Coupon Effects on Corporate Bonds

Pricing, Empirical Duration and Spread Convexity

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We explore several effects of coupon level (discounts versus premiums) on the pricing and performance of corporate bonds. We find the following:

- **Discount bonds tend to have lower spreads than premiums, reflecting the fact that they are better shielded from default risk by recovery values.**
- **This phenomenon has an asymmetric effect on empirical duration. Corporate bonds trading at a discount have a reduced sensitivity to rising rates and an increased sensitivity to falling rates; premiums exhibit the opposite effect.**
- **This "spread convexity" effect should lead to long-term outperformance of discounts over premiums. We back-test a strategy that goes long discounts versus premiums, controlling for issuer exposures. The strategy shows promising results, with an information ratio of 1.01 (not adjusted for transaction costs). Performance is best when default risk is perceived to be highest.**

Introduction

Bond portfolio managers rely on various types of duration measures to manage risk, such as option-adjusted durations (OAD) or key rate durations (KRD) to measure exposures to changes in rates, or option-adjusted spread durations (OASD) to measure spread exposures. Typically, these measures are based on individual bond calculations in which the projected cashflows promised by a bond are discounted by a combination of rates and spreads, with no distinction between principal and interest cashflows, and no explicit modelling of default and recovery. In this framework, at first glance, there is no reason to expect discount bonds to behave any differently than premiums; bonds with higher coupons will naturally trade at accordingly higher prices, but once all the cashflows have been properly discounted along the curve, the standard duration measures should be equally accurate and applicable regardless of coupon or price.

An alternative viewpoint can be reached if we explicitly consider the role of default and recovery in the pricing model. In survival-based pricing, rather than discounting all the cashflows of a credit-risky security at a spread over the risk-free curve, we discount all cashflows using the risk-free curve, but adjust each for the probability of its occurrence. In each time period from now to maturity, there is a certain probability that the bond will default; should this occur, the bondholders will immediately receive some recovery value, but will forfeit all future cashflows. This type of model captures the effect of a corporate bond market reality that is ignored in the spread-based models: in case of default, recovery values are expressed as a percent of par. Should corporation XYZ default on its debt, all holders of its bonds at a given seniority level will receive the same amount per dollar of face value – regardless of the fact that the investors holding their 8% coupon bond paid considerably more than those holding the 4% coupon.

Consideration of this survival-based pricing approach leads to the conclusion that, all else equal, a lower-priced (lower-coupon) bond is less exposed to default risk than a higher-priced bond from the same issuer, since the recovery value of the firm protects more of the bond's value.[1]

In some market environments, such coupon effects are immaterial. Most bonds are priced at par upon issuance, and if yields and spreads remain stable, each issuer might be characterized by a particular range of coupons. However, when a large shift in Treasury yields causes new issues to come to market at very different yield levels than previously existing debt, we can find wide dispersion among the coupons of outstanding bonds within a single issuer. In today's market, bonds issued before the onset of the global financial crisis will tend to carry much higher coupons than those issued over the past couple of years. If and when rates move higher again, many of the issues trading near par today will trade as discounts under the new regime. For this reason, investors have expressed interest in gaining a better understanding of how coupon levels should affect corporate bond pricing and performance. Our colleagues in US Credit Strategy discussed the potential performance benefits of discount bonds earlier this year[2], highlighting some specific opportunities offered by current markets. In this article, we seek historical evidence of the effect that coupon level has had on relative pricing and performance.

We carry out empirical studies of three distinct effects. First, can we detect a clear relationship between the price of a bond and its spread relative to other bonds of the same issuer? Second, can we find that coupon level has an effect on the empirical duration of a bond – i.e., its sensitivity to changes in Treasury yields? Finally, do these effects present an opportunity for portfolio outperformance?

We begin our study with a comparison of simple spread-based and survival-based pricing models applied to several bonds from a single corporate issuer, to illustrate some of the effects described above. We then address each of the above questions in turn, using appropriate data samples from within the Barclays U.S. Corporate Bond Index database. At each stage, we will face the challenge of isolating the coupon effect from all of the other fine distinctions among different securities.[3]

Why Should Price Level Matter?

At first glance, it may seem that there should be no reason to expect coupon levels to influence spreads. We all are familiar with pricing formulas that express the price of a bond as the present value of future cashflows, discounted by a spread over Treasuries. For example, we could write:

$$P = \sum_t \frac{CF_t}{\left(1 + \frac{r_t + s}{2}\right)^{2t}} \tag{1}$$

where CF_t denotes the cashflow occurring at time t, r_t is the Treasury rate for maturity t, and s is a constant spread over the Treasury curve that will make the formula tie out with

[1] Note that this argument is based on the assumption that we are comparing two bonds from the same issuer at the same seniority level. For two bonds from different issuers, or at different seniority levels, one possible explanation for differences in pricing would be that the bond with the lower price has a lower expected recovery value. Similarly, if the price of a single bond declines over time, it might be due to a decline in expected recovery.

[2] Shobhit Gupta and Alex Gennis, "Get Low", **US Credit Focus**, 31 January 2014, Barclays Research. The authors recommend an overweight to discount bonds, highlighting both the wide dispersion of coupons in current markets and specific opportunities for swapping from high-coupon to comparable low-coupon bonds from the same issuers.

[3] As we proceed through the different sections of this article, we alternate among three slightly different metrics for measuring the extent to which one bond is considered more or less premium than another: dollar price, coupon level, and the differential between coupon and yield. Generally speaking, these measures should agree when applied to bonds of similar maturities from the same issuer. For example, whether a bond's coupon is above or below its yield should determine whether it trades above or below par. We choose the metric most appropriate for each specific study.

the bond's price. Consider two bonds from the same issuer, with the same seniority level and maturity date, but with two different coupons. If we use equation (1) to price the two bonds at the same spread *s* over the Treasury curve, we will get different prices, with the higher coupon bond commanding a higher dollar price[4]. Shouldn't this price differential fully account for the difference in coupon?

The answer is that the model shown in equation (1) does not fully account for what may happen in case of default. All promised cashflows are considered fixed[5]. The model adjusts for the possibility that these cashflows may not arrive due to default simply by discounting them at a spread over the Treasury curve. This spread may be considered roughly equivalent to a hazard rate (annual probability of default) if we assume that when a bond defaults, investors forfeit all future cashflows and receive no further compensation (e.g., the recovery rate is assumed to be zero).

An alternative approach to modelling credit-risky securities is to use a modelling framework like the one used to value credit default swaps (CDS). In this approach, we use hazard curves to estimate the probability that an issuer will default at a particular point in time, and then value the cashflow obtained at time *t* under three distinct possibilities. If the security is not in default at time *t*, the investor receives the cashflow scheduled to occur at that time. If the security goes into default at time *t*, the investor is assumed to be able to liquidate his position immediately for some recovery value equal to a fixed percentage of face value. If the security has defaulted in the past, no further cashflows are received. The expected cashflow is obtained by weighting these three possibilities by the estimated probabilities of each event (based on the hazard curve), and the stream of these expected cashflows is then discounted along the Libor curve. In this type of model, the adjustment for credit risk is reflected explicitly in the probability of obtaining a cashflow, and so no further spread is needed in the discounting process.

Barclays Live contains a calculator for a model of this type, which calculates a Bond-implied CDS spread (BCDS). The model starts by taking data from the CDS market to fit an issuer-specific hazard curve that correctly prices CDS of different maturities for a specific issuer and seniority level. This model can then be used, as described above, to obtain a fair price for a bond based on its scheduled cashflows and an assumed recovery rate. To adjust for the fact that a bond's actual price is different from this fair price, the model introduces a constant shift to the hazard curve, pushing all default probabilities either higher or lower, until the model price matches the actual price of the bond. This shifted hazard curve is then used to find the CDS spread corresponding to the maturity of the bond.[6] To illustrate the dependence of spread on coupon as viewed by the BCDS model, we examine the spreads of four Verizon bonds with very similar maturities of 24-25 years but carrying very different coupons. Figure 1 shows a snapshot of these four bonds as of April 28, 2014. All four of these bonds are struck with coupons significantly higher than their current yield levels of 5.0% to 5.2%, and thus all trade at premium to par. This effect is quite extreme due to the long maturity of the bonds, and the highest coupon bond trades at over 150% of face value. The figure shows both the ZV spreads of the bonds (similar to equation 1 and to the OAS model typically used for corporate bonds) and their BCDS spreads.[7] These spread levels are also plotted in Figure 2.

[4] Due to having a higher proportion of present value due to the near-term coupon flows rather than the principal payment at maturity, this model will also show that the higher-coupon bond has a shorter duration.
[5] For the purposes of this discussion, we limit ourselves to the case of bullet bonds without embedded options. In this case, cashflows are fixed as long as no default occurs, and we can use equation (1) as is or modify it to reflect default/recovery assumptions. For callable bonds, cashflows cannot be assumed to be fixed, since they depend on the issuer's decision on option exercise. Equation (1) would be replaced by a more complex OAS model, and the treatment of default and recovery assumptions would need to be implemented as a modification to the OAS model.
[6] The details of the BCDS model may be found in Pedersen, Claus, "Explaining the Bond-Implied CDS Spread and the Basis of a Corporate Bond", **Quantitative Credit Research Quarterly**, Volume 2006-Q2, Lehman Brothers, p. 29-42.
[7] All of the BCDS spreads shown here use a base case assumption of a 40% recovery rate.

FIGURE 1

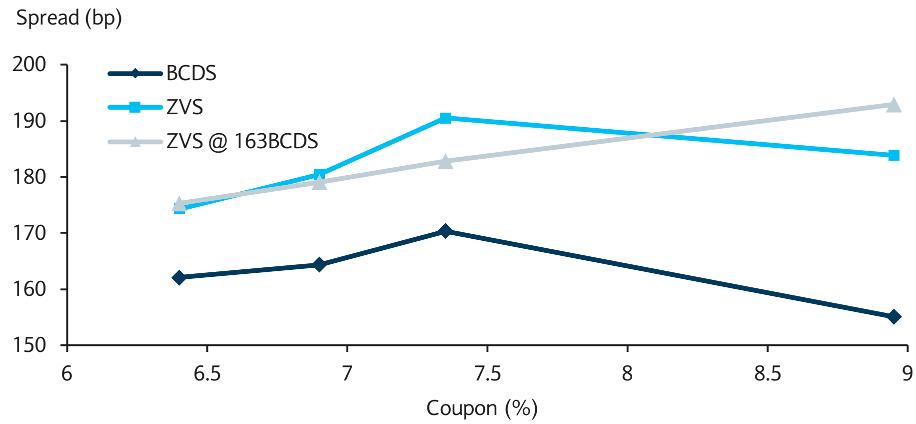
Spreads of four Verizon bonds as of April 28, 2014

Ticker	Coupon	Maturity	Price	Yield	ZVS	BCDS	ZVS @ 163BCDS
VZ	6.4	2/15/2038	118.97	5.024	174.3	162.0	175.3
VZ	6.9	4/15/2038	125.15	5.074	180.4	164.4	179.1
VZ	7.35	4/1/2039	130.27	5.174	190.5	170.4	182.8
VZ	8.95	3/1/2039	154.18	5.084	183.9	155.1	192.9

Source: Barclays Live Credit Analytic Toolkit

FIGURE 2

Spreads of Verizon bonds as a function of coupon, April 28, 2014



Source: Barclays Live Credit Analytic Toolkit

For the first three bonds in this list, we see a clear trend of spreads increasing with coupon level. The fourth bond, with the 8.95% coupon, seems to violate this rule. There are certainly any number of technical factors that could be creating demand for this specific bond, which seems to be currently trading rich to its peers. To eliminate any such pricing noise, and highlight the difference between the BCDS and ZVS models, we took the average BCDS of these four bonds, 163bp, used the calculator to reprice all four bonds at exactly this level, and recorded the resulting ZV spreads. As shown in Figure 2, these spreads follow a straight line relationship, continuing to increase with coupon level. That is, if one believes that the BCDS approach is the correct one and recovery rates are non-zero, there is a theoretical basis for the assumption that higher-coupon bonds should trade at higher spreads. In the remainder of this article, using historical option-adjusted spreads (OAS) of index bonds, we test the extent to which the market has priced in this effect historically.

Do Premium Corporates Have Higher Spreads?

We now turn to the first empirical question we have outlined: do spreads depend on the extent to which a bond is premium or discount? To address this question, we gathered a dataset of bonds from "frequent issuers", such that each issuer would have a well-defined issuer spread curve. Specifically, using corporate bond data from January 1992 through April 2014, we selected the set of issuers with seven or more bonds outstanding each month[8]. We regress bond spreads against coupon levels, after adjusting for the slope of the issuer spread curve. Specifically, we run a separate cross-sectional regression each month as follows:

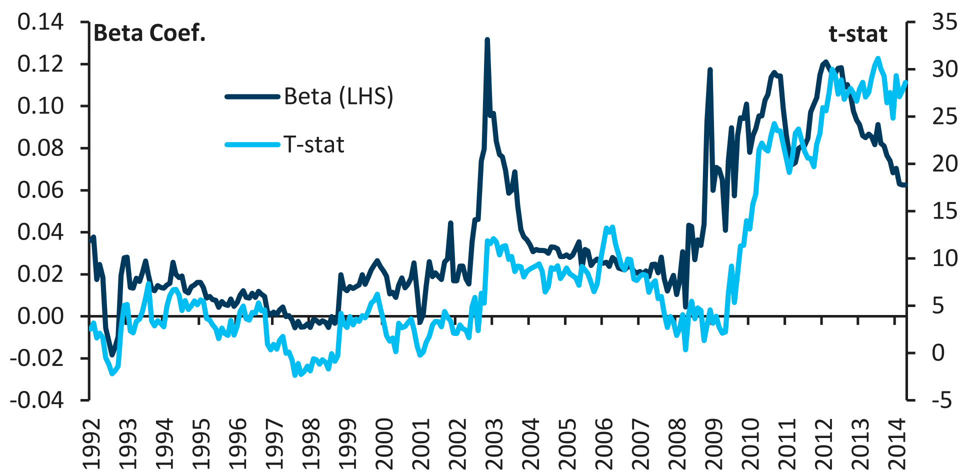
[8] We arrived at this definition of "frequent issuers" as a compromise between two opposing motivating factors. A larger number of bonds per issuer should ensure that each spread curve is well-defined; a less stringent requirement would allow more observations overall, and hence allow greater statistical significance in our results. With the requirement of seven bonds per issuer, our dataset includes, on average, 11.7% of index issuers, but 40.5% of the eligible bonds. In April 2014, for example, only 158 of 1040 issuers were designated as "frequent,, yet these account for 1,757 of the 3,752 eligible bonds in the index. Over the course of the 268 months included in the study, our regressions included bonds from an average of 105 issuers per month.

$$OAS_{i,j} - \overline{OAS_j} = \alpha_j \cdot \left(sprdDur_{i,j} - \overline{sprdDur_j}\right) + \beta \cdot \left(Coupon_{i,j} - \overline{Coupon_j}\right)$$

where the dummy variables α_j represent the slope of the issuer spread curve for issuer *j* in the selected month. The variable β represents an additional dependence of spread on coupon across all issuers, above and beyond the term structure of spreads for each issuer. This regression can be viewed as equivalent to a two-step process, in which we first fit a slope α_j to each issuer spread curve to explain as much as possible of the variation in spreads across each issuer. We then take the extent to which each bond's spread is rich/cheap relative to its issuer curve, pool together all the bonds in a single month, and regress these against coupon to see if we can identify a market-wide coupon effect. A positive value for β implies that higher coupons have higher spreads. Figure 3 charts the results of this regression over time, including both the value of the coefficient β and the t-statistic measuring the strength of the relationship. We find that over the past few years in particular, this coefficient has been high, with a value of about 0.1 and strong statistical significance. The value of 0.1 for β means that if there are two otherwise identical bonds from the same issuer with coupons 1% apart, we would expect the higher coupon bond to trade 10bp higher in spread.

FIGURE 3

Time series of regression results for dependence of spread on coupon



Source: Barclays Research

We note that the high values for β in 2008-2012 were achieved in one earlier episode as well. Towards the end of 2002, β spiked to a level above 0.1, and then steadily decayed back down to more moderate levels over the course of 2003. As in 2008, this corresponds to a period at the end of the dot-com crisis when portfolio managers had reason to be especially wary of default risk. We will investigate this in more depth later in the article.

How Does Coupon Level Affect Empirical Duration?

Once we have established that investors indeed consider premium bonds to carry more credit risk and hence higher spreads, we can start to think about how this affects spread dynamics. Specifically, how will credit spreads of discount and premium bonds change in reaction to changes in Treasury rates, and what effect will this have on empirical durations?

To test this, we set up a regression of corporate bond returns against changes in Treasury yields. We begin by assembling a dataset of monthly returns and explanatory variables for all non-callable bonds in the Barclays US Investment-Grade Corporate Index[9] from January 1992 through April 2014. As a control, we first set up a simple regression of returns against yield changes, allowing for dependence of empirical duration on spread but not yet including any coupon effect, as follows:

$$R_{i,t}^{adj} = -\beta_{treas} D_{i,t} \Delta y - \beta_{spread} D_{i,t} S_{i,t} \Delta y + \varepsilon_{i,t}$$

We will refer to this base case as Model 1. In this regression, our dependent variable $R_{i,t}^{adj}$ represents the carry-adjusted return of bond *i* at time *t*, calculated as the bond's total return minus one-twelfth of the beginning-of-month yield[10]. Note that this is a pooled regression, using all index bonds across all observed months to solve for just two constants, β_{treas} and β_{spread}. The interpretation of the results is that to obtain the best estimate for the empirical duration of a bond, or the sensitivity of its return to changes in Treasury yield[11], we should adjust it by an empirical hedge ratio that is a linear function of spread:

$$\frac{D_i^{emp}}{D_i} = \beta_{treas} + \beta_{spread} \cdot S_i$$

If, as is often assumed, the duration of a bond gives the best estimate of its sensitivity to changes in Treasury yield, the results would be that $\beta_{treas} = 1$ and $\beta_{spread} = 0$. We do not find this to be the case; we instead find strong evidence that β_{spread} is negative, and hence that empirical duration decreases as spreads rise.

Both the setup and the results of this first regression are consistent with earlier work we have done on empirical durations of credit securities[12]. Using a pooled regression of daily data, with a formulation similar to this one, we found that empirical durations of credit securities tend to be less than their analytical durations, and that this effect becomes stronger as spreads widen. We found this effect to be connected to the negative correlation that usually prevails between changes in rates and spreads. When rates fall, bond prices increase. Due to this negative correlation, however, spreads tend to widen, and thus the bond prices do not increase by as much as would have been expected based on analytical duration alone. We traced the spread dependence of this effect to other empirical work of ours on Duration Times Spread (DTS)[13]. Here, we found that spread changes tend to follow a proportional pattern, in which bonds trading at wider spreads react more strongly to systematic spread changes in the market. Due to this effect, the price impact of the negative correlation of rates and spreads is greater for bonds with higher spreads.

To explore the coupon effect, we now modify this regression, inserting an additional term reflecting a dependence of empirical duration on bond price. We now look for a relationship of the form

[9] In this section, we do not limit ourselves to bonds from frequent issuers as we did in the previous section. Before, when we were trying to explain pricing effects, we needed to ensure that we were only detecting differences among bonds from the same issuers. Here we are measuring sensitivity to Treasury yield changes. We already have durations for each bond, but we are seeking to pool as many observations as possible to identify any systematic adjustments to the analytical duration that can help improve our estimate of empirical duration. By including all eligible bonds, our pooled regression includes a total of 737,506 observations over 268 months, of which 171,762 are classified as "premium" and 34,616 as "discount," as will be described.

[10] In our prior work on empirical duration, we used price return as the dependent variable. This removes an estimated carry based on the bond's coupon. This was not a material difference in any case because that study was based on daily returns. In the current study, using monthly returns, the difference is more pronounced. Furthermore, the difference between a carry adjustment based on yield and one based on coupon is most pronounced when coupon is far from yield – that is, when bonds are strongly premium or discount – the very cases we want to investigate. For this reason, it was important to us to use a carry adjustment that does not introduce a bias based on coupon level.

[11] The treasury yield change used for each observation is the monthly change in the fitted yield of an appropriate constant-maturity Treasury: for bonds with less than seven years to maturity, we use the 5y Treasury yield; for those with above seven but less than 15 years, we use the 10y; for those with 15 years or more to maturity, we use the 30y.

[12] Ambastha, M., A. Ben Dor, L. Dynkin, J. Hyman, and V. Konstantinovsky, *Empirical Duration of Corporate Bonds and Credit Market Segmentation*, Barclays Research, January 25, 2010.

[13] Ben Dor, A., Dynkin, L., Houweling, P., Hyman, J., van Leeuwen, E., *A New Measure of Spread Exposure in Credit Portfolios*, Barclays Research, February 6, 2009.

$$\frac{D_i^{emp}}{D_i} = \beta_{treas} + \beta_{spread} \cdot S_i + \gamma \cdot PriceDistPar_i$$

where $PriceDistPar_i$ denotes the absolute distance of the price of bond *i* from par. Bonds trading further from par in either direction – either deep discounts or premiums – are assumed to require an additional adjustment to their empirical durations, and γ represents the extent to which this adjustment should depend on the distance of a bond's price from par. However, we suspect that the required adjustment might be different for premium and discount bonds, and that each of the above is likely to react differently to upward and downward yield changes[14]. Therefore, our modified regression, which we will refer to as Model 2, includes not just a single γ coefficient, but four distinct ones corresponding to premium and discount bonds in months with upward and downward Treasury yield changes.

In this model, we label as "discounts" all bonds with prices of 90 or less, and as "premiums" all bonds with prices of 110 or more. For bonds trading near par (e.g., with prices from 90 to 110), price changes are modelled as in Model 1, based only on β_{treas} and β_{spread}. For every observation of a discount bond, we include an adjustment using one of our additional coefficients, either γ_{disc}^{up} for observations in which Treasury yields rise or γ_{disc}^{dn} for observations in which they fall. Similarly, premium bonds will have an adjustment controlled by either γ_{prem}^{up} or γ_{prem}^{dn}. In each case, the magnitude of the correction effect is assumed to be proportional to the distance of the bond's price from par. The results of these regressions are summarized in Figure 4. We indeed find that the results are broadly consistent with our earlier work: in both Model 1 and Model 2, we find that empirical duration is slightly lower than analytical duration for low spreads, and continues to decrease as spreads rise. Furthermore, the adjustment terms that measure the sensitivities to rising and falling yields confirm our hypothesis: for premium bonds, rate sensitivity is higher when yields rise and lower when they fall; for discount bonds, the direction is reversed. In both cases, the effect is proportional to the distance of the bond price from par.

FIGURE 4

Results of regression models for yield sensitivity, with and without coupon adjustment[15]

Pooled data, all non-callable bonds in the Barclays US IG Corporate Index, January 1992-April 2014.

		Model 1		Model 2	
Coefficient	**Interpretation**	**Coeff.**	**t-Stat.**	**Coeff.**	**t-Stat.**
β_{treas}	Base case hedge ratio (low spread limit)	0.97	405.0	0.98	355.3
β_{spread}	Hedge ratio sensitivity to spread	-0.13	-144.1	-0.15	-140.6
γ_{prem}^{up}	Sensitivity of premium bonds to rising yields			0.27	14.6
γ_{prem}^{dn}	Sensitivity of premium bonds to falling yields			-0.25	-11.8
γ_{disc}^{up}	Sensitivity of discount bonds to rising yields			-1.09	-41.0
γ_{disc}^{dn}	Sensitivity of discount bonds to falling yields			1.67	76.1
Adj. R-Sq:		24%		25%	

Source: Barclays Research

These results imply that discount bonds should follow a highly desirable behaviour in which they react more strongly to favourable yield changes and less strongly to unfavourable ones – a positive convexity effect. Premium bonds, by contrast, should display the opposite

[14] It may even be the case that different root causes drive the behavior of premium and discount bonds, with the price of deep discounts supported by recovery values and the price of premiums suppressed by investor aversion due to accounting considerations. Perhaps a simple way to view this is that the market tends to resist extreme valuations in either direction.

[15] The t-statistics shown in Figure 4 are somewhat distorted due to the fact that under the pooled regression, the residuals may be correlated. As a result, the test for statistical significance needs to be adjusted. However, we tested these results by including a monthly dummy factor to capture this dependence, and found the resulting coefficients to be little changed.

behaviour, similar to negative convexity. Figure 5 illustrates the magnitude of this effect for two hypothetical bonds trading at the same spread of 100bp, but with prices of 110 and 90, respectively. Model 1, based purely on spread, estimates the same empirical hedge ratio of 0.83 for the two bonds. Model 2 includes an additional term based on the distance of the price from par, estimated separately for premium and discount securities. As a result of this effect, we find that our discount bond should have a significantly higher empirical sensitivity to falling yields than our premium bond, and a significantly lower sensitivity to rising yields, and should therefore be expected to outperform in both of these environments.

FIGURE 5

Illustration of coupon effect on empirical hedge ratios for premium and discount bonds

	Bond A (Premium)	Bond B (Discount)
Price	110	90
Distance of price from par (absolute value)	10%	10%
OAS (bp)	100	100
Estimated empirical hedge ratio (Model 1):	0.83	0.83
Estimated empirical hedge ratio (Model 2, for falling yields):	0.80	1.00
Estimated empirical hedge ratio (Model 2, for rising yields):	0.86	0.72

Source: Barclays Research

Do Discount Corporates Outperform?

We have thus shown two clear types of differentiation between the market behaviour of premium and discount bonds. In terms of valuation, it seems that there is an investor preference for discount bonds, which translates into higher spreads for premiums. In terms of rates sensitivity, discount bonds enjoy some sort of positive convexity that should help improve performance when rates change. On a long-term performance basis, these two effects should offset each other – but to what extent? If we could compare two portfolios that are otherwise equivalent, except that one is biased towards high-coupon bonds while the other is biased to low-coupon bonds, which one would achieve better performance over the long term?

We seek to construct two portfolios whose characteristics are as similar to each other as possible, except for a bias towards higher or lower coupons. We will then analyse the performance differences between the two portfolios. We considered two distinct approaches to constructing such an experiment. One, using a top-down portfolio construction technique, would use all the bonds in the index, and achieve the desired coupon bias by partitioning the index universe and reweighting the cells. A second approach would use a bottom-up construction, using only bonds from frequent issuers. The top-down approach would have the advantage of using much more diversified portfolios. However, we found it very difficult to introduce the desired coupon bias while controlling for all other important portfolio attributes. With this method, it was not clear exactly what additional exposures might have crept into our portfolios – to specific industries or issuers, perhaps – in addition to the premium or discount characteristics that we sought to emphasize. We therefore found it preferable to work with the more limited dataset of frequent issuers, and use a bottom-up approach that explicitly matches issuer exposures in the discount and premium portfolios.

Our bottom-up portfolio experiment was carried out as follows. For each month of the study, we first identified the universe of available corporate bonds from “frequent issuers”, defined as those issuers with seven or more bonds outstanding, as in our above analysis of the dependence of spread on coupon. From this set of bonds, we then constructed two portfolios with the same sector and issuer contributions, as follows.

Within each issuer each month, we use the difference between a bond's coupon and its yield[16] to divide the available bonds into two equally populated groups[17]. We then subdivide each of these two groups by duration. Ideally, we can then find a target duration that is between the durations of the long and short cells in both groups, and reweight the two halves of each group to match this. When possible, we choose the overall average duration of the issuer as the target duration for both the premium and discount groups; if this would lead to a short position in one of the portfolios we adjust the target duration accordingly. The only case in which it is not possible to match the durations is when both duration cells of one group (premium or discount) have longer durations than both duration cells of the other group. In such a case, we just omit this issuer from our portfolio. Once we do this at the level of each issuer, we just combine these groups using issuer market weights to form a premium portfolio and a discount portfolio[18]. Without the need for any further adjustments, these two portfolios should be almost perfectly matched in their allocations to issuers, sectors and qualities, by both market value and contributions to spread duration. While we do not explicitly control for spreads, there is no possibility of large issuer-specific positions.

We carried out the portfolio construction according to this algorithm. Of 28,198 unique issuer*month observations, we needed to discard almost 33% because the durations of the two groups of bonds could not be matched by the simple rebalancing described above. The results of this experiment are shown in Figure 6. In addition to the discount and premium portfolios, we report results for an active portfolio that goes long the discounts and short the premiums, by taking the difference between the two portfolio returns.

We find that the discount and premium portfolios seem to be quite well-matched. The average durations are the same, at 5.25. The premium portfolio carries a slightly higher spread on average, as we would have expected based on our earlier result that premium bonds trade at higher spreads. The volatility of the active portfolio is quite small, at just 12bp/month out of an overall return volatility of about 150bp/month for either the discount or the premium portfolio. Given this close tracking between the two portfolios, and despite the spread carry advantage of the premium portfolio, the active portfolio (long the discounts and short the premiums) achieves an impressive average outperformance of 3.5bp/mo, for an information ratio of 1.01. The statistics are roughly the same in terms of excess returns; this is consistent with our hypothesis that the advantage of the discount portfolio over time has to do with subtle differences in the way spread changes in the two types of portfolios are influenced by changing rates.

[16] When a bond's coupon is above its yield, it will trade at a price above par; if coupon is less than yield, price will be below par. The extent of this price difference will be greater for longer-duration bonds. In this exercise, we are trying to favor premium bonds while not introducing a bias towards longer or shorter durations. For this reason, we chose to use coupon minus yield as our key metric.

[17] We arbitrarily decided that when there are an odd number of bonds from an issuer, the middle bond is assigned to the premium portfolio. Thus, for an issuer with seven bonds outstanding, four would be assigned to the premium portfolio and three to the discount one. For this reason, the premium portfolio contains a greater number of bonds on average.

[18] We divide the total market weight of all included bonds for each issuer by the total market weight of all included bonds each month. These overall issuer weights are used to weight both the discount and premium portfolios.

FIGURE 6

Performance of Discount vs. Premium Portfolios, bottom-up (issuer-matched) construction, January 1992 – April 2014

		Discount Portfolio	Premium Portfolio	Active Portfolio
Total Returns	Average (bp/mo)	57.1	53.7	3.5
	Volatility (bp/mo)	151.1	149.5	12.0
	Inf. Ratio (Annualized)			1.01
Excess Returns	Average (bp/mo)	8.0	4.9	3.1
	Volatility (bp/mo)	119.74	118.31	11.8
	Inf. Ratio (Annualized)			0.91
Portfolio Averages	OAS (bp)	129.9	133.4	
	OAD	5.25	5.25	
	Price	100.59	107.91	
	Number of Bonds	382.9	424.7	

Source: Barclays Research

We then sought to double-check our hypothesis that the outperformance of the discount portfolio was due to a convexity effect in which outperformance is achieved when rates move quickly in either direction. To do this, we partitioned the months of the study into quartiles by the amount of the monthly change of the 10-year fitted Treasury yield. Figure 7 shows the performance results by quartile for our discount, premium and active portfolios. We do not find evidence that our strategy is directional in rates; the active portfolio shows positive returns in all four quartiles. It seems to perform best when yields rally. In quartiles 1 and 2, the performance of the active strategy is truly large relative to its risk, earning information ratios of 1.84 and 1.65, respectively.

FIGURE 7

Performance of Discount vs. Premium Portfolios partitioned by Treasury yield change, January 1992 – April 2014

Treasury Yield Change		Total Returns (bp/mo)				Excess Returns (bp/mo)			
Quartile	Yield Change (bp)	Discount Portfolio	Premium Portfolio	Active Portfolio	Information Ratio (Annualized)	Discount Portfolio	Premium Portfolio	Active Portfolio	Information Ratio (Annualized)
1	< -19	175.5	169.8	5.8	1.84	-36.9	-41.2	4.3	1.50
2	-19 to -2	101.8	96.9	4.9	1.65	13.7	9.3	4.5	1.71
3	-2 to 14	20.6	19.8	0.8	0.29	9.7	8.4	1.3	0.39
4	> 14	-69.4	-71.9	2.5	0.56	45.6	43.2	2.4	0.52

Source: Barclays Research

We similarly want to check whether returns of our strategy are directional with credit spreads. If we instead partition our sample by overall excess returns[19], we find that the largest outperformance comes in the extreme top and bottom deciles, when there are large positive or negative excess returns across the market. This is shown in Figure 8. The return of the active strategy is in the range of 6-10bp/month in both the top two and the bottom two deciles; in the middle six deciles, the strategy returns are near zero on average. The truly surprising results are those in deciles 9 and 10. Generally, as mentioned above, we have found that spread changes tend to be proportional to spreads. We would therefore expect that if two asset portfolios have the same durations, but one has a higher spread than the other, that the higher spread portfolio would show excess returns of greater magnitude in both up and down months. The results in deciles 1 and 2 are consistent with this idea; the premium portfolio, with a spread 2bp higher than the discount portfolio, has returns that are more negative in months of widening spreads. However, deciles 9 and 10 represent large spread rallies, in which all credit assets show positive excess returns. Here, where the spread advantage of the premium portfolio is even greater, we would have expected the premiums to outperform. Yet the discount portfolio outperforms by even more in these deciles.

FIGURE 8

Performance of Discount vs. Premium portfolios partitioned by excess return deciles, January 1992 – April 2014

	Average Spreads (bp)			Total Returns (bp/mo)				Excess Returns (bp/mo)			
Excess Return Decile	Discount Portfolio	Premium Portfolio	Active Portfolio	Discount Portfolio	Premium Portfolio	Active Portfolio	Information Ratio (Annualized)	Discount Portfolio	Premium Portfolio	Active Portfolio	Information Ratio (Annualized)
1	217.4	219.4	-2.0	-60.7	-71.3	10.5	2.42	-213.1	-220.4	7.3	1.40
2	129.9	132.5	-2.6	35.0	28.5	6.5	2.29	-53.2	-59.3	6.1	2.21
3	101.0	105.3	-4.3	6.0	7.2	-1.3	-0.71	-20.1	-18.8	-1.3	-0.98
4	77.4	80.7	-3.4	46.5	47.1	-0.6	-0.54	-3.1	-1.9	-1.2	-0.97
5	85.4	87.6	-2.2	79.0	77.7	1.3	0.67	7.4	6.2	1.2	0.87
6	93.3	95.3	-2.0	38.3	38.5	-0.2	-0.14	16.4	16.3	0.0	0.03
7	90.4	94.0	-3.5	75.6	74.4	1.1	0.77	23.7	22.2	1.5	1.10
8	119.9	123.9	-4.0	62.6	61.4	1.2	0.50	34.4	33.2	1.1	0.47
9	138.6	143.0	-4.4	94.1	86.0	8.0	1.92	60.4	52.9	7.5	1.89
10	253.5	260.0	-6.4	196.0	187.2	8.8	1.29	227.4	218.3	9.1	1.37

Source: Barclays Research

Note: Data partitioned into deciles by excess return of the discount portfolio.

Recalling that our key motivation for investigating the coupon effect was based on a consideration of defaults and recoveries, it stands to reason that these effects should be stronger when credit markets are in a stressed environment and investors are thinking carefully about default risk. Does our discount versus premium strategy show better performance when expected default rates are high? To address this, we chose to partition our sample by the yield spread between Baa and Aaa bonds.[20] However, we noticed that there was a clear difference in duration between our Baa Credit and Aaa Credit indices. To

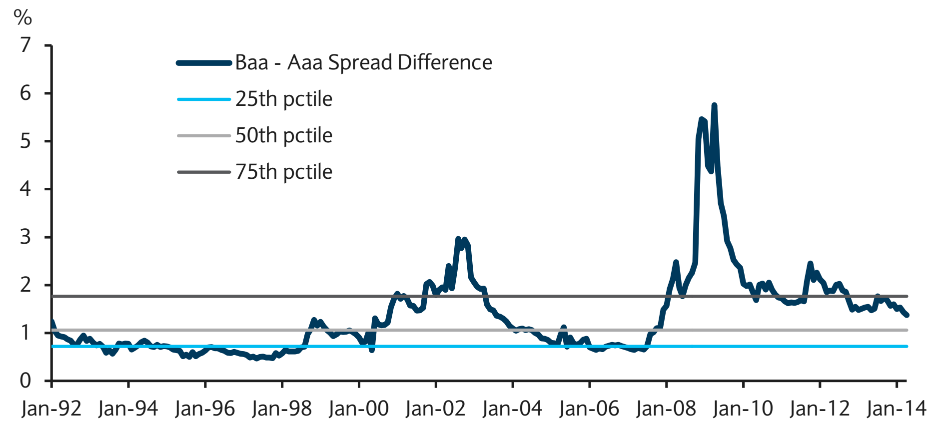
[19] We arbitrarily chose to use the excess returns of the discount portfolio to carry out this partition. Ranking the months by the excess returns of the premium portfolio or the index as a whole should produce similar results.

[20] We did not want to use absolute spread levels because these contain some common components that are not necessarily linked to default expectations. One notable example is liquidity. During the global financial crisis, spreads of cash bonds were hundreds of basis points higher than those of corresponding CDS due to the lack of liquidity in the market. CDS spreads themselves might be a good metric for measuring overall default risk, but historical data are not available for the full extent of our sample period. We therefore chose to work with the Baa-Aaa differential, which is a fairly standard metric in the credit risk literature.

adjust for this, we took the Intermediate and Long Aaa Credit indices, reweighted them to match the duration of the Baa Credit index, and took the difference between their yields. This time series for this metric is shown in Figure 9.

FIGURE 9

Credit Spread Premium, represented by Baa-Aaa Yield Difference, using duration-adjusted yields of Barclays US Credit Indices, January 1992 – April 2014



Source: Barclays Research

Note: The credit spread premium shown here is derived based on the Aaa and Baa components of the Barclays US IG Credit Index. A blend of the Long (maturities above 10 years) and Intermediate (maturities below 10 years) Aaa Credit indices is found each month to match the OAD of the Baa Credit Index. We define the credit spread premium as the yield difference between the Baa Credit Index and this duration-matched Aaa Credit Index.

We then use this metric to divide our data sample into four quartiles, ranging from those in which the market seems to be the least concerned about credit risk (Quartile 1) to the most (Quartile 4). The horizontal lines shown in Figure 9 mark the breakpoints between these quartiles; the figure thus identifies which time periods are included in each quartile. The performance of our discount and premium portfolios in each of these quartiles is shown in Figure 10. This analysis indeed shows a very clear differentiation of the performance of the strategy in different credit environments. Quartiles 1 and 2 show near-zero returns for the strategy, with very low risk as well: active strategy volatility is just 3.2bp/month in quartile 1 and 6.1bp/month in quartile 2. In higher-spread environments, the strategy does quite well: discounts outperform premiums by 12.2bp/month in quartile 4. Furthermore, this outperformance is accomplished with very little volatility. As a result, the issuer-matched active strategy shows an information ratio of 0.59 in quartile 3 and 2.28 in quartile 4. It is perhaps worth noting that recent levels of the credit spread premium, as seen in Figure 9, are consistent with those in quartile 3.

FIGURE 10

Performance of Discount vs. Premium portfolios partitioned by quartiles of credit spread premium, January 1992 – April 2014

Credit Spread Premium		Average Total Returns (bp/mo)			Total Return Volatility (bp/mo)			
Quartile	Baa-Aaa Spread Diff.	Discount Portfolio	Premium Portfolio	Active Portfolio	Discount Portfolio	Premium Portfolio	Active Portfolio	Information Ratio (Annualized)
1	< 71 bp	64.7	64.6	0.1	119.1	119.7	3.2	0.14
2	71-106 bp	28.6	28.5	0.1	115.6	114.0	6.1	0.03
3	106-176 bp	57.9	56.3	1.6	132.3	129.1	9.2	0.59
4	> 176 bp	77.4	65.2	12.2	214.5	213.5	18.5	2.28

Source: Barclays Research

We had one final concern regarding the validity of extrapolating forward from these historical results. The average prices of the securities in our "Premium" and "Discount" portfolios over the full period of our study were 107.9 and 100.6, respectively. That is, over the time period studied, the bond market as a whole was more premium than discount, consistent with the steady decrease in yields. If one sees our historical results as primarily a story of newly issued par bonds outperforming more seasoned premium bonds, one could question the extent to which these results would be applicable in a very different environment of rising rates. On that basis, it might be a stretch to predict outperformance of seasoned discount bonds over newly issued par bonds.

To confirm that this is not the case, we profile the performance of our bottom-up discount versus premium strategy in one more dimension – this time based on the average price of bonds in the Discount portfolio. The results, shown in Figure 11, demonstrate that despite the bias in our sample towards prices above par, the outperformance was not strongest when the premium portfolio traded at the highest price above par – but rather when the discount portfolio traded at the lowest price below par. We therefore see no reason to believe that the market dynamics should change in a rising rates environment.

FIGURE 11

Performance of Discount vs. Premium Portfolios, partitioned by quartiles of average price of discount portfolio, January 1992 – April 2014

	Average Bond Price		Total Returns of Active Portfolio		
Quartile	Discount Portfolio	Premium Portfolio	Average (bp/mo)	Volatility (bp/mo)	Information Ratio (Annualized)
1	98.0	105.4	6.5	14.7	1.53
2	101.3	112.7	3.4	8.5	1.39
3	103.4	114.0	3.0	12.8	0.82
4	108.4	120.5	1.0	10.6	0.34

Source: Barclays Research

Conclusion

We have suggested one possible motivation for premium and discount bonds to follow different pricing dynamics. Because recoveries in case of default are based on face values rather than market value, premium bonds are at risk to lose more of their value in such events than discount bonds from the same issuers. This effect is not considered by standard models for OAS and duration. Although the probability of default is low, it seems that the market does tend to incorporate this knowledge in several ways.

We have demonstrated that within corporate bonds, all else equal, bonds with higher prices tend to trade at wider spreads.[21] While this means that discount bonds are more expensive, they also exhibit some spread convexity, tending to widen less when rates rally and tighten more when rates rise. Over the long term, and especially in high credit risk environments, this results in better performance for discount bonds, despite the initial pay-up to buy them.

It is not clear that this performance effect is large enough to justify a stand-alone active strategy after consideration of transaction costs. However, long-only portfolio managers may wish to maintain a bias towards lower-coupon bonds whenever possible.

If and when the market sees a significant secular rise in yields, existing corporate bonds may offer attractive performance relative to higher-coupon new issues.

[21] The tendency of high-priced bonds to trade at higher spreads may not be due entirely to the default/recovery argument described in this article. Other technical factors may contribute to this effect as well. For example, some investors prefer not to invest in premium bonds due to accounting considerations.

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