BARCLAYS

Quantitative Portfolio Strategy

5 May 2014

Structure of US Corporate Excess Returns

The Hunt for a "Low-Risk" Anomaly

Kwok Yuen Ng
+1 212 526 6685
kwok-yuen.ng@barclays.com

Bruce Phelps, CFA
+1 212 526 9205
bruce.phelps@barclays.com

www.barclays.com

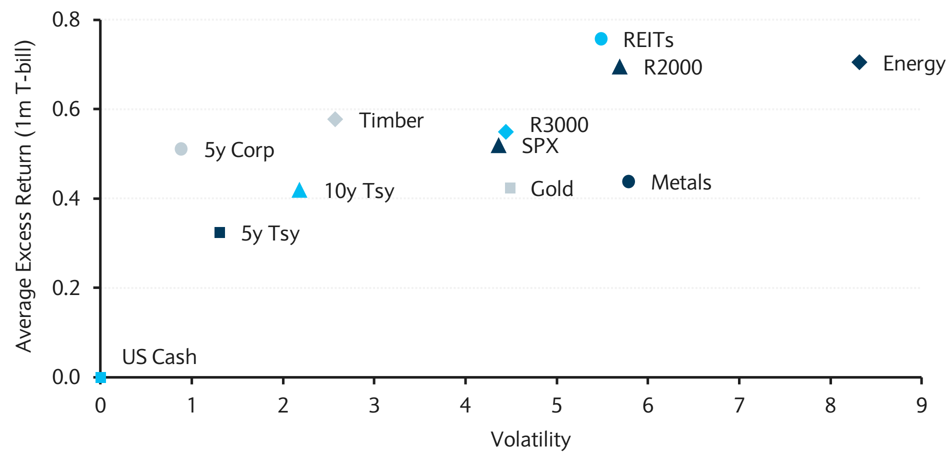
- Investors expect assets to have similar risk-adjusted returns over time, as assets with higher risk tend to have higher realized returns. However, within asset classes (e.g., equities), low-risk assets are observed to have greater risk-adjusted returns than high-risk assets. This observation is often called a "low-risk" anomaly.
- We investigate the empirical risk-return relationship for USD corporate bonds (investment grade and high yield) using various single measures of *ex ante* spread risk. Do corporate bond investors earn higher excess returns for taking more risk? More important, do *risk-adjusted* returns vary by the degree of risk?
- Using duration-times-spread (DTS) as the spread risk measure, we find a clear positive risk-return relationship. This should be reassuring for credit investors. In addition, we find no relationship between DTS risk and risk-adjusted returns. In other words, there is little evidence of a low-risk anomaly.
- For another spread risk measure, OASD, we find evidence of a low-risk anomaly, but caution that this measure does a poor job differentiating corporate bonds by risk. Using OAS as the risk measure, we find it does a good job sorting bonds by risk, but produces results contradictory to a low-risk anomaly.
- We examine the possibility that interaction effects between OAS and OASD could obfuscate the presence of a low-risk anomaly. We perform two-way (OAS, OASD) sorts and still find little evidence of an anomaly.
- In OASD-OAS risk terms, the "sweet spot" for corporate risk-adjusted excess returns is low OASD, high OAS bonds. The "sour spot" is high OASD, low OAS bonds. For a given DTS, low OASD, high OAS outperforms high OASD, low OAS.
- The existence of a low-risk anomaly would imply that investors can earn positive returns by forming long-short portfolios that hedge out the risk exposure. However, we find that returns on such strategy portfolios can be highly correlated with market returns and exhibit joint tail risk. Consequently, positive returns on these long-short strategies are not necessarily reflective of an exploitable low-risk anomaly, but instead reflect non-diversifiable market risk.
- We re-examine our findings controlling for industry effects. These results do not alter our conclusions.
- Sharpe ratios declining with risk are not necessarily anomalous. To illustrate, we project corporate excess returns onto equity and bond factors. Loadings on these two factors vary depending on the risk bucket. Using the estimated loadings to form stock-bond replicating portfolios, we find that Sharpe ratios decline with increasing risk, reflecting the interaction between these two risk factors and not a pricing anomaly.

Introduction

Intuition and finance theory argue that investors who bear more *ex-ante* risk earn higher expected returns. If so, we would expect to see a positive relationship between risk and realized returns over time. In fact, Figure 1 shows that across asset classes, there is a positive relationship between one measure of risk – total return volatility – and average returns (net of 1m Treasury bills).

FIGURE 1

Average Excess Returns (Net of 1m T-bill) versus Realized Volatility; November 1990-October 2011



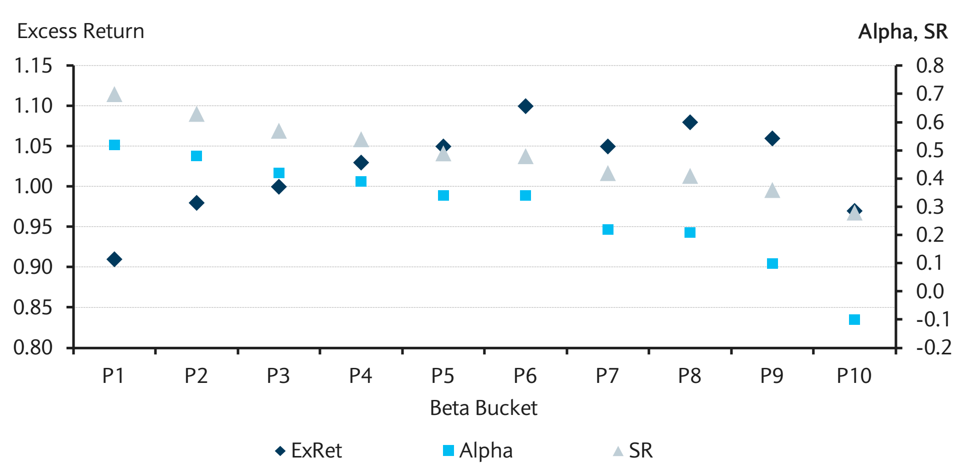
Source: Barclays Research

Investors also expect to observe this risk-return relationship cross-sectionally within an asset class. From CAPM, we expect stocks with higher risk (i.e., higher beta, β) to earn higher returns. In addition, in an efficient capital market, stocks are expected to earn a risk-adjusted return (i.e., alpha) of zero, irrespective of beta.

However, within an asset class, there is not always a positive risk-return relationship. In fact, within equities, researchers have long reported that there seems to be a weak (or negative) cross-sectional risk-return relationship. Borrowing data from Frazzini & Pedersen (2013), Figure 2 shows how average excess returns (net of 1m Treasury bill returns), Sharpe ratio,

FIGURE 2

The Low-Risk Phenomenon in US Equity Market; 1929-2012



Source: Table III; Frazzini & Pedersen (2013); 1929-2012; Excess returns vs. 1m T-bill; CAPM alpha and (CAPM) alpha vary across beta buckets over 1929-2012. While average realized excess returns generally increase with β, Sharpe ratios and alphas decline with β. In other words, lower-risk assets have better risk-adjusted performance than higher-risk assets.

This negative risk-return pattern is sometimes called an “anomaly” because it suggests that investors can create a risk-neutral, long-short portfolio by buying low-risk assets and selling high-risk assets in a way that cancels out the risk, but leaves a positive return.

Explanations for the Low-Risk Anomaly

Researchers have offered several explanations for the observed risk-return pattern of cross-sectional equity returns. An initial explanation was that beta was an inadequate equity risk measure and that the low-risk anomaly was not an anomaly, but reflected omitted risk factors. This led to a scramble to identify those omitted priced risk factors (book-to-price, momentum, etc.) that could solve this riddle. While adding these other factors seem to remove the anomaly, researchers often have difficulty explaining why these other “risk” factors are compensated risk factors.

A second set of explanations argue that beta may be an adequate risk measure, but there are behavioral reasons for the observed pattern of returns. For example, high-risk assets can, at times, become overpriced relative to low-risk assets because of investor overconfidence, risk-seeking preferences, a need to quickly demonstrate performance, irrationality, etc. The problem with these behavioral explanations is that it is difficult to explain why they would persist. Even if they persist, other investors could profit from the “low-risk” anomaly and presumably remove it.

Another set of explanations tries to offer structural reasons for the observed cross-sectional risk-return pattern. Researchers argue that investors with a return target above the market return, and who cannot use leverage to increase their market exposure, have no alternative but to overweight high-risk assets and underweight low-risk assets.[1] As a result, high-risk assets tend to be overpriced (i.e., with lower Sharpe ratios and negative alphas) relative to low-risk assets (i.e., with higher Sharpe ratios and positive alphas).

Another possible structural explanation for the persistent risk-return pattern is that many investors care more about their performance relative to a benchmark than their absolute performance.[2] These investors are satisfied to hold overpriced high-risk assets because it reduces the risk of underperforming the benchmark. The consequence of these overpriced assets losing value would be suffered equally by both the portfolio and the benchmark and, so, is not a performance risk.

Why Study the Low-Risk Anomaly?

Our goal is to examine the risk-return relationship in the USD corporate bond market. How are returns related to risk over time? Do we see evidence of a low-risk anomaly where, using a single measure of risk, lower-risk corporates have better risk-adjusted returns than higher-risk corporates?

Corporate portfolio managers have a natural motivation to study the low-risk anomaly, as it addresses a key question: Are you appropriately compensated for taking more spread risk? Most managers believe that absolute excess returns are positively related to risk, but as we will show, this is not always the case. Many managers, however, are probably less sure how risk-adjusted returns are related to risk.

[1] Fisher Black (1972) and, recently, Frazzini & Pedersen (2013).
[2] Falkenstein (2012). At a recent Barclays conference, we polled a large group of senior portfolio managers as to why a low-risk anomaly might persist: 48% stated that limited arbitrage capital prevented the correction of the anomaly; 44% stated that investors care about relative risk versus a benchmark, not absolute risk; 4% stated “other,” and 4% did not believe in a low-risk anomaly.

Discovering a low-risk anomaly could direct portfolio managers to profitable alpha opportunities. Buying (overweighting) low-risk corporates and selling (underweighting) high-risk corporates would allow a manager to “hedge out” risk while capturing a positive return. We often hear of this as a corporate alpha strategy. The rationale and performance of this strategy depend on the existence of a low-risk anomaly.

Finally, there has been considerable interest in alternative portfolio construction strategies that determine asset class weights based on the contribution of each asset class to the portfolio’s risk. These types of strategies have such names as “risk parity,” “smart beta,” or “low volatility.” Often, these strategies produce solutions that have large (often leveraged) positions in low-volatility assets (e.g., bonds) and much smaller positions in high-volatility assets (e.g., stocks). The challenge for risk parity strategies is to offer a theoretical justification for why such a portfolio construction approach is optimal. One way to build support for risk parity has been to show that low-risk assets, within an asset class, display the low-risk phenomenon. If somehow this low-risk phenomenon can be shown to be a universal within-asset class phenomenon, then perhaps investors can infer that risk parity is an optimal portfolio construction method.[3]

Defining a Low-Risk Anomaly in USD Corporate Bonds

A low-risk anomaly is defined as lower-risk corporate bonds having higher risk-adjusted excess returns than higher-risk corporates. We measure corporate returns using “excess returns,” where the Treasury duration component of return is removed from the corporate bond’s total return. (See Appendix for details.) Corporate excess returns measure the return from bearing corporate risk (i.e., default and liquidity risk). While the term “risk-adjusted returns” can take several forms, it is typically defined as the Sharpe ratio (excess returns divided by volatility of excess returns) or alpha (regression intercept of excess returns on the market’s excess returns).

We consider a low-risk anomaly to have the following characteristics:

- Sharpe ratios are higher for low-risk corporates than for high-risk corporates; not necessarily monotone in risk;[4]
- Risk-adjusted returns (i.e., alphas) are higher for low-risk corporates than for high-risk corporates; not necessarily monotone in risk; and
- A long-short risk-neutral strategy portfolio is profitable with little or no risk, and its returns are uncorrelated with the market’s excess return.

In our search for a low-risk anomaly, we will examine the relationship between realized corporate excess returns, Sharpe ratios, risk-adjusted returns, and measures of corporate spread risk. But what is the appropriate measure of risk? We examine several single-risk measure candidates. We then form long-short portfolios with zero net exposure to the risk measure and see if there are positive realized returns. We also want to know if positive returns are evidence of a low-risk anomaly in corporate bonds.

[3] Asness, Frazzini, and Pedersen (2012).
[4] In the absence of arbitrage, well-diversified portfolios (i.e., risk “buckets”) are expected to have similar Sharpe ratios. This does not necessarily hold for individual securities due to diversifiable idiosyncratic risk.

Corporate Bond Excess Returns versus Risk

Corporate Bond Excess Return Risk Measures

We define "risk" as the volatility of excess returns. Volatility is a symmetrical measure of risk, and an argument could be made that this is inadequate for corporates that have a skewed excess return distribution. Nevertheless, we will be examining the risk-return pattern for large, diversified corporate portfolios whose returns are much less skewed.

Which single-risk measure best captures the volatility of corporate bond excess returns? There are many candidates:

1. **Historical excess return volatility (HistVol):** Investors may use realized historical return volatility to estimate a bond's excess return volatility. Using HistVol as a risk measure is perhaps an odd choice, as it is entirely backward looking. Is a bond's historical volatility a good estimator of its future volatility? HistVol has practical limitations as well, because some bonds may not have the minimum required excess return history. However, HistVol has an advantage in that it is not dependent on proprietary analytics (e.g., OAS) or subjective evaluations (e.g., quality rating).

2. **Sensitivity to "corporate market" returns ($\beta_{CorpIndex}$).** This measure captures a "CAPM"-flavor type of risk: not absolute volatility, but correlation with corporate market excess returns.

3. **Sensitivity to macroeconomic risk (β_{CFNAI} and β_{CPI}).** Investors could form portfolios based on exposure to macroeconomic risks such as "growth" and "inflation."[5] Perhaps investors care about the correlation of a corporate bond's excess returns with macroeconomic risks?

4. **Default risk.** Default is the corporate investor's ultimate risk, which is all the more painful because defaults tend to occur and cluster at times when marginal utility is high (e.g., recessions). Variations in the probability of default, as well as recovery amount, are reflected by the variation in a bond's spread to Treasuries. How do investors measure a bond's default risk? There are several possibilities:

   a. **OASD:** Higher spread duration corporate bonds have more sensitivity to fluctuations in spreads.

   b. **OAS:** Option-adjusted spread reflects the additional compensation demanded by investors for the higher default risk and lower liquidity of corporate bonds versus Treasuries.

   c. **DTS = OASD x OAS:** Although DTS is a single risk measure, it does capture both OASD and OAS. DTS as a spread risk measure reflects the observation that absolute spread changes tend to be proportional to the level of spreads.

   d. **Quality:** Rating agency quality ratings are a traditional measure of default and spread risk.

   e. **Financial statement variables:** Some investors might use published accounting variables (e.g., leverage and net interest coverage) to determine a bond's spread risk.

5. **Idiosyncratic volatility.** Perhaps investors demand compensation for a bond's idiosyncratic risk? Theory argues that idiosyncratic risk is a diversifiable risk in investor portfolios and should not earn an excess return. However, investors often hold small

[5] We use the Chicago Fed National Activity Index to measure growth and the Consumer Price Index to measure inflation.

portfolios and, thus, may require higher compensation for bonds with higher idiosyncratic risk.

We sort the constituents of the US corporate bond market (investment grade-only, high yield-only or both combined) according to a particular risk measure. For example, suppose that we use OASD as the risk measure. At the beginning of each month, we sort all US corporate bonds by their OASD into 10 equal (by number) buckets. For each bucket, we then calculate (using market value weights) average OASD, OAS, DTS, and excess return. And finally, we calculate the monthly average excess return ("return") and its standard deviation ("risk"), as well as an annualized Sharpe ratio and alpha (risk-adjusted return).[6]

Our dataset is the Barclays USD Investment Grade (IG) and High Yield (HY) Corporate indices. Our data period is from January 1997 through October 2013. (In the Appendix, we discuss the rationale for selecting this period.)

For this study, we analyze the risk-return relationship for five single risk measures: HistVol, OASD, OAS, DTS, and Quality.[7]

Risk versus Return: HistVol

For each bond in the relevant index, we use the bond's trailing 12m excess return volatility as the estimator for its spread risk.[8] At the beginning of each month, we sort the universe of corporate bonds into 10 HistVol buckets, from lowest to highest. Each risk bucket contains an average of 393 bonds each month over the data period.[9] Figure 3 shows the HistVol results for the IG & HY combined universe.

We review Figure 3's format in detail, as it will be used frequently. In the top third of the figure, we calculate various statistics for each risk bucket using market value weights. For example, for HistVol bucket II, the average OASD = 3.35, OAS = 116bp, and DTS = 3.82.

The middle third of the table presents the average monthly excess return, its standard deviation, and annualized Sharpe ratio. Continuing with risk bucket II as our example, we see that the average monthly excess return was 5bp, with a standard deviation of 77bp, producing an annualized Sharpe ratio of 0.23.

The bottom third shows risk-adjusted returns as measured by the intercept term of a regression (full sample) of the bucket's monthly excess returns on the excess returns of the combined IG & HY Index. We also report the t-statistic of the estimated intercept term. For risk bucket II, the estimated alpha is 2bp with a t-stat of 0.65.[10]

[6] Annualized Sharpe ratio: SQRT(12) × average monthly excess return/volatility of monthly excess returns. Alpha: OLS estimated intercept of risk bucket monthly excess returns on the relevant corporate index excess return.

[7] Results for other risk measures (except idiosyncratic risk) are available from the authors. Also, see Ng and Phelps (2013).

[8] We use reported index excess returns that compute a monthly excess return using the corporate bond's analytical duration. We also conducted this analysis using empirical durations, but results were little changed.

[9] Here we dropped bonds that had less than 12 months of returns history. The reader will see a higher average number of bonds per risk bucket for other risk measures that do not require historical estimation.

[10] We use a two-sided test with a significance level of 5%. We use Student's t-distribution with degrees of freedom equal to the number of observations less one. With 201 degrees of freedom, the critical value is 1.96.

FIGURE 3

Average Monthly Excess Returns and Alphas by HistVol Bucket; IG & HY Combined; January 1997-October 2013

	Low (HistVol)	II	III	IV	V	VI	VII	VIII	IX	High (HistVol)	Total
Avg OASD	2.13	3.35	4.45	5.38	6.25	7.13	7.25	7.06	6.76	6.11	5.55
Avg OAS	0.93	1.16	1.37	1.58	1.82	2.10	2.47	2.95	3.92	7.39	2.37
Avg DTS	2.04	3.82	5.73	7.76	9.99	12.75	15.07	17.52	22.04	34.87	12.24
Avg ExRet	0.06	0.05	0.05	0.05	0.03	0.05	0.07	0.11	0.18	0.25	0.09
Stdev	0.49	0.77	0.99	1.29	1.56	1.83	2.11	2.34	2.92	4.70	1.65
Ann SR	0.42	0.23	0.19	0.12	0.07	0.10	0.11	0.16	0.21	0.18	0.18
Alpha	0.04	0.02	0.01	-0.02	-0.05	-0.04	-0.04	-0.01	0.03	0.03	
t-stat	2.00	0.65	0.24	-0.65	-1.65	-1.44	-1.83	-0.36	0.58	0.22	

Source: Barclays Research

Figure 3 shows that prospective excess return volatility increases monotonically with HistVol. HistVol accurately sorts bonds by risk. Average excess returns are relatively flat across most risk buckets, increasing only with the last three buckets.

Using HistVol as the risk measure, we see some evidence of a low-risk anomaly. The Sharpe ratio for the lowest risk bucket is larger compared with all other buckets. Sharpe ratios then decline, reaching a minimum for the middle risk buckets, but then increase for the highest risk buckets.

Figure 3 shows that while the alpha declines as we move beyond the lowest risk bucket, it then rises as we approach the highest risk buckets. The lowest risk bucket is the only bucket with a positive and significant alpha, while some of the middling risk buckets have negative and almost significant alphas. However, the highest risk buckets clearly have alphas that are not significantly different from zero. Although these results are consistent with a low-risk anomaly, as the low-risk bucket has the best performance across buckets, some of the behavioral and structural explanations for the existence of the low-risk anomaly are not supported. For example, the presence of leverage-constrained investors would be expected to produce lowest alphas for the highest risk buckets.

To investigate the economics of a low-risk anomaly, we construct a long-short strategy portfolio. Using the IG & HY combined corporate universe, we form a low-HistVol portfolio by combining the two lowest risk buckets (using market value weights). We then form a high-HistVol portfolio by combining the two highest risk buckets. We then buy the low-HistVol portfolio and, in order to be risk neutral, sell X% of the high-HistVol portfolio, where X% is the ratio of the two risk factor values of the low-risk and high-risk portfolios: X% = HistVol (low-risk portfolio)/HistVol (high-risk portfolio). We then compute the excess return of the strategy for the following month defined as excess return (low-risk portfolio) – X% × excess return (high-risk portfolio). Each portfolio in the strategy is assumed to be financed by the corresponding short Treasury portfolio that removes duration exposure. The long-short strategy portfolio is rebalanced monthly.

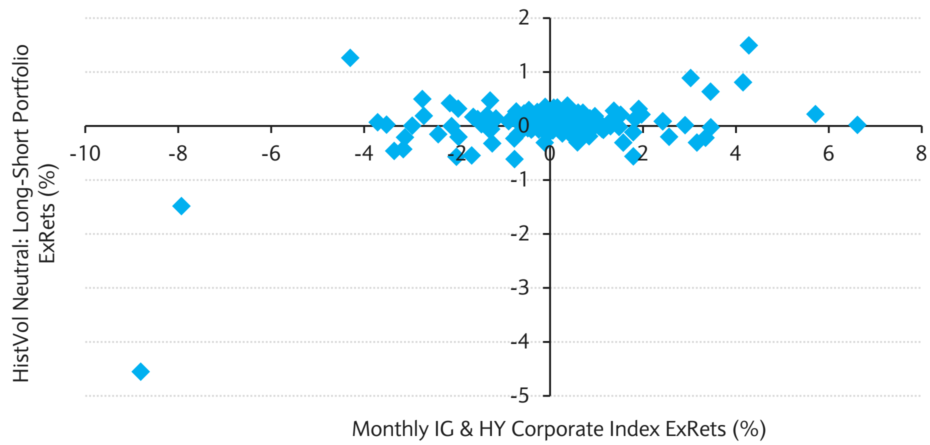
For HistVol, the long-short strategy has been profitable, with an average monthly excess return of 3bp/m, a volatility of 42bp, and an annualized Sharpe ratio of 0.29.[11] The correlation of the strategy with the corporate market was 0.45, driven in large part by the

[11] The performance figures for all the strategies in this paper do not account for transactions costs. In the Appendix, we present the liquidity cost scores (LCS) for the OASD, OAS, and DTS risk buckets for various months. See Figure A7. Based on our liquidity cost scores (LCS), a 3bp monthly return is unlikely to be sufficient to cover the strategy's transactions costs.

October 2008 large negative (almost -5%) joint tail event (see Figure 4). The strategy does have positive joint tail dependence on the market return, suggesting that the strategy has not removed market risk. While the performance of the strategy is supportive of a low-risk anomaly, it is also consistent with compensation an investor would demand for bearing such tail risk.

FIGURE 4

Long-Short HistVol-Neutral Portfolio versus IG & HY Combined Corporate Index; Monthly Excess Returns; January 1997-October 2013



Source: Barclays Research

When we analyze investment grade and high yield bonds separately, we see that HistVol continues to sort bonds by risk accurately. Except for the highest risk bucket, average excess returns do not increase with risk, and there is a pattern of alphas that more clearly supports a low-risk anomaly (see Appendix; Figures A3 and A4).

HistVol is arguably the most direct way to search for a low-risk anomaly. It accurately sorts bonds by future excess return volatility without relying on proprietary analytics or qualitative judgments. We see that bonds with the lowest HistVol earn a positive risk-adjusted return. And as risk increases, the risk-adjusted returns are negative. However, for the riskiest bonds, risk-adjusted returns are statistically zero.

While HistVol does a good job sorting bonds by risk, it is likely not a risk measure used by corporate bond investors. A significant limitation of HistVol is that new issues have no excess return history, and our results exclude such bonds. Presumably, investors use other prospective risk measures, such as option-adjusted spread duration (OASD), option-adjusted spread (OAS), duration-time-spread (DTS), or rating agency quality ratings. We now search for a low-risk anomaly using these more common risk measures.

Risk versus Return: OASD

Spread duration is often used as the single risk metric for corporate bond excess returns. Many investors use contribution to spread duration to measure their portfolio exposure to credit risk.

At the beginning of each month, we sort bonds in the IG & HY combined universe into 10 OASD buckets, from lowest to highest. The average number of bonds in each bucket is 498, ranging from a minimum of approximately 389 in February 1998 to a maximum of 684 bonds in October 2013. Figure 5 shows the results.

FIGURE 5

Average Monthly Excess Returns and Alphas by OASD Bucket; IG & HY Combined; January 1997-October 2013

	Low (OASD)	II	III	IV	V	VI	VII	VIII	IX	High (OASD)	Total
Avg OASD	1.36	2.36	3.17	3.87	4.51	5.22	6.04	7.06	9.52	12.56	5.71
Avg OAS	2.14	2.40	2.81	2.93	3.19	3.12	2.40	1.73	2.21	1.61	2.42
Avg DTS	2.99	5.83	8.98	11.37	14.43	16.27	14.44	12.16	21.33	19.96	12.82
Avg ExRet	0.13	0.12	0.12	0.11	0.05	0.07	0.04	-0.01	0.09	-0.03	0.07
Stdev	0.78	1.20	1.47	1.64	2.09	2.26	1.96	1.61	2.45	2.27	1.71
Ann SR	0.56	0.36	0.28	0.24	0.09	0.10	0.08	-0.01	0.13	-0.05	0.14
Alpha	0.10	0.08	0.06	0.05	-0.03	-0.02	-0.03	-0.07	0.00	-0.12	
t-stat	4.10	2.94	2.65	2.23	-0.95	-0.62	-1.57	-3.36	-0.10	-2.34	

Source: Barclays Research

Moving to higher OASD risk buckets, we see, of course, that average OASD increases. We also see that average OAS increases, but then decreases. As discussed in the next section, this pattern of rising OASD and falling OAS suggests the presence of interaction effects between these two risk measures that may distort results when we sort bonds using a single risk factor.

Figure 5 shows that average realized excess returns are relatively flat for the first few OASD buckets, and then they start to decline. The lowest risk bucket has the highest average excess return (13bp/m), and the highest risk bucket has the lowest average return (-3bp/m). This risk-return pattern may be surprising to portfolio managers. Even before adjusting for risk, we see compelling evidence of a low-risk anomaly.

However, realized excess return volatility displays an unexpected pattern. Volatility increases up to the middle risk buckets but then flattens as we move to higher and higher risk buckets. These results make OASD an odd risk measure, as excess return volatility does not increase with the measure.

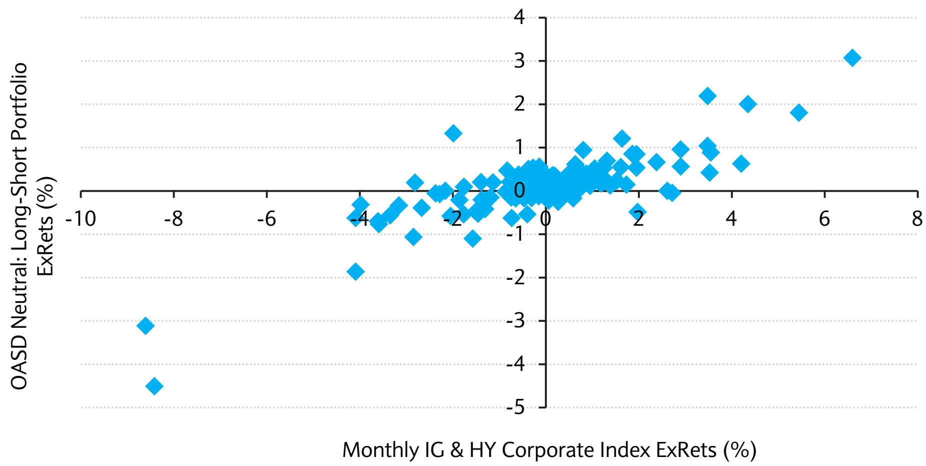
Nevertheless, using OASD, we see a definite risk-return pattern reflecting a low-risk anomaly. Sharpe ratios generally decline as we move into higher risk buckets – a result of the lower returns, not higher volatility. The risk-adjusted alphas also decline with the risk bucket. For the low-risk buckets, the alphas are positive and statistically significant, while we see negative and significant alphas for the high-risk buckets. We see strong and clear evidence of a low-risk anomaly.

This pattern of risk-adjusted returns also bodes well for a long-short strategy. Indeed, the strategy has been very profitable, with an average monthly excess return of 12bp/m, volatility of 62bp, and a Sharpe ratio of 0.69. However, for the strategy to support a low-risk anomaly conclusion, it should display a time series of returns neutral to the market. Instead, the trade was highly correlated with the overall corporate bond market (correlation of 0.81; see Figure 6). Moreover, it contained significant joint tail risk with corporate market returns.

The long-short OASD-neutral portfolio is a credit spread steepening portfolio strategy. As discussed in Naik, et al. (2007), credit spread steepeners are pro-cyclical, so a long-short OASD-neutral portfolio will tend to outperform as corporate excess returns do well, and vice versa. Although the strategy's performance seems to reflect a low-risk anomaly, given the high positive correlation of the strategy to the market, the strategy's performance could readily be considered required compensation for the strategy's long market exposure.

FIGURE 6

Long-Short OASD-Neutral Portfolio versus IG & HY Combined Corporate Index; Monthly Excess Returns; January 1997-October 2013



Source: Barclays Research

Some investors are restricted to holding only investment grade or high yield debt, so we might see different signs of a low-risk anomaly in these market segments. Given some of the theories supporting a low-risk anomaly, we might expect the anomaly to be more pronounced in one segment relative to the other. For example, IG investors might be more "constrained" than HY investors. If so, IG investors who are reaching for a yield target, but are leveraged constrained, might have excess demand and overpay for high-return, high-risk IG corporates and have negative excess demand and ignore undervaluation for low-return, low-risk IG corporates. Also, many IG managers are benchmarked against the IG corporate index and care greatly about their relative performance. In contrast, many HY managers tend to be evaluated more in total return terms rather than relative to a benchmark. Overall, the greater constraints and increased benchmark focus of IG investors might make a low-risk anomaly more pronounced in investment grade than in high yield.

We segment the OASD results according to whether a bond was IG or HY (using index ratings) at the beginning of each month. The average number of bonds in each bucket for IG-only is 340, ranging from a minimum of approximately 251 bonds to a maximum of 474. For HY-only, the counts are 153, 33, and 210, respectively.

The segmented results display a similar pattern as for the IG & HY combined universe. Figure 7 presents the OASD results for IG-only. Average excess returns decrease with higher risk buckets. We also see that realized excess return volatility has more of a tendency to increase as we move to the higher risk buckets (except for the highest OASD bucket). Compared with the combined results, we see stronger evidence for the low-risk anomaly for IG-only bonds: Sharpe ratios and alphas decline with the risk bucket. The low-risk buckets have positive and significant alphas, while the high-risk buckets have some negative and significant alphas.[12]

[12] The IG-only and HY-only alphas are estimated versus the IG-only and HY-only corporate indices, respectively. The combined IG & HY alpha is versus the IG & HY combined corporate index (market value weighted).

FIGURE 7

Average Monthly Excess Returns and Alphas by OASD Bucket; IG-only; January1997-October 2013

	Low (OASD)	II	III	IV	V	VI	VII	VIII	IX	High (OASD)	Total
Avg OASD	1.43	2.39	3.27	4.09	4.97	5.93	6.82	8.17	10.94	12.99	6.09
Avg OAS	1.29	1.36	1.47	1.49	1.72	1.75	1.57	1.59	1.90	1.49	1.56
Avg DTS	1.92	3.35	4.85	6.10	8.68	10.44	10.68	13.52	20.87	19.23	9.87
Avg ExRet	0.08	0.08	0.05	0.07	0.08	0.05	-0.02	0.02	0.01	-0.04	0.04
Stdev	0.60	0.87	1.04	1.06	1.53	1.58	1.54	1.75	2.54	2.18	1.40
Ann SR	0.43	0.31	0.17	0.22	0.17	0.11	-0.05	0.05	0.01	-0.07	0.09
Alpha	0.06	0.06	0.03	0.04	0.04	0.01	-0.06	-0.02	-0.05	-0.10	
t-stat	3.04	2.62	1.10	2.73	1.62	0.43	-3.41	-0.87	-1.23	-2.10	

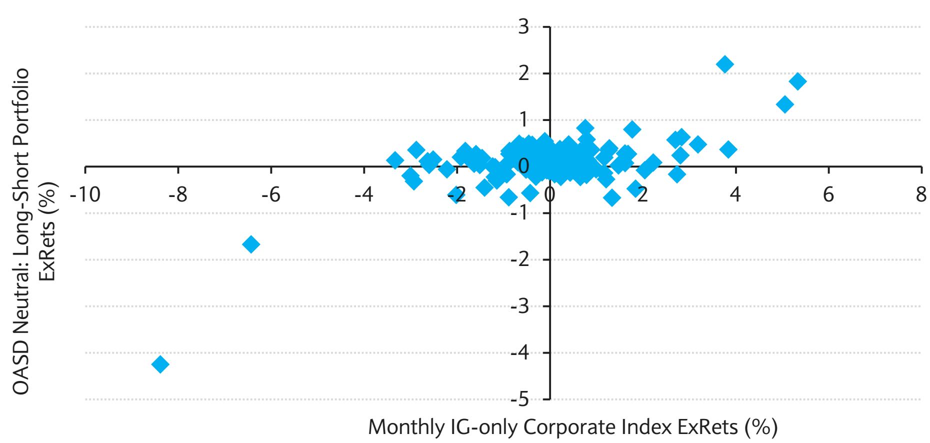
Source: Barclays Research

These IG-only results suggest that a long-short OASD-neutral strategy has been profitable. Again, we form a (low-OASD) – (high-OASD) strategy portfolio by combining the two lowest and two highest risk buckets (using market value weights). Using IG-only bonds, the strategy remained very profitable, with an average monthly return of 8bp/m, volatility of 45bp, and a Sharpe ratio of 0.62.

However, as before, the strategy contained some significant tail risk with some large positive and negative returns. More important, however, the trade remained highly correlated with the overall corporate bond market (correlation of 0.64; see Figure 8). Without the tail events, the strategy appeared, however, to be less correlated with the market compared with the IG & HY combined sample.

FIGURE 8

Long-Short OASD-Neutral Portfolio versus IG-only Corporate Index; Monthly Excess Returns; January1997-October 2013



Source: Barclays Research

For HY-only, excess returns decline with the risk measure, and realized excess return volatility quickly flattens as we move to higher risk buckets (Figure 9). However, the highest risk bucket has an average excess return that is above average. We also observe positive and significant alphas for the lowest risk bucket and negative and almost significant alphas for some of the higher risk buckets (but not the highest risk bucket). Overall, as we suspected, the strength of the low-risk anomaly appears stronger in investment grade than in high yield. This offers some support for the behavioral and structural explanations given for a low-risk anomaly.

FIGURE 9

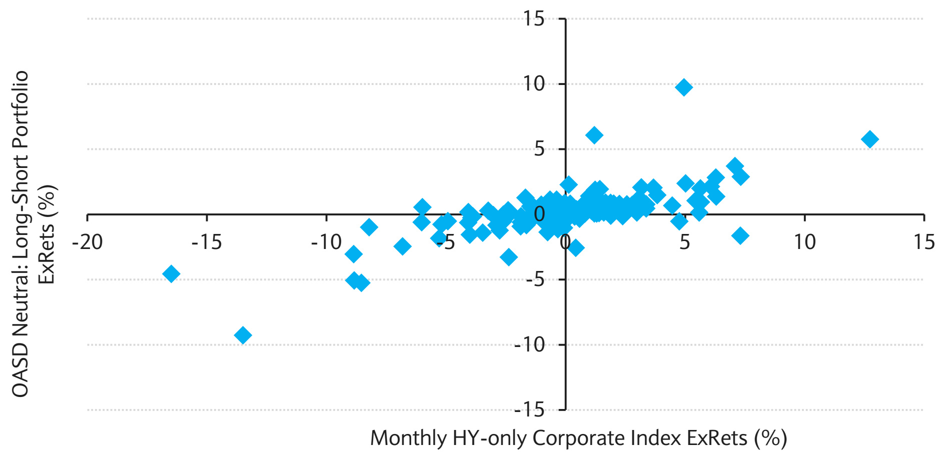
Average Monthly Excess Returns and Alphas by OASD Risk Bucket; HY-Only; January1997-October 2013

	Low (OASD)	II	III	IV	V	VI	VII	VIII	IX	High (OASD)	Total
Avg OASD	1.22	2.32	3.04	3.60	4.06	4.49	4.90	5.37	6.10	8.79	4.47
Avg OAS	5.20	6.24	6.41	6.31	6.06	5.82	5.45	5.02	4.32	4.16	5.45
Avg DTS	7.47	15.21	19.70	22.73	24.52	25.94	26.52	26.75	26.01	34.94	23.20
Avg ExRet	0.25	0.22	0.24	0.29	0.15	0.13	0.11	0.13	0.09	0.19	0.18
Stdev	2.00	2.77	3.21	3.45	3.54	3.58	3.55	3.66	3.57	3.85	3.20
Ann SR	0.44	0.28	0.26	0.29	0.14	0.12	0.11	0.12	0.09	0.17	0.19
Alpha	0.16	0.09	0.07	0.11	-0.04	-0.07	-0.08	-0.07	-0.10	-0.01	
t-stat	2.21	1.07	1.11	1.93	-0.83	-1.49	-1.88	-1.24	-1.78	-0.12	

Source: Barclays Research

FIGURE 10

Long-Short OASD-Neutral Portfolio versus HY-Only Corporate Index; Monthly Excess Returns; January1997-October 2013



Source: Barclays Research

Using HY-only, the long-short strategy was very profitable, with an average monthly excess return of 23bp/m, volatility of 154bp, and an annualized Sharpe ratio of 0.53. Unfortunately, the strategy contained significant tail risk, with some large positive and negative returns that were highly correlated with the overall corporate bond market (correlation of 0.70; see Figure 10).

While the Sharpe ratios and alphas seem consistent with a low-risk anomaly when risk is measured by OASD, the performance of the long-short OASD-neutral portfolio strategy does not provide unequivocal supporting evidence. The high returns on the strategy are equally consistent with required compensation for the large amount of long market exposure retained by the strategy.

However, the OASD results suffer from a more severe weakness. To serve as support for the low-risk anomaly, OASD must be a good measure of corporate bond spread risk. But as shown, OASD does a poor job differentiating corporate bonds by risk. Examining Figure 5 (or 7 or 9), we observe that the standard deviation of excess returns levels off by the middle risk bucket and, in some cases, declines with higher OASD risk buckets. It is far from clear that OASD is a reliable risk measure.

Another sign that OASD is not a good risk measure is that absolute average excess returns decline as OASD increases. Could OASD really be the risk measure used by investors? Investors reaching for high-OASD bonds to boost excess returns (say, as argued by the "leverage aversion" hypothesis) seem to have no empirical justification for doing so.

Risk versus Return: OAS

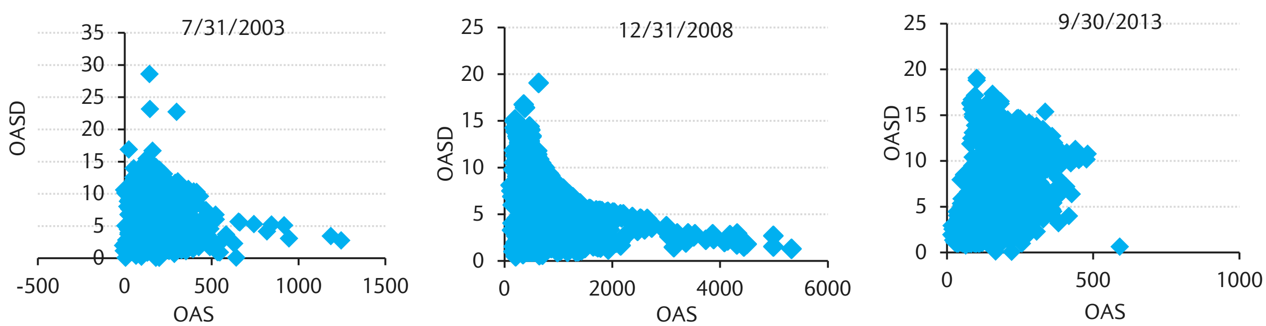
There are other single measures of corporate spread risk that may produce evidence supporting a low-risk anomaly. We first consider option-adjusted spread (OAS) as the spread risk measure, and in the following sections we examine DTS and rating agency quality grades.

A bond's OAS is probably a natural measure of spread risk for investors, as OAS measures the incremental yield spread over Treasuries for bearing corporate default and liquidity risk. Higher OAS likely reflects compensation for higher spread risk.

OAS and OASD partition the bond universe quite differently (Figure 11). Bonds with low OAS but high duration will now tend to be in a lower risk bucket compared with using OASD as the risk measure. Similarly, bonds with high spread but low duration will now tend to be in a higher risk bucket.

FIGURE 11

Bond-Level OASD and OAS; IG & HY Combined; Selected Months

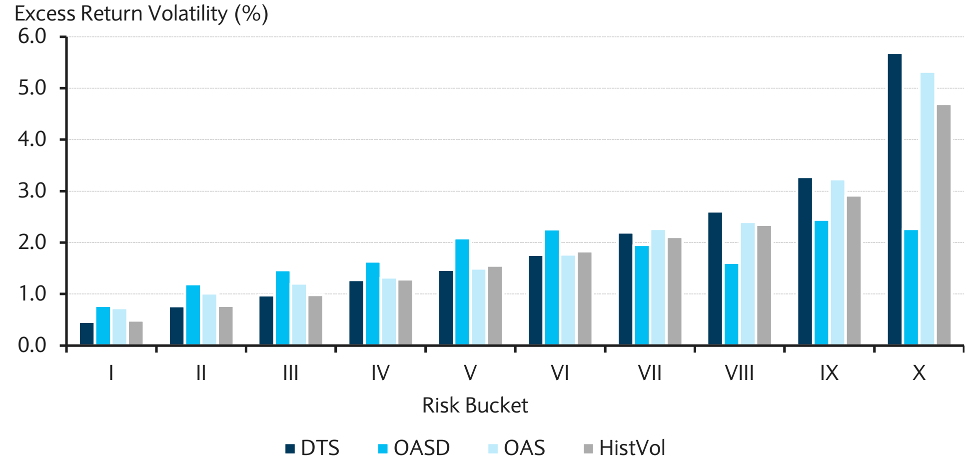


Source: Barclays Research

Figure 12 shows that OAS does a better job than OASD sorting corporate bonds by excess return volatility. Excess return volatility increases monotonically by OAS risk bucket. If a low-risk anomaly is at work, we should expect to see it more strongly when we analyze risk and return using OAS rather than OASD as the risk factor.

FIGURE 12

Monthly Excess Return Volatility by OASD, OAS, HistVol and DTS Buckets; IG & HY Corporates Combined; January1997-October 2013



Source: Barclays Research

Figure 13 shows the OAS results for the IG & HY combined universe. We see that as OAS increases, OASD does as well, but only up to a point. As we reach the middle OAS bucket, OASD starts to decline, reflecting the high spreads of bonds with short durations trading below par and the effect that high spreads have on a bond's analytical spread duration. Again, this pattern suggests the presence of interaction effects between OAS and OASD that may affect the conclusions regarding the presence of a low-risk anomaly using a single risk measure.

FIGURE 13

Average Monthly Excess Returns and Alphas by OAS Bucket; IG & HY Combined; January1997-October 2013

	Low (OAS)	II	III	IV	V	VI	VII	VIII	IX	High (OAS)	Total
Avg OASD	3.58	4.98	5.90	6.49	7.10	7.23	6.63	5.48	4.70	4.23	5.71
Avg OAS	0.64	0.98	1.19	1.41	1.66	2.02	2.62	3.52	4.95	10.04	2.42
Avg DTS	2.86	5.26	7.28	9.15	11.52	13.90	16.27	18.25	22.47	38.92	12.82
Avg ExRet	-0.02	-0.01	0.02	0.02	0.06	0.04	0.07	0.22	0.27	0.30	0.07
Stdev	0.73	1.01	1.21	1.33	1.50	1.77	2.27	2.40	3.23	5.32	1.71
Ann SR	-0.10	-0.03	0.07	0.06	0.14	0.09	0.10	0.32	0.29	0.19	0.14
Alpha	-0.05	-0.05	-0.02	-0.03	0.01	-0.02	-0.02	0.13	0.15	0.11	
t-stat	-1.63	-1.52	-0.67	-0.85	0.21	-0.85	-0.50	2.91	2.25	0.63	

Source: Barclays Research

Compared with OASD, OAS risk bucketing displays a very different risk-return relationship. In contrast to OASD, average realized excess returns increase almost monotonically with the OAS risk measure. Also, Sharpe ratios display a strong *positive* relationship with the risk bucket. The low-OAS risk buckets have the worst Sharpe ratios, while the high-OAS buckets have the best. More significantly, the alphas for the low-risk buckets are negative (but not significantly different from zero), while the high-risk buckets have positive (and often significant) alphas. Where is the low-risk anomaly when risk is more accurately measured?

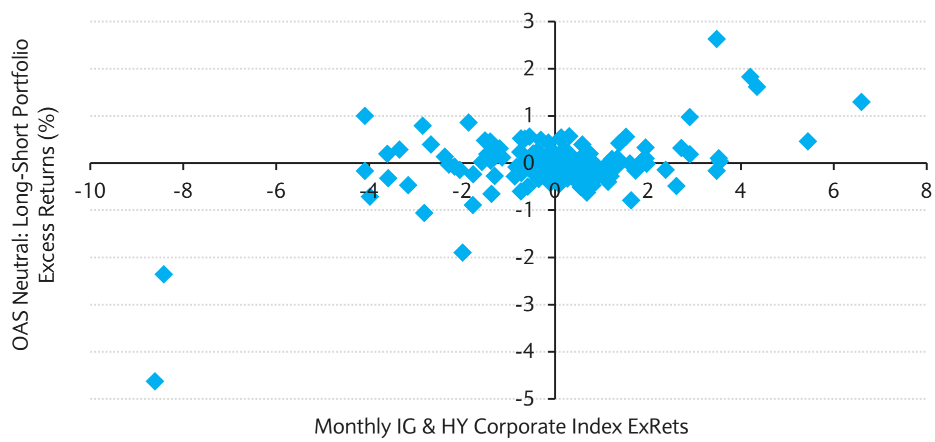
The performance of a long-short OAS-neutral strategy also contradicts a low-risk anomaly. The strategy has been unprofitable, with an average monthly excess return of -2bp/m. The volatility of the strategy portfolio was 56bp, with an annualized Sharpe ratio of -0.14.

Figure 14 shows the relationship between the strategy's returns and the excess returns of the corporate bond market. Except for the outlier returns, there appears to have been little correlation between the two sets of returns. Nevertheless, the strategy contained some significant joint tail risk exposures with the corporate market, producing a correlation of 0.51 (Figure 14). There is no evidence of a profitable, risk-neutral, long-short strategy. In fact, a *short-long* strategy would have had anomalous positive returns, with negatively correlated returns in the tail.

Constrained investors who need to own high-OAS bonds for their high realized excess returns (say, as argued by the "leverage aversion" hypothesis) have not produced a low-risk anomaly in the corporate bond market.

FIGURE 14

Long-Short OAS-Neutral Portfolio versus Corporate Index; Excess Returns; IG & HY Combined; January1997-October 2013



Source: Barclays Research

We also examine investment grade and high yield bonds separately using OAS as the risk measure. For IG-only (Figure 15), OAS sorts bonds by their excess return volatility, and realized excess returns generally increase with risk. In addition, OASD generally increases with OAS, perhaps lessening any OAS-OASD interaction effects that could cloud the results. Sharpe ratios are a bit uneven but certainly do not display a tendency to decline with risk. Risk-adjusted returns – alpha – also show a tendency to increase with the risk bucket, but none are significantly different from zero. Using OAS as the risk measure, there is little evidence to support a low-risk anomaly in investment grade corporates.

FIGURE 15

Average Monthly Excess Returns and Alphas by OAS Bucket; IG-Only; January1997-October 2013

	Low (OAS)	II	III	IV	V	VI	VII	VIII	IX	High (OAS)	Total
Avg OASD	3.36	4.41	5.23	5.87	6.28	6.73	7.15	7.45	7.64	7.11	6.09
Avg OAS	0.60	0.87	1.03	1.18	1.33	1.48	1.67	1.91	2.32	3.72	1.56
Avg DTS	2.55	4.32	5.76	7.18	8.40	9.90	11.60	13.47	16.22	21.77	9.87
Avg ExRet	-0.03	0.00	-0.01	0.03	0.01	0.05	0.07	0.07	0.06	0.17	0.04
Stdev	0.69	0.90	1.10	1.20	1.26	1.39	1.51	1.72	2.40	3.31	1.40
Ann SR	-0.14	0.00	-0.02	0.08	0.03	0.12	0.16	0.14	0.08	0.18	0.09
Alpha	-0.04	-0.02	-0.03	0.00	-0.02	0.01	0.03	0.03	0.00	0.10	
t-stat	-1.67	-0.87	-1.20	-0.08	-0.95	0.63	1.15	1.26	-0.05	0.83	

Source: Barclays Research

For HY-only (Figure 16) OAS again accurately sorts bonds by their excess return volatility. Realized average excess returns are worse for the low-risk bucket and best for the high-risk bucket. However, returns are somewhat uneven for the other buckets. Sharpe ratios are worst for the low-risk bucket, but then increase with risk until the middle-risk buckets and then decline. Finally, the alpha for the lowest-risk bucket is negative and statistically significant. While the alphas for some of the middle risk buckets are positive and significant, the highest risk buckets have alphas that are statistically indistinguishable from zero. These results do not support a low-risk anomaly.

FIGURE 16

Average Monthly Excess Returns and Alphas by OAS Bucket; HY-Only; January1997-October 2013

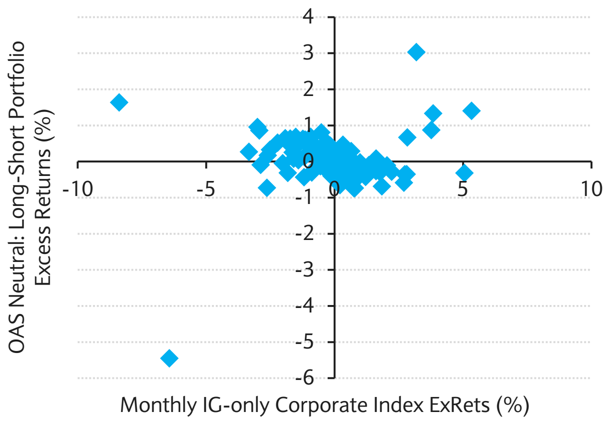
	Low (OAS)	II	III	IV	V	VI	VII	VIII	IX	High (OAS)	Total
Avg OASD	4.18	4.63	4.66	4.67	4.60	4.53	4.50	4.42	4.32	3.79	4.47
Avg OAS	2.09	2.95	3.42	3.88	4.39	5.01	5.86	7.15	9.52	16.74	5.45
Avg DTS	9.74	13.93	15.96	17.99	19.81	22.26	25.78	30.72	39.28	57.39	23.20
Avg ExRet	-0.06	0.12	0.18	0.22	0.27	0.28	0.19	0.19	0.08	0.49	0.18
Stdev	1.74	2.10	2.32	2.58	2.77	3.29	4.01	4.73	6.05	7.77	3.20
Ann SR	-0.12	0.20	0.27	0.29	0.34	0.29	0.16	0.14	0.05	0.22	0.19
Alpha	-0.14	0.02	0.06	0.08	0.13	0.10	-0.02	-0.06	-0.23	0.13	
t-stat	-2.31	0.30	1.14	1.53	2.48	1.86	-0.35	-0.56	-1.41	0.46	

Source: Barclays Research

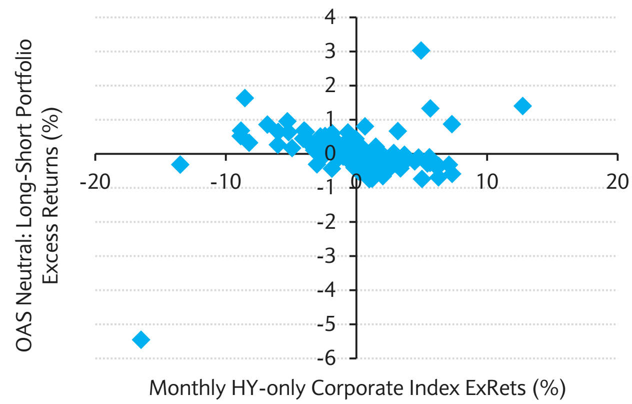
Long-short strategy results for both IG-only and HY-only were similar (Figure 17). Both have an average excess return of 0bp with a volatility of 56bp. However, correlations of strategy returns with their corresponding market's excess return were low: 0.11 and 0.08 for IG-only and HY-only, respectively. Overall, although the strategies had low correlation with the market, they had no positive return, and they had tail risk. These results do not support a low-risk anomaly.

FIGURE 17

Long-Short OAS-Neutral Portfolio versus Corporate Index; Excess Returns; IG-Only and HY-Only; January1997-October 2013



Source: Barclays Research



Source: Barclays Research

Risk versus Return: DTS

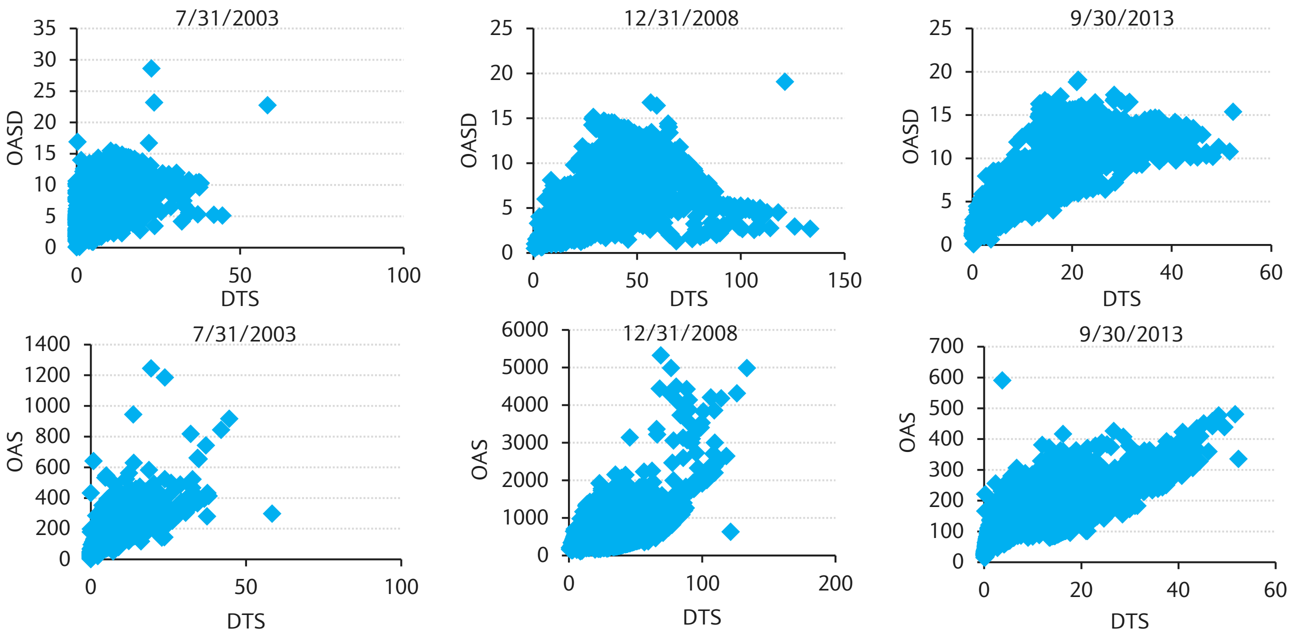
If two bonds have similar OASs, but one has a higher OASD than the other, then the former will likely have the higher excess return volatility. This is because absolute spread changes tend to be proportional to the spread level. These two bonds will have similar absolute spread changes, but the former, given its higher OASD, will produce a larger absolute spread return. Hence, the first bond will tend to have higher excess return volatility than the second.

So while OAS seems to partition the bond universe accurately by risk, it seems reasonable that OASD should have some role to play as well. In fact, multiplying OASD by OAS, or DTS, is a good *ex-ante* measure of spread volatility. As a risk measure, DTS has an advantage over OAS because it incorporates a bond's spread duration to more accurately capture the excess return effect of a given proportional change in a bond's OAS. DTS also has an advantage over OASD because it is immediately updated by changes in a bond's OAS. For example, if a bond's OAS increases because of concerns about its creditworthiness, its DTS value will increase to reflect the higher risk, while its OASD will be little affected.

DTS and OASD partition the bond universe quite differently (Figure 18). Low-OASD bonds trading at high spreads will now be in a higher risk bucket, and high-OASD but low spread bonds will be in a lower risk bucket. DTS also sorts the corporate universe differently than OAS. Low-OAS bonds with high durations will now be in middle DTS buckets, as will high-OAS bonds with low durations. Low-DTS buckets will contain proportionally more low-OAS, low-OASD bonds, and high-DTS buckets will have more high-OAS, high-OASD bonds.

FIGURE 18

Bond-Level OASD and DTS; Bond-Level OAS and DTS; IG & HY Combined; Selected Months



Source: Barclays Research

Figure 12 (presented earlier) shows that DTS does a much better job sorting corporate bonds by excess return volatility than either OASD, OAS, or HistVol. If the low-risk anomaly is at work, it should be most evident when we analyze risk and return by DTS buckets.

Figure 19 presents DTS results for the IG & HY combined universe. We see that both OASD and OAS increase across DTS risk buckets (except the highest-DTS buckets, where OASD declines a bit). In contrast to the results for OAS and OASD, these two risk measures are moving in the same direction as the DTS factor. This suggests that the DTS results, a single risk measure, might be less contaminated by interaction effects among risk factors.

FIGURE 19

Average Monthly Excess Returns and Alphas by DTS Bucket; IG & HY Combined; January1997-October 2013

	Low (DTS)	II	III	IV	V	VI	VII	VIII	IX	High (DTS)	Total
Avg OASD	1.85	3.06	4.19	5.18	5.96	6.74	7.71	8.43	8.37	7.01	5.71
Avg OAS	0.88	1.21	1.42	1.63	1.88	2.23	2.57	3.00	4.00	8.45	2.42
Avg DTS	1.46	3.34	5.22	7.30	9.58	12.40	15.88	20.03	25.99	44.06	12.82
Avg ExRet	0.03	0.05	0.04	0.03	0.05	0.05	0.08	0.10	0.23	0.24	0.07
Stdev	0.46	0.77	0.98	1.28	1.48	1.76	2.20	2.61	3.28	5.69	1.71
Ann SR	0.20	0.21	0.14	0.07	0.12	0.10	0.12	0.14	0.24	0.14	0.14
Alpha	0.01	0.02	0.00	-0.02	0.00	-0.02	-0.01	0.00	0.11	0.03	0.00
t-stat	0.66	0.80	0.11	-0.76	-0.17	-0.94	-0.30	0.04	1.65	0.19	0.00

Source: Barclays Research

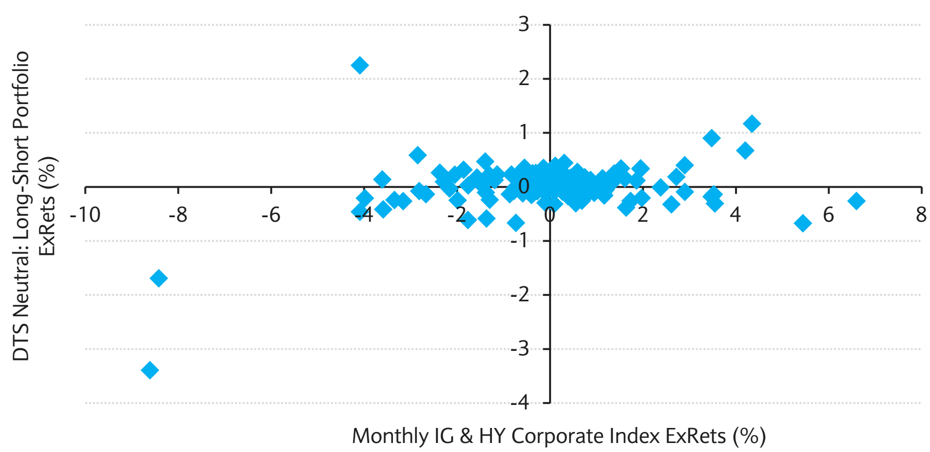
As with OAS, DTS displays a sensible risk-return relationship as average realized excess returns increase with DTS risk. However, the Sharpe ratio displays a weak relationship with the DTS risk bucket. While the lowest-DTS risk buckets have above-average Sharpe ratios, a high-risk bucket has the highest Sharpe ratio. The estimated alphas display a similar "U"-shaped pattern. However, all the alphas are statistically zero. DTS not only does the best job of partitioning the corporate bond universe by risk, but also produces realized excess returns increasing in risk and zero risk-adjusted returns across risk buckets. This should be reassuring to corporate bond managers using DTS as their risk measure. And, there is little sign of a low-risk anomaly.

To measure the profitability of a DTS low-risk anomaly, we form a long-short DTS-neutral portfolio. The strategy has been profitable, with an average monthly excess return of 3bp/m. The volatility of the strategy portfolio was 38bp with an annualized Sharpe ratio of 0.24.

Figure 20 shows the relationship between the strategy's returns and the excess returns of the corporate market. Except for the outlier returns, there is little correlation between the two sets of returns, which might bolster the case for a low-risk anomaly given the strategy's positive return. However, as we have seen using other risk measures, the strategy contained significant joint tail risk exposure with the market, causing the strategy's monthly returns to remain reasonably correlated with the market (correlation of 0.33). For DTS risk, we know the risk buckets have zero alphas, so the strategy's modest positive performance might more likely be explained as compensation for the joint tail risk exposure.

FIGURE 20

Long-Short DTS-Neutral Portfolio versus Corporate Index; Excess Returns; IG & HY Combined; January1997-October 2013



Source: Barclays Research

DTS results for IG-only are presented in Figure 21. Again, we see that DTS nicely sorts investment grade bonds by their excess return volatility. Average OAS and OASD both monotonically increase with DTS. Interestingly, unlike the IG & HY combined results, average realized excess returns are quite flat across all risk buckets, except for the highest risk bucket. As we saw for the IG & HY combined universe, the IG-only low-risk buckets have above average Sharpe ratios, but so does the highest risk bucket. Unlike the IG & HY combined results, alphas show a tendency to decline with risk. However, the low-risk buckets do not have a statistically significant positive alpha. While some of the high-risk buckets have negative and almost significant alphas, the highest risk alpha is statistically zero. These results offer only a hint of a low-risk anomaly.

FIGURE 21

Average Monthly Excess Returns and Alphas by DTS Bucket; IG-Only; January1997-October 2013

	Low (DTS)	II	III	IV	V	VI	VII	VIII	IX	High (DTS)	Total
Avg OASD	1.74	2.69	3.65	4.55	5.41	6.18	7.11	8.69	10.45	10.95	6.09
Avg OAS	0.77	1.04	1.18	1.31	1.44	1.57	1.73	1.85	2.03	2.95	1.56
Avg DTS	1.30	2.66	4.03	5.50	7.16	9.00	11.22	14.34	18.83	27.33	9.87
Avg ExRet	0.02	0.04	0.04	0.03	0.01	0.03	0.04	0.02	0.01	0.18	0.04
Stdev	0.41	0.67	0.84	1.01	1.27	1.38	1.67	2.01	2.45	3.55	1.40
Ann SR	0.19	0.19	0.18	0.09	0.04	0.08	0.09	0.03	0.02	0.17	0.09
Alpha	0.01	0.02	0.02	0.00	-0.02	-0.01	0.00	-0.03	-0.05	0.09	
t-stat	0.81	1.02	1.06	0.11	-0.78	-0.32	-0.10	-1.69	-1.79	0.93	

Source: Barclays Research

The DTS results for HY-only are in Figure 22. Sharpe ratios decline with the risk bucket, and the alpha for the lowest risk bucket is positive and statistically significant, while the alphas for some of the highest risk buckets are all negative but not statistically significant. High yield (somewhat oddly) has a stronger suggestion of a low-risk anomaly than investment grade. While both give a hint of a low-risk anomaly compared to the combined universe, the results do not offer compelling evidence of a low-risk anomaly.

FIGURE 22

Average Monthly Excess Returns and Alphas by DTS Bucket; HY-Only January1997-October 2013

	Low (DTS)	II	III	IV	V	VI	VII	VIII	IX	High (DTS)	Total
Avg OASD	1.64	2.91	3.82	4.41	4.79	5.04	5.28	5.57	5.88	5.72	4.47
Avg OAS	2.90	3.55	3.75	4.01	4.41	4.97	5.70	6.77	8.73	14.36	5.45
Avg DTS	4.20	9.54	13.25	16.41	19.46	22.89	27.19	33.10	42.48	64.12	23.20
Avg ExRet	0.14	0.15	0.16	0.20	0.19	0.22	0.27	0.20	0.10	0.32	0.18
Stdev	1.08	1.76	2.14	2.55	2.88	3.33	3.87	4.84	6.40	8.21	3.20
Ann SR	0.44	0.29	0.25	0.27	0.23	0.23	0.24	0.14	0.05	0.14	0.19
Alpha	0.08	0.06	0.04	0.07	0.04	0.04	0.06	-0.06	-0.23	-0.08	
t-stat	2.20	1.25	0.92	1.24	0.82	0.77	1.00	-0.80	-1.48	-0.29	

Source: Barclays Research

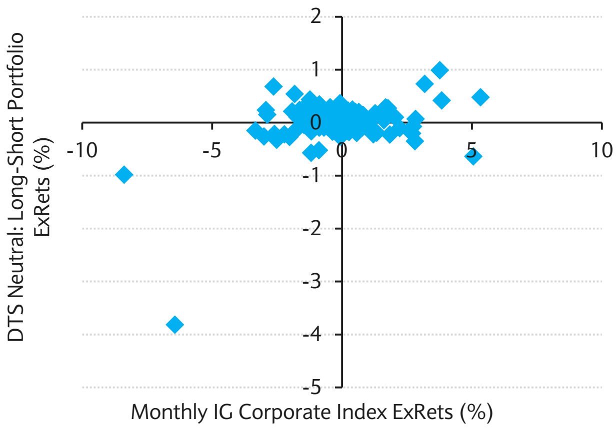
Despite the statistically zero alphas for the low-risk buckets, the long-short DTS-neutral IG-only strategy had an average excess return of 2bp with a volatility of 34bp (Figure 23). Correlation with the market excess return was 0.41. As we have seen, the strategy continues to have tail risk correlated with the market. Ignoring the joint tail risk, perhaps this is some weak support for an IG-only low-risk anomaly?

The DTS-neutral HY-only strategy had a much higher average excess return of 7bp, but with a higher volatility of 90bp. As a result, the HY-only strategy produced almost the same Sharpe ratio (0.29) as the IG-only strategy (0.24). The HY-only strategy also had a low correlation with the market of 0.16 because of some large positive returns when the market had large negative returns. Again this risk-neutral strategy had large tail risk. These results weakly support a low-risk anomaly.

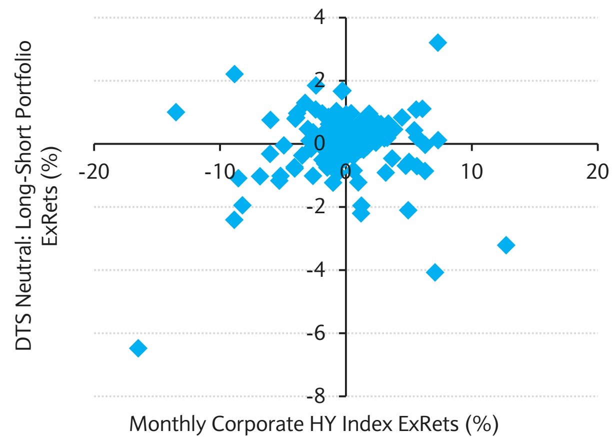
Overall, while the DTS measure does not support a low-risk anomaly for investment grade and high yield combined, the results for investment grade only and high yield only offer a suggestion of a low-risk anomaly, but not one that can be economically exploited without bearing market risk.

FIGURE 23

Long-Short DTS-Neutral Portfolio versus Corporate Index; Excess Returns; IG-Only and HY-Only; January1997-October 2013



Source: Barclays Research



Source: Barclays Research

Risk versus Return: Quality

Rating quality is another common risk measure for corporates and is often used in empirical studies of the corporate bond risk-return trade-off.[13] At the beginning of each month, we sort the IG & HY combined universe into 10 quality buckets (using Index ratings). However, unlike our previous risk-based sorts, the average number of bonds varies across buckets, from a high of 1,470 in the A-quality bucket to a low of 155 in the BA2 bucket.

Figure 24 shows that excess return volatility generally increases as we move to lower and lower quality buckets. In addition, average realized excess returns unevenly increase with declining quality. The noticeable drop in the A-bucket's excess return is due to the financial crisis, when a number of A-rated financial bonds went directly to default. The figure also shows a nice pickup in excess return as we cross the investment grade-high yield boundary.[14]

Across all rating categories, Sharpe ratios are roughly increasing with quality risk, as are the alphas. None of the high-quality rating categories have positive and significant alphas. In fact, the BA3-bucket is the only one with a positive and significant alpha. Overall, we see little evidence of a low-risk anomaly.

Within investment grade, we also do not observe a low-risk anomaly. Sharpe ratios and alphas are basically flat across ratings. Within high yield, the Sharpe ratios and alphas are generally greater for better quality BA-rated bonds than for worse quality CAA-rated bonds. However, middle quality B-rated bonds show the worst high yield performance. So, within high yield, there is some indication of a low-risk anomaly.[15]

[13] For example, see Kozhemiakin (2007).
[14] See Ng and Phelps (2011).
[15] The relatively strong performance of BA-rated bonds versus B and CAA is not due to bonds entering this rating category at abnormally low prices because of downgrade from investment grade. If we filter our data set to exclude bonds downgraded from investment grade, the same alpha pattern for high yield remains.

FIGURE 24

Average Monthly Excess Returns and Alphas by Quality Bucket; IG & HY Combined; January1997-October 2013

	AAA/AA	A	BAA1	BAA2	BAA3	BA1	BA2	BA3	B	≤CAA	Total
Avg OASD	5.46	6.08	6.57	6.47	6.15	5.22	4.82	4.42	4.26	4.12	5.71
Avg OAS	1.03	1.41	1.75	1.97	2.39	3.45	3.88	4.02	5.47	9.90	2.42
Avg DTS	6.13	8.93	11.79	12.69	14.45	17.45	18.38	17.82	22.99	38.54	12.82
Avg ExRet	0.03	0.01	0.05	0.04	0.06	0.20	0.14	0.28	0.11	0.24	0.07
Stdev	1.01	1.45	1.56	1.67	2.00	2.43	3.00	2.57	3.25	4.93	1.71
Ann SR	0.10	0.03	0.12	0.08	0.11	0.28	0.16	0.37	0.11	0.17	0.14
Alpha	-0.01	-0.04	0.00	-0.02	-0.01	0.11	0.04	0.18	-0.01	0.07	
t-stat	-0.21	-1.12	-0.17	-0.63	-0.22	1.59	0.31	2.56	-0.11	0.40	

Source: Barclays Research

Figure 25 provides a summary of the five corporate bond spread risk measures employed in this study. None shows unequivocal evidence to support the existence of a low-risk anomaly.

FIGURE 25

Summary

Risk Measure	Avg ExRets	Sharpe Ratios	Alphas	L/S Strategy	Notes
HistVol	Increase for highest risk buckets; otherwise flat	Highest for lowest risk bucket. Lowest for middle risk buckets. Increase for highest risk buckets.	Positive and significant for lowest risk bucket. Negative but not significant for middle risk buckets. Positive but not significant for highest risk buckets.	+3bp/m. Correlation (0.45) with corporate market. Significant joint tail risk with market.	Properly sorts bonds by risk but has practicality issues for use as a risk measure. Results somewhat stronger for IG-only and HY-only.
OASD	Decline with risk buckets	Low risk bucket has highest SR; SR generally declines with risk bucket	Low risk buckets have positive and significant alphas; high risk buckets have negative and significant alphas. A low-risk anomaly?	+12bp/m. Significant joint tail risk with market; very high correlation (0.81) with corporate market returns.	Does not sort bonds by risk, as volatility does not increase with OASD. Not an accurate risk measure.
OAS	Increase with risk bucket	Increase with risk bucket	Increase with risk bucket. Positive and significant for high risk buckets. Negative but not significant for low risk buckets.	-2bp/m. Correlation (0.51) with corporate market. Significant joint tail risk with market.	Properly sorts bonds by risk. Results contradictory to a low-risk anomaly. Similar results for IG-only and HY-only.
DTS	Increase with risk bucket	Highest for lowest and highest risk buckets.	Highest for lowest and highest risk buckets. No alphas are significantly different from zero.	+3bp/m. Significant joint tail risk with market. Correlation (0.33) with corporate market. Joint tail risk.	Best sort of bonds by risk. Little support for a low-risk anomaly Results for IG-only and HY-only somewhat more supportive of a low-risk anomaly.
Quality	Increase with risk bucket across all ratings. Flat for IG-only and flat for HY-only.	Increase with risk bucket across all ratings. Flat for IG-only and flat for HY-only.	Generally increase with risk bucket but not significantly different from zero. Flat for IG-only. Decline for HY-only. BA3 has best risk-adjusted returns.		No low-risk anomaly within IG. Some suggestion of the anomaly within HY.

Controlling for Industry Effects

Our results provide little support for a low-risk anomaly in USD corporate bonds. One possibility is that we are not controlling for industry effects. It is possible that low-risk bonds and high-risk bonds may have different industry concentrations. For example, if low-risk bonds have typically been financial issues, then the effect of the credit crisis on financial issuers may cause the low-risk buckets to show relatively poor risk-adjusted performance.

To control for industry effects, we re-ran our analysis first for each of the three broad index industry sector classifications (Class 3): FIN, IND, and UTL. All index corporate bonds map to one of these three sectors. For each sector, we sorted bonds across ten risk buckets. We then combined the buckets of all three sectors so that overall, each risk bucket contains the same mix, by number, of bonds across the three sectors.

Using OASD as the risk measure, Figure 26 shows that, controlling for industry effects, average excess returns and Sharpe ratios generally decline as we move to higher risk buckets. Furthermore, the alphas for the low-OASD risk buckets are positive and statistically significant, and the alphas for several of the high-OASD risk buckets are negative and statistically significant. This is the same pattern of average excess returns, Sharpe ratio, and alpha that we saw for OASD when we did not control for industry effects. As before, these results are supportive of the existence of a low-risk anomaly.

FIGURE 26

Average Monthly Excess Returns and Alphas by OASD Bucket; IG & HY Combined; Controlling for Industry Effects; January1997-October 2013

	Low (OASD)	II	III	IV	V	VI	VII	VIII	IX	High (OASD)	Total
Avg OASD	1.37	2.37	3.15	3.84	4.47	5.16	6.00	7.11	9.22	12.39	5.71
Avg OAS	2.21	2.57	2.87	2.97	3.00	2.98	2.40	1.85	2.06	1.64	2.42
Avg DTS	3.16	6.37	9.30	11.63	13.56	15.40	14.31	13.16	19.27	20.12	12.82
Avg ExRet	0.12	0.12	0.11	0.11	0.08	0.07	0.06	0.01	0.06	-0.02	0.07
Stdev	0.78	1.15	1.49	1.71	1.90	2.18	1.94	1.77	2.18	2.33	1.71
Ann SR	0.52	0.35	0.27	0.21	0.14	0.11	0.10	0.02	0.10	-0.03	0.14
Alpha	0.09	0.07	0.06	0.04	0.00	-0.01	-0.02	-0.06	-0.02	-0.10	
t-stat	3.86	3.06	2.42	1.84	0.11	-0.42	-0.76	-3.02	-0.63	-1.97	

Source: Barclays Research

However, we continue to see the flattening of realized excess return volatility across OASD buckets. OASD remains an unreliable measure of risk. In addition while the long-short OASD strategy performed well (average excess return of 12bp/m, standard deviation of 61bp, and a Sharpe ratio of 0.65), the strategy's returns remained highly correlated with the market excess return (correlation = 0.81).

Figure 27 shows that after controlling for industry effects, DTS continues to nicely segment the corporate market by excess return volatility. We also see that realized excess returns increase with DTS risk. Sharpe ratios and alphas display little pattern with respect to the risk bucket, and none of the alphas are statistically different from zero.[16]

[16] Results for IG-only and HY-only are similar as the IG & HY combined results. Details are available from the authors.

FIGURE 27

Average Monthly Excess Returns and Alphas by DTS Bucket; IG & HY Combined; Controlling for Industry Effects; January1997-October 2013

	Low (DTS)	II	III	IV	V	VI	VII	VIII	IX	High (DTS)	Total
Avg OASD	1.90	3.18	4.30	5.01	5.80	6.75	7.48	8.01	8.06	7.71	5.71
Avg OAS	0.92	1.25	1.46	1.71	1.98	2.24	2.53	2.97	4.00	7.52	2.42
Avg DTS	1.56	3.55	5.46	7.50	9.90	12.61	15.61	19.44	25.34	40.76	12.82
Avg ExRet	0.03	0.04	0.04	0.04	0.06	0.06	0.07	0.14	0.19	0.18	0.07
Stdev	0.45	0.76	1.01	1.27	1.47	1.83	2.17	2.54	3.27	5.17	1.71
Ann SR	0.26	0.20	0.13	0.12	0.14	0.11	0.12	0.18	0.21	0.12	0.14
Alpha	0.02	0.02	0.00	0.00	0.00	-0.01	-0.01	0.04	0.07	-0.01	
t-stat	1.02	0.73	0.02	-0.13	0.21	-0.60	-0.48	1.27	1.20	-0.08	

Source: Barclays Research

After controlling for industry effects, the performance of the DTS long-short strategy remained essentially unchanged from before: average monthly excess returns of 3bp/m, volatility of 36bp, and a Sharpe ratio of 0.32. However, correlation with the market excess return remained positive at 0.30.

Overall, controlling for industry effects does little to change our conclusions regarding the lack of evidence supporting a low-risk anomaly in the corporate bond market.

Two-Way Risk Factor Sorts

Using a single spread risk measure offers little support for a low-risk anomaly. OASD seems to show strong evidence supporting a low-risk anomaly, but does a poor job of sorting bonds by risk. In contrast, OAS properly sorts bonds by risk, but produces evidence strongly contradicting a low-risk anomaly. Finally, DTS produces a third set of results: it sorts bonds accurately by risk, but produces weak evidence of a low-risk anomaly.

These disparate results likely stem from the limitation of some of these single risk factors in their ability to measure risk. The data suggest that a bond's OAS and OASD are both positively related to its excess return volatility. As we saw, sorting bonds by one of these factors alone does not control for changes in the other. For example, in Figure 5, we saw that moving to higher and higher OASD buckets was, after a point, associated with sharply declining OAS. Since higher OASD bonds had, on average, lower OAS, the risk from higher OASD might have been reduced by the lower OAS. This could explain why OASD poorly sorts bonds by risk.

Figure 13 shows similar interaction effects when using OAS as the single risk measure: higher OAS buckets tend to have much lower OASD. The interaction of OASD declining as OAS increases might be sufficient to slow the increase in volatility so that the higher OAS buckets produce greater risk-adjusted returns for higher risk.

By construction, DTS picks up some of the interaction between OAS and OASD. In Figure 19, we saw that as DTS increases, both OAS and OASD increase (except for the highest DTS buckets, where OASD drops a bit). DTS produces both an accurate sorting of bonds by several risk measures and shows little evidence of a low-risk anomaly.

Although both OAS and DTS did a good job sorting bonds by risk, why did they produce different conclusions regarding the presence of a low-risk anomaly? Perhaps the interaction effects can explain it? If so, we cannot properly search for a low-risk anomaly using just one risk measure without controlling for the other. To correct for possible interaction effects, we perform two-way sorts. For example, holding OAS fixed, do we observe risk increasing as OASD increases? And if so, what is the risk-return trade-off? Similarly, do we observe risk increasing as OAS increases holding OASD fixed, and if so, do we observe a different risk-return trade-off?

Performing two-way sorts allows us to examine several questions, including:

- Controlling for interaction effects, do OAS and OASD now show evidence of a low-risk anomaly or, at least, do they tell a more consistent story?;
- Can we use the two-way OAS-OASD sorts to identify regions of the corporate market with better and worse risk-adjusted returns?; and
- For a given DTS bucket, what happens to the risk-return relationship as we vary OASD (or OAS)? Does volatility increase or decrease? What happens to average and risk-adjusted returns as a function of risk?

We perform two-way sorts as follows.[17] For an (X, Y) two-way sort, we first sort bonds into X deciles. Then, within each X decile, we sort bonds into Y deciles. Consequently, each month all of the 10 x 10 buckets are populated with the same number of bonds. Note that an (X, Y) two-way sort may produce different results than a (Y, X) sort.

Two-Way Sort: (OASD × OAS)

For the (OASD × OAS) sort, we first sort bonds into OASD deciles. Then, each month, within each OASD decile, we sort by OAS. Figure 28 displays the excess return volatility for each of the 10 × 10 buckets. Results are displayed by OASD risk bucket, from low to high. Then, within each OASD bucket, we show the volatility for each of the ten OAS buckets, from low to high. Our focus is on the behavior of the OAS deciles *within* each OASD bucket.

In each OASD bucket, we see that average volatility increases when moving to higher OAS deciles.[18] This is expected. If spread changes are proportional to spread levels, then for a given OASD bucket, excess return volatility should increase with OAS. Note that this pattern is consistent with our one-way OAS sorts (see Figure 13).

Figure 28 also shows the importance of conducting two-way sorts when using either OAS or OASD as the risk measure. Within a given OASD bucket, risk can vary dramatically depending on the OAS level. This is particularly true for some of the lower OASD buckets.

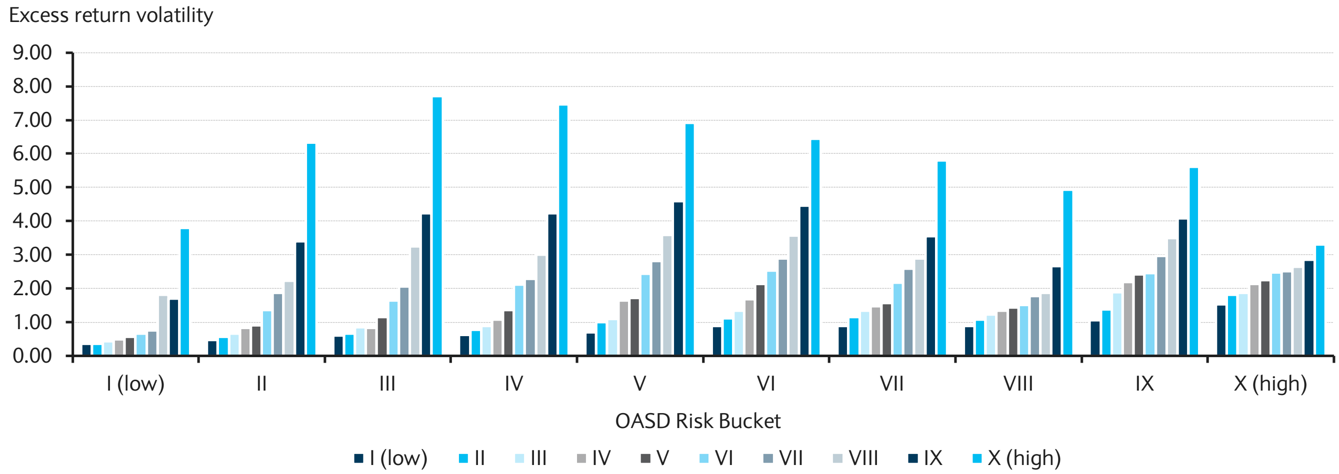
What is the risk-return trade-off as we move to higher OAS bonds within an OASD bucket?

[17] An alternative two-way sort is as follows: In a given month, a bond is assigned to an (X, Y) bucket depending on its X decile and Y decile, each determined independently of the other. For example, suppose in a month, a bond is in the IIIrd X decile and is in the VIth Y decile. This bond is then assigned to the (III, VI) bucket of the 10 x 10 X, Y grid. However, there is a potential problem with this type of two-way sort. There is no guarantee in a given month that all buckets will be populated. As a result, when comparing relative historical performance across buckets, some bucket returns may be from different time periods than other bucket returns.

[18] Detailed results are available from the authors.

FIGURE 28

Volatility of Excess Returns by Two-Way (OASD × OAS) Sorts; IG & HY Combined; January1997-October 2013

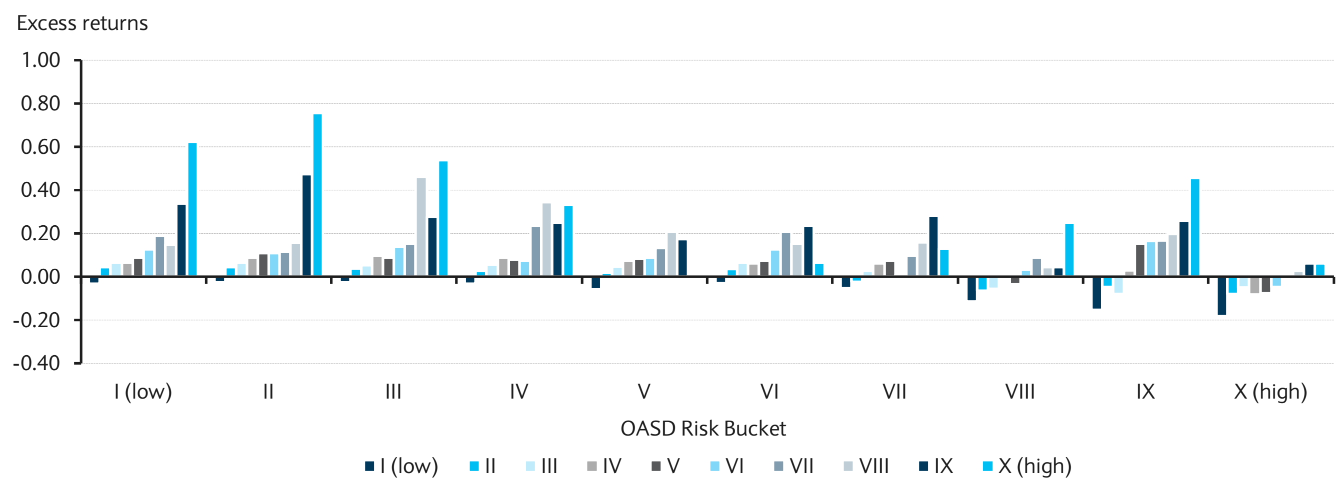


Source: Barclays Research

Figure 29 shows that within each OASD bucket, average excess returns increase with OAS. We see the same pattern when we examine risk-adjusted returns (Figure 30). Controlling for OASD, alphas increase as both OAS and volatility increase. To simplify matters, Figure 31 shows only the statistically significant alphas. Again, alphas increase with volatility. These findings do not support a low-risk anomaly.

FIGURE 29

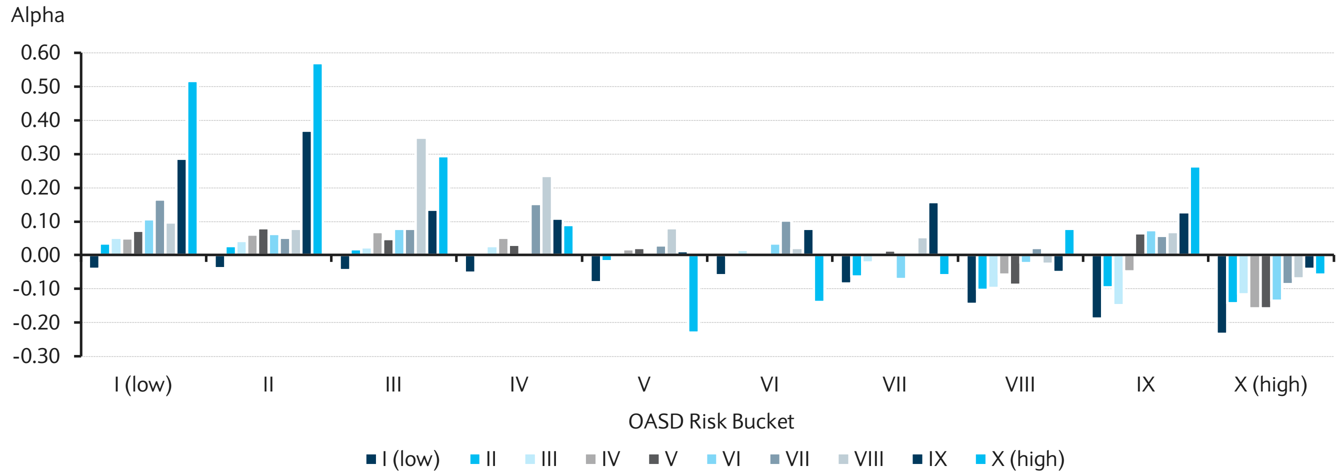
Average Monthly Excess Returns by Two-Way (OASD × OAS) Sorts; IG & HY Combined; January1997-October 2013



Source: Barclays Research

FIGURE 30

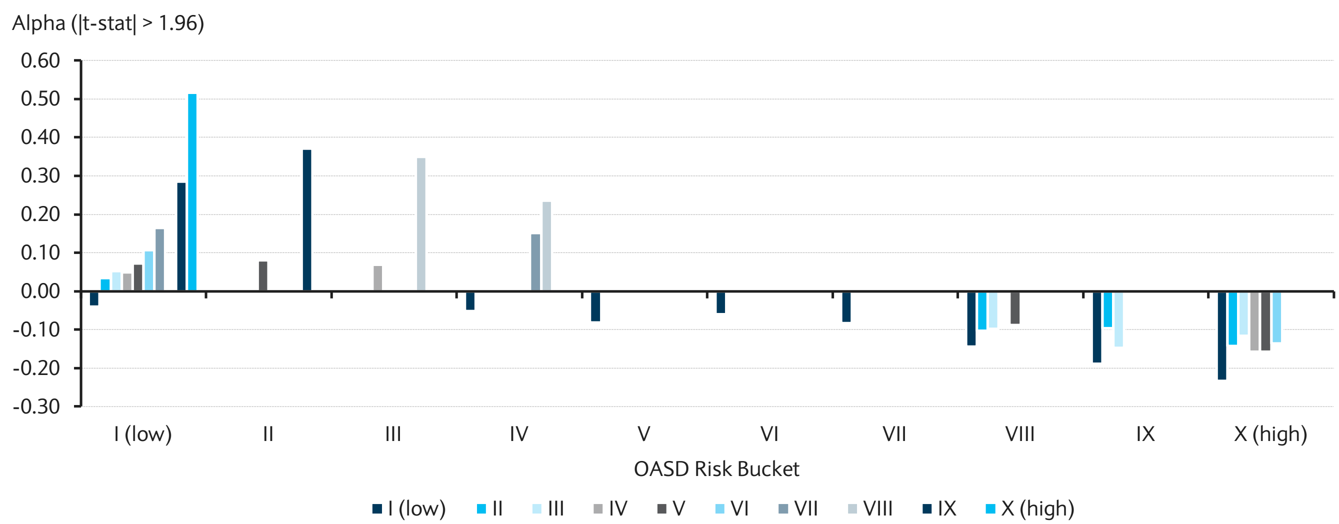
Alphas by Two-Way (OASD × OAS) Sorts; IG & HY Combined; January1997-October 2013



Source: Barclays Research

FIGURE 31

Statistically Significant Alphas by Two-Way (OASD × OAS) Sorts; IG & HY Combined; January1997-October 2013



Source: Barclays Research

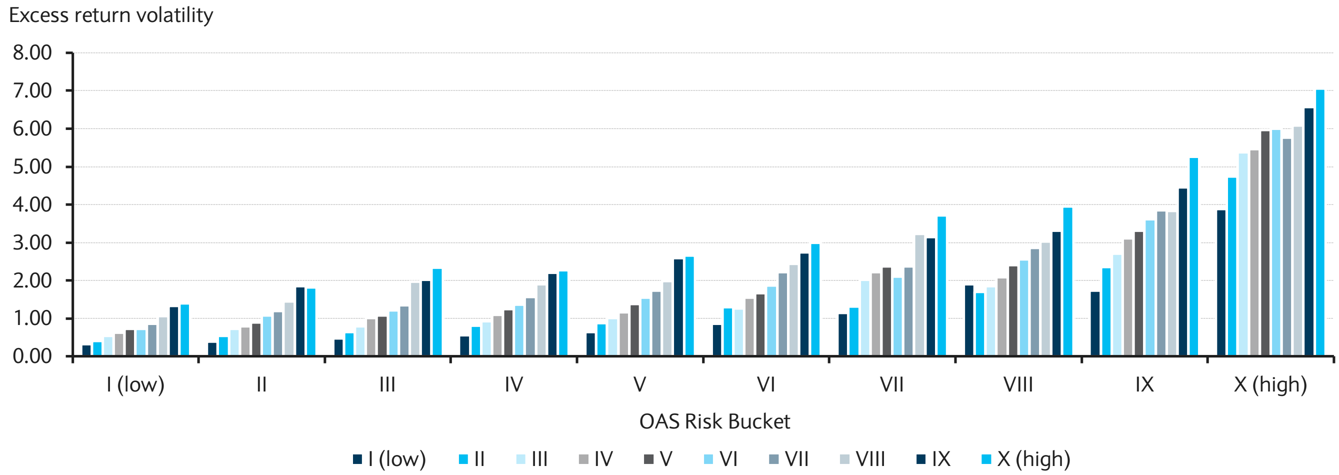
Two-Way Sort: (OAS × OASD)

We next control for OAS and sort bonds into OASD deciles. Again, our focus is on the risk-return pattern of the OASD deciles *within* each of the OAS buckets.

Controlling for OAS, average volatility increases as OASD increases (Figure 32). Note that this pattern contradicts the one-way OASD sort (see Figure 5), where we saw volatility either not increasing or declining as we moved to higher OASD buckets. What is the risk-return trade-off as OASD increases once we control for OAS?

FIGURE 32

Volatility of Excess Returns by Two-Way (OAS × OASD) Sorts; IG & HY Combined; January1997-October 2013

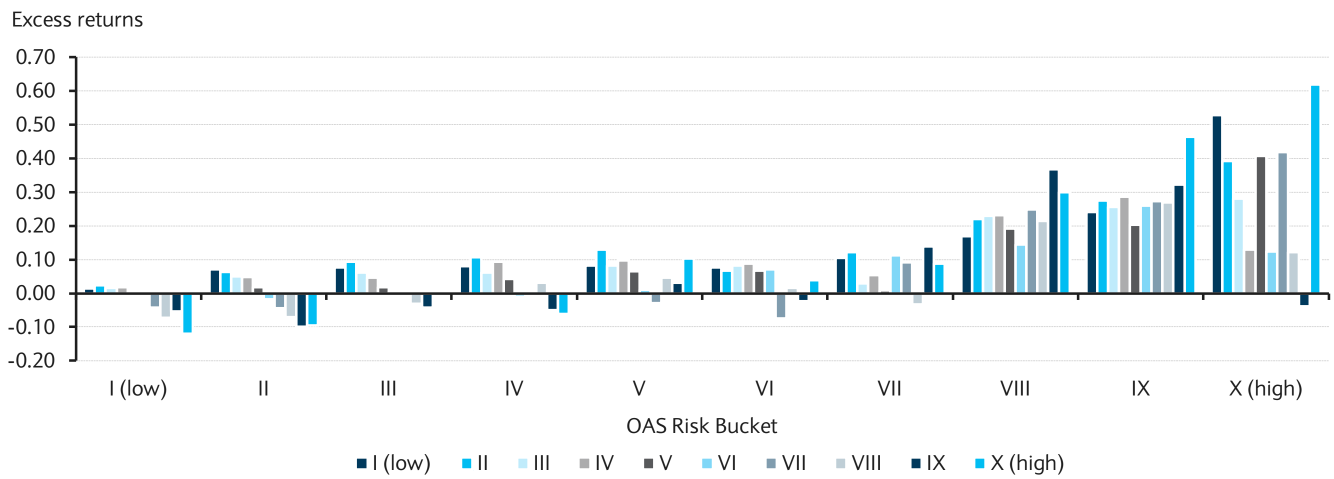


Source: Barclays Research

Figure 33 shows that, controlling for OAS, there is a mixed picture regarding the relationship between average excess returns and OASD. In the lower OAS buckets, returns decrease as OASD and volatility increase, with a reversed pattern for higher OAS buckets.

FIGURE 33

Excess Returns by Two-Way (OAS × OASD) Sorts; IG & HY Combined; January1997-October 2013

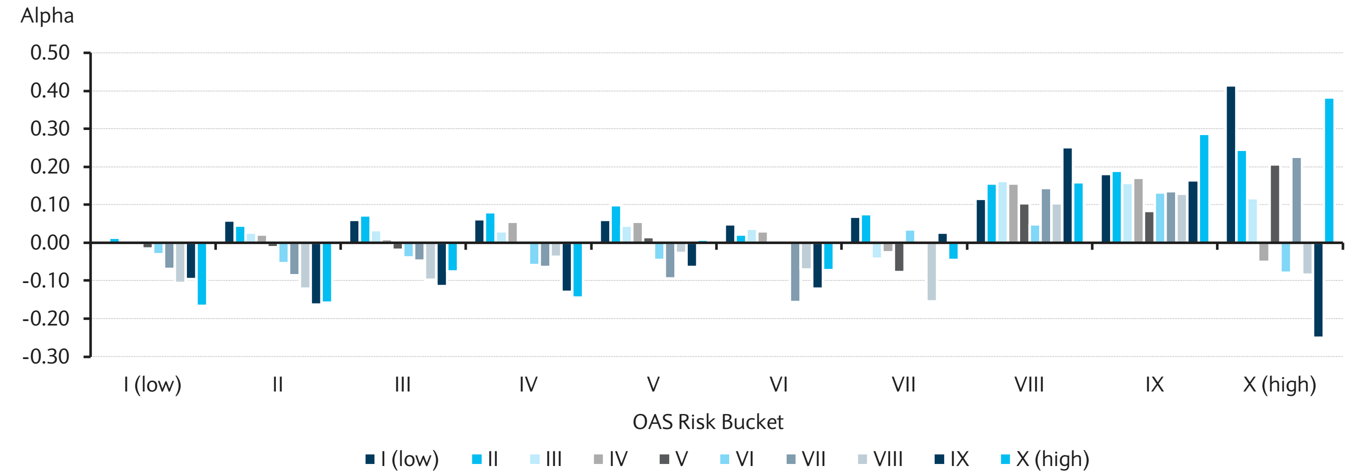


Source: Barclays Research

We see a similar mixed pattern when we examine risk-adjusted returns (Figures 34). Within some OAS buckets, risk-adjusted returns decrease with increasing OASD and volatility. In other OAS buckets, we see the opposite pattern – not strong support for a low-risk anomaly.

FIGURE 34

Alpha by Two-Way (OAS × OASD) Sorts; IG & HY Combined; January1997-October 2013

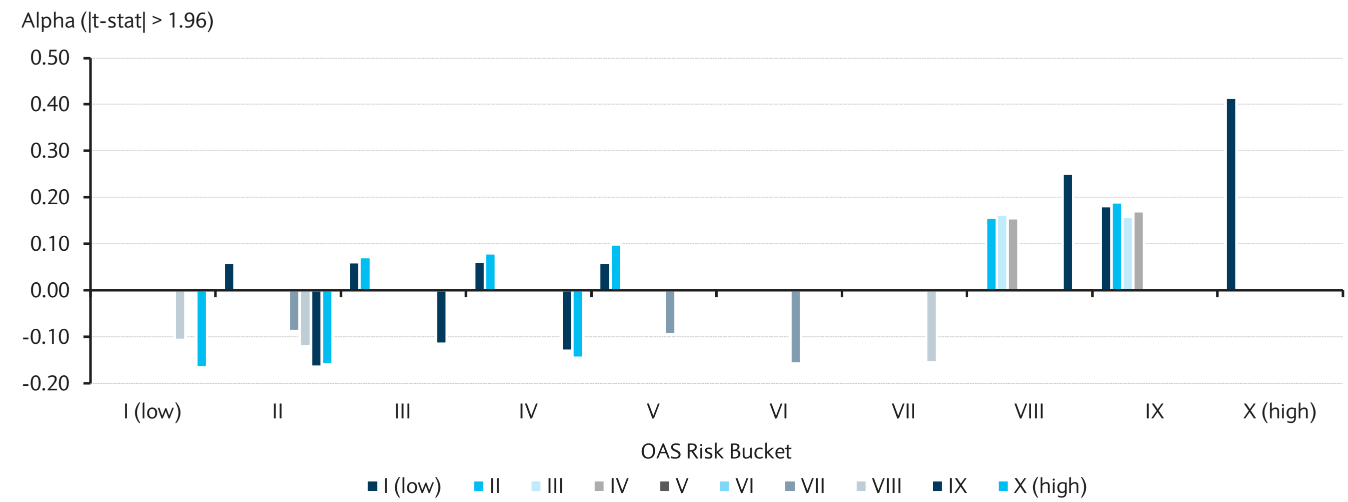


Source: Barclays Research

Figure 35 shows only those alphas statistically different from zero. Here, the pattern is much clearer and more supportive. Within an OAS bucket, the higher volatility OASD deciles have lower alphas compared with the lower volatility OASD deciles. These two-way sort results provide support for a low-risk anomaly.

FIGURE 35

Statistically Significant Alphas by Two-Way (OAS × OASD) Sorts; IG & HY Combined; January1997-October 2013



Source: Barclays Research

To summarize, the two-way sorts produce the following results:

Given OASD → higher OAS → higher volatility → higher excess returns → higher alpha

Given OAS → higher OASD → higher volatility → "mixed" excess returns → lower alpha

Overall, these results highlight that a single risk measure is not necessarily sufficient to make the case for or against a low-risk anomaly. Instead, there are regions in two-dimensional OAS-OASD risk space, some with relatively low volatility and some with relatively high volatility that produce positive risk-adjusted returns.

Figure 36 shows the (OASD × OAS) buckets with significant alphas. We see the "sweet spot" in the corporate market: low-OASD, high-OAS bonds. Alphas are positive and significant for low OASD bonds, and they increase with OAS; and alphas are positive and significant for high OAS bonds, but decrease with OASD. The "sour spot" is bonds with high OASD and low OAS.

FIGURE 36

Statistically Significant Alphas by Two-Way (OASD × OAS) Sorts; IG & HY Combined; January1997-October 2013

	Alpha (|t-stat| > 1.96) (by OAS)									
(by OASD)	I	II	III	IV	V	VI	VII	VIII	IX	X
I (low)	-0.04	0.03	0.05	0.05	0.07	0.11	0.16		0.29	0.52
II					0.08				0.37	
III				0.07				0.35		
IV	-0.05						0.15	0.24		
V	-0.08									
VI	-0.06									
VII	-0.08									
VIII	-0.14	-0.10	-0.10		-0.09					
IX	-0.19	-0.10	-0.15							
X (high)	-0.23	-0.14	-0.12	-0.16	-0.16	-0.14				

Source: Barclays Research

Figure 37 shows the excess return volatility of these significant alpha buckets. The message is that low-OASD, high-OAS bonds offer the highest alphas, with the alpha increasing as OAS and volatility increase. In addition, low-OASD, low-OAS bonds offer higher alphas, with the alpha decreasing as OASD and volatility increase. In this two risk-factor world, we find some zones where a low-risk anomaly is supported and others where it is contradicted. Overall, however, the correlation between alpha and volatility is +0.47, which is not supportive of a low-risk anomaly.

FIGURE 37

Volatility of Excess Returns by Two-Way (OASD × OAS) Sorts; IG & HY Combined; January1997-October 2013

	Excess Return Volatility (by OAS)									
(by OASD)	I	II	III	IV	V	VI	VII	VIII	IX	X
I (low)	0.35	0.36	0.43	0.50	0.57	0.65	0.76		1.71	3.80
II					0.90				3.40	
III				0.84				3.24		
IV	0.62						2.29	3.00		
V	0.70									
VI	0.90									
VII	0.89									
VIII	0.89	1.07	1.23		1.44					
IX	1.05	1.38	1.89							
X (high)	1.54	1.81	1.88	2.14	2.26	2.47				

Source: Barclays Research

What about DTS? Figure 38 shows the DTS values corresponding to the buckets with significant alphas in Figure 36. The low-OASD, high-OAS sweet spot and the high-OASD, low-OAS sour spot share similar DTS values. This is why, when using DTS as the risk measure, we found little relationship between DTS and alpha. The correlation between DTS and alpha is 0.00, again not supportive of a low-risk anomaly.

FIGURE 38

DTS by Two-Way (OASD × OAS) Sorts; IG & HY Combined; January1997-October 2013

DTS for Buckets with Significant Alphas (by OAS)

(by OASD)	I	II	III	IV	V	VI	VII	VIII	IX	X
I (low)	0.59	1.08	1.32	1.61	1.96	2.44	3.11		5.93	13.63
II					3.54				13.91	
III				4.52				15.14		
IV	2.92						14.55	19.10		
V	3.46									
VI	4.75									
VII	5.51									
VIII	5.64	7.02	8.05		10.06					
IX	7.93	11.24	13.78							
X (high)	11.62	14.61	15.88	17.13	18.48	19.98				

Source: Barclays Research

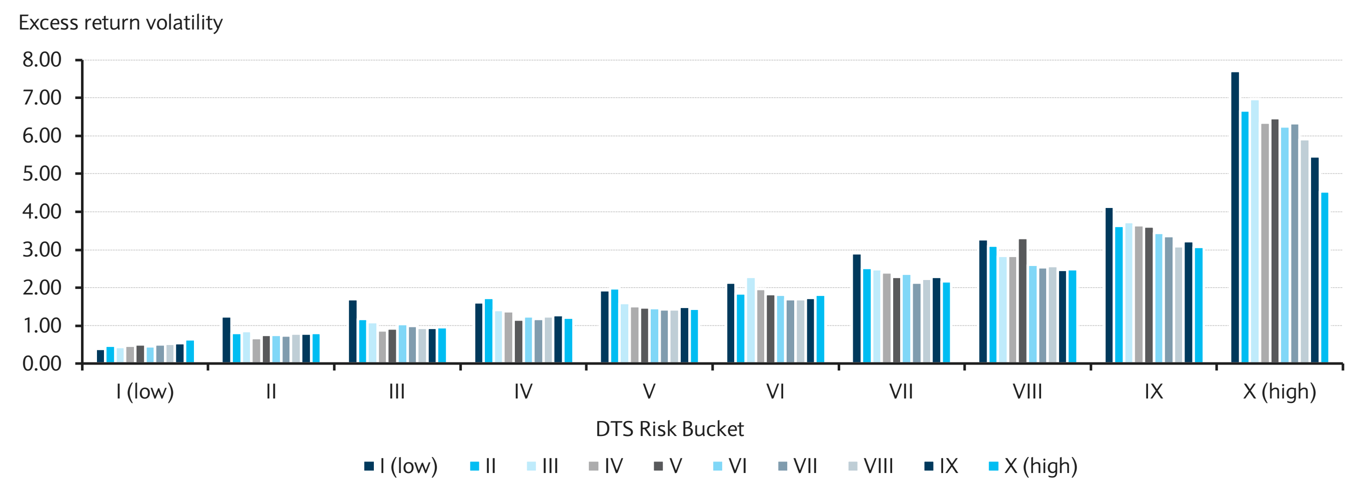
Two-Way Sort: (DTS × OASD)

It is important to examine two-way sorts when using OAS and OASD because when controlling for one factor, the volatility of a bucket can change significantly as the other factor changes. DTS, although a single factor, allows for interaction effects between OAS and OASD. As a check on the usefulness of DTS as a single risk measure, we perform a two-way (DTS × OASD) sort. Given the definition of DTS = OAS × OASD, this sort is also comparable with a two-way (DTS × OAS) sort.[19] We wish to see if, controlling for DTS, the volatility of a bucket changes significantly as we vary OASD (OAS)? If not, this is another sign that DTS is a reliable risk measure.

Figure 39 sorts bonds first by DTS and then by OASD to produce a 10 x 10 grid. Within a DTS bucket, excess return volatility generally declines with OASD, although the decline is quite gentle (except for the highest DTS bucket). Contrast Figure 39 with Figures 28 and 32. This shows that DTS alone does a good job sorting bonds by risk.

FIGURE 39

Volatility of Excess Returns by Two-Way (DTS × OASD) Sorts; IG & HY Combined; January1997-October 2013



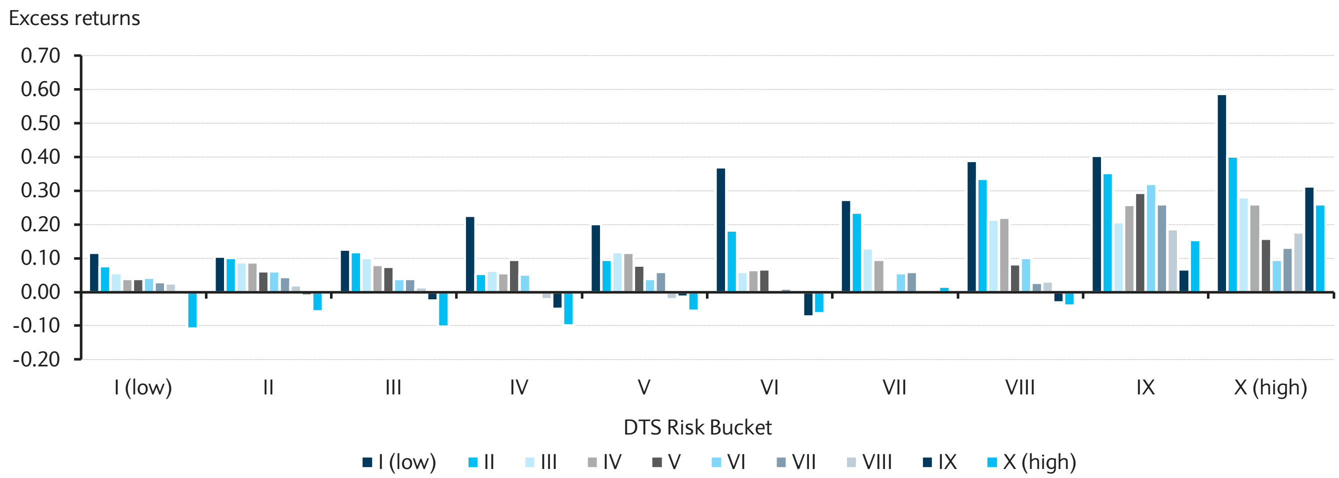
Source: Barclays Research

[19] Results are available from the authors.

However, we can still ask if a low-risk anomaly is supported *within* DTS buckets. Figure 40 shows that average excess returns (and volatility) decline as OASD increases (or as OAS decreases), once we control for DTS. On a risk-adjusted basis, alphas decline as OASD increases and volatility decreases (Figures 41 and 42). These results fail to confirm a low-risk anomaly.

FIGURE 40

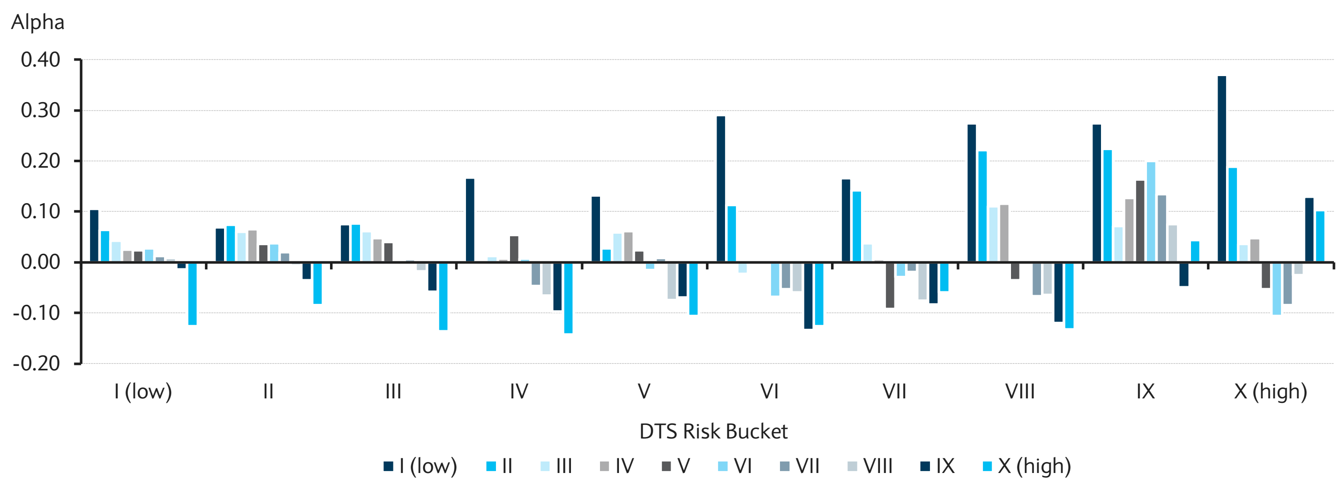
Excess Returns by Two-Way (DTS × OASD) Sorts; IG & HY Combined; January1997-October 2013



Source: Barclays Research

FIGURE 41

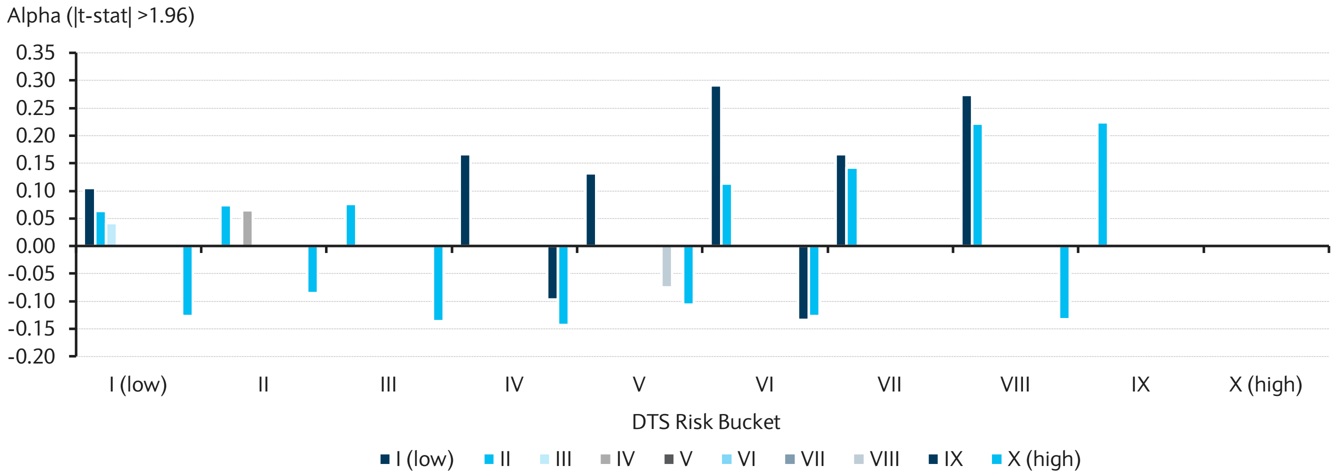
Alpha by Two-Way (DTS × OASD) Sorts; IG & HY Combined; January1997-October 2013



Source: Barclays Research

FIGURE 42

Statistically Significant Alphas by Two-Way (DTS × OASD) Sorts; IG & HY Combined; January1997-October 2013



Source: Barclays Research

For investors using DTS as their single corporate risk measure, these results provide some helpful guidance. Within a DTS bucket, the best average excess returns and alphas are found in the lower-OASD (or higher-OAS) – higher volatility – buckets.

Bond/Equity Market Exposures and the Low-Risk Anomaly

A pattern of falling Sharpe ratios with increasing risk is not necessarily a sign of anomalous returns. In a recent study of the low-risk anomaly in equities, low-beta deciles were again shown to have higher Sharpe ratios than higher beta deciles.[20] While realized returns were somewhat constant across beta deciles, return volatility increased with higher deciles.

To investigate further, beta decile returns were regressed (full sample) on a "bond" factor return and an "equity" factor return. The idea is that equities have both "fixed income-like" features and "equity-like" features and that stocks with different risks have different relative loadings on the two factors. Lower-risk (i.e., low-beta) equities, such as utilities, have balanced loadings on both the equity and fixed-income factors, whereas higher-risk (i.e., high-beta) equities load only on the equity factor, a less diversified exposure.

To see this, we proxy bond and equity risk factor returns by the (US Treasury Index total return – 1m T-bill) return and (SPX total return – 1m T-bill return), respectively. From January 1997 to October 2013, returns on these two factors have been:

FIGURE 43

Bond and Equity Factor Returns; January 1997-October 2013

	Equity Factor	Bond Factor
Average Monthly Return	34bp	26bp
Volatility	463bp	131bp
Annualized Sharpe Ratio	0.25	0.69
Correlation	- 0.26	

Source: Barclays Research

Because the factors have been negatively correlated, stocks that load heavily on both factors have a diversification benefit that will tend to lower their volatility. Stocks that load heavily just on the equity factor have no such diversification benefit.

[20] Arne Staal, "Low Volatility Investing in Equities," Presentation, Barclays Research, January 2014.

Empirically, moving to higher and higher beta deciles, the loading on the equity factor increases while the loading on the bond factor decreases. The drivers of beta decile returns become less diversified as you move to higher deciles, producing relatively lower Sharpe ratios for the higher-beta deciles.

This analysis explains why observed equity returns could resemble a low-risk anomaly. However, there is no pricing anomaly – just different combinations of relative risk exposures as you move to higher beta risk buckets. In addition, a long-short risk (i.e., beta)-neutral portfolio would not net out the two underlying bond/equity risk factor exposures.

Corporate bond excess returns can also be considered as combinations of returns linked to an equity factor and a bond factor. Perhaps low-risk corporate bond buckets load relatively heavily on the bond factor while high-risk buckets load heavily on the equity factor. To investigate this, we ran the following regression (full sample) of DTS risk bucket excess returns on both the equity and bond factors:

$$\text{ExRet(DTS bucket)}_t = a + b \times \text{Ret(SPX)}_t + c \times \text{Ret(Tsy)}_t + e_t$$

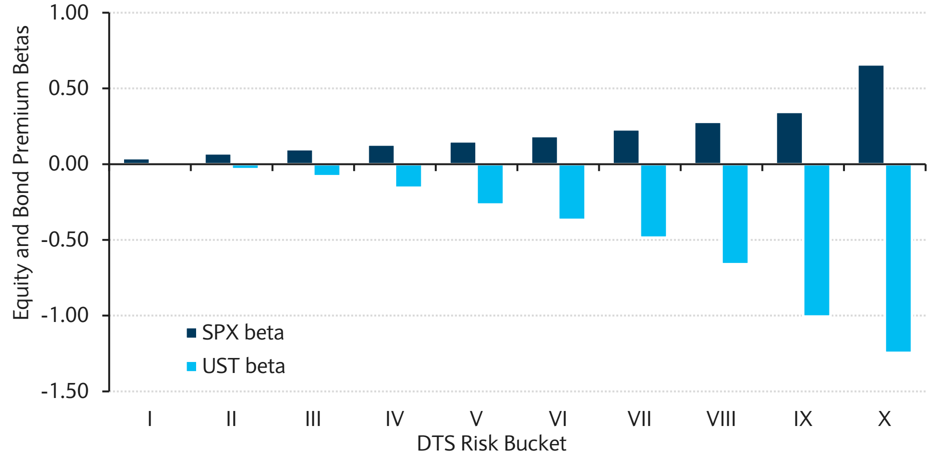
A positive coefficient on the equity factor returns indicates that corporate excess returns are positively related to equity returns. A positive coefficient on the bond factor indicates that corporate excess returns are negatively related to changes in Treasury yields. A frequent observation is that higher Treasury yields (i.e., negative Treasury returns) are correlated with tightening corporate spreads (i.e., positive corporate excess returns).[21]

Figure 44 shows the results for DTS risk buckets for the IG & HY combined universe. (Results for IG-only and HY-only can be found in the Appendix [Figures A5 and A6]). We see that the various DTS risk buckets load positively on the equity factor and negatively on the bond factor. Since these two factors are negatively correlated, overall risk will tend to increase if the absolute loadings increase on both factors. As shown, the absolute loadings (all significantly different from zero except for the very low-risk bucket bond betas) increase monotonically on both factors as we move to higher and higher DTS risk buckets.

[21] See Lazanas, Ng, and Phelps (2013).

FIGURE 44

Equity and Bond Premium Betas; DTS Risk Buckets; IG & HY Combined; January1997-October 2013

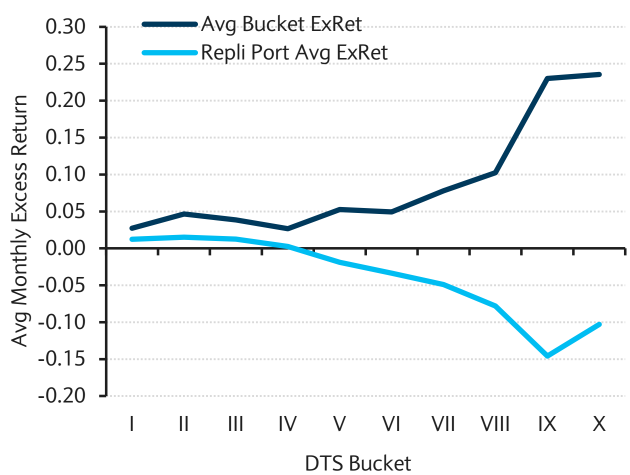


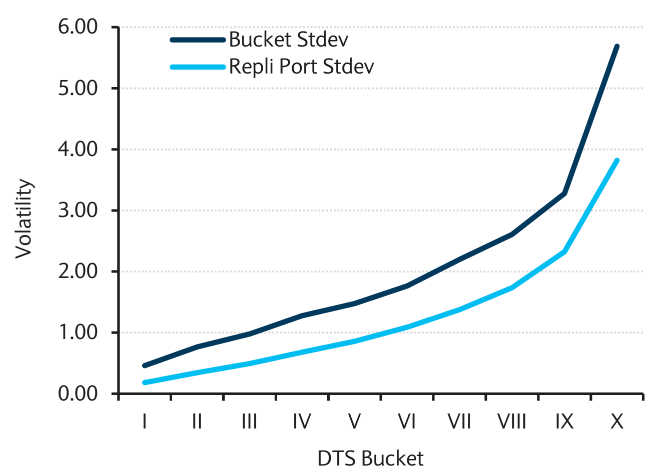
Source: Barclays Research

What type of average excess returns, volatilities, and Sharpe ratios would we expect to see across buckets solely from these exposures to the bond and equity risk factors? To examine this for each DTS risk bucket, we form a "replicating" portfolio containing only the estimated exposures to the two risk factors, dropping the constant term (which was not significantly different from zero). Figure 45 shows the average monthly excess returns and volatility for both the DTS risk buckets and the replicating factor portfolios. As we move to higher risk buckets, the loadings increase on both bond and equity risk factors, increasing volatility. However, the negative loading on the bond factor increases more rapidly, leading to a decline in overall average excess returns. As shown in Figure 46, the bond and equity risk exposures alone suggest a declining Sharpe ratio as risk increases – not evidence of a pricing anomaly, but simply reflecting the relative combination of bond/equity risk exposures and their correlation.

FIGURE 45

Average Monthly Excess Return and Volatility by DTS Bucket; IG & HY Combined and Replicating Factor Portfolio; January1997-October 2013

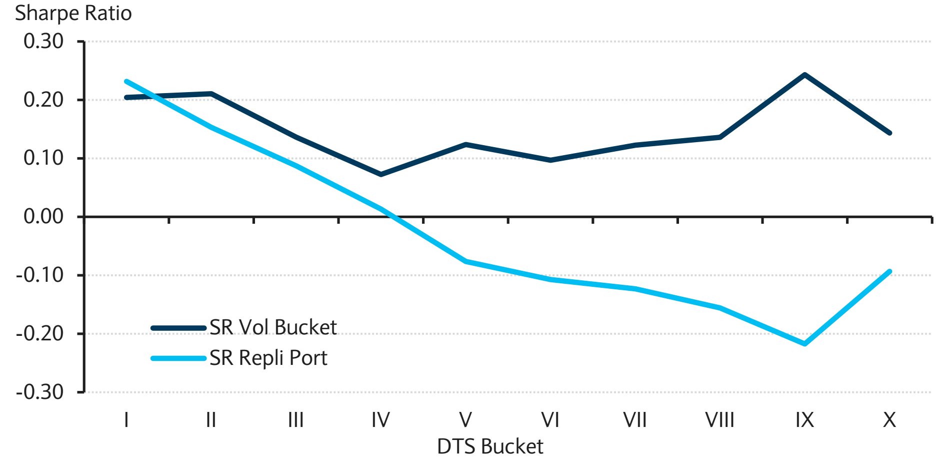




Source: Barclays Research

FIGURE 46

Sharpe Ratio by DTS Bucket; IG & HY Combined and Replicating Factor Portfolio; January1997-October 2013



Source: Barclays Research

Figure 46 also shows that the higher-risk DTS risk buckets actually outperform the replicating factor portfolio, while the lowest-risk DTS bucket underperform the replicating portfolio. Higher risk corporates have better risk-adjusted performance compared with their bond/equity factor portfolio – further arguing against a low-risk anomaly in corporate excess returns.

Conclusion

We have examined five reasonable measures of corporate bond spread risk. Irrespective of the risk measure, there is little evidence supporting the existence of a low-risk anomaly. While some risk factors show signs of low-risk anomaly under the popular Sharpe ratio measure, they often fail other tests – namely, reliability as a risk measure, practicality, alpha, and long-short risk-neutral strategy performance. After all, we have shown that declining Sharpe ratios alone may not be an indication of low-risk anomaly, as they can be explained by the negatively correlated equity and bond factors.

While HistVol and OASD show that the low-risk buckets have the highest risk-adjusted returns compared to the high-risk buckets, they are not good risk measures. HistVol (as we define it) is not available for bonds with less than 12 months of excess return history, limiting its usefulness as a risk measure. OASD does not provide an accurate sorting of bonds by risk. In addition, while the long-short strategies earn positive returns, they are highly correlated with market returns.

DTS, OAS, and quality do a very good job of sorting bonds by risk, but they produce results that either fail to find a low-risk anomaly (IG & HY combined DTS, quality), weakly support the low-risk anomaly (IG-only DTS, HY-only DTS), or plainly contradict the anomaly (OAS). Risk-adjusted returns either increase with risk (OAS) or are not significantly different from zero (DTS). The long-short strategies either lose money (OAS) or produce a small gain but suffer from joint tail risk with the market (DTS).

Overall, we see little evidence of a low-risk anomaly in the US corporate bond universe.[22]

[22] We examined the US Treasury market and found strong evidence supporting a low-risk anomaly. This is a surprising result, because many investors have stated that they actively engage in long-short OAD-neutral strategies, and given the ready availability of leverage (e.g., via the futures markets). Results are available from the authors.

References

Asness, C., A. Frazzini and L. Pedersen. "Leverage Aversion and Risk Parity." *Financial Analysts Journal*. January/February 2012.

Black, F. "Capital Market Equilibrium with Restricted Borrowing." *Journal of Business*. 1972

Falkenstein, E.G. *The Missing Risk Premium*. 2012.

Frazzini, A and L. Pedersen. "Betting against Beta". Working Paper. 4 February 2013.

Hyman, J., A. Maitra and S. Polbennikov. "Term Structure Effects in Relative Credit Spread Volatility." Barclays Research. 30 October 2012.

Ilmanen, A. *Expected Returns*. Wiley. 2011.

Kozhemiakin, A. "The Risk Premium of Corporate Bonds." *Journal of Portfolio Management*. Winter 2007.

Lazanas, A., K Y Ng and B. Phelps. "Credit Risk Premium: Measurement, Interpretation & Portfolio Allocation." Barclays Research. 19 February 2013.

Naik, V., M. Devarajan and E. Wong. "The Anatomy of Credit Curve Trades Over the Economic Cycle." *Quantitative Credit Quarterly*. Lehman Brothers. 27 June 2007.

Ng, Kwok Yuen and B. Phelps. "Capturing Credit Spread Premium." *Financial Analysts Journal*. Vol 67, No. 3 May/June 2011.

Ng, Kwok Yuen and B. Phelps. "The Structure of Corporate Bond Excess Returns: US Corporate Excess Returns in the Cross-Section." *Barclays Presentation*. Barclays Research. 6 June 2013.

Staal, A. "Low Volatility Investing in Equities." *Barclays Presentation*. Barclays Research. January 2014.

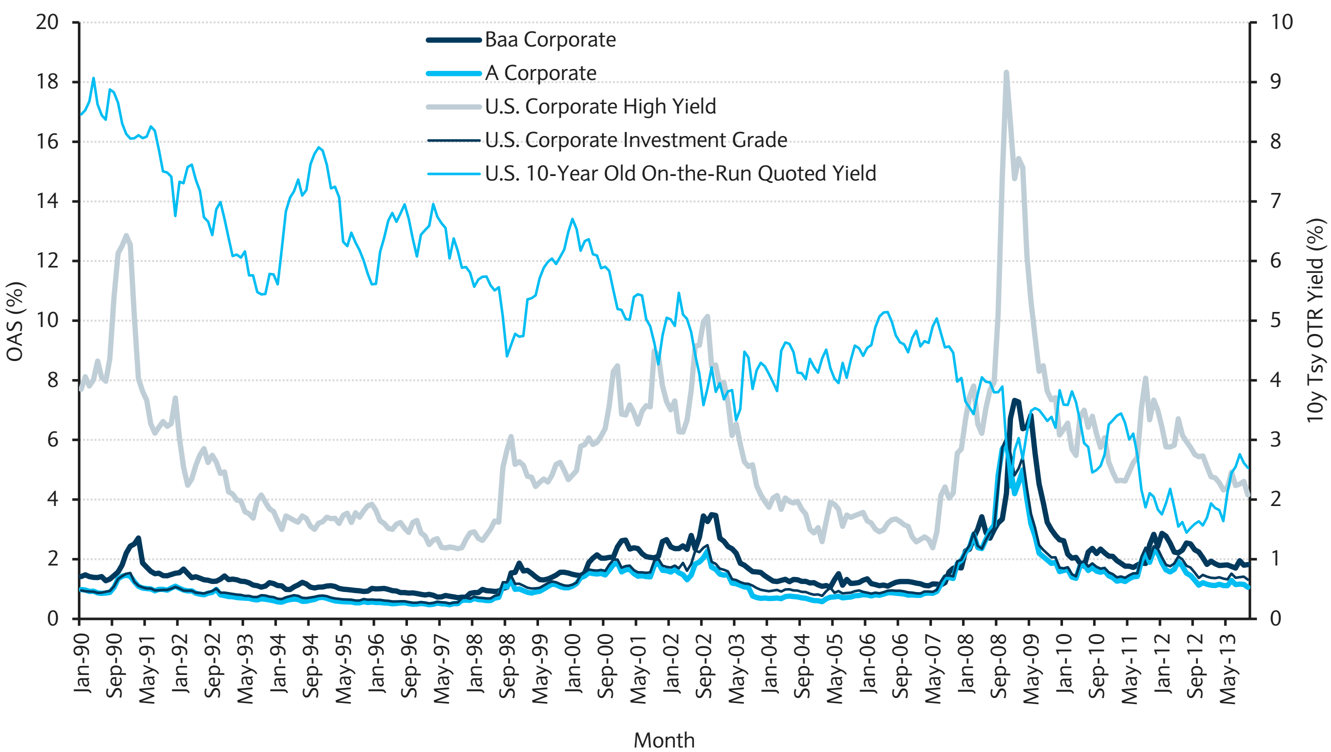
Appendix

Selection of the Data Period

Barclays corporate bond index data begin in January 1990. Ideally, we want to select a data period in which the net spread change is small, or at least similar, across bonds. Figure A1 shows the OAS time series for various corporate indices, as well as the 10y on-the-run (OTR) Treasury yield. Compared with 1990, investment grade spreads are modestly higher in 2013, but high yield spreads are significantly lower. For consistency, we want the relative changes in spreads to be comparable across all classes of the corporate market. This suggests a somewhat shorter time period.

FIGURE A1

US Corporate Index OAS Levels; IG and HY; US 10y Treasury OTR Yield; January1997-October 2013



Source: Barclays Research

From January 1997 to October 2013, the percentage changes in spread for the US Investment Grade Corporate, A-rated, Baa-rated, and High Yield Indices were 133%, 105%, 110%, and 44%, respectively. We recognize that the percentage changes across these indices are not the same – it would be close to impossible to find a set of beginning and ending dates in which they were. However, they are comparable and of the same sign.

FIGURE A2

US Corporate Index OAS Levels; IG and HY; US 10y Treasury OTR Yield; January1997-October 2013

OAS (%)			
	Jan-97	Oct-13	% chg
US Corp Index	0.56	1.31	1.33
A Index	0.52	1.06	1.05
Baa Index	0.82	1.72	1.10
HY Index	2.88	4.16	0.44

Source: Barclays Research

Another reason to favor a shorter time period is the changing percentage of callable corporates in the index. As much of the analysis in this study relies on analytical measures of spread and duration, it is advisable to avoid using data from periods that relied heavily on proprietary and, possibly, elementary option pricing models. From 1990 to 1997, the market value weight of callable corporates (excluding make-whole callables) fell from 70% to 20% (10% in 2000), and at the same time, the sophistication of option-adjusted analytics improved. The 1997-2013 period has a relatively low percentage of callable bonds throughout.

Data

Data for this study come from the Barclays index database. We use reported bond-level excess returns that are computed using the bond's key rate (0.5y, 2y, 5y, 10y, 20y, and 30y) analytical durations and a basket of six hypothetical par Treasury bonds constructed to match the key rate exposures. (Before 2000, when key rate durations were not available, we use a bond's analytical duration and a basket of cash Treasury bonds to match its duration). A bond's excess return equals the bond's total return less the total return on the matched-duration Treasury portfolio.

We use several filters to remove outlier observations. Specifically, we remove monthly observations for bonds having either zero or negative OASD. Most of these bonds are in the earlier months of our study period. They tend to have stale or incorrect returns and/or analytics. We also remove bonds with an OAS larger than 5,000bp. These highly distressed bonds are almost always in the lowest quality bucket, and their analytics are either spurious or unavailable. In addition, returns for these bonds are often stale, missing, or very large, especially in the earlier months of the index database. Overall, however, we found that our filtering does not materially affect the results.

HistVol – IG-Only and HY-Only Results

Figures A3 and A4 present the IG-only and HY-only results for HistVol risk bucketing.

FIGURE A3

Average Monthly Excess Return and Alpha by HistVol Bucket; IG-Only; January1997-October 2013

	Low (HistVol)	II	III	IV	V	VI	VII	VIII	IX	High (HistVol)	Total
Avg OASD	1.94	2.91	3.70	4.57	5.42	6.25	7.33	8.31	9.11	8.97	5.91
Avg OAS	0.87	1.05	1.19	1.31	1.42	1.54	1.66	1.82	2.04	2.88	1.59
Avg DTS	1.74	3.09	4.33	5.81	7.40	9.14	11.43	14.03	17.11	22.33	9.77
Avg ExRet	0.06	0.06	0.05	0.05	0.03	0.03	0.02	0.02	0.04	0.10	0.05
Stdev	0.42	0.65	0.85	0.98	1.24	1.44	1.76	2.02	2.23	2.97	1.37
Ann SR	0.46	0.30	0.22	0.18	0.09	0.08	0.04	0.03	0.06	0.12	0.13
Alpha	0.04	0.04	0.03	0.02	-0.01	-0.02	-0.04	-0.06	-0.04	0.00	
t-stat	2.58	1.69	1.04	0.74	-0.61	-1.02	-1.95	-2.69	-1.27	0.02	

Source: Barclays Research

FIGURE A4

Average Monthly Excess Return and Alpha by HistVol Bucket; HY-Only; January1997-October 2013

	Low (HistVol)	II	III	IV	V	VI	VII	VIII	IX	High (HistVol)	Total
Avg OASD	2.17	3.09	3.60	3.96	4.24	4.51	4.78	5.01	5.21	5.01	4.19
Avg OAS	3.14	3.52	3.78	4.07	4.44	4.98	5.47	6.60	8.28	11.84	5.44
Avg DTS	6.86	10.66	13.32	15.64	18.00	21.23	24.13	29.20	36.49	48.45	21.88
Avg ExRet	0.18	0.19	0.22	0.20	0.22	0.19	0.17	0.18	0.20	0.50	0.23
Stdev	1.24	1.75	2.10	2.40	2.72	3.16	3.53	4.48	5.34	7.17	3.08
Ann SR	0.51	0.38	0.36	0.29	0.28	0.21	0.16	0.14	0.13	0.24	0.26
Alpha	0.10	0.07	0.07	0.03	0.03	-0.04	-0.09	-0.15	-0.18	0.03	
t-stat	2.46	1.52	1.40	0.63	0.55	-0.73	-1.67	-1.81	-1.39	0.12	

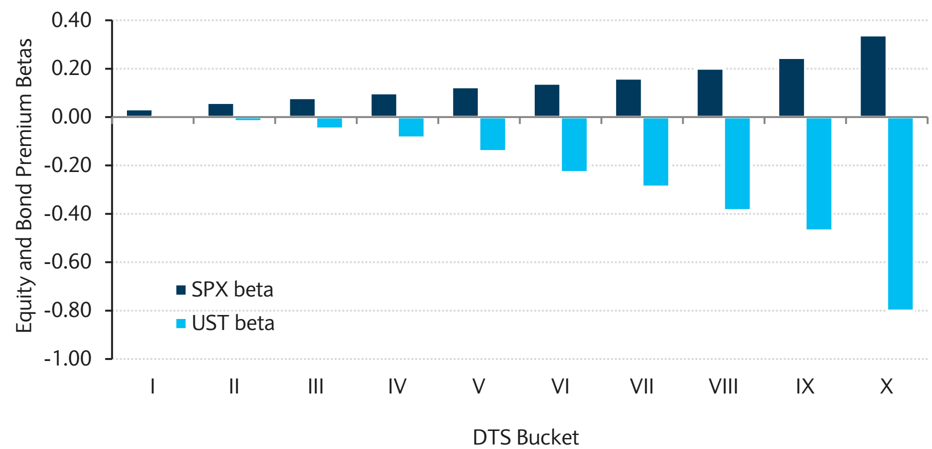
Source: Barclays Research

Bond/Equity Market Exposures – IG-Only and HY-Only Results

Figures A5 and A6 give the estimated bond and equity factor betas for the IG-only and HY-only universes using DTS risk partitioning.

FIGURE A5

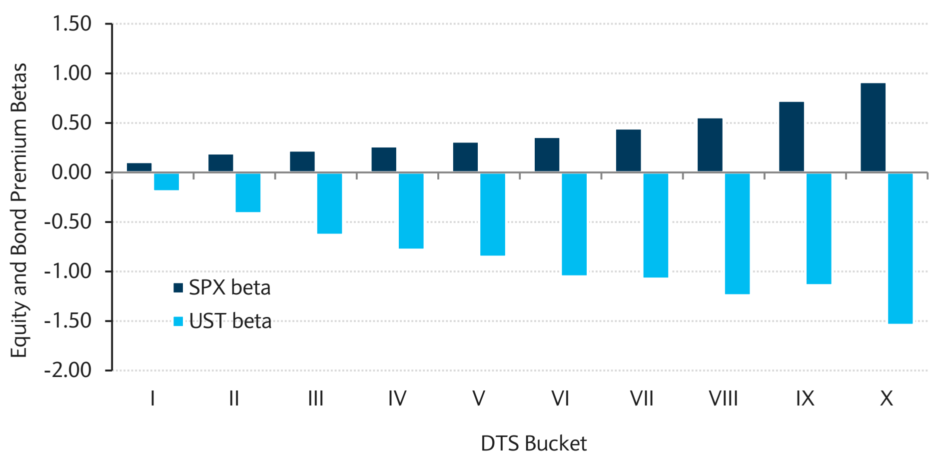
Equity and Bond Premium Betas; DTS Risk Buckets; IG-Only; January1997-October 2013



Source: Barclays Research

FIGURE A6

Equity and Bond Premium Betas; DTS Risk Buckets; HY-Only; January1997-October 2013



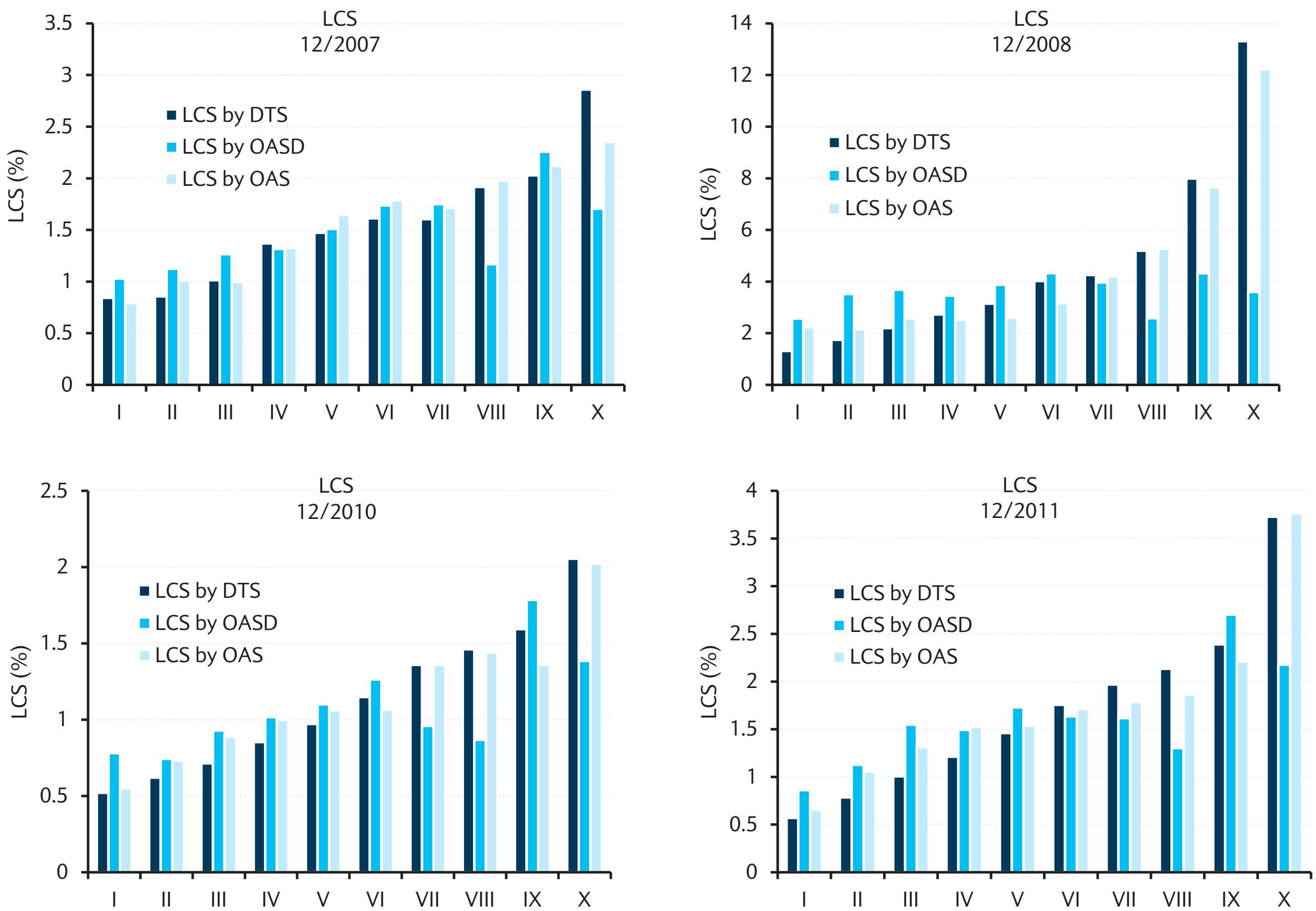
Source: Barclays Research

Liquidity Cost Scores – IG & HY, by Various Risk Measures

Figure A7 presents liquidity cost scores (LCS) for various months and risk measures.

FIGURE A7

Liquidity Cost Scores (LCS) by OASD, OAS, and DTS Buckets; IG & HY Combined; Selected Months



Source: Barclays Research

Analyst Certification

We, Kwok Yuen Ng and Bruce Phelps, CFA, hereby certify (1) that the views expressed in this research report accurately reflect our personal views about any or all of the subject securities or issuers referred to in this research report and (2) no part of our compensation was, is or will be directly or indirectly related to the specific recommendations or views expressed in this research report.

Important Disclosures:

Barclays Research is a part of the Corporate and Investment Banking division of Barclays Bank PLC and its affiliates (collectively and each individually, "Barclays"). For current important disclosures regarding companies that are the subject of this research report, please send a written request to: Barclays Research Compliance, 745 Seventh Avenue, 14th Floor, New York, NY 10019 or refer to http://publicresearch.barclays.com, or call 212-526-1072.

Barclays Capital Inc. and/or one of its affiliates does and seeks to do business with companies covered in its research reports. As a result, investors should be aware that Barclays may have a conflict of interest that could affect the objectivity of this report. Barclays Capital Inc. and/or one of its affiliates regularly trades, generally deals as principal and generally provides liquidity (as market maker or otherwise) in the debt securities that are the subject of this research report (and related derivatives thereof). Barclays trading desks may have either a long and/or short position in such securities, other financial instruments and/or derivatives, which may pose a conflict with the interests of investing customers. Where permitted and subject to appropriate information barrier restrictions, Barclays fixed income research analysts regularly interact with its trading desk personnel regarding current market conditions and prices. Barclays fixed income research analysts receive compensation based on various factors including, but not limited to, the quality of their work, the overall performance of the firm (including the profitability of the investment banking department), the profitability and revenues of the Fixed Income, Currencies and Commodities Division and the potential interest of the firm's investing clients in research with respect to the asset class covered by the analyst. To the extent that any historical pricing information was obtained from Barclays trading desks, the firm makes no representation that it is accurate or complete. All levels, prices and spreads are historical and do not represent current market levels, prices or spreads, some or all of which may have changed since the publication of this document. Barclays produces various types of research including, but not limited to, fundamental analysis, equity-linked analysis, quantitative analysis, and trade ideas. Recommendations contained in one type of research may differ from recommendations contained in other types of research, whether as a result of differing time horizons, methodologies, or otherwise. Unless otherwise indicated, Barclays trade ideas are provided as of the date of this report and are subject to change without notice due to changes in prices. In order to access Barclays Statement regarding Research Dissemination Policies and Procedures, please refer to https://live.barcap.com/publiccp/RSR/nyfipubs/disclaimer/disclaimer-research-dissemination.html. In order to access Barclays Research Conflict Management Policy Statement, please refer to: http://group.barclays.com/corporates-and-institutions/research/research-policy.

Disclaimer:

Subject to the conditions of this publication as set out above, the Corporate & Investment Banking Division of Absa Bank Limited, an authorised financial services provider (Registration No.: 1986/004794/06. Registered Credit Provider Reg No NCRCP7), is distributing this material in South Africa. Absa Bank Limited is regulated by the South African Reserve Bank. This publication is not, nor is it intended to be, advice as defined and/or contemplated in the (South African) Financial Advisory and Intermediary Services Act, 37 of 2002, or any other financial, investment, trading, tax, legal, accounting, retirement, actuarial or other professional advice or service whatsoever. Any South African person or entity wishing to effect a transaction in any security discussed herein should do so only by contacting a representative of the Corporate & Investment Banking Division of Absa Bank Limited in South Africa, 15 Alice Lane, Sandton, Johannesburg, Gauteng 2196. Absa Bank Limited is a member of the Barclays group.

In Japan, foreign exchange research reports are prepared and distributed by Barclays Bank PLC Tokyo Branch. Other research reports are distributed to institutional investors in Japan by Barclays Securities Japan Limited. Barclays Securities Japan Limited is a joint-stock company incorporated in Japan with registered office of 6-10-1 Roppongi, Minato-ku, Tokyo 106-6131, Japan. It is a subsidiary of Barclays Bank PLC and a registered financial instruments firm regulated by the Financial Services Agency of Japan. Registered Number: Kanto Zaimukyokucho (kinsho) No. 143.

Barclays Bank PLC, Hong Kong Branch is distributing this material in Hong Kong as an authorised institution regulated by the Hong Kong Monetary Authority. Registered Office: 41/F, Cheung Kong Center, 2 Queen's Road Central, Hong Kong.

Information on securities/instruments that trade in Taiwan or written by a Taiwan-based research analyst is distributed by Barclays Capital Securities Taiwan Limited to its clients. The material on securities/instruments not traded in Taiwan is not to be construed as 'recommendation' in Taiwan. Barclays Capital Securities Taiwan Limited does not accept orders from clients to trade in such securities. This material may not be distributed to the public media or used by the public media without prior written consent of Barclays.

This material is distributed in South Korea by Barclays Capital Securities Limited, Seoul Branch.

All equity research material is distributed in India by Barclays Securities (India) Private Limited (SEBI Registration No: INB/INF 231292732 (NSE), INB/INF 011292738 (BSE) | Corporate Identification Number: U67120MH2006PTC161063 | Registered Office: 208 | Ceejay House | Dr. Annie Besant Road | Shivsagar Estate | Worli | Mumbai - 400 018 | India, Phone: + 91 22 67196363). Other research reports are distributed in India by Barclays Bank PLC, India Branch.

Barclays Bank PLC Frankfurt Branch distributes this material in Germany under the supervision of Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin).

This material is distributed in Malaysia by Barclays Capital Markets Malaysia Sdn Bhd.

This material is distributed in Brazil by Banco Barclays S.A.

This material is distributed in Mexico by Barclays Bank Mexico, S.A.

Barclays Bank PLC in the Dubai International Financial Centre (Registered No. 0060) is regulated by the Dubai Financial Services Authority (DFSA). Principal place of business in the Dubai International Financial Centre: The Gate Village, Building 4, Level 4, PO Box 506504, Dubai, United Arab Emirates. Barclays Bank PLC-DIFC Branch, may only undertake the financial services activities that fall within the scope of its existing DFSA licence. Related financial products or services are only available to Professional Clients, as defined by the Dubai Financial Services Authority.

Barclays Bank PLC in the UAE is regulated by the Central Bank of the UAE and is licensed to conduct business activities as a branch of a commercial bank incorporated outside the UAE in Dubai (Licence No.: 13/1844/2008, Registered Office: Building No. 6, Burj Dubai Business Hub, Sheikh Zayed Road, Dubai City) and Abu Dhabi (Licence No.: 13/952/2008, Registered Office: Al Jazira Towers, Hamdan Street, PO Box 2734, Abu Dhabi).

Barclays Bank PLC in the Qatar Financial Centre (Registered No. 00018) is authorised by the Qatar Financial Centre Regulatory Authority (QFCRA). Barclays Bank PLC-QFC Branch may only undertake the regulated activities that fall within the scope of its existing QFCRA licence. Principal place of business in Qatar: Qatar Financial Centre, Office 1002, 10th Floor, QFC Tower, Diplomatic Area, West Bay, PO Box 15891, Doha, Qatar. Related financial products or services are only available to Business Customers as defined by the Qatar Financial Centre Regulatory Authority.

This material is distributed in the UAE (including the Dubai International Financial Centre) and Qatar by Barclays Bank PLC.

This material is distributed in Saudi Arabia by Barclays Saudi Arabia ('BSA'). It is not the intention of the publication to be used or deemed as recommendation, option or advice for any action(s) that may take place in future. Barclays Saudi Arabia is a Closed Joint Stock Company, (CMA License No. 09141-37). Registered office Al Faisaliah Tower, Level 18, Riyadh 11311, Kingdom of Saudi Arabia. Authorised and regulated by the Capital Market Authority, Commercial Registration Number: 1010283024.

This material is distributed in Russia by OOO Barclays Capital, affiliated company of Barclays Bank PLC, registered and regulated in Russia by the FSFM. Broker License #177-11850-100000; Dealer License #177-11855-010000. Registered address in Russia: 125047 Moscow, 1st Tverskaya-Yamskaya str. 21.

This material is distributed in Singapore by the Singapore branch of Barclays Bank PLC, a bank licensed in Singapore by the Monetary Authority of Singapore. For matters in connection with this report, recipients in Singapore may contact the Singapore branch of Barclays Bank PLC, whose registered address is One Raffles Quay Level 28, South Tower, Singapore 048583.

Barclays Bank PLC, Australia Branch (ARBN 062 449 585, AFSL 246617) is distributing this material in Australia. It is directed at 'wholesale clients' as defined by Australian Corporations Act 2001.

IRS Circular 230 Prepared Materials Disclaimer: Barclays does not provide tax advice and nothing contained herein should be construed to be tax advice. Please be advised that any discussion of U.S. tax matters contained herein (including any attachments) (i) is not intended or written to be used, and cannot be used, by you for the purpose of avoiding U.S. tax-related penalties; and (ii) was written to support the promotion or marketing of the transactions or other matters addressed herein. Accordingly, you should seek advice based on your particular circumstances from an independent tax advisor.