The price of portfolio diversification

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The only “free lunch”

Harry Markowitz once called diversification “the only free lunch” in finance. He observed that combining two less than perfectly correlated risky assets will result in a portfolio with less risk than the sum of the assets’ risks. In other words, diversification can deliver benefits (lower risk) over time at no additional cost, which in turn increases risk-adjusted returns.

However, should we own assets because they provide diversification without considering the price we are paying for this benefit? In other words, is there a point where investors should avoid being “diversified” because it is so expensive?

Measuring diversification

It is clear that moving from a stock-only portfolio to one that combines equities and bonds increases diversification. The questions is how much is this effect.

For example, in the last 20 years a stock-only portfolio (MSCI World) would have had a volatility of 15.5% whilst a portfolio that invest 60% in equities and 40% in fixed income (Bloomberg Barclays US Aggregate) would have had a volatility of 9.3%. This is a fall of 6.2% in volatility. It is tempting to think of this reduction in risk as the benefit of diversification. But this is wrong.

To understand why this is the case, we need to look at the reasons portfolio volatility declined in our example. One of those is indeed the benefit of diversification - adding an asset that is not perfectly correlated reduces volatility. However, a second reason is that bonds themselves are less risky than stocks. Even if bonds did not have any diversification properties (i.e. a correlation of 1 with equities) a bond-stock portfolio will still have lower volatility than that of a stock-only portfolio.

Put it simply, bonds are less risky than equities.

How much of the risk reduction comes from diversification rather than from de-risking is critical in understanding how diversified a portfolio really is.

In the case of the above example, Figure 1 shows that most (nearly 80%) of the reduction in risk is from de-risking the portfolio. The main reason for the drop in volatility is because the portfolio is less risky, not because it is more diversified.

In our example, the diversification impact was calculated as the difference of the weighted average of volatilities versus the portfolio volatility. This is the same as quantifying the difference between the portfolio volatility if all assets are perfectly correlated and the actual portfolio volatility. This gap is Markowitz’s “free lunch”. When computed as a ratio (weighted average of volatilities divided by the portfolio volatility) it is called the “diversification ratio”. Research suggests that maximising it, instead of the Sharpe ratio, creates robust portfolios that tend to outperform out-of-sample.

1 Against the Gods” Peter Bernstein. 1998
2 In mathematical terms, from a two asset portfolio where variance is equal to $w_A \sigma^2(R_A) + w_B \sigma^2(R_B) + 2w_A w_B \text{Cov}(R_A, R_B)$, the diversification impact comes from the last term. Hence, it is related to the asset covariance.
3 “Toward Maximum Diversification” Chouefaty & Coignard. 2008

Figure 1: Sources of risk reduction

Diversified Sharpe ratio

Investors should try to increase the “free lunch” effect as much as possible. Diversified portfolios protect investors from inaccurate investment views and unexpected market events. However, maximising the “diversification ratio” does not take into account the price we must pay to be diversified.

Although bonds can reduce drawdowns in market downturns or recessions, they diminish prospective returns (bonds tend to have lower returns than equities) and can reduce the portfolio Sharpe ratio. There should be a point in which bond prospective returns are so low that the detriment to risk-adjusted returns outweighs the diversification benefit.

In order to assess this, we have created an equally-weighted ratio between the impact on the Sharpe and the diversification ratio when the asset mix changes. This metric balances the trade-off between achieving high risk-adjusted returns if the asset views are vindicated and increasing diversification to protect the portfolio in case the views are wrong. We called this ratio the “Diversified Sharpe ratio” or DS ratio.

In this framework, the ideal asset to include in a portfolio is one that increases both the risk-adjusted returns and our measure of the diversification benefit. However, the more we allocate to this asset, the lower the diversification benefit. The approach will naturally avoid concentrated allocations to a single asset class. As a result, maximising the DS ratio will tend to produce less extreme allocations compared to maximising the Sharpe ratio.

Bonds for the win?

The DS ratio can be an interesting way to construct portfolios where investors have conviction in their investment views, but, just in case, they want to be diversified too. It can also tell us the breakeven point between views and diversification.

For example, looking at combinations of equities (MSCI World) and bonds (10-year US Treasuries) for a balanced portfolio, the DS ratio will tell us the point at which US treasuries become unattractive for multi asset investors. Even if treasuries are a diversifying asset, we need to think about how much we should own under different estimates of expected bond excess return (term premium).

If we were maximising the Sharpe ratio, as expected, the bond allocation changes substantially with small changes in the expected return. It would go from 45% when the term premium is 20bps to 0% when it is -20bps. On the other hand, the allocation to bonds under the DS ratio approach continues to be 45% until -100bps of term premium. Above this level the diversification benefit of owning bonds was greater than the negative impact they have on risk adjusted returns. The allocation then gradually reaches zero at -180 bps, highlighting also that the DS ratio produces more stable weights than if we were to use the Sharpe ratio.

In this example, although bonds offer poor risk-adjusted returns, they are part of the portfolio because of their diversification properties. However, after -100bps of term premium, poor prospective returns outweigh the diversification characteristics of bonds.

Changing correlations

The diversification benefit we expect from bonds is directly related to its correlation with risky assets⁴, but this correlation is not constant over time. It has even moved from positive to negative over time. So what are the drivers that move the equity-bond correlation?

One key determinant is the relationship between inflation and interest rates with the real economy⁵. How inflation and rates interact with economic growth influence the comovement behaviour between bond and equity returns.

In general, investors should demand positive term premium when inflation risk is high and bonds exhibit high volatility, leading to a positive correlation between bonds and equities. Conversely, investors should be willing to sacrifice returns and pay negative term premium when the main concern is a fall in economic activity (e.g. a recession) since bonds can act as deflation hedges.

Hence, the equity-bond correlation is state dependent. This will impact any allocation strategy since a lower correlation will contribute to an increasing reduction in risk (more diversification) from owning bonds.

Figure 2 shows the bond allocation under different equity-bond correlation assumptions. We see that a lower correlation implies that the pricing of bonds has to be more extreme (more negative term premium) to start reducing the exposure. If we assume a correlation of 0, which is in line with long historical averages, the bond allocation starts to fall at a term premium of 20bps, and reaches 0% at -130bps.

Figure 2: Bond allocation under different equity-bond correlations

60%
50%
40%
30%
20%
10%
0%
-1.60%
-1.20%
-0.80%
-0.40%
0.00%
0.40%
Bond allocation
Term premium
0% 0 0.25

⁴ The previous analysis used a 20-year sample in which the correlation between bonds and equities was close to -0.25.
⁵ “Inflation Bets or Deflation Hedges? The Changing Risks of Nominal Bonds” Campbell, Sunderam & Viceira. 2016
Conclusion

In a Goldilocks scenario of good growth and low inflation, we should think of government bonds as an asset class that has lower prospective risk-adjusted returns than risky assets, but great diversification properties. Thus, we can argue that bonds have a place in a balanced risk portfolio...up to a point. Balancing the need of high risk adjusted returns and diversification is key.

By combining the Sharpe and Diversification ratios into a single metric we can identify the breakeven point where the diversification benefit that bonds provide is no longer enough to compensate for lower prospective returns. We argued that the diversification property is dependent in the bond-equity correlation assumed and on how this changes over time. Current correlation is at historic lows and if inflation risk increases we should expected less diversification benefits from bonds. Our analysis suggest that a modest underweight when the term premium is below zero and an aggressive underweight when it is below -100 bps makes sense.

Diversification can enhance portfolio returns while suppressing volatility, but we should always be aware of the price we are paying for the “free lunch”.

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