

A four-factor model for selecting corporate bonds

LAURA RYAN and MARTIN EMERY examine the factors that help predict returns in the Australian corporate bond market.

In financial theory and in practice, equity returns have been shown to be predictable in part, by a common set of risk factors. Studies such as Haugen and Baker (1996) and Fama and French (1997) have shown that value factors such as price earnings ratios, and momentum signals can form the basis for outperforming strategies. While evidence of these effects on equities is extensive, there has been much less research utilising similar ideas in the corporate bond market.

One notable study into the corporate bond market by Hottinga, Leeuwen and Ijserloo (2001) analysed the corporate bond market using factors that are similar in nature to factors used in equity market studies. In their model, they used a combination of equity factors and bond factors to determine outperforming strategies.

We have chosen to take a similar approach and have identified four factors that have some explanatory power for relative returns of Australian corporate bonds. These factors are similar to styles commonly cited in equity studies, viz.: value, momentum and risk and performance.

DATA

We have used the yields on fixed rate Australian bank bonds for a four-year period to February 2003. This gives us a sample of 30 bonds over the entire period, of various maturities and several credit ratings.

Restricting the analysis to bank bonds removes the need to account for sectoral issues. Bank bonds are quite homogenous in nature, (compared to other sectors of the market), and so by restricting our

analysis to banks only, we can test for 'pure factor' effects in the market. We also note that bank bonds in the Australian market tend to have different trading characteristics from other corporate bonds of similar ratings and duration.

APPROACH

In Hottinga, Leeuwen and Ijserloo (2001), the authors noted that the level of the spread of a corporate bond's yield over the yield of a comparable government bond gave the highest out-performance and information ratio. Momentum was found to be the next best factor for adding value. Of the equity factors examined (equity value, equity momentum and equity revisions), earnings revisions gave the best bond outperformance.

For our model, we have used four factors: one *value* indicator, two *momentum* indicators (one related to the corporate bond and one related to the share price of the issuer) and a *risk* proxy. Our factors are described in detail below.

THE FOUR BOND FACTORS

1. VALUE FACTOR

Spread to Fair Yield Curve

For our value factor, we have looked at the yields of bonds relative to a fair value yield curve for corporate bonds of the same Standard and Poor's long-term credit rating. Bonds that are yielding higher than fair value would be considered 'good value', while bonds that are trading at lower yields would be considered to be 'poor value'.

To derive this fair value yield curve, we have used the fair value yield curve derived by CBASpectrum. The CBASpectrum product calculates fair



Laura Ryan
Quantitative Manager,
AMP Capital.



Martin Emery
Associate Director,
Quantitative Research,
Macquarie Equities.

value yield curves, based on Nelson-Siegel (1986) models for each credit rating in the Australian corporate bond market. Each yield curve is calculated using a simultaneous regression, using all the bonds in the Australian corporate bond market.¹

Each corporate bond is valued against its respective fair value yield curve relative to its matching duration. The yield curves measure yields against duration in order to remove any bias created by coupon effects. The difference in the actual bond yield and the fair value curve is our value indicator. The use of this yield differential allows us to make comparisons of bonds with different ratings and different maturities.

2. MOMENTUM FACTORS

Bond Reversion

For our bond reversion factor, we have used the weekly change in the value factor. In practice, this is a reversion factor. Bonds that show short-term movements away from fair value would be expected to revert to fair value faster than bonds that are trending towards fair value.

Equity Momentum

Our equity momentum factor is the trailing two-week return in the underlying equity of the bond issuer. If the underlying equity is performing relatively well, one would expect that this would be reflected in the underlying corporate bonds. The weekly share price information has been obtained from Bloomberg.

3. RISK FACTOR

Option-implied Volatility

Campbell and Taksler (2002) examined the effect of historical equity volatility on corporate bond yields and found that there was a significant relationship between the two. We have used option-

implied volatility rather than the actual historical equity volatility, as implied volatility reflects the current expected level of risk, rather than the realised historical level. We would expect that an increase in the expected volatility would flow through to the corporate security, creating a widening of the corporate spread.

Since we have concentrated our analysis to bank issued bonds, the majority of these equities are from large companies listed on the ASX. This allows for us to compare the implied volatilities from the underlying options from the equity of each company. For our factor, we have used the weekly change in implied volatility. The implied volatility is the average of the put and call volatility (to remove any put call volatility skews) from the nearest in-the-money option, as supplied by Bloomberg.

4. PERFORMANCE MEASUREMENT

For our return proxy we use the weekly change in coupon-matched asset swap margin (ASM). The ASM is the margin received over the three month bank bill swap reference rate after a fixed rate bond is swapped to a floating rate instrument. Hottinga, Leeuwen and Ijserloo (2001) use return over treasury in their study. We chose to use the change in ASM as the return proxy as it is a more investable quantity. This is due to the fact that not all corporate bonds have corresponding benchmark government bonds of a like maturity. Further to this, the asset swap is a duration neutral strategy, unlike a swap to a term equivalent bond.

TESTING METHODOLOGY

For our testing methodology, we have tested each factor separately and jointly in two ways:

1. Naïve portfolio analysis; and
2. Statistical analysis.

The Naïve Portfolio

The purpose of the naïve portfolio analysis is to evaluate the performance of a portfolio where the construction relies purely on the input factor. To construct portfolio weights, we have calculated cross sectional Z-scores for each of our four factors. This is similar to the standard quantifying of exposures to risk factors described in Grinold and Kahn (2000). However, unlike Grinold and Kahn (2000), we then use these Z-scores as weights for the future weights in the naïve portfolio, hence last week's factor scores become next week's weights. This process is repeated every week, for the entire sample period.

An example of the ranking strategy using the value factor is shown below.

We calculate the Z-score as:

$$\text{Z-score} = \frac{(\text{Value-average all value scores})}{\text{Std. Deviation (all value scores)}}$$

Looking at bond A, we see that in week one its Z-score is -0.92. For the following week, the weight of this bond in our portfolio will be -0.92. The contribution to the return of the portfolio that week would then be the return over the week (spread point change) multiplied by the weight of the bond, as derived at the start of the week. (See Table 1)

A naïve portfolio has several benefits> Firstly, the total of all weights is zero, as with a market neutral strategy. Secondly, bonds that score strongly on the factor score are weighted heavier the next week. This is what we would generally expect to happen in an actual portfolio.

Finally, all analysis and portfolio construction is only done on the historical information of the factor.

TABLE 1: NAÏVE PORTFOLIO CONSTRUCTION METHODOLOGY

Bond	Value Factor	Weight in Portfolio (Z-score) (A)	Spread Return (following week) (B)	Return Contribution to Portfolio (A) x (B)
A	-2.7	-0.92	-0.40	0.37
B	3.7	1.06	-0.38	-0.40
C	-0.2	-0.14	-0.99	0.14
Sum of Weights		0	Total Return on Portfolio	0.10

Other potential issues that may influence our results, such as optimisations and risk matrices, have been excluded.

For our combined four-factor strategy, we aggregate the Z-score from each factor, for each bond. Again this is used for the future weights in the naïve portfolio.

We calculate the spread return performance of our portfolio in week t as:

$$\sum_{n=1} (ASM_{n,t} - ASM_{n,t-1}) \times Z_{n,t-1}$$

Where:

$ASM_{n,t-1}$ = Asset Swap Margin for bond n at time $t - 1$

$ASM_{n,t}$ = Asset Swap Margin for bond n at time t

$Z_{n,t-1}$ = Z-score for bond n at time t

We then sum over all t to give total cumulative performance of the portfolio over the entire period:

$$\sum_{n=1} \sum_{t=1} (ASM_{n,t} - ASM_{n,t-1}) \times Z_{n,t-1}$$

Because we are trying to identify factors that add value, rather than construct a portfolio purely for trading purposes, we have excluded transaction costs from our analysis.

STATISTICAL ANALYSIS

For our statistical analysis, we have used panel (or pooled) based regression techniques. This is where all data is put together in one ‘pool’, and one equation is estimated for all the data. This is a beneficial way of analysing our model, as we are concerned with analysing bonds in a cross sectional framework, rather than in individual isolation. Panel estimation is also useful in modelling data that is noisy. Pooled estimation also reflects our final ‘all factor’ naïve portfolio strategy.

To account for the fact that we may have a set of equations which are related by their error structure, we use

CHART 1: VALUE FACTOR: SPREAD TO CBASpectrum

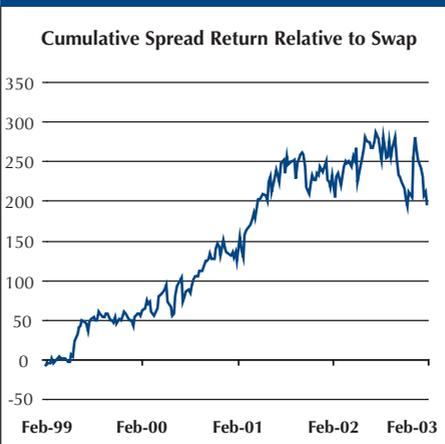


CHART 2: MOMENTUM FACTOR: CHANGE IN SPREAD TO CBASpectrum

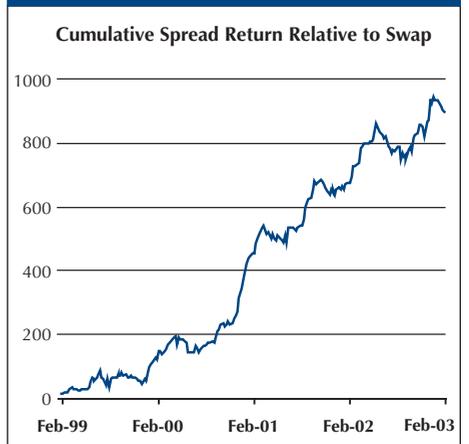


CHART 3: MOMENTUM FACTOR: 2 WEEK PRICE RETURN

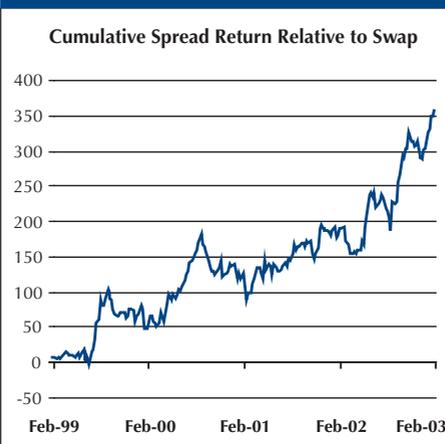


CHART 4: RISK PROXY FACTOR: CHANGE IN OPTION IMPLIED VOLATILITY

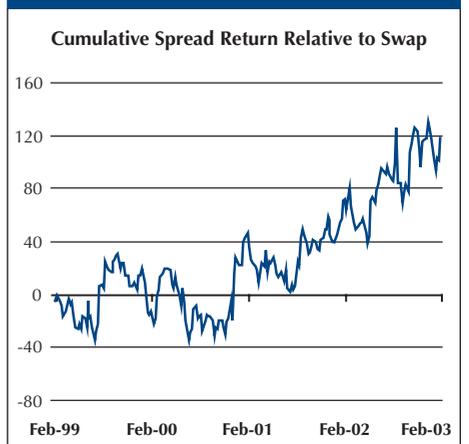
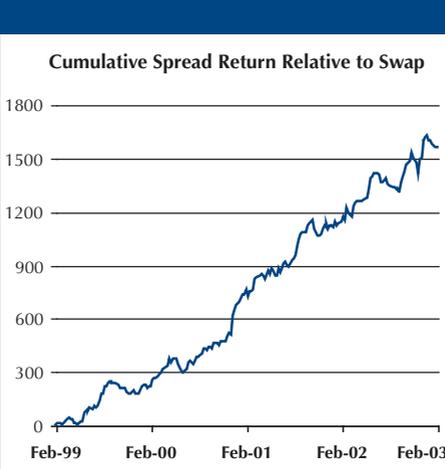


CHART 5: RETURNS FROM ALL FACTORS



RESULTS FROM ANALYSIS

The Naïve Portfolio Strategy Results

The results show that the factors consistently add value to the naïve portfolio. Charts 1 to 4 above show the cumulative performance of each of the factors.

The value factor (spread to CBASpectrum) and bond momentum (change in spread to CBASpectrum) strategies have the strongest results, while the equity momentum factor also had a strong contribution to the model. This is in direct contrast to Hottinga, Leeuwen and Ijserloo (2001), who found that equity momentum added little value.

Option-implied volatility was the poorest performing of the indicators, although it does add value. The performance of the factor improved over the sample analysis, possibly due to an increasing sample cross-section.

The cumulative performance of the combined strategy is shown in Chart 5.

seemingly unrelated regression (SUR) based estimation. SUR-based estimation accounts for the correlation within the errors of the regression. For simplicity, the results tabled here are standard pooled estimation results.

TABLE 2: NAÏVE PORTFOLIO PERFORMANCE

Strategy	Value	Bond Momentum	Equity Momentum	Risk Proxy	Combined Factors
Value Added	48.69	222.29	88.29	28.94	388.21
Info Ratio	0.56	2.00	1.17	0.42	2.30
Success Rate	52.63 %	60.77 %	56.94 %	49.28%	61.72%

What is also worth noting is that the performance of the combined portfolio exceeds any of the single portfolios (Table 2).

STATISTICAL ANALYSIS RESULTS

The statistical results also support the results obtained from the naive portfolios. The bond momentum and the equity momentum factors are clearly the strongest factors, with bond value equity momentum and volatility weaker, but significant.

For the combined strategy we use the following model:

$$R_t = \alpha + \sum \beta_k \times F_{k,t} + \varepsilon_t$$

Where:

R_t = Spread return on combined strategy portfolio (change in ASM)

$F_{k,t}$ = Value of factor k at time t

The results from the pooled SUR estimations are shown below (Table 3).

Generally speaking the regression results are quite supportive of the model. The value and two momentum factors are quite significant, and have the correct sign. In contrast to this, the implied option volatility fails statistical tests, even though it is correctly signed. As an individual model, the statistical performance of implied volatility greatly improves.

While further analysis of the regression results showed that several statistical improvements could be made to the model (due to serial correlation

of errors for example), we believe that it adds little value in this example. The purpose of the regression here is to help validate the factors chosen for the naive portfolio strategies, rather than construct the best-fit regression model.

OTHER FACTORS

Similar to Hottinga, Leeuwen and Ijserloo (2001) we have also analysed some of the equity “value” ratios, such as PEs, PBs and dividend yields.

Contrary to our expectations, none of these factors were indicative of future outperformance in the bond market. Price-to-book was of some interest, in that it showed consistent performance, but the result was in direct contrast to what we expected.

Conclusions

The results from the study have been positive in that the analysis has shown that there are factors that have strong explanatory power with respect to the changes in corporate bond asset swap margins. The value added to our naive portfolio from the strategy has been significant. Although more cross-sections would be needed for a more complete study, the analysis does suggest that strong excess returns could be generated.

References

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Notes

¹ The Australian corporate bond market includes all issues considered to be ‘domestic’ Australian dollar corporate bond issues. There is a developed Eurobond market for Australian dollar corporate bonds issued in Europe and Japan for bonds sold primarily to retail investors. These bonds generally are not traded in the domestic market by institutional investors and are not considered part of the Australian corporate bond market. **J**

TABLE 3: FULL MODEL USING ALL VARIABLES
SAMPLE FEB 1999–FEB 2003 USING SUR ESTIMATION

	Constant	Value	Bond Momentum	Equity Momentum	Risk Proxy
Coefficient	-0.128	-0.005	-0.092	-2.195	0.002
T-Stat	(-1.26)	(-1.95)	(-5.61)	(-2.26)	(0.58)
R ²	1%				