# Credit Portfolio Management in a Turning Rates Environment

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## Executive Summary

This paper analyzes correlations between credit spreads and interest rates across various sectors and credit ratings in the US. Our work was prompted by chairman Bernanke's announcement this summer of possible tapering of the ongoing quantitative easing program which marked a turning point for interest rates from their historically low levels. We analyze data from 1990 to the present and use a statistically robust multi-factor risk model framework which can be calibrated to draw both long-term and short-terms conclusions. Our findings are relevant for credit portfolio managers contemplating the impact of rising interest rates and steepening Treasury curve on corporate bond portfolios.

Consistent with our earlier studies, we find strong negative correlation between sector spreads and rate shifts and twists. A uniform increase in rates is associated with tighter credit spreads, while a uniform drop in rates leads to wider spreads. In most industries, with the exception of the banking and brokerage and the consumer sector, lower credit quality is associated with stronger negative correlation.

We compare our current estimates with the results of a similar analysis we conducted in 2003 and find many similarities but also some notable differences. The long-term models estimated currently and 10 years ago show similar patterns. However, the short-term versions are quite different. The short-term correlation estimates in 2013 are much weaker than those from 2003 – likely a result of the Fed's ongoing quantitative easing program which has weakened the normal relationships between the economic recovery (represented by spreads) and monetary policy (represented by rates). Moreover, correlation patterns in the banking and brokerage sector have changed prior and post the financial crisis. These results have important implications for risk management as well as for identifying relative value opportunities across sectors with different rate sensitivities.

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# Section One
# Introduction

The gradual recovery of the U.S. economy from the consequences of the financial crisis has brought the prospect of the Fed ending its extraordinary quantitative easing (QE) policies. The "moderate tapering" of the rate of QE, pre-announced in May 2013, has jolted the bond market and perhaps marked the turning point in the interest rates from historically low levels. Although the timing might still be uncertain, the expected eventual rise in rates has come to the forefront of many investors' concerns.

Over the past few years, we have witnessed an (albeit slow) economic recovery and a concurrent emergence of a benign credit cycle associated with tight spreads and low volatility. The management of credit portfolios in such an environment requires a more precise positioning with respect to the movements of the underlying interest rates, as the credit-specific spread movements become less pronounced and the impact of systemic factors becomes relatively more important.

It is a widely held belief among credit bond portfolio managers that rates and spreads are negatively correlated. The main fundamental reason is that both Treasury yields and credit spreads reflect the state of the economy, and therefore one can expect their changes to be correlated to the extent that they are caused by the same underlying economic expectation. A worsening economy is generally associated with falling rates, while an improving economy is associated with rising overall level of interest rates. For spreads the direction of the dependence is precisely the opposite — spreads rise when the economy deteriorates and default risk rises, and they tighten as the economic conditions improve. Accordingly, analysts find negative correlation between corporate bond spreads and US Treasury yields (see Ng, Phelps and Lazanas (2013) for a recent look into this issue).

The above statement on negative correlation applies only to overall changes in Treasury rates, i.e., to "parallel shifts" of the Treasury curve. However, the shape of the yield curve can change in a much more complex way, including twists and butterflies. The dependence of spreads on such changes in the underlying yield curve is much less documented. In terms of economic as well as statistical significance, the parallel shifts and (flattening or steepening) twists are the primary modes of change of the Treasury curve, explaining more than 80% of its variability. Therefore, we focus on these factors and their impact on credit spreads.

In this paper we revisit the analysis of the co-movement between the interest rates and spreads originally published in 2003-2004 (see Berd and Ranguelova (2003) and Berd and Silva (2004)). We analyze the relationship between US interest rates and credit spreads using the statistically robust framework of the Barclays POINT® Global Risk Model (see Lazanas et al. (2011)).

We confirm the strong evidence that rates and spreads are negatively correlated: higher rates are associated with tighter spreads and steeper credit curves while lower rates are associated with wider spreads and flatter credit curves across all industries. The change in the slope of the treasury yield curve has a different effect on credit OAS: yield curve flattening typically coincides with narrowing and steepening of credit spread curves, with yield curve steepening having the opposite effect. Furthermore, we observe characteristic differences in the impact of rates on various sectors and on spread curve shapes and OAS dispersion.

Our results are qualitatively robust to different periods of analysis and different data calibration methodologies. However, our findings are conditional on the historical relationship between interest rates and spreads. Managers forecasting a reversal on this stable historical pattern (e.g., due to QE policies and intervention or increased sovereign risk) will find this analysis less useful[3].

Our findings have significant implications for credit portfolio managers. The negative correlation of spreads with rates affects the duration management of credit portfolios, particularly when there is a significant under- or overweight position with respect to a benchmark containing Treasury bonds. The differential effect across industries and ratings gives rise to potential curve-driven cross-sector relative value opportunities.

## Section Two

# The Co-Movements of Credit Spreads and Interest Rates

Before presenting the model results, let us define the relevant components of the interest rate curve and illustrate the historical co-movement of credit spreads and interest rates.

## 2.1 Defining the Treasury curve shifts and twists

We define the Treasury shift factor as a uniform increase in the five key-rate factors included in the Barclays POINT® Global Risk Model[4], corresponding to the 2, 5, 10, 20 and 30-year key rates. The Treasury twist factor is defined as a series of changes in the same key-rate factors that correspond to a steepening rotation around the 10-year maturity. Table 1 uses a 10 bp scale for shifts and twists as an illustration.

3. In this regard Eisenthal-Berkovitz et al. (2013) document positive correlation between treasury and credit bonds for some European distressed countries.
4. We exclude the 0.5 year key rate factor in order to avoid picking up dependencies on peculiar movements of the short end of the Treasury curve.

These definitions differ slightly from the statistically more precise approach known as *principal component analysis*. However, they get us pretty close to the true principal components of rates changes and are easier to visualize and discuss.

**Table 1: Treasury Curve Primary Factors**

| Key Rate Maturity (years) | 2 | 5 | 10 | 20 | 30 |
|---|---|---|---|---|---|
| Treasury Curve Shift (bps) | 10 | 10 | 10 | 10 | 10 |
| Treasury Curve Twist (bps) | -10 | -5 | 0 | 5 | 10 |

To explain in practical terms, assume that the yield curve has undergone an arbitrary change in each of its key rate points, denoted as $\Delta y_i$, where the index $i$ corresponds to maturities 2, 5, 10, 20, and 30 years. We can now define the approximation to the yield curve change in terms of the shift and twist factors as a linear combination of a unit parallel shift and a unit steepening twist with yet undetermined coefficients and the residual term containing the portion of the yield curve change that is not captured by shift and twist:

$$\begin{bmatrix} \Delta y_2 \\ \Delta y_5 \\ \Delta y_{10} \\ \Delta y_{20} \\ \Delta y_{30} \end{bmatrix} = \gamma_{shift} \cdot \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix} + \gamma_{twist} \cdot \begin{bmatrix} -2 \\ -1 \\ 0 \\ 1 \\ 2 \end{bmatrix} + \begin{bmatrix} \varepsilon_2 \\ \varepsilon_5 \\ \varepsilon_{10} \\ \varepsilon_{20} \\ \varepsilon_{30} \end{bmatrix}$$

If we assume that, by construction, the residual term does not contain either a parallel shift of a steepening/flattening component, we can easily find the factor loadings $\gamma_{shift}$ and $\gamma_{twist}$ of the two primary yield curve components as follows:

$$\gamma_{shift} = \frac{1}{5} \cdot \left( \Delta y_2 + \Delta y_5 + \Delta y_{10} + \Delta y_{20} + \Delta y_{30} \right)$$

$$\gamma_{twist} = \frac{1}{10} \cdot \left( -2 \cdot \Delta y_2 - \Delta y_5 + \Delta y_{20} + 2 \cdot \Delta y_{30} \right)$$

These formulas justify the representation of the shift and twist factors in Figure 1.

## 2.2 Historical co-movement of credit spreads and interest rates

The past two decades were characterized by large shifts and twists of the Treasury yield curve, with the current levels of interest rates just off the historical lows and stands almost 600 bps lower than in 1990, while the curve steepness being close to its historical highs. At the same time, the Barclays Credit Index OAS has experienced wide swings from the tightest levels of around 50 bps in early 1997 to the widest of over 535 bps in November 2008, returning to moderate levels of 140 bps more recently. The corresponding time series are shown in Figure 1, where we show the cumulative time series of the shift and twist factors, normalized to start from zero in December 1989, and the OAS.

We can identify several periods in the past fourteen years when rate changes have visibly correlated with credit spreads.

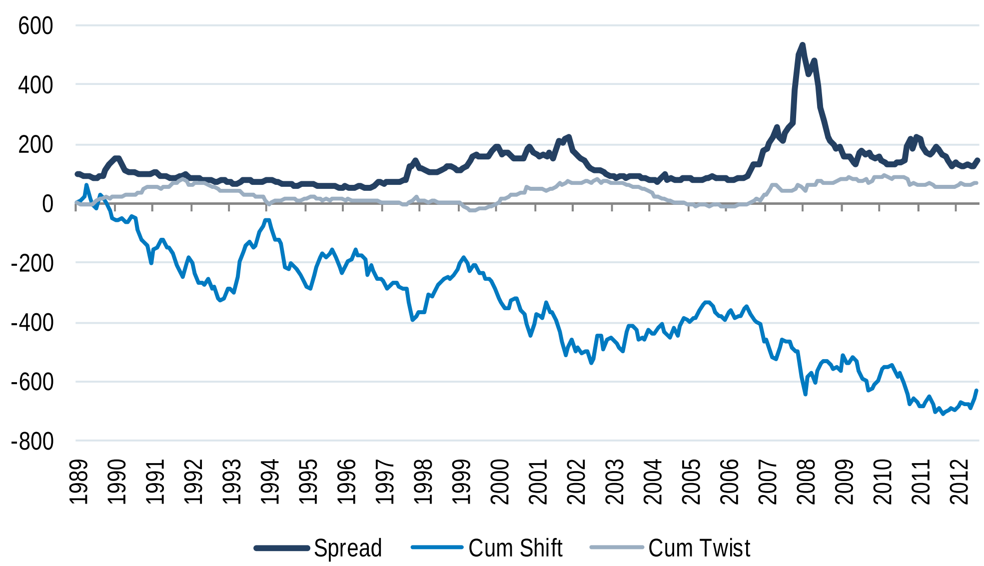
First, the first Gulf War in 1991 resulted in a quick drop in Treasury rates by over 80 bps and a moderate 5 bp steepening of the curve. At the same time, the credit OAS widened by almost 60 bps.

The dramatic rates swings in 1994, ignited by the Mexican peso crisis and followed by MBS market problems in the US, saw the Treasury rates shift up by about 250 bps, with a simultaneous flattening of the curve by 45 bps. The OAS over the same period remained range bound, eventually widening by 10 bps, almost all of it during the last four months of the year, when most of the Treasury curve flattening also took place.

Then, in August-October 1998 the Treasury curve shifted 100 bps in a negative direction and twist moved 10 bps in a positive direction after the Russian default and LTCM crisis prompted the Fed to cut the short rates. Spreads moved sharply wider by 40 bps, but then reversed just as the yield curve twist subsided and the rates themselves moved higher in the beginning of 1999.

Next, the interest rate curve inverted (twist became negative) in the latter part of 1999 and beginning of 2000 as the FOMC raised the Fed Funds rate up to 6.50%, pushing the 2 year yield to 6.70% while the Treasury buybacks, budget surpluses and dampened inflation expectations helped to keep the long yields subdued at 6.00%. The credit spreads widened through this period by over 60 bps, apparently anticipating the coming risks in the equity markets which were nearing the end of the Nasdaq bubble.

**Figure 1: Treasury Shift and Twist vs. Credit Index OAS, 1990 – 2013**




*Source: Bloomberg*

Then the rates curve steadily shifted down (200 bps) and significantly steepened (80 bps) from 2000 till 2003 as the Fed cut rates 12 times, from 6.50% to 1.25%. Spreads swung widely for most of this period, from lows close to 100 bps to highs above 220 bps. The correlation of spreads with the twists becomes significantly positive — in contrast to the negative correlation with the level of rates. Spreads seemed more sensitive to expectations for the near-term economic outlook, related to the short end of the yield curve, than to long-run growth and inflation, which are related to the long end of the curve.

The economic recovery, accompanied by the rebound in rates (shift higher) and gradual reduction of the steepness of the Treasury curve from 2002 through the beginning of 2006, also saw the credit spreads tightening from over 200 bps to the lowest of 78 bps at the end of this period. Yet again, we see the negative co-movement of spreads and Treasury shifts and positive co-movement of spreads and twists.

And of course the most dramatic demonstration of this relationship came in 2007 and 2008 when the unfolding financial crisis pushed the credit spreads to historic wides, while the interest rates were brought further down by both the actions of the Fed and the effects of the economic recession. Between July 2007 and the end of 2008 the curve shifted down by another 300 bps across the board, while steepening by 50 bps.

The emergence from the crisis in 2009 brought a small rebound of the rates up (driven by the long end) but the still ongoing Fed quantitative easing program has led to further shift down and maintenance of the historically steep shape of the rates curve. The fastest credit spreads tightening coincided with the rates shift rebound in 2009.

However, the co-movement of rates and spreads from 2011 onward shows some change, with spreads widening while rates decline — as before — but with Treasury curve steepening. We discuss this in more detail later in the report.

Of course, spreads are influenced by many other factors beside the Treasury curve and the macro-economic outlook encoded therein. However, typically the significant trends of the rate changes do get reflected in spread moves. While the anecdotal evidence presented in this section helps in motivating our research project, it is not sufficiently precise to draw conclusions for the future. To do that, we need a robust statistical estimation of co-movements in treasury rates and credit spreads, which we undertake in the next section.

## Section Three

# Estimates from the Multi-Factor Risk Model

To quantify the joint behavior of interest rates and credit spreads, we turn to the Barclays POINT® Global Risk Model (see Appendix 1 and Lazanas et al. [2011] for a good introduction to these types of models). The current approach employs the DTS (duration times spread) methodology to model credit risk (see Silva

[2009]). However, the model allows for different risk configurations. In particular, for this report, we use the following decomposition: six Treasury (key-rate) factors and 27 spread factors, from a combination of nine industries times three rating buckets (AAA/AA, A, and BBB)[5].

The model estimates the covariance matrix of all common driving factors as well as the issuer-specific risk of bonds belonging to each industry/rating sector. We analyze the covariance estimates as of June 2013 and discuss their implications for the relationship between rates and spreads.

The multi-factor risk model has different calibrations available. In this paper we use two standard ones: the first weights all past observations equally, while the second is an exponential-weighted moving average (12month half live) that overweights recent data relative to more distant historical one. The corresponding versions are referred to as long-term and short-term model, respectively.

In order to take into account the issuer-specific risk and incomplete diversification of typical investor's portfolios, we defined a sector portfolio to consist of 20 equally weighted bonds having on average the same maturity and same OAS as the corresponding sector. By construction of the risk model, such portfolio is not exposed to spread twist or OAS dispersion factors. The sector correlations discussed in this paper are the correlations of OAS changes of these hypothetical sector portfolios with the Treasury shift and twist factors.

The results are shown in Table 2 for the long- and short-term models estimated as of June 2013. For comparison, and to highlight the time variability of estimates, we also show the results estimated at the time of the most recent turning rates environment: Table 3 shows the results for the long- and short-term models estimated as of December 2003.

The statistical dependence patterns found in these results are discussed in the rest of this section. Their implications for the duration management of credit portfolios are covered in section 4.

## 3.1 The effect of a Treasury curve shift

We start by documenting the effect of the Treasury curve shift on credit spreads. The results (Table 2) demonstrate a strong negative correlation between these variables for each credit sector. Uniform increase in rates is associated with tighter credit spreads while uniform drop in interest rates leads to wider credit spreads.

As an example, we find a –33% correlation for the A-rated Banking and Brokerage sector in Table 2, which implies that if all rates rise by a typical amount (an amount equal to 1 standard deviation of the shift factor), the credit spreads in this sector will likely tighten by amount equal to 0.33 of a typical movement (a standard deviation) of the sector's spread factor, all else equal. To

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5. We use this decomposition to keep our approach consistent with previous versions of this research and to allow the analysis to be done across different levels of spread, here proxied by different ratings. The qualitative results should be similar across approaches.

translate this statement into nominal levels, we note that the standard deviation of the shift factor, according to the risk model, is 24 bps, and the standard deviation of the A-rated Banking and Brokerage sector spreads is 14 bps, therefore the above prediction is that a 24 bp positive shift in rates will on average translate into almost 5 bps of tightening of the A-rated Banking and Brokerage spreads.

### Table 2: Spread Correlations with Treasury Curve Shifts (June 2013)

| Model | Long-Term Model (UW) | | | Short-Term Model (WW) | | |
|---|---|---|---|---|---|---|
| Rating | AAA/AA | A | BBB | AAA/AA | A | BBB |
| **Financials** | | | | | | |
| Banking and Brokerage | -32% | -33% | -31% | -39% | -34% | -38% |
| Financial Companies, Insurance & REITS | -26% | -33% | -38% | -21% | -34% | -42% |
| **Industrials** | | | | | | |
| Basic Industries and Capital Goods | -32% | -35% | -35% | -25% | -26% | -36% |
| Consumer Cyclicals | -38% | -34% | -30% | -29% | -27% | -32% |
| Consumer Non-Cyclicals | -35% | -32% | -30% | -25% | -23% | -26% |
| Communication and Technology | -31% | -34% | -36% | -19% | -29% | -37% |
| Energy and Transportation | -37% | -37% | -38% | -21% | -31% | -36% |
| **Utilities** | -24% | -35% | -34% | -34% | -29% | -30% |
| **Non-Corporate** | -32% | -34% | -36% | -23% | -36% | -15% |

*Source: Barclays POINT®*

The negative correlation between sector spreads and rates shift is, overall, quite similar across both the long- and short-term versions of the models. However, there are some important differences regarding the range of correlations: they are significantly more dispersed on the short-term model, while showing stronger convergence (about –30%) for the longer-term model. Another interesting difference is that the correlations are stable across ratings in the longer-term model while tending to show a negative slope for the short-term model (e.g., correlations are typically more negative for lower rating portfolios).

For comparison and to highlight the time variability of these estimates, Table 3 shows the results estimated at the time of the most recent (potentially similar) turning rates environment: December 2003. We note that while the long-term risk models estimated currently and 10 years ago show similar patterns, the short-term versions are quite different. In particular, the short-term estimates from 2003 showed a significantly stronger negative correlation (an average of about -50%, against about -30% for the three other calibrations).

One could argue that these weaker correlations are due to the effects of the Fed's quantitative easing program, which has weakened the normal relationships between the economic recovery (represented by spreads) and monetary policy (represented by rates). We will see an even stronger evidence of this in the twist factor impact. If this hypothesis is correct, and if one assumes that the QE program is about to end — taking the economy closer to its historical norm — then the long-term model or perhaps even the models estimated in 2003 may be more appropriate for prediction than the short-term model of the 2013 vintage.

In the end, the particular patterns of dependence of the strength of negative correlation on the sector or credit quality are driven by several factors, including the underlying economics of the corresponding sectors, fiscal and monetary policy, and the varying composition of the Credit Index, which occasionally has a greater representation of certain types of companies in a particular rating class. These shifts were particularly visible after the financial crisis. Many companies were downgraded from AAA/AA to A, or even to the BBB category, thus changing the compositions of those baskets and their dependence.

### Table 3: Spread Correlations with Treasury Curve Shifts (Dec. 2003)

| Model | Long-Term Model (UW) | | | Short-Term Model (WW) | | |
|---|---|---|---|---|---|---|
| Rating | AAA/AA | A | BBB | AAA/AA | A | BBB |
| **Financials** | | | | | | |
| Banking and Brokerage | -31% | -31% | -22% | -56% | -52% | -46% |
| Financial Companies, Insurance & REITS | -38% | -31% | -29% | -52% | -43% | -45% |
| **Industrials** | | | | | | |
| Basic Industries and Capital Goods | -31% | -43% | -36% | -61% | -62% | -56% |
| Consumer Cyclicals | -41% | -41% | -22% | -58% | -56% | -49% |
| Consumer Non-Cyclicals | -40% | -35% | -33% | -57% | -53% | -55% |
| Communication and Technology | -31% | -38% | -31% | -44% | -51% | -45% |
| Energy and Transportation | -41% | -43% | -40% | -57% | -60% | -60% |
| **Utilities** | -21% | -36% | -29% | -56% | -54% | -40% |
| **Non-Corporate** | -31% | -35% | -41% | -60% | -53% | -55% |

*Source: Barclays POINT®*

The dependence patterns in correlations between industry sector/rating category spreads and interest rates shift factor, which remain valid across time and model types, include:

- Cyclical industries exhibit a stronger negative correlation with the shift factor than do non-cyclical industries. This should come as no surprise, because by definition the dependence of cyclical industries on economic decline or recovery, reflected by the changing levels of interest rates, is stronger.
- In most industries, with the exception of the Banking and Brokerage and Consumer sectors, lower credit quality is associated with greater degree of negative correlation. This is rather intuitive, because companies with lower credit quality are typically more affected by the changes in the economic outlook, as reflected in the general level of interest rates.

Equally telling are some of the dependence patterns in correlations which changed substantially with time and depend strongly on model type:

- In the years prior to the financial crisis, the Financials sector uniformly exhibited a pattern of the higher credit ratings being associated with greater degree of negative correlation (see Table 3). After the crisis, the pattern changed — the correlations in the Banking and Brokerage sector are now almost independent of the rating level, and those in the Financial Companies, Insurance and REITs are actually strongly increasing with the lower rating (see Table 2), closer to the pattern seen for other industries.

- Before the crisis, the short- and long-term models showed a similar variability of correlations across sectors and ratings. After the crisis, markets tended to move more in tandem, and long-term variability decreased. Only recently (short-term model) do we see an increased range of behavior, more consistent with historical patterns.

## 3.2 The effect of a Treasury curve twist

We now discuss the effect of the Treasury curve twist on credit spreads. One of the biggest casualties of the financial crisis and subsequent QE-filled years was the statistical dependence of credit sectors on the Treasury twist factor.

Credit spreads across all sectors and ratings used to have a consistently positive correlation with the steepening yield curve (see Table 4 for 2003 estimates). That is, a steepening of the curve is associated with higher spreads. This was consistent with what we observed during the periods at the bottom of the economic cycle when the curve inversions and steepening were driven by the Fed actions at the short end of the curve.

However, quantitative easing has changed this situation dramatically, with the Fed now explicitly targeting also the longer end of the rate curve. The moderate flattening of the curve caused by the start of the QE a few years ago coincided with some spread widening that arose from uncertainty about the strength of the economic recovery. Contrary to the normal pattern, this combination resulted in negative correlations between Treasury twists and spread. More recently, the further steepening of the curve due to concerns about the end of QE — while the short end is still nailed down by the Fed's near-zero interest rate policy — coincided with a modest credit pickup, again in contrast to the long-term norm. This is most obvious if one contrasts the results from the more recent short-term model in Table 5 with those from the short-term model as of 2003, in Table 4. The effect is also seen in long-term calibrations, but to a lesser extent. In this regard, changes in monetary policy can have a significant effect on how portfolios react to changes in interest rates.

**Table 4: Portfolio Spread Correlations with Treasury Curve Twists (Dec. 2003)**

| Model | Long-Term Model (UW) | | | Short-Term Model (WW) | | |
|---|---|---|---|---|---|---|
| Rating | AAA/AA | A | BBB | AAA/AA | A | BBB |
| **Financials** | | | | | | |
| Banking and Brokerage | 17% | 19% | 15% | 33% | 31% | 30% |
| Financial Companies, Insurance & REITS | 20% | 18% | 16% | 35% | 33% | 23% |
| **Industrials** | | | | | | |
| Basic Industries and Capital Goods | 15% | 21% | 20% | 23% | 28% | 31% |
| Consumer Cyclicals | 19% | 21% | 15% | 22% | 32% | 40% |
| Consumer Non-Cyclicals | 19% | 17% | 18% | 25% | 23% | 25% |
| Communication and Technology | 16% | 20% | 18% | 26% | 32% | 36% |
| Energy and Transportation | 18% | 21% | 21% | 26% | 29% | 30% |
| **Utilities** | 11% | 18% | 16% | 27% | 31% | 33% |
| **Non-Corporate** | 15% | 18% | 21% | 21% | 26% | 36% |

*Source: Barclays POINT®*

**Table 5: Spread Correlations with Treasury Curve Twists (June 2013)**

| Model | Long-Term Model (UW) | | | Short-Term Model (WW) | | |
|---|---|---|---|---|---|---|
| Rating | AAA/AA | A | BBB | AAA/AA | A | BBB |
| **Financials** | | | | | | |
| Banking and Brokerage | 13% | 13% | 13% | -26% | -24% | -26% |
| Financial Companies, Insurance & REITS | 11% | 13% | 12% | -16% | -23% | -28% |
| **Industrials** | | | | | | |
| Basic Industries and Capital Goods | 11% | 12% | 13% | -18% | -18% | -24% |
| Consumer Cyclicals | 13% | 13% | 14% | -20% | -19% | -22% |
| Consumer Non-Cyclicals | 12% | 12% | 12% | -18% | -17% | -19% |
| Communication and Technology | 9% | 13% | 14% | -14% | -20% | -25% |
| Energy and Transportation | 12% | 13% | 14% | -15% | -22% | -25% |
| **Utilities** | 10% | 12% | 13% | -23% | -20% | -21% |
| **Non-Corporate** | 8% | 13% | 14% | -14% | -25% | -12% |

*Source: Barclays POINT®*

## Section Four

# Duration Management of Credit Portfolios

The results of our study have important implications for risk management as well as for identifying relative value opportunities across sectors with different interest-rate sensitivities.

The directionality of credit spreads and interest rates poses a challenge to credit investors who want to manage the interest rate exposure of their portfolio. Because spreads tend to move in conjunction with underlying interest rates, a corporate bond is not fully insulated from rate movements if hedged with the same-duration Treasury bond. In other words, a credit bond portfolio benchmarked against government bond index (such as the overweight credit portion of a typical fixed income portfolio) will not be neutral to interest rate movement if it has a matching duration with the Treasury benchmark.

Indeed, duration measures the sensitivity of bond prices with respect to the change in yield. For a given shift in interest rates, the corresponding change in the corporate yield is smaller because it gets partially offset by the tightening of the spread. To account for this fact, we introduce the concept of *Effective Duration*, defined as the sensitivity of corporate bond prices to changes in the interest rate component of the yield.

The multi-factor risk model allows us to estimate the volatility $\sigma_F$ of the shift and twist factor of the yield curve as well as the volatility $\sigma_S$ of the typical industry/rating sector portfolio spread and its correlation $\rho(S, F_{treas})$ with the rate factors. Given these values, the expected change in spread given the change in the treasury factor (either shift or twist) is:

$$\frac{\Delta S}{\sigma_S} = \rho(S, F_{treas}) \cdot \frac{\Delta F_{treas}}{\sigma_F}$$

Using this relationship, we can estimate the price effect of the parallel shift on the credit bond using the chain rule:

$$\frac{1}{P} \cdot \frac{\Delta P}{\Delta F_{shift}} = \frac{1}{P} \cdot \frac{\Delta P}{\Delta Y} \cdot \frac{\Delta Y}{\Delta F_{shift}} + \frac{1}{P} \cdot \frac{\Delta P}{\Delta S} \cdot \frac{\Delta S}{\Delta F_{shift}}$$

In the first term in the left hand side, we introduced the change in the underlying yield of the Treasury curve, which by construction is assumed to be same as the change in the shift factor when the parallel shift is the sole movement of the yield curve. Therefore $\Delta Y / \Delta F_{shift} = 1$. The fractional change in price with respect to change in yield is, by definition, the modified duration of the bond (with negative sign).

In the second term, we introduced the spread, whose relationship with the shift factor we explained above. The fractional change in price with respect to change in spread is, by definition, the spread duration of the bond (with negative sign).

Defining the fractional change in price with respect to change in shift factor as the effective duration (with negative sign) we obtain:

$$D_{eff} = D_{mod} + \rho(S, F_{shift}) \cdot \frac{\sigma_{spread}}{\sigma_{shift}} \cdot D_{spread}$$

Here, $D_{eff}$ stands for the effective duration, $D_{mod}$ is the modified duration, $D_{spread}$ is the spread duration, $\rho$ is the correlation between spreads and Treasury shift, $\sigma_{spread}$ is the volatility of spreads, and $\sigma_{shift}$ is the volatility of the Treasury shift factor (both volatilities must be measured in absolute terms and expressed in equal units, e.g. bp/month).

Since the correlation of spreads and yields is negative and quite substantial, the effective duration will be typically smaller than modified duration. For most fixed coupon bonds modified duration and spread duration differ very slightly, hence the effective duration is approximately equal to a fraction of the modified duration. We denote this fraction as *Effective Duration Multiplier* $M_{eff}$, and rewrite the effective duration definition as follows:

$$D_{eff} \approx M_{eff} \cdot D_{\text{mod}}$$

$$M_{eff} = 1 + \rho\left(S, F_{shift}\right) \cdot \frac{\sigma_{spread}}{\sigma_{shift}}$$

The estimated values of the effective duration multiplier are shown in Tables 6 and 7, for each of the estimates of the risk model, respectively. To illustrate with an example, look at Table 6 for the results from the long-term risk model from 2013, and consider two 10-year par bonds — a Treasury and a typical corporate bond in A-rated Consumer Cyclicals. Suppose both have modified duration of 7.5 years, the spread duration of the corporate bond is also 7.5 years.

**Table 6: Effective Duration Multipliers for Industry/Rating Sectors (June 2013)**

| Model | Long-Term Model (UW) | | | Short-Term Model (WW) | | |
|---|---|---|---|---|---|---|
| Rating | AAA/AA | A | BBB | AAA/AA | A | BBB |
| **Financials** | | | | | | |
| Banking and Brokerage | 79% | 81% | 65% | 68% | 70% | 48% |
| Financial Companies, Insurance & REITS | 83% | 69% | 46% | 83% | 65% | 32% |
| **Industrials** | | | | | | |
| Basic Industries and Capital Goods | 87% | 79% | 67% | 88% | 84% | 62% |
| Consumer Cyclicals | 84% | 75% | 63% | 85% | 79% | 63% |
| Consumer Non-Cyclicals | 84% | 82% | 77% | 88% | 86% | 78% |
| Communication and Technology | 88% | 74% | 59% | 92% | 75% | 55% |
| Energy and Transportation | 82% | 79% | 70% | 88% | 80% | 66% |
| **Utilities** | 87% | 79% | 69% | 79% | 83% | 73% |
| **Non-Corporate** | 91% | 82% | 66% | 93% | 75% | 82% |

*Source: Barclays POINT®*

We observe that the correlation between the 10-year yield and the spread on the corporate is –34%. This means that a 10 bp increase in Treasury rates will be typically accompanied by a decrease in the spread of the corporate bond, equal to the correlation multiplied by the ratios of the standard deviations of spreads and rates factors. The standard deviation of the rate shifts is 24.3 bps/month (as determined from the Barclays POINT® risk model), and the standard deviation of the spreads in A Consumer Cyclicals is 18.2 bps/month. Therefore, the corresponding spread tightening, predicted by the risk model, is equal to 10 bps * 34% * 18.2 / 24.3 = 2.5 bps.

The price impact of the 10 bp increase in rates is 7.5 * 0.10 = 0.75 decrease in price per 100 initial value in both bonds. However, for the corporate bond this price decrease will be offset by a 2.5 bp decrease in spreads, and associated price impact of 7.5 * 0.025 = 0.1875 per 100 initial value. Thus the price of the corporate bond will decrease only by 0.75 – 0.1875 = 0.5625. Since this price change was effected by a 10 bp rise in rates, the effective duration is 0.5625 / 0.10 = 5.625 years. This effective duration value represents 75% of the original modified duration of 7.5 years (as reported in the figure).

### Table 7: Effective Duration Multipliers for Industry/Rating Sectors (Dec. 2003)

| Model | Long-Term Model (UW) | | | Short-Term Model (WW) | | |
|---|---|---|---|---|---|---|
| Rating | AAA/AA | A | BBB | AAA/AA | A | BBB |
| **Financials** | | | | | | |
| Banking and Brokerage | 89% | 87% | 81% | 84% | 83% | 79% |
| Financial Companies, Insurance & REITS | 88% | 87% | 84% | 85% | 79% | 75% |
| **Industrials** | | | | | | |
| Basic Industries and Capital Goods | 92% | 87% | 84% | 83% | 79% | 75% |
| Consumer Cyclicals | 89% | 83% | 79% | 85% | 75% | 64% |
| Consumer Non-Cyclicals | 89% | 89% | 87% | 83% | 83% | 79% |
| Communication and Technology | 89% | 84% | 78% | 80% | 76% | 58% |
| Energy and Transportation | 87% | 86% | 82% | 80% | 80% | 77% |
| **Utilities** | 93% | 87% | 81% | 77% | 77% | 62% |
| **Non-Corporate** | 93% | 88% | 71% | 89% | 86% | 61% |

*Source: Barclays POINT®*

Thus, a credit portfolio that is overweight in this corporate bond, while benchmarked to a Treasury portfolio with matching modified duration will in fact be mismatched in terms of effective duration, and consequently in terms of expected sensitivity to interest rate moves.

Another interesting take-away from this analysis is related to the Banking and Brokerage portfolios. The effective duration of these portfolios is significantly lower in 2013 (compared with 2003), especially in the short-term model. As discussed previously, this may be the consequence of the atypical behavior this industry has registered since the financial crisis.

We emphasize that when measuring the risk of credit portfolios within the Barclays POINT® portfolio analytics system, the effect of the correlation between the credit spreads and Treasury rates is fully taken into account by virtue of using the complete multi-factor risk model with full covariance matrix of dependencies. The example above illustrates the source of the high contribution of interest rate risks to the tracking error of many credit portfolios even when they are apparently well balanced in terms of modified duration.

Many credit portfolio managers are not actively managing the duration or curve position of their portfolios, but are instead following the constraints imposed by broader multi-asset class and duration allocations within risk budgeting frameworks of aggregate fixed income portfolios. In such cases, either the portfolio managers responsible for asset allocation can take into account the rates-spreads directionality in setting the goals for the credit PMs, or the credit portfolio managers can explicitly adjust their duration targets if the implicit assumption in the asset allocation process is that of independence of rates and spreads.

# Section Five
# Conclusions

In this paper we used the statistically robust framework of the Barclays POINT® Global Risk Model to analyze the co-movements of interest rates and credit spreads. The main message is that both shifts and twists of the Treasury yield curve are accompanied by significant changes in both the level and slope of the credit spread curve.

We reiterate that this study concerns contemporaneous correlations and is not, by itself, a statement of causal relationship. Rather, the existence and robustness of correlations across a long historical period from 1990 until the present can be taken as a evidence for the common economic driving factors between rates and spreads.

Portfolio managers need to consider the rates-spreads directionality effects when fine-tuning their interest-rate hedging strategies and relative value decisions across credit sectors in the environment when credit specific news are dominated by macro-economic news leading to significant Treasury curve moves.

The years since our original studies saw periods ranging from very low risk (2005 and 2006) to extremely high risk (2008), as well as the subsequent recovery accompanied by the peculiar experience of the Fed's quantitative easing, which influenced both interest rates and credit markets. As discussed in section 3, some of the results (such as the negative correlation of spreads and Treasury curve shifts) remain quite robust, while others (the correlation of the spreads with Treasury curve twists) have become dislocated or even changed signs.

Although we do not provide specific forecasts in this paper, we caution investors to choose their scenarios carefully and pick those they believe will be representative of the near future, when applying this framework for credit portfolio management. Whether the most recent estimates will continue to hold depends on the assumption that economic conditions and the effect of the Fed's actions on the shape of the Treasury curve will remain the same. For investors who think that these conditions will change, it is possible that the more representative statistics for the future may be found in the more distant past.

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# Appendix 1

### The Barclays POINT® Global Risk Model

This paper analyzes the relationship between US interest rates and credit spreads using the statistically robust framework of the Barclays POINT® Global Risk Model. This is a multi-currency cross-asset model that covers many different asset classes across fixed income, equity markets, commodities, etc., and includes derivatives in these markets. At the heart of the model is a covariance matrix of risk factors. The model has more than 500 factors, many specific to a particular asset class. The asset class models are periodically reviewed. Structure is imposed to increase the robustness of the estimation of such large covariance matrix. The model is estimated from historical data. It is calibrated using extensive security-level historical data and is updated on a monthly basis.

The model offers different calibrations, namely the unconditional and the conditional models. The unconditional or unweighted covariance matrix requires fewer assumptions than the conditional covariance matrix and can be thought of as the long-run level of the covariance matrix. The unweighted covariance matrix assigns the same weight to every observation in the sample. It has perfect "memory," i.e., it never forgets a past event, no matter how far back in the past the event occurred. In particular, it does not distinguish between the recent and the distant past, which, depending on the circumstances, may be a desirable feature. The conditional covariance matrix is usually calculated using a time-weighted estimation method: this method assigns more weight to recent observations relative to more distant ones, with the goal of conditioning the final estimates toward the current state of the markets. POINT® uses an exponential weighted moving average with a half-life of 12 months: a one-year old observation receives half the weight of the most recent observation. The unweighted volatility is very stable over time and over the state of the economy, whereas the weighted volatility is strongly time varying. In the situation when the dynamics of the market change rapidly, e.g., during the recent credit crisis, the weighted covariance matrix reflects the changed market conditions in a timely manner as it allocates more weight to the recent past. Both the speed and the magnitude of the changes in the weighted volatility estimate are higher than for the unweighted volatility estimate. This is true both for periods of increasing and decreasing volatility.

# Appendix 2

**Quantitative Easing in the United States**

Quantitative easing (QE) is an unconventional monetary policy used by central banks to stimulate the economy when short-term interest rates are at or close to zero and normal monetary policy can no longer lower interest rates. QE was first used by Japan in 2001-2006 and involves an expansion of the central bank's balance sheet. It is typically implemented by the central bank buying long term financial assets from commercial banks and other private institutions, thus increasing the monetary base and lowering the yield on those financial assets. In the United States, QE was first introduced in November 2008 in response to the financial crisis exacerbated by the default of Lehman Brothers. It was followed by two other rounds of QE with the current one still ongoing. Fed Chairman Ben Bernanke argued in 2009 that the Fed's QE program is actually a "Credit Easing" program as it targets to buy a particular credit mix of loans and securities (as opposed to buying government bonds) with the goal of using that particular composition of assets to affect credit conditions for households and businesses.
(http://www.federalreserve.gov/newsevents/speech/bernanke20090113a.htm)

**QE1: November 2008 – June 2010**

In November 2008, during a period of financial panic in the aftermath of the Lehman default, the Fed announced plans to buy $100bn of GSE debt and $500bn of agency mortgage-backed securities over the following few quarters. The Fed eventually accumulated a balance sheet of $2.1 by June 2010 when it stopped the program as the economy started showing signs of improvement.

**QE2: November 2010 – June 2011**

In August 2010, the Fed decided that the economic growth in the US was not as robust as expected and they resumed purchases, and resume purchasing $30bn of 2- and 10-yr Treasuries every month to maintain the Fed balance sheet around $2 trillion. In November 2010, the Fed announced that they will buy additional $600bn of Treasury securities by the end of Q2'11 as a second significant round of QE.

**QE3: September 2012 – present**

In September 2012 the Fed announce a third round of QE, planning to buy $40bn of non-agency MBS per month, an amount which was raised to $85bn per month starting Dec 2012. In June 2013, Ben Bernanke announced the possibility of "tapering" QE3 by scaling down bond purchases from $85bn to $65bn a month, starting in September 2013. However, on September 18, 2013, the Fed decided to hold off on tapering the current bond buying program. Current consensus is that tapering will not start before March 2014 but surprises are always possible.