Why are fixed income managers disadvantaged?

The equity market may have picked up, but money managers continue to look for ways to add value to portfolios. **LAURA RYAN** and **MARTIN EMERY** suggest that putting some eggs in the lower investment grade fixed interest basket is not necessarily a better option.

In the current low return environment, more and more money managers are looking for ways to add value to portfolios.

Other assets have recently shown increasing volatility and uncertainty, which has meant that managers and asset consultants are looking to the fixed interest asset class to be the stable, safe and relatively low volatile saviour of portfolio value. But in the fixed income market low yields mean that it is become increasingly difficult to add value through duration and yield curve management.

This suggests that one of the most important ways of adding value to a fixed income portfolio is from the selection of individual bonds. This leads to a problem. It seems that the investment universe presented to fixed income managers in Australia is lacking diversification. One of the reasons for the lack of diversification is that fixed interest mandates are very restrictive. One such restriction is minimum credit ratings. As a consequence many portfolios consist of bonds that are rated A– or above (the minimum grade for the UBS Index).

While the role of these restrictions is to minimise risk to the fund, risk can be specified in different ways. A credit rating is considered a measure of the credit risk or sometimes, the probability of default.

Perhaps a more important risk measure for a portfolio is the standard deviation, or volatility, of return. We have compared both measures of risk for the various credit grades, and noted that, generally speaking, a decrease in credit risk actually increases the volatility risk to the fund.

In fact, the decrease in credit risk not only increases the volatility to the fund, but it also decreases the expected returns to the fund. This is not only contrary to the expectations and desires of investors, but it is also contrary to accepted finance theory that, as volatility increases, the return an investor receives should increase to compensate them for taking on extra risk.

In our analysis we have examined both the expected and the realised returns for various ratings in the Australian corporate bond market. We have modelled realised returns using fair yields generated from CBASpectrum (discussed later), and we have modelled expected returns by incorporating global default probabilities and recovery rates.

Our results were striking. The further investors moved down the credit spectrum, the better the risk/return trade-off. In other words, the lower the credit rating, the better the return and the lower the volatility of returns. We conclude that investing in bonds lower down the credit spectrum not only provides greater returns, but diversity and stability.

These results are particularly important for fixed income managers. The analysis suggests that there are better opportunities further down the credit spectrum. However, most fixed income managers can't take advantage of these opportunities because they fall outside the allowable investment universe. Bonds rated below A are often considered 'sub investment' or too risky. In contrast, the same constraints don't apply to equity managers. For example, household names such as Southcorp (BB+) and even Qantas

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(BBB+) are off limits for many fixed income managers. But the equity of these companies is freely available to equity managers. This can lead to some risk biases in mandates.

To model historical returns, we have used fair-value yields for each credit rating in the Australian corporate bond market from the CBASpectrum product. CBASpectrum extends the Nelson-Siegel approach used in government yield curve modelling to estimate fair-value yields for corporate bonds. CBASpectrum estimates a full set of ratings yield curves, with each curve corresponding to a Standard & Poor's credit rating.

We also use global default, transition, and recovery research produced by Standard & Poor's Risk Solutions.

HISTORICAL RETURN ANALYSIS OF CREDITS

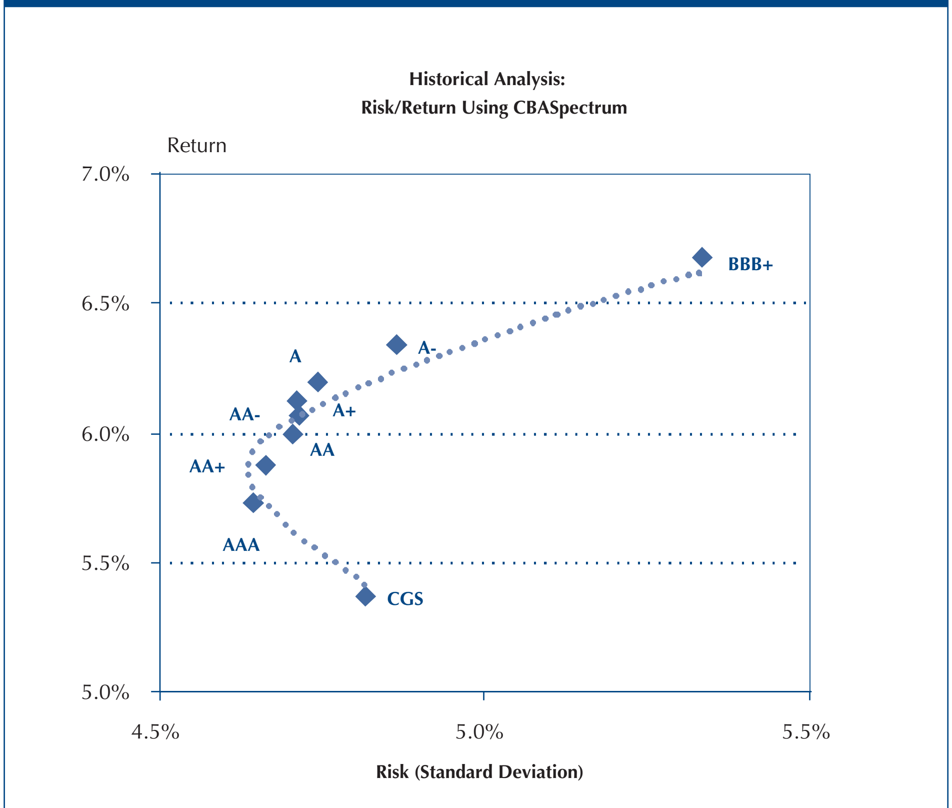
Initially we analysed historical-realised returns excluding default probabilities and recovery rates. We calculated annualised returns based on five years of daily CBASpectrum accumulation indices and plotted this against annualised volatility of those returns. Figure 1 shows that returns from credits (rated A or higher) have dominated returns over Commonwealth Government Securities (CGS). For credits rated A or higher, not only was volatility less than that of CGS but their returns were higher.

The reason for this result is that corporates are partially protected from movements in the yield curve. When the yield curve rises spreads fall: an inverse relationship between movements in the yield curve and credit spreads.

This relationship also exists in the US and is documented by Gregory R. Duffee in a working paper titled: 'Treasury yields and corporate bond yield spreads; an empirical analysis'. Below right is the ratio of return to risk for each credit rating. (Table 1)

We conclude that lower grade credits have historically provided a better risk/return trade-off. But this doesn't account for default probabilities or recovery rates. Further, the past does not necessarily reflect the future, so we also modelled expected future returns.

FIGURE 1 **HISTORICAL ANALYSIS: RISK RETURN USING CBA SPECTRUM**



EXPECTED FUTURE RETURNS

To evaluate expected future returns, we modelled corporate bonds using default probabilities and transition probabilities. Unlike CGS, a corporate bond has the possibility of defaulting. A company rated AAA is obviously very creditworthy and is less likely to default on its financial commitments than a company rated BBB+. That is, an investor who purchases an AAA- rated bond is more likely to receive the coupons due and face value of the bond at maturity than an investor who purchases a B+ rated bond.

This is an important part of the modelling process because we need to know the default probabilities for each of the different credit ratings. We also need to understand how likely it is that a company will change credit ratings. A company that has a rating of AAA today may get downgraded to AAC next month. The probability of changing credit rating over a period is called the transition rate.

Examples of companies defaulting are not common in the market, but do happen from time to time (for example HIH). When a company defaults, part of the value of the bond is lost, but part of the bond produces returns to the holder of the bond. This is known as the recovery rate.

We use global default rates, transition rates and recovery rates as supplied by S&P. We have used global rates, rather than Australian rates, as the domestic market has historically been overweight in banks, which are much less likely to default. As the Australian corporate bond market matures, we would expect it to become more like

TABLE 1 **RATIO OF RETURN TO RISK**

Historical analysis

Rating	Return/Risk Ratio
A	1.31
A–	1.30
A+	1.30
AA–	1.29
AA	1.27
AA+	1.26
BBB+	1.25
AAA	1.23
CGS	1.12

the international market. But we also need fair-value bond yields to evaluate expected returns. CBASpectrum calculates fair-value yields for each credit rating in the Australian corporate bond market.

To calculate the expected future return, we assume a coupon is paid each year until maturity. The coupon is equal to our CBASpectrum yield (we assume a par bond). However, if the bond defaults, then the owner of the bond only receives a portion of the face value. To calculate the expected return of the bond, each future possible payment is assigned a probability and then discounted to give a value of "par" today. The discount rate is then the expected return.

We calculated the expected return on every day since 1 July 1998 for every rating with a term to maturity of four years. This lets us estimate not only the latest expected returns but also the volatility of expected returns, which is our risk measure.

Results

Initially, we assume a recovery rate of 41%, which is the global average as published by S&P. This is to say that if a bond defaults, the holder of the bond will get back 41 cents in every dollar of face value.

Our results were unexpected (see Figure 2). After incorporating our default probabilities and transitions, we found that lower grade credits are expected to provide better return and lower risk. The most optimal point was the lowest credit grade: BBB+. In fact, the relationship between risk and return is linear with a negative slope. A counter intuitive result: the credit rating with the highest credit risk has the lowest volatility of return and vice versa.

The unexpected result has to do with the time value of money. If a bond defaults, you receive the face value earlier (or at least the recovery rate of the face value of the bond). The earlier you receive a future payment, the more it is worth today.

Incorporating the probability of default means that a higher probability of default gives the possibility that a proportion (λ) of the face value will be received earlier than later. Discounting the same value over a shorter period of time gives a higher net present value. Another way to look at this is that the possibility of default means that the duration of the bond is shortened. Duration is a measure of the sensitivity of price to shifts in the yield curve. So lower duration means sensitivity is lowered and therefore volatility (risk) is lower.

While a higher return and a lower risk is an interesting result, there is another very interesting point. Because corporate bonds have a probability of default, they need to have a higher yield to compensate for the risk. But our results so far show that this risk is more than compensated for. The excess yields on corporate bonds more than makes up for the probability of default, making lower grade credits for the sector with the highest expected returns.

We have shown that lower grade bonds provide the best risk rewards available to investors. This now leads us to a crucial question: why are fixed income managers disadvantaged? The answer is that the best risk/reward part of the credit spectrum is lower grade credits. But, as we have stated before, many fixed income managers can't hold these types of securities.

What's more interesting is that the generally stated reason that managers can't hold these securities is that they are too risky for investors. The perverse result is clear: in order to minimise risk, fixed income managers are prevented from allocating to the low risk part of the credit spectrum.

Scenario testing

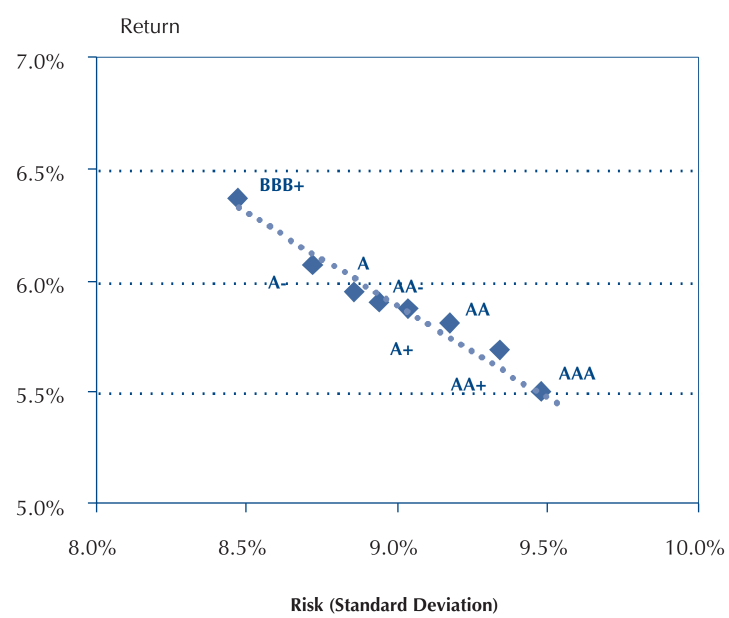
Many analysts would note that different economic climates produce higher or lower probability of companies defaulting, and the possibility of recovering debts. To make our analysis more robust, we

TABLE 2 **RATIO OF RETURN TO RISK**

41% recovery

Rating	Return/Risk Ratio
BBB+	0.75
A–	0.70
A	0.67
A+	0.66
AA–	0.65
AA	0.64
AA+	0.61
AAA	0.58

FIGURE 2 **EXPECTED RETURNS: 41% RECOVERY (GLOBAL AVERAGE) RISK/RETURN USING CBA SPECTRUM**



undertook some scenario testing. We first tested the worst-case scenario: if a company defaults, then none of the debt is returned to bond holders. (NB: Global recovery rates are nowhere near this level—the minimum that could reasonably be assumed is a 20% recovery rate.) (See Figure 3)

Under the worst case scenario of a 0% recovery rate given default, the "safe haven" credit rating of AAA was still sub optimal. Again, as with our previous analysis, the lower grade credits are preferable when ranked on a risk/return basis.

But had we missed something? We decided to test all recovery rates (0% to 100% with 1% increments) and calculate the return/risk ratio for each credit rating and term to maturity. (See Figure 4.)

The results were very surprising, and have some major implications for managers and investors. Under no scenario was AAA the optimal point to invest. At low recovery rates, AA was the optimal point on the credit spectrum. At standard recovery rates or higher recovery rates, BBB+ was the optimal investment on the credit spectrum.

FIGURE 3 **WORST CASE SCENARIO: 0% RECOVERY RATE**

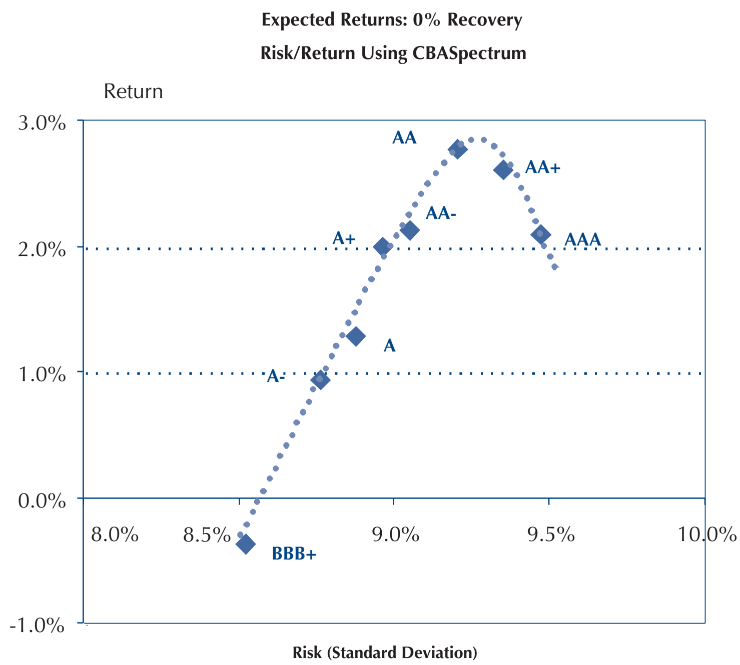
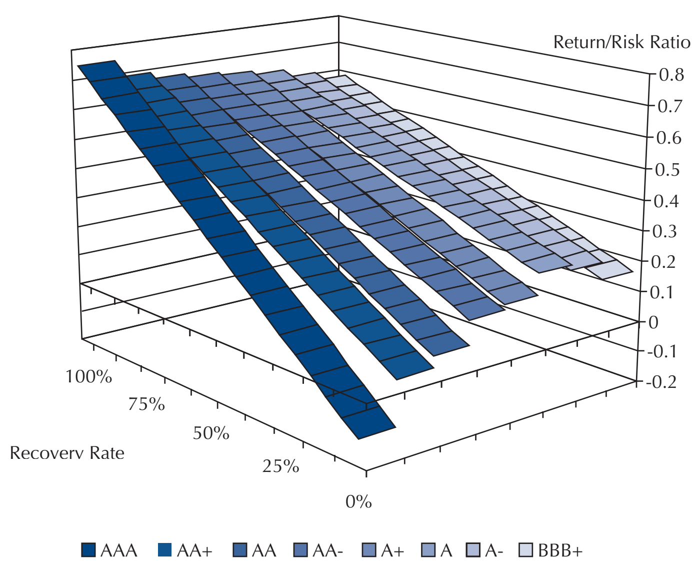


FIGURE 4 **RETURN/RISK: ANALYSIS BY RATING AND RECOVERY RATE**



CONCLUSION

During the analysis we have examined historical and expected returns on Australian corporate bonds, from grades AAA down to BBB+. We have looked at not only the historical risk and return analysis, but we have also analysed the expected future risk and returns on bonds. In all of this analysis we have found one constant: AAA was never the least volatile or the optimal place to be. Further to this—and perhaps most importantly—under normal assumptions, lower grade credits clearly provided the best risk reward ratios.

These results have clear and important results for managers. For many managers, to be able to access the better performing parts of the market, they need to change their portfolio mandates. The problem is how? It would be difficult to convince

TABLE 3 **RATIO OF RETURN TO RISK**

0% Recovery

Rating	Return/Risk Ratio
AA	0.30
AA+	0.28
AA-	0.24
A+	0.22
AAA	0.22
A	0.15
A–	0.11
BBB+	–0.04

any trustee that by moving to lower grade credits, the portfolio would actually be taking less risk (measured by volatility of returns). We can only hope that independent research such as this provides some assistance to fund managers.

Technical appendix of the default probability model

For our default modelling process, we have used the following parameters:

r = Expected return
λ = Recovery rate
C = Coupon

We also use a Markov process with transition matrices described below.

Say we have four states that a bond can be in: ratings classes A and B, default C and defaulted last period D. Suppose we also have the one period transition matrix (see Equation 1.)

Note that state D is an absorbing state. Absorbing states are states where the probability of leaving that state is zero. That is, if a bond is in state D this period, it will be in state D the next period. Also note that if a bond is in state C this period, then it will be in state D next period with a probability of 1.

But we need to model expected returns for bonds with a term to maturity of a year or greater. So we need n-period transition matrices. An n-period transition matrix is calculated in Equation 2.

We can also represent elements of the transition matrix as a tree diagram. As an example, assume that a bond is initially in state A. Also assume that the bond transitions to state C over two periods. We can derive each element in the n-period transition matrix from each element in the one period transition matrix.

Assumptions and parameters

Our assumptions are as follows:

1. The recovery rate (λ) is the proportion of face value of a bond that is recovered after a bond has defaulted;
2. We assume a hold to maturity strategy so that the coupon received remains the same for the entire life of the investment;
3. We also assume that the bonds are par-bonds. This means that the coupon is the same as the yield;
4. Recovery after a bond has defaulted occurs immediately.

The pay-off at any time t can be represented as in Equation 3.

Some explanation of the pay-off is required. If we assume unit face value for the bond, then if at time t (prior to maturity) the bond has not defaulted, the investor will receive a coupon of C. However if at time t, the bond defaults, the investor will receive C, plus (λ), the proportion of face value recovered.

But to calculate the Expected Payoff at time t, we need to incorporate default probabilities and transition rates.

We also need to define the initial state vector. This is the vector that describes what state the bond started out in. This is a vector where a 1 appears if the bond starts out in that state and 0 appears for every other state. For example, if a bond is initially in state B the initial vector would look like:

$$\text{Initial Vector} = \Pi_0 = [0\ 1\ 0\ 0]$$

We then incorporate the initial vector,

EQUATION 1

$$P = \begin{pmatrix} \Pi_{A,A} & \Pi_{A,B} & \Pi_{A,C} & \Pi_{A,D} \\ \Pi_{B,A} & \Pi_{B,B} & \Pi_{B,C} & \Pi_{B,D} \\ \Pi_{C,A} & \Pi_{C,B} & \Pi_{C,C} & \Pi_{C,D} \\ \Pi_{D,A} & \Pi_{D,B} & \Pi_{D,C} & \Pi_{D,D} \end{pmatrix} = \begin{pmatrix} .8 & .1 & .1 & 0 \\ .5 & .3 & .2 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

Where: $\Pi_{A,B}$ = Given that a bond is in state A, the probability of moving from state A to state B over one period.

EQUATION 2

$$P^n = \begin{pmatrix} \Pi_{A,A} & \Pi_{A,B} & \Pi_{A,C} & \Pi_{A,D} \\ \Pi_{B,A} & \Pi_{B,B} & \Pi_{B,C} & \Pi_{B,D} \\ \Pi_{C,A} & \Pi_{C,B} & \Pi_{C,C} & \Pi_{C,D} \\ \Pi_{D,A} & \Pi_{D,B} & \Pi_{D,C} & \Pi_{D,D} \end{pmatrix}^n = \begin{pmatrix} .8 & .1 & .1 & 0 \\ .5 & .3 & .2 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{pmatrix}^n = \begin{pmatrix} \Pi^n_{A,A} & \Pi^n_{A,B} & \Pi^n_{A,C} & \Pi^n_{A,D} \\ \Pi^n_{B,A} & \Pi^n_{B,C} & \Pi^n_{B,D} & \Pi^n_{B,D} \\ \Pi^n_{C,A} & \Pi^n_{C,B} & \Pi^n_{C,C} & \Pi^n_{C,D} \\ \Pi^n_{D,A} & \Pi_{D,B} & \Pi^n_{D,C} & \Pi^n_{D,D} \end{pmatrix}$$

Where: $\Pi^n_{A,C}$ = is the probability of moving from state A to state B in n periods.

EQUATION 3

$$Payoff\ (t) = \begin{cases} \begin{matrix} C \\ C \\ \lambda + C \\ 0 \end{matrix} & if\ t < N \\ \\ \begin{matrix} 1 + C \\ 1 + C \\ \lambda + C \\ 0 \end{matrix} & if\ t = N \end{cases}$$

Where:
C = Coupon
λ = Recovery rate
N = Maturity

EQUATION 4

$$E[Payoff\,(t)] = \Pi_0 \cdot P^t \cdot Payoff\,(t)$$

EQUATION 5

$$0 = \sum_{t=1}^{N} \frac{E[Payoff\,(t)]}{(1+r)^t} - \Pr ice$$

multiple period transition matrix and the pay-off at time to give us the expected payoff at time *t* as seen in Equation 4. But how do we calculate expected returns? We calculate the expected return as the value of *r* (Equation 5.)

Since we assume par bonds, the price equals $100 per $100 face value.

BIBLIOGRAPHY

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Nelson, Charles, Parsimonious modelling of yield curves.

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NOTES

1. It is important to note that while Figure 1 gives the impression of an 'efficient frontier', it is not. There are two important differences:
1. An efficient frontier incorporates expected returns, whereas our results are realised returns based on the CBASpectrum accumulation indices, and;
2. There is no 'risk free' asset. A hold to maturity strategy using government bonds is generally considered to be risk free, but when marking-to-market or selling bonds prior to maturity, the return is driven by shifts in the yield curve. J