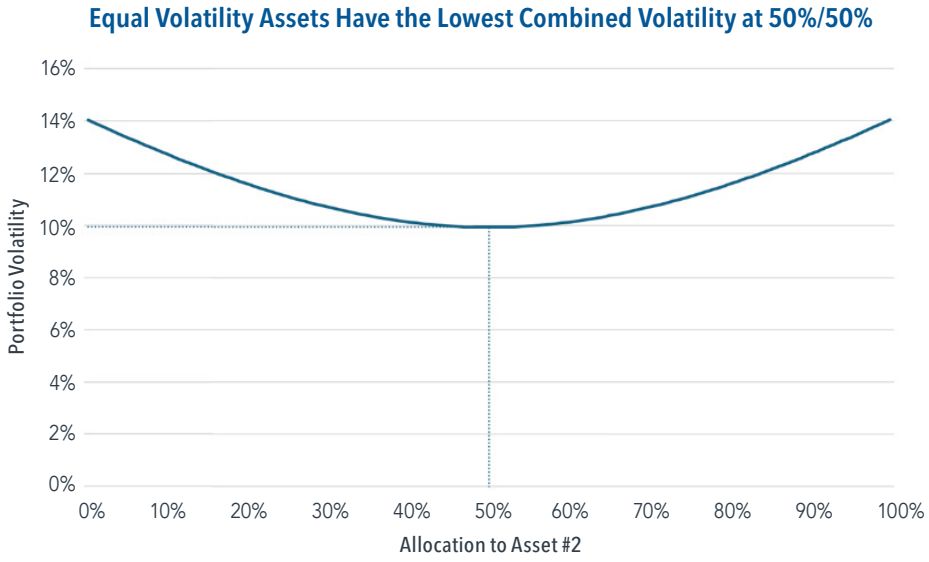
Sharpe Ratio of Asset #2

Diversification benefit explains a lot about optimal allocations, but it's only one part of the equation. It gives you a point where a combination of assets lowers expected volatility optimally but tells you nothing about the portfolio's expected return. Here's a clear example:[1]

	S&P 500	Asset #2
Excess Return	12.57%	50.00%
Volatility	14.04%	14.04%
Weight	50%	50%
Correlation	0.00	
Combined Excess Return	31.29%	
Combined Total Return	32.79%	
Combined Volatility	9.93%	

As we know, when two uncorrelated assets have the same volatility, they'll contribute the same amount to portfolio risk, and thus maximize diversification benefit, at equal allocations. In this example, at 50%/50% allocations, the combined portfolio's volatility of 9.93% is the lowest that can be produced with any combination of these two assets.

[1] S&P 500 Index ("S&P 500") excess return and volatility statistics are for the 15-year period from January 2011 through December 2025. 1.50% is the average risk-free rate over the past 15 years (January 2011 through December 2025) and is used to calculate excess return throughout this piece.

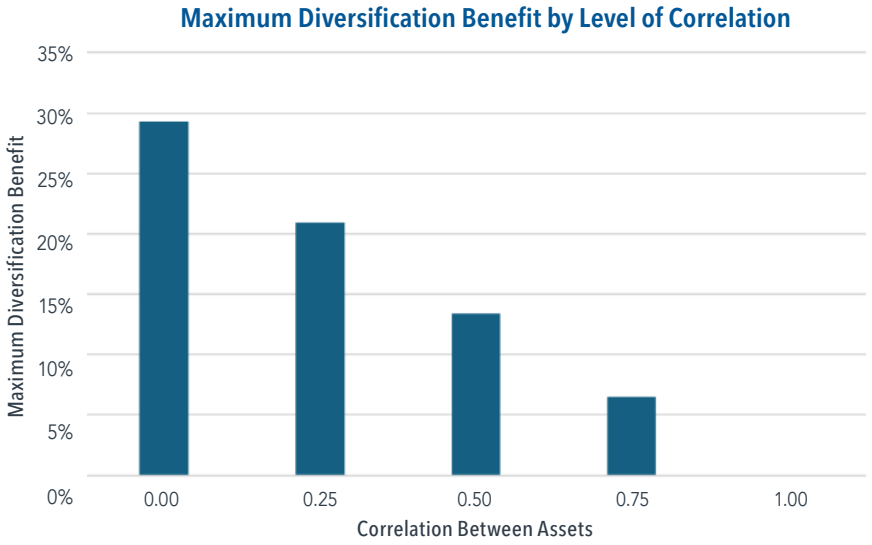


However, if presented with these two assets, is 50%/50% really the portfolio you'd choose? Of course not. You could instead maximize Sharpe ratio with 80% in Asset #2, which would increase the portfolio's expected volatility by about 1.6% but increase its expected total return by over 11%. You could even blindly put 100% in Asset #2, with the attractive tradeoff of about 4.1% higher volatility for 18.7% higher expected return compared to a 50%/50% split.

Pure diversification would suggest an equal risk weighting between two assets, but a difference in Sharpe ratios can pull you away from that point, in favor of the higher Sharpe asset.

Correlation between Asset #1 and Asset #2

Finally, correlation determines the relative importance of volatility and Sharpe ratio. If two assets have a correlation of 1, there is no diversification benefit when combining them into a portfolio, so you would simply choose to invest in the highest Sharpe-ratio asset. With anything less than perfect correlation, the benefits of diversification come into play. The magnitude of possible diversification benefit is determined by how uncorrelated assets are, with a 0.0 correlation (as in the previous examples) enabling a nearly 30% decrease in portfolio volatility compared to the weighted average volatility of the two constituent assets. The possible diversification benefits are less for assets that have higher expected correlations, as shown on the next page.



How Do We Combine All These Factors?

Here's a handful of example portfolios to give a sense of what matters, and how much, in different contexts. Relative Sharpe ratio and correlation of the assets determine the grid below and the allocation split at equal volatility levels (the first percentage). Then, the percentages in parentheses represent how much the optimal allocations vary when Asset #1 has half the expected volatility of Asset #2 up to when Asset #1 has double the volatility of Asset #2.

	Equal Sharpe	Low Difference in Sharpe (5%)	High Difference in Sharpe (20%)
Zero Correlation (0.0)	50% (33%-67%)	51% (34%-68%)	55% (38%-71%)
Low Correlation (0.4)	50% (33%-67%)	53% (36%-69%)	61% (43%-75%)
High Correlation (0.8)	50% (33%-67%)	61% (44%-76%)	91% (83%-95%)

Base allocation shown with (range) as volatility ratio varies from 2x to 0.5x

Consider the top left corner. With equal Sharpe ratios and zero correlation between two assets, we want to split our allocation 50%/50%, the first example we discussed. As the asset's volatilities change (holding Sharpe ratios constant), we shift our allocations to keep contribution to risk equal between the two assets. If Asset #1 has double the volatility of Asset #2, we would want it to be 33.3% in size. If it had half the volatility, we'd want it to be 66.7% in size. As you go down the column, you see that the level of correlation doesn't affect the relative sizes. It will affect the resulting portfolio volatility (higher correlation = less diversification benefit = higher portfolio volatility), but not the relative weightings. If you travel right from the top left corner, you see that as Asset #1 has a higher Sharpe ratio

we begin to favor that asset with a higher allocation. At zero correlation the shifts seem relatively small, as diversification benefit outweighs the difference in Sharpe. Even at 0.4 correlation the difference in Sharpe has to be large to justify shifting >10% of allocation. At high correlations, you see much more decisive shifts as the gap in Sharpe ratio increases. As before, volatility differences will cause you to shift as much as 15%-20% in the direction of the lower volatility asset when its volatility is half that of the higher volatility asset.

We find the following decision framework helpful in our portfolio management. Note that we apply the three factors in a different order than we introduced them.

First, evaluate the combination of correlation and Sharpe ratio difference. In most scenarios, where either correlation is moderate-to-low or the Sharpe difference is small, diversification benefit dominates and you're shifting at most about 10% of allocation toward the higher Sharpe asset. Only when both conditions are met (a large Sharpe difference of roughly 10%+ AND high correlation of roughly 0.7+) should you tilt meaningfully toward the higher Sharpe asset.

Second, adjust for volatility differences. Lean toward the lower-volatility asset so that each asset contributes closer to equal amounts of risk to the portfolio. As shown in the table, this adjustment can shift allocations by roughly 15-20% in either direction.

This approach converts sophisticated optimization into reasonably easy intuition: most scenarios favor near-equal risk weighting, with meaningful tilts only when high correlation and large Sharpe differences combine.

Preview of Part 3

We now have a complete theoretical framework: volatility determines the diversification sweet spot, Sharpe ratio differences pull you toward stronger risk/reward assets, and correlation determines how much diversification benefit is available to offset Sharpe differences.

But theory only gets you so far. In Part 3, we'll apply this framework to the way investors actually build portfolios — typically constrained by either a maximum volatility target or a required return threshold. We'll return to our original puzzle (the Low-Vol/High-Sharpe fund versus the Medium-Vol/Lower-Sharpe fund) and show exactly why the "worse" standalone asset wins. We'll also take a deeper look at leverage — when it changes the math, when it doesn't, and why the idealized case rarely applies in practice.

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