

High Yield Spread Model, Refined

Eric Gross
+1 212 412 7997
eric.gross@barclays.com

Anthony Bakshi
+1 212 412 5272
anthony.bakshi@barclays.com

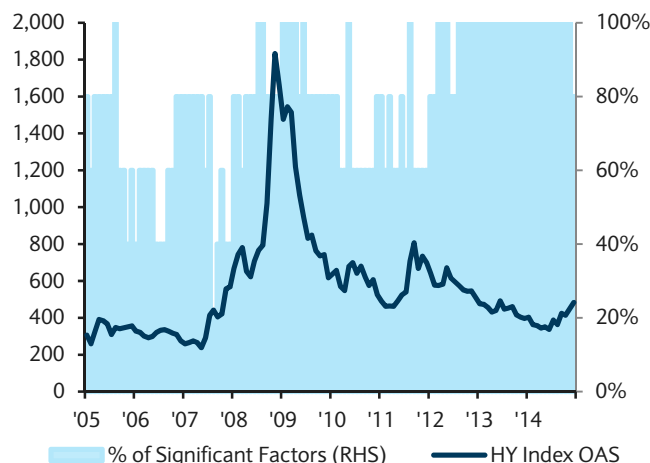
We present an updated OAS model that decomposes the compensation received for various risks in the high yield cash market. It provides a perspective of how much spread investors have required for different risk factors across various market environments over the past decade. It is also an effective quantitative tool for selecting individual bonds that could outperform the market. We recognize that high yield has been increasingly idiosyncratic of late, but still feel that this model is helpful in highlighting opportunities that investors might otherwise miss.

We build on our previous work on cash spread models in the U.S. (*A Model for Outperformance*) and Europe (*Modelling high yield bond spreads*) to construct a five-factor model for high yield bond spreads. It serves multiple purposes, providing a historical view of shifts in market risk premia for several priced factors and a bond-by-bond screening tool that can be used to identify attractive opportunities. The difference between actual and model-predicted “fair value” spreads is strongly predictive of future bond performance at multiple investment horizons, which allows us to systematically generate trade recommendations (Figures 10-13).

The Ingredients of OAS

The spread on high yield bonds compensates investors for four broad areas of risk: credit quality, liquidity, the term of the investment, and potential call. We identified five factors to capture these risks and estimated their relationship with OAS using cross-sectional multivariate regressions at discrete points in time (see the Appendix for model specification details). The study spans 10 years of monthly data, or 120 sets of constituents of the Barclays U.S. High Yield Index (January 2005-December 2014). Bonds trading with an OAS above 1,500bp are excluded from the analysis, as spread becomes a less meaningful measure in deeply distressed situations. The factors in our model capture a decent share of the cross-sectional variation in spreads, with a median monthly adjusted R^2 of 45% (Figures 1 and 2).

FIGURE 1
Statistical Significance of Model Factors: 2005-14



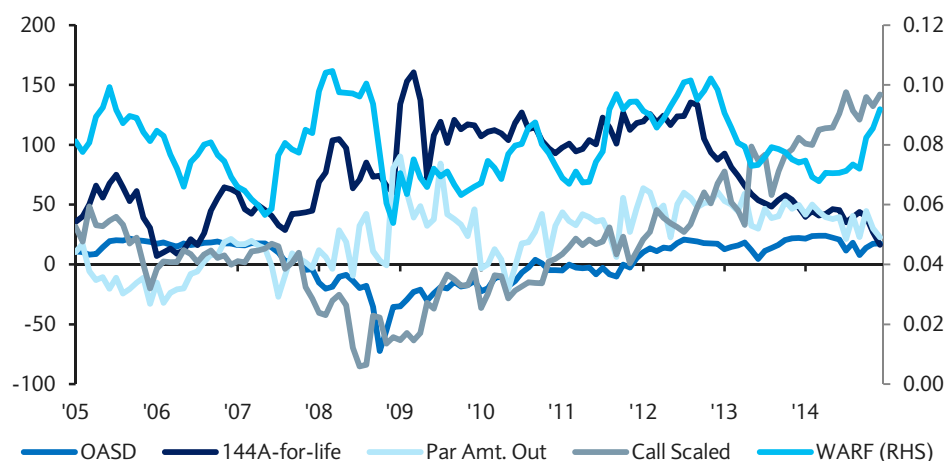
Note: Significance measured at the 95% level.
Source: Barclays Research

FIGURE 2
Model Adjusted R^2 : 2005-14



Note: 120 regressions run on each month in 2005-14 yielded the R^2 values.
Source: Barclays Research

FIGURE 3

Historical Spread Compensation by Factor (bp)

Note: Intercept omitted. Sample consists of end-of-month universes of U.S. high yield, excluding bonds with OAS greater than 1,500bp. Source: Barclays Research

Model Factors

Credit Rating: To quantify credit risk, we convert the index ratings of individual issues to their respective Weighted Average Rating Factors (WARF). WARF is a quantitative measure designed by Moody's to effectively capture the nonlinear relationship between ratings notches and default risk. Said differently, a one-notch downgrade implies an increasingly large increment in default risk as you walk down the ratings spectrum, and WARF captures that acceleration in default risk.

Given that WARF increases as credit quality decreases, it makes sense that this factor's coefficient is positive versus OAS in all sample periods (Figure 3). The consistency of the coefficient throughout the decade is noteworthy and reflects the obvious importance of credit quality in determining bond spreads. For example, the current coefficient on the WARF factor (0.094) indicates that a bond rated B+ (WARF of 2,220) trades an average 43bp wider than a BB- (WARF of 1,766) bond, assuming all other characteristics are identical. Interestingly, the current average spread difference between BB- and B+ bonds in the index is exactly 43bp.

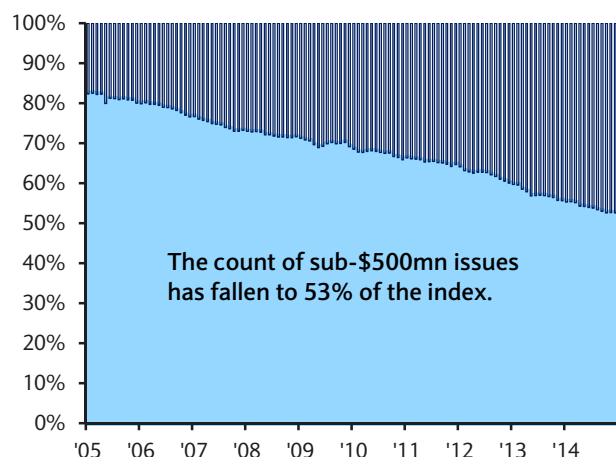
Issue Size: Smaller issues are expected to trade at a discount due to their lower liquidity. We incorporate this idea using a binary variable with a \$500mn cut-off value between "small" and "large" deals. The choice of a binary variable, rather than just using size directly, reflects the diminishing marginal effect of issue size on liquidity. For instance, the liquidity gap between \$400mn and \$900mn issues is likely greater than that between \$1bn and \$1.5bn issues.

The coefficient on issue size is typically positive, as expected, and has averaged 36bp since 2010. The variable was statistically significant at the 95% confidence level in about two-thirds of the sample months, with the insignificant values clustered in the early months of the sample (2005-06). This corresponds with a period in our sample when small issues were more prevalent (Figure 4) and liquidity was at its highest, and it is therefore no surprise that issue size was not a priced factor at that time.

144A-for-Life: Our second proxy for liquidity is a 144A-for-life binary variable. Although the popularity of unregistered bonds has grown steadily during our sample period (Figure 5), the spread premium for this risk has fluctuated and dropped steeply in recent months to its current level of 18bp. The increased post-trade transparency of 144As has certainly contributed to the decline, as 144A trade data became available through TRACE on June 30, 2014. However, the

FIGURE 4

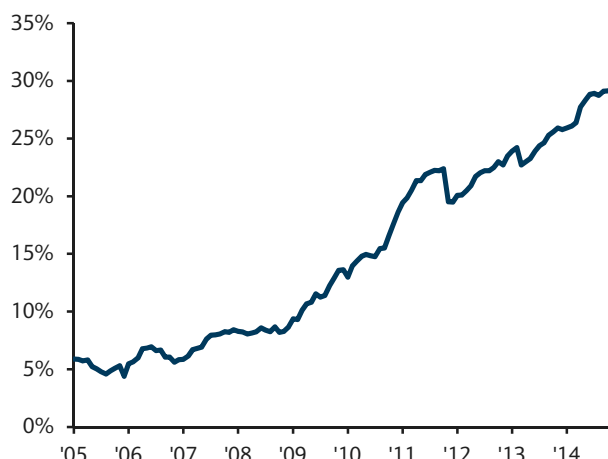
Sub-\$500mn Issuer Count Percentage of High Yield Index



Note: Includes all bonds in the U.S. HY Index. Source: Barclays Research

FIGURE 5

144A-For-Life Component of High Yield Index (%)



Source: Barclays Research

steep decline in the coefficient began several years ago, and the portion of the change attributable to the placement type's increased popularity and transparency is difficult to quantify.

Spread Duration (OASD): Credit curves are typically upward sloping, reflecting the fact that the survival rate of all companies declines over time. We capture this effect using spread duration (OASD) as a factor in the model. This is a slight change from our previous model, which used OAD to capture curve shape, because OASD is the more appropriate way to capture spread curve steepness, while OAD effectively captures yield curve steepness. The average compensation for a one-year increase in spread duration is currently 20bp. The OASD risk premium has been positive for most of the past decade, as expected, with a median value of 11bp across the monthly samples. The exception occurred during the steep, market-wide sell-off during the financial crisis, when spread curves inverted and the OASD factor coefficient turned negative.

Callability: Our final explanatory variable accounts for the risk premium that investors should receive for taking on the negative convexity intrinsic in callable bonds. The risk of experiencing negative convexity increases as the non-call period shortens, so the factor we chose to capture this risk is not a simple binary variable for callable/non-callable. Instead, the variable is scaled such that it ramps linearly from 0 to 1 as it goes from three years to first call to fully callable. As seen in Figure 3, the premium for callability dipped into negative territory during the crisis. Indeed, an issuer having the option to refinance more cheaply may have been seen in a more positive light at that time, given the state of the primary markets. The spread compensation for callability has increased steadily since 2011, as issuer call options have gone deeper in the money and investors have experienced periods of duration extension inherent in negatively convex bonds. The premium for a bond that is currently callable above an otherwise equivalent bullet bond is now a hefty 140bp. Please see the appendix for a brief discussion of this risk factor.

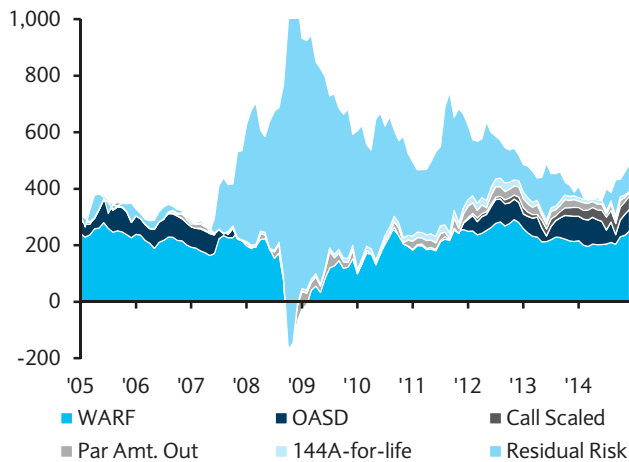
Market Spread Composition

Along with the historical evolution of individual risk factors, it is helpful to examine market risks in aggregate. We do so by calculating the average value of each of our five factors across all bonds in the high yield universe every month and multiplying those by the risk premia estimated in our regressions. This allows us to calculate each factor's contribution¹ to the

¹ A 2010 Quantitative Portfolio Strategy report, *Credit Spread Decomposition: Decomposing Bond-Level Credit OAS into Default and Liquidity Component*, first referred to such a breakdown of model variables as contributions.

FIGURE 6

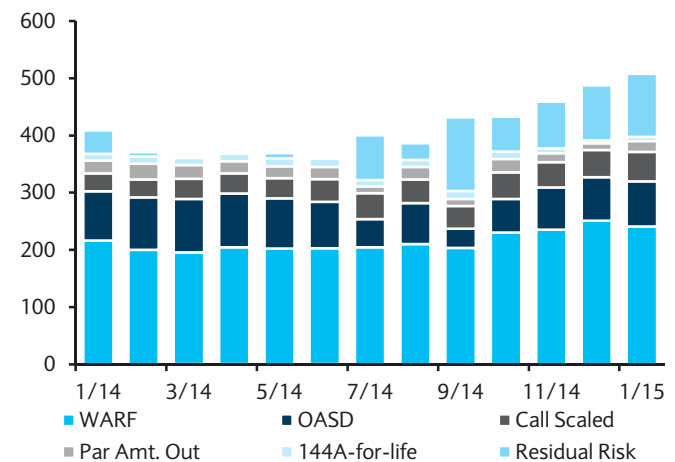
Risk Factor Composition of Market Average OAS: 2005-14



Source: The decomposition assumes an equal-weighted portfolio of bonds in the sample. Source: Barclays Research

FIGURE 7

Risk Factor Composition of Market Average OAS: 2014-15



Source: Barclays Research

average index OAS, which the linear regression is estimating every month, and leads to a visual representation of compensation received over time across the entire market.

As Figures 6 and 7 illustrate, credit risk (as captured by WARF) typically accounts for the bulk of spread compensation. Indeed, credit risk accounted for an average of 49% of the market spread across the 120 months in the sample. This is a sensible result, in our view, as the inherent credit and default risks reflected in ratings are usually most important for determining trading levels. Periods of market distress represent the exception. In such times, the residual risk not captured by the model forms the majority of the index OAS. This residual risk, which is the intercept value of the regressions, picks up all of the other types of market risk not accounted for in the model, including the tremendous uncertainty that comes with primary markets freezing. In such scenarios, detailed credit analysis loses some significance, and all issuers are at greater risk.

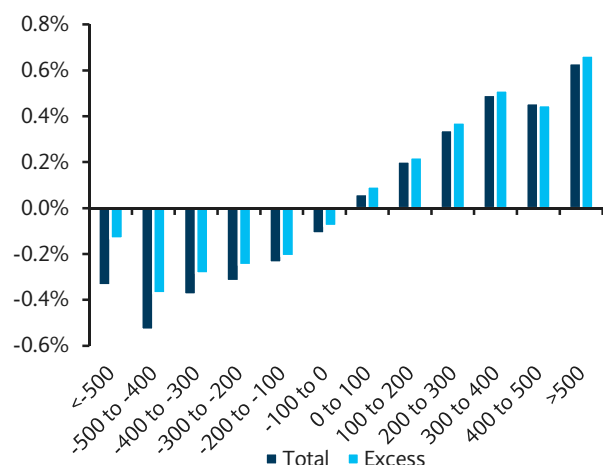
Model Performance

The model's value lies in its ability to identify undervalued bonds that then go on to outperform the index in subsequent months. Figures 8 and 9 show the median relative returns of individual bonds depending on the initial difference between their actual OAS and the model-implied OAS. Median total and excess returns are shown for all of the bonds in the 10-year span, which forms a robust sample set of nearly 200,000 data points. As seen in the charts, bonds that the model determines are undervalued tend to outperform the broad high yield market over the short term (one month) and medium term (one year). For instance, bonds that are 200-300bp undervalued according to the model generate a median 3.83% of relative excess returns in the next year.

The outperformance of bonds deemed cheap by the model (and vice versa for those deemed rich) relative to the market is not isolated in the tails of the distribution, but is a relatively steady function of how cheap/rich the bond is according to the model. This suggests the model has predictive power for bonds trading near their "fair" values and is not just picking up mean reversion at the overvalued and undervalued extremes. Similarly, the persistent underperformance of overvalued bonds provides a way to analyze selling opportunities and avoid potential new positions.

FIGURE 8

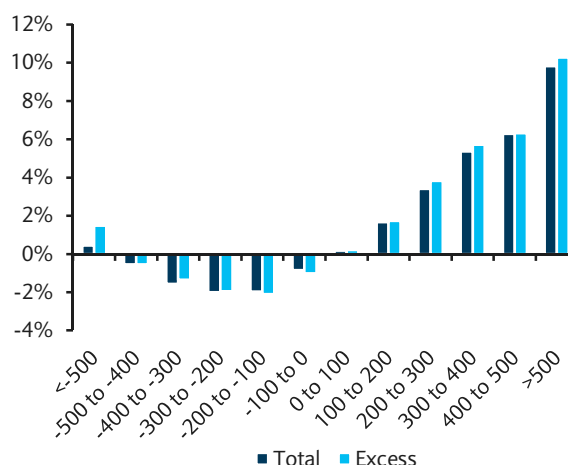
Next Month's Median Relative Return by Spread Residual



Note: Returns are calculated versus the U.S. High Yield Index in the same period.
Source: Barclays Research

FIGURE 9

Next Year's Median Relative Return by Spread Residual



Note: Returns are calculated versus the U.S. High Yield Index in the same period.
Source: Barclays Research

Trade Recommendations

To help capitalize on the model's strong historical performance, we apply the model to the current constituents of the index. The results provide model-predicted spreads for all of the bonds in the index, and the residuals allow us to gauge the most attractive relative value opportunities. Unsurprisingly, given the scale of the energy sell-off, the majority of the long recommendations are credits in that sector. Meanwhile, the overvalued bonds come from a diverse set of sectors – 14 total – that include media and entertainment, gaming, and consumer cyclical. The top 20 undervalued and overvalued bonds, according to the model, are presented in Figures 10 and 11, respectively.

Admittedly, the credit ratings that play an influential role in our quantitative model may be lagging the rapid changes that have recently occurred in the energy sector. To assuage such concerns and provide a broader view of undervalued opportunities in today's market, we present two more tables with a fundamental overlay on our quantitative screen (Figures 12 and 13). In these tables, we show the bonds that are considered cheapest by the model and are also rated Overweight or Market Weight by an analyst. Similarly, the final table presents the bonds considered richest by the model that are also rated Underweight or Market Weight.

FIGURE 10

Top 20 Undervalued Bonds

Ticker	Issuer	Par (\$mn)	Cpn (%)	Mat.	Price (\$)	YTW (%)	OAD	Rating	Placement	OAS (bp)	Model OAS (bp)	Excess Spread (bp)
KEG	Key Energy	675	6.750	Mar-21	63.50	16.48	4.6	B2	Registered	1447	519	928
ENQLN	Enquest	650	7.000	Apr-22	59.00	17.11	5.1	B3	144A-for-life	1493	567	925
CHAPAR	Chaparral Energy	550	7.625	Nov-22	61.50	16.61	5.3	B3	Registered	1443	554	890
TSIACQ	Aston Escrow	440	9.500	Aug-21	73.25	16.31	4.4	B3	144A-for-life	1427	579	848
BAS	Basic Energy	300	7.750	Oct-22	66.00	15.45	5.3	B2	Registered	1335	498	837
PACD	Pacific Drilling	500	7.250	Dec-17	83.25	14.70	2.5	B2	144A-for-life	1339	507	832
SSE	Seventy Seven Operating	648	6.625	Nov-19	73.00	14.68	4.0	B1	Registered	1295	471	824
BBEP	Breitbart Energy	850	7.875	Apr-22	66.50	15.83	5.0	B3	Registered	1375	560	815
ARP	Atlas Energy	375	7.750	Jan-21	66.25	16.98	4.6	CAA1	Registered	1494	712	782
CSMAU	Consolidated Minerals	400	8.000	May-20	74.00	15.36	4.1	B3	144A-for-life	1353	585	768
ARP	Atlas Energy	250	9.250	Aug-21	71.50	16.55	4.5	CAA1	Registered	1449	683	767
BBEP	Breitbart Energy	302	8.625	Oct-20	73.00	16.02	4.3	B3	Registered	1409	643	766
NUVOTV	SITV	240	10.375	Jul-19	86.50	14.63	3.5	B3	144A-for-life	1300	567	733
PKD	Parker Drilling	225	7.500	Aug-20	75.75	13.97	4.4	B1	Registered	1218	488	730
CFGSP	CFG Investment	288	9.750	Jul-19	85.50	14.23	3.7	B2	144A-for-life	1262	540	722
BTU	Peabody Energy	1,516	6.000	Nov-18	83.00	11.69	3.3	BA3	Registered	1032	314	718
TALPRO	Talos Production	300	9.750	Feb-18	84.50	16.45	2.5	CAA1	144A-for-life	1494	778	717
SQRTW	SquareTwo Financial	290	11.625	Apr-17	95.00	14.38	1.9	B3	Registered	1329	628	702
VTG	Offshore Group Investment	730	7.125	Apr-23	66.13	14.28	5.6	B3	Registered	1221	522	699
SELA	Seitel	250	9.500	Apr-19	84.50	14.55	3.4	B3	Registered	1296	602	694

Note: Bid-side levels as of 2/4/15 close. Source: Barclays Research

FIGURE 11

Top 20 Overvalued Bonds

Ticker	Issuer	Par (\$mn)	Cpn (%)	Mat.	Price (\$)	YTW (%)	OAD	Rating	Placement	OAS (bp)	Model OAS (bp)	Excess Spread (bp)
IDC	Interactive Data	350	5.875	Apr-19	100.00	5.87	2.9	CAA2	144A-for-life	447	941	-495
BZH	Beazer	173	8.125	Jun-16	105.75	3.75	1.3	CAA2	Registered	345	760	-415
IHRT	Clear Channel	300	7.250	Oct-27	79.50	10.16	7.7	CA	Registered	806	1220	-414
DMND	Diamond Foods	230	7.000	Mar-19	102.25	6.19	3.0	CAA2	144A-for-life	500	900	-400
BMET	Biomet	800	6.500	Oct-20	105.50	2.91	1.1	CAA1	Registered	264	660	-397
HDSUPP	HD Supply	1,275	7.500	Jul-20	106.13	5.64	3.0	CAA2	Registered	425	814	-390
LBIMED	LBI Media	220	10.000	Apr-19	104.50	7.72	1.7	CAA3	144A-for-life	675	1065	-389
AFFGRP	Affinia	250	7.750	May-21	103.75	6.71	3.9	CAA2	Registered	515	894	-379
IHRT	Clear Channel	250	5.500	Dec-16	96.00	7.85	1.8	CA	Registered	722	1100	-378
MOTOR	CCM Merger	275	9.125	May-19	108.00	5.92	2.0	CAA2	144A-for-life	505	875	-370
USFOOD	US Foods	1,324	8.500	Jun-19	105.25	5.67	1.2	CAA2	Registered	492	856	-364
INTEL	Intelsat Luxembourg	500	6.750	Jun-18	101.50	6.04	2.5	CAA2	Registered	506	869	-363
PTICN	JLL/Delta Patheon	450	7.500	Feb-22	101.50	7.14	4.8	CAA2	144A-for-life	539	896	-357
SGRHSE	Sugarhouse HSP Gaming	240	6.375	Jun-21	94.50	7.48	4.8	CAA2	144A-for-life	582	927	-345
RLGY	Realogy	450	4.500	Apr-19	100.25	4.43	3.8	CAA1	144A-for-life	325	665	-341
PBH	Prestige Brands	400	5.375	Dec-21	97.50	5.82	5.1	CAA1	144A-for-life	409	744	-335
RLGY	Realogy	300	5.250	Dec-21	98.75	5.47	5.3	CAA1	144A-for-life	377	702	-325
COMPOL	CPG Merger Sub	315	8.000	Oct-21	102.00	7.48	4.4	CAA2	144A-for-life	580	903	-323
RAD	Rite Aid	810	6.750	Jun-21	106.25	5.13	3.4	CAA1	Registered	353	675	-322
NMG	Neiman Marcus	960	8.000	Oct-21	103.88	7.01	4.2	CAA2	144A-for-life	538	855	-318

Note: Bid-side levels as of February 4, 2015, close. Source: Barclays Research

FIGURE 12

Top 20 Undervalued Bonds with Fundamental Rating Overlay

Ticker	Issuer	Par (\$mn)	Cpn (%)	Mat.	Price (\$)	YTW (%)	OAD	Rating	Placement	OAS (bp)	Model OAS (bp)	Excess Spread (bp)	Analyst Rating
CHAPAR	Chaparral Energy	550	7.625	Nov-22	61.50	16.61	5.3	B3	Registered	1443	554	890	MW
HKUS	Halcon	400	9.250	Feb-22	69.00	16.96	4.6	CAA2	Registered	1483	850	633	MW
HKUS	Halcon	1,350	8.875	May-21	70.44	16.63	4.5	CAA2	Registered	1459	842	618	MW
AVYA	Avaya	1,384	10.500	Mar-21	83.25	14.77	4.2	CAA1	144A-for-life	1290	677	614	MW
AOI	Alliance One	731	9.875	Jul-21	81.50	14.37	4.7	CAA1	Registered	1249	651	598	OW
FMGAU	FMG Resources	1,500	8.250	Nov-19	90.75	10.79	3.8	BA2	144A-for-life	930	408	522	MW
DCP	DynCorp	455	10.375	Jul-17	90.00	15.50	2.2	CAA2	Registered	1424	917	507	MW
BTU	Peabody Energy	650	7.375	Nov-16	98.50	8.31	1.6	BA3	Registered	771	279	492	MW
HXN	Hexion U.S. Finance	1,145	8.875	Feb-18	85.50	15.08	2.7	CAA2	Registered	1368	887	481	OW
FMCN	First Quantum	1,120	7.000	Feb-21	86.75	9.98	4.7	B1	144A-for-life	833	400	433	OW
FMCN	First Quantum	1,120	6.750	Feb-20	89.00	9.56	4.1	B1	144A-for-life	805	434	371	OW
FMCN	First Quantum	350	7.250	Oct-19	88.50	10.40	3.9	B1	144A-for-life	894	532	362	OW
FMCN	First Quantum	850	7.250	May-22	87.00	9.78	5.5	B1	144A-for-life	801	449	352	OW
CDE	Coeur Mining	450	7.875	Feb-21	86.25	11.08	4.8	B3	Registered	939	593	346	MW
BONT	Bon-Ton Stores	350	8.000	Jun-21	80.50	12.53	4.9	CAA1	Registered	1075	746	329	MW
ATW	Atwood Oceanics	650	6.500	Feb-20	90.44	8.92	4.2	BA3	Registered	744	426	319	MW
AMD	Advanced Micro Devices	598	6.75	Mar-19	96.13	7.88	3.5	B2	Registered	663	407	256	MW
JCG	J Crew	500	7.75	May-19	82.50	13.27	3.5	CAA2	144A-for-life	1174	922	252	OW
EPENEG	EP Energy	2,000	9.375	May-20	101.50	8.82	3.5	B2	Registered	733	490	244	MW
MEGCN	MEG Energy	1,000	7.000	Mar-24	91.50	8.34	6.3	B1	144A-for-life	641	431	210	MW

Note: Bid-side levels as of 2/4/15 close. Source: Barclays Research

FIGURE 13

Top 20 Overvalued Bonds with Fundamental Rating Overlay

Ticker	Issuer	Par (\$mn)	Cpn (%)	Mat.	Price (\$)	YTW (%)	OA D	Rating	Placement	OAS (bp)	Model OAS (bp)	Excess Spread (bp)	Analyst Rating
BZH	Beazer	173	8.125	Jun-16	105.75	3.75	1.3	CAA2	Registered	345	760	-415	UW
HDSUPP	HD Supply	1,275	7.500	Jul-20	106.13	5.64	3.0	CAA2	Registered	425	814	-390	UW
HDSUPP	HD Supply	675	11.000	Apr-20	114.00	3.47	1.1	CAA1	Registered	325	636	-311	MW
BMET	Biomet	1,825	6.500	Aug-20	106.75	2.49	0.7	B3	Registered	230	540	-310	MW
BZH	Beazer	235	9.125	May-19	103.75	6.84	1.6	CAA2	Registered	601	906	-305	UW
HDSUPP	HD Supply	1,000	11.500	Jul-20	115.00	5.39	1.7	CAA2	Registered	486	788	-302	UW
RAD	Rite Aid	295	7.700	Feb-27	112.00	6.26	8.1	CAA1	Registered	431	733	-302	MW
SVU	Supervalu	278	8.000	May-16	107.25	2.04	1.2	B3	Registered	181	473	-292	MW
RMK	Aramark	1,000	5.750	Mar-20	103.88	4.40	2.3	B3	Registered	302	590	-288	MW
PF	Pinnacle Foods	350	4.875	May-21	99.00	5.06	4.6	B3	Registered	337	624	-287	MW
FDC	First Data	1,609	11.750	Aug-21	115.50	5.75	1.5	CAA2	Registered	532	804	-272	MW
SWY	Safeway	269	5.000	Aug-19	99.73	5.07	4.0	CAA1	Registered	381	652	-271	MW
IDC	Interactive Data	350	8.250	Dec-17	101.00	7.02	1.0	CAA2	144A-for-life	648	911	-264	MW
EMS	Envision Healthcare	750	5.125	Jul-22	101.75	4.75	5.1	B3	144A-for-life	294	556	-262	MW
RYI	Ryerson	201	11.250	Oct-18	105.50	8.90	2.3	CAA3	Registered	786	1037	-251	UW
BERY	Berry Plastics	800	9.750	Jan-21	111.13	2.85	0.9	B3	Registered	273	523	-250	UW
FDC	First Data	2,000	8.250	Jan-21	107.00	4.89	1.7	CAA1	144A-for-life	429	678	-248	MW
BZH	Beazer	200	7.500	Sep-21	96.50	8.19	4.8	CAA2	Registered	648	895	-247	UW
MTW	Manitowoc	300	5.875	Oct-22	108.25	3.68	3.8	B2	Registered	223	467	-244	MW
RAD	Rite Aid	902	9.250	Mar-20	109.75	4.27	1.3	CAA1	Registered	399	643	-243	MW

Note: Bid-side levels as of February 4, 2015, close. Source: Barclays Research

Appendix

Model Specification and Robustness

The full specification is shown below, for bond i in month t .

$$OAS_{it} = \alpha_t + \beta_1(WARF_{it}) + \beta_2(IssueSize_{it}) + \beta_3(144A_{it}) + \beta_4(OASD_{it}) + \beta_5(Callscale_{it}) + \varepsilon_{it}$$

- **Issue Size:** Binary variable that equals 1 if issue size is below \$500mn, 0 otherwise
- **144A:** Binary variable that equals 1 if issue is 144A-for-life, 0 otherwise
- **Callscale:** Variable equals $\max\{0, 1 - \frac{1}{3} * (\text{years to next call})\}$

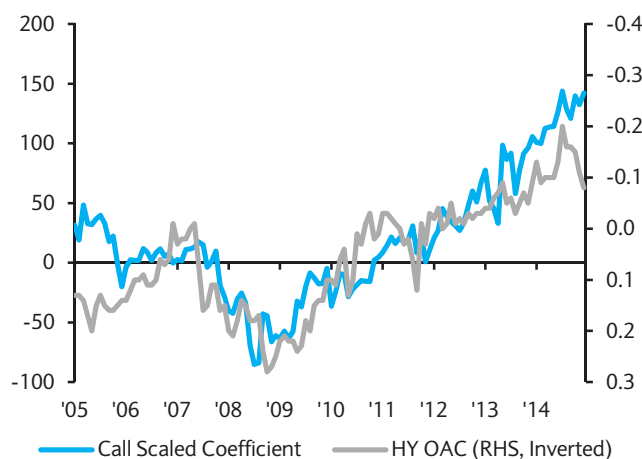
Robust standard errors were calculated to account for heteroskedasticity and were used throughout the analysis to calculate variable significance.

To confirm the efficacy of our model specification, we ran goodness-of-fit tests on our sample. The predictor variables do not suffer from multicollinearity, which we aimed to avoid through our selection of factors that account for different sources of market risk. The variance inflation factor (VIF), a common test of multicollinearity that involves regressing each factor on the rest of the independent variables and then calculating each new model fit, was below two for all but a few instances across the 600 variable-month combinations. For reference, a VIF of 10 or more is generally considered to be a level that warrants concern about a model's specification.

The Question of Convexity

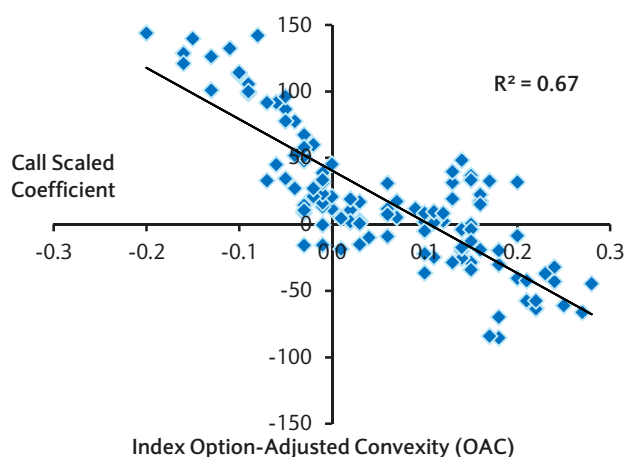
Callability and the related risk of negative convexity were the most difficult to incorporate into our model. That said, with a significant share of the high yield market becoming call constrained in recent years, we saw this risk as important enough to investigate further. The magnitude of the risk inherent in being short a call option is directly intertwined with spread levels, making it especially difficult to pin down. Indeed, in high-price markets, extension risk is an important consideration for investors (see [The Price of Extension Risk](#) and [Extension School](#) for details), but it is less important in low-price markets, and an issuer call can even be perceived as a positive by investors in deeply distressed markets. Another way to see this is by looking at the relationship between the coefficient on our callability variable and the index-wide option-adjusted convexity (OAC), which is strong (Figure 14). In high-price markets (negative average OAC), the premium required by investors for callable bonds

FIGURE 14
Callable Factor Coefficient and High Yield Index Convexity



Source: Barclays Research

FIGURE 15
Convexity Explains a Large Amount of the Call Coefficient



Note: 120 monthly data points. Source: Barclays Research

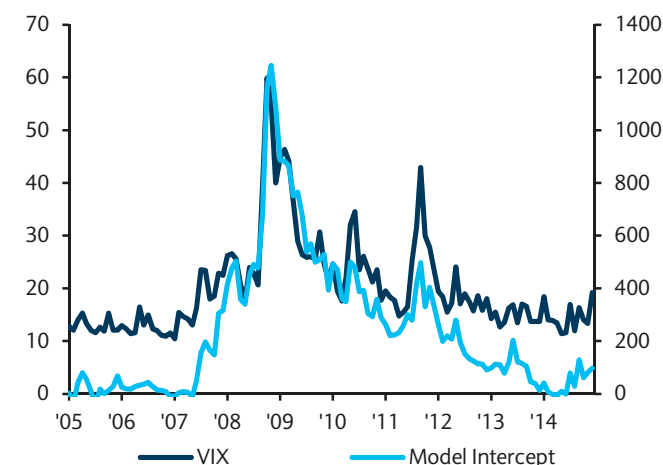
is high and positive. In very low-price markets (very positive average OAC), the market is actually willing to forego some spread to own issuers with call options (Figure 15).

Another issue with capturing callability is that bonds with high extension risk trade on price much more so than spread, and small fluctuations around the call price can change the OAS drastically, especially in the days leading up to the call date. This incongruity between a price-driven risk factor and our spread decomposition model makes it difficult to identify an extension risk variable that has a strong enough relationship with OAS.

Crisis Concerns

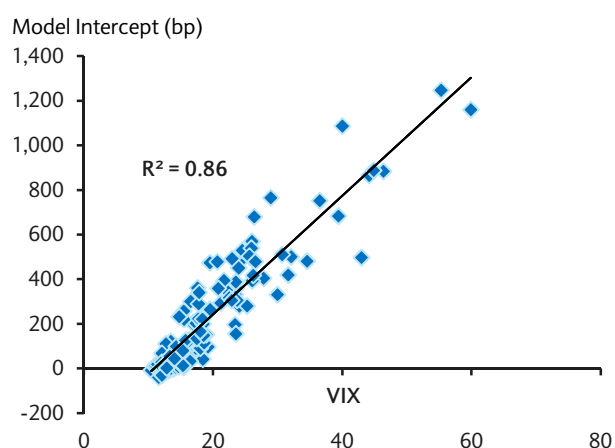
As seen in Figure 2, the model fit deteriorated significantly during the financial crisis. This is partly attributable to the structure of the model, which is meant to provide fair value spreads for nearly all of the bonds in the index at any given time. It is a reflection of how quickly risk aversion can flare up, sending the entire market much wider despite only small apparent increases in traditional risk factors. One simple way to observe the importance of market-wide aversion is to compare a gauge of general market sentiment, such as the VIX, with the evolution of the model fit. Below, we chart the VIX and the model intercept, which naturally picks up the large amount of excess spread that is independent of our variables during risk-off periods (Figure 16). The two series track other closely, and this is confirmed by a good linear fit of the model intercept on VIX (Figure 17). This correlation reflects the potential benefit of adding macroeconomic state variables to a variation of this spread model.

FIGURE 16
VIX and Model Intercept Track Each Other Closely



Source: Bloomberg, Barclays Research

FIGURE 17
VIX Levels Explain a Large Amount of Excess Model Spread



Note: 120 monthly data points. Source: Bloomberg, Barclays Research

Analyst Certification

We, Anthony Bakshi and Eric Gross, 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: <https://live.barcap.com/publiccp/RSR/nyfipubs/disclaimer/disclaimer-conflict-management.html>.

Other Material Conflicts

The Corporate and Investment Banking division of Barclays is providing investment banking services to Rexam PLC (REX) in relation to the potential sale of the Containers & Closures division of its Healthcare business to Berry Plastics Group, Inc (BERY). The ratings, price targets and estimates on Rexam PLC (REX) and Berry Plastics (BERY) do not incorporate this potential transaction.

Barclays Barclays Bank PLC and/or an affiliate is providing investment banking services to Onex Corp. (OCX.TO) in relation to its agreement to acquire SIG Combibloc AG. The rating for Reynolds Group Holdings Inc. as issued by the Firm's Research Department has been temporarily suspended due to Barclays role in the transaction.

Explanation of the Barclays Research Sector Rating System

Overweight (OW):

For sectors rated against the Barclays U.S. Credit Index, the Barclays Pan-European Credit Index, the Barclays EM Asia USD High Grade Credit Index or the Barclays EM USD Corporate and Quasi-Sovereign Index, the analyst expects the six-month excess return of the sector to exceed the six-month excess return of the relevant index.

For sectors rated against the Barclays U.S. High Yield 2% Issuer Capped Credit Index, the Barclays Pan-European High Yield 3% Issuer Capped Credit Index excluding Financials or the Barclays EM Asia USD High Yield Corporate Credit Index, the analyst expects the six-month total return of the sector to exceed the six-month total return of the relevant index.

Market Weight (MW):

For sectors rated against the Barclays U.S. Credit Index, the Barclays Pan-European Credit Index, the Barclays EM Asia USD High Grade Credit Index or the Barclays EM USD Corporate and Quasi-Sovereign Index, the analyst expects the six-month excess return of the sector to be in line with the six-month excess return of the relevant index.

For sectors rated against the Barclays U.S. High Yield 2% Issuer Capped Credit Index, the Barclays Pan-European High Yield 3% Issuer Capped Credit Index excluding Financials or the Barclays EM Asia USD High Yield Corporate Credit Index, the analyst expects the six-month total return of the sector to be in line with the six-month total return of the relevant index.

Underweight (UW):

For sectors rated against the Barclays U.S. Credit Index, the Barclays Pan-European Credit Index, the Barclays EM Asia USD High Grade Credit Index or the Barclays EM USD Corporate and Quasi-Sovereign Index, the analyst expects the six-month excess return of the sector to be less than the six-month excess return of the relevant index.

For sectors rated against the Barclays U.S. High Yield 2% Issuer Capped Credit Index, the Barclays Pan-European High Yield 3% Issuer Capped Credit Index excluding Financials or the Barclays EM Asia USD High Yield Corporate Credit Index, the analyst expects the six-month total return of the sector to be less than the six-month total return of the relevant index.

Sector definitions:

Sectors in U.S. High Grade Research are defined using the sector definitions of the Barclays U.S. Credit Index and are rated against the Barclays U.S. Credit Index.

Sectors in U.S. High Yield Research are defined using the sector definitions of the Barclays U.S. High Yield 2% Issuer Capped Credit Index and are rated against

the Barclays U.S. High Yield 2% Issuer Capped Credit Index.

Sectors in European High Grade Research are defined using the sector definitions of the Barclays Pan-European Credit Index and are rated against the Barclays Pan-European Credit Index.

Sectors in European High Yield Research are defined using the sector definitions of the Barclays Pan-European High Yield 3% Issuer Capped Credit Index excluding Financials and are rated against the Barclays Pan-European High Yield 3% Issuer Capped Credit Index excluding Financials.

Sectors in Asia High Grade Research are defined on Barclays Live and are rated against the Barclays EM Asia USD High Grade Credit Index.

Sectors in Asia High Yield Research are defined on Barclays Live and are rated against the Barclays EM Asia USD High Yield Corporate Credit Index.

Sectors in EEMEA and Latin America Research are defined on Barclays Live and are rated against the Barclays EM USD Corporate and Quasi Sovereign Index. These sectors may contain both High Grade and High Yield issuers.

To view sector definitions and monthly sector returns for Asia, EEMEA and Latin America Research, go to <https://live.barcap.com/go/RSL/servlets/dv.search?pubType=4511&contentType=latest> on Barclays Live.

Explanation of the Barclays Research Credit Rating System

For all High Grade issuers covered in the US, Europe or Asia, and for all issuers in Latin America and EEMEA (excluding South Africa), the credit rating system is based on the analyst's view of the expected excess return over a six-month period of the issuer's index-eligible corporate debt securities* relative to the expected excess return of the relevant sector, as specified on the report.

Overweight (OW): The analyst expects the six-month excess return of the issuer's index-eligible corporate debt securities to exceed the six-month expected excess return of the relevant sector.

Market Weight (MW): The analyst expects the six-month excess return of the issuer's index-eligible corporate debt securities to be in line with the six-month expected excess return of the relevant sector.

Underweight (UW): The analyst expects the six-month excess return of the issuer's index-eligible corporate debt securities to be less than the six-month expected excess return of the relevant sector.

Rating Suspended (RS): The rating has been suspended temporarily due to market events that make coverage impracticable or to comply with applicable regulations and/or firm policies in certain circumstances including where the Investment Bank of Barclays Bank PLC is acting in an advisory capacity in a merger or strategic transaction involving the company.

Coverage Suspended (CS): Coverage of this issuer has been temporarily suspended.

Not Covered (NC): Barclays' fundamental credit research team does not provide formal, continuous coverage of this issuer and has not assigned a rating to the issuer or its debt securities. Any analysis, opinion or trade recommendation provided on a Not Covered issuer or its debt securities is valid only as of the publication date of this report and there should be no expectation that additional reports relating to the Not Covered issuer or its debt securities will be published thereafter.

For all High Yield issuers (excluding those covered in EEMEA or Latin America), the credit rating system is based on the analyst's view of the expected total returns over a six-month period of the rated debt security relative to the expected total return of the relevant sector, as specified on the report.

Overweight (OW): The analyst expects the six-month total return of the debt security subject to this rating to exceed the six-month expected total return of the relevant sector.

Market Weight (MW): The analyst expects the six-month total return of the debt security subject to this rating to be in line with the six-month expected total return of the relevant sector.

Underweight (UW): The analyst expects the six-month total return of the rated debt security subject to this rating to be less than the six-month expected total return of the relevant sector.

Rating Suspended (RS): The rating has been suspended temporarily due to market events that make coverage impracticable or to comply with applicable regulations and/or firm policies in certain circumstances including where the Investment Bank of Barclays Bank PLC is acting in an advisory capacity in a merger or strategic transaction involving the company.

Coverage Suspended (CS): Coverage of this issuer has been temporarily suspended.

Not Covered (NC): Barclays' fundamental credit research team does not provide formal, continuous coverage of this issuer and has not assigned a rating to the issuer or its debt securities. Any analysis, opinion or trade recommendation provided on a Not Covered issuer or its debt securities is valid only as of the publication date of this report and there should be no expectation that additional reports relating to the Not Covered issuer or its debt securities will be published thereafter.

For all issuers in South Africa, the credit rating system is based on the analyst's view of the expected total return over a six-month period of the issuer's rand-denominated fixed rate notes or floating rate notes (as applicable) relative to the South African Credit Fixed Market Index (CFIX95) or the South African Credit Floating Market Index (CFL020), respectively.

Overweight (OW): The analyst expects the six-month total returns of the issuer's rand-denominated fixed rate notes or floating rate notes (as applicable) to exceed the six-month expected total returns the South African Credit Fixed Market Index (CFIX95) or the South African Credit Floating Market Index (CFL020), respectively.

Market Weight (MW): The analyst expects the six-month total returns of the issuer's rand-denominated fixed rate notes or floating rate notes (as applicable) to be in line with the six-month expected total returns the South African Credit Fixed Market Index (CFIX95) or the South African Credit Floating Market Index (CFL020), respectively.

Underweight (UW): The analyst expects the six-month total returns of the issuer's rand-denominated fixed rate notes or floating rate notes (as applicable) to be below the six-month expected total returns the South African Credit Fixed Market Index (CFIX95) or the South African Credit Floating Market Index (CFL020), respectively.

Rating Suspended (RS): The rating has been suspended temporarily due to market events that make coverage impracticable or to comply with applicable regulations and/or firm policies in certain circumstances including where the Investment Bank of Barclays Bank PLC is acting in an advisory capacity in a merger or strategic transaction involving the company.

Coverage Suspended (CS): Coverage of this issuer has been temporarily suspended.

Not Covered (NC): Barclays' fundamental credit research team does not provide formal, continuous coverage of this issuer and has not assigned a rating to the issuer or its debt securities. Any analysis, opinion or trade recommendation provided on a Not Covered issuer or its debt securities is valid only as of the publication date of this report and there should be no expectation that additional reports relating to the Not Covered issuer or its debt securities will be published thereafter.

*In EEMEA and Latin America, analysts may occasionally rate issuers that are not part of the Barclays EM USD Corporate and Quasi Sovereign Index. In such cases the rating will reflect the analyst's view of the expected excess return over a six-month period of the issuer's corporate debt securities relative to the expected excess return of the relevant sector, as specified on the report.

Disclaimer

This publication has been prepared by the Corporate and Investment Banking division of Barclays Bank PLC and/or one or more of its affiliates (collectively and each individually, "Barclays"). It has been issued by one or more Barclays legal entities within its Corporate and Investment Banking division as provided below. It is provided to our clients for information purposes only, and Barclays makes no express or implied warranties, and expressly disclaims all warranties of merchantability or fitness for a particular purpose or use with respect to any data included in this publication. Barclays will not treat unauthorized recipients of this report as its clients. Prices shown are indicative and Barclays is not offering to buy or sell or soliciting offers to buy or sell any financial instrument.

Without limiting any of the foregoing and to the extent permitted by law, in no event shall Barclays, nor any affiliate, nor any of their respective officers, directors, partners, or employees have any liability for (a) any special, punitive, indirect, or consequential damages; or (b) any lost profits, lost revenue, loss of anticipated savings or loss of opportunity or other financial loss, even if notified of the possibility of such damages, arising from any use of this publication or its contents.

Other than disclosures relating to Barclays, the information contained in this publication has been obtained from sources that Barclays Research believes to be reliable, but Barclays does not represent or warrant that it is accurate or complete. Barclays is not responsible for, and makes no warranties whatsoever as to, the content of any third-party web site accessed via a hyperlink in this publication and such information is not incorporated by reference.

The views in this publication are those of the author(s) and are subject to change, and Barclays has no obligation to update its opinions or the information in this publication. The analyst recommendations in this publication reflect solely and exclusively those of the author(s), and such opinions were prepared independently of any other interests, including those of Barclays and/or its affiliates. This publication does not constitute personal investment advice or take into account the individual financial circumstances or objectives of the clients who receive it. The securities discussed herein may not be suitable for all investors. Barclays recommends that investors independently evaluate each issuer, security or instrument discussed herein and consult any independent advisors they believe necessary. The value of and income from any investment may fluctuate from day to day as a result of changes in relevant economic markets (including changes in market liquidity). The information herein is not intended to predict actual results, which may differ substantially from those reflected. Past performance is not necessarily indicative of future results.

This material has been issued and approved for distribution in the UK and European Economic Area ("EEA") by Barclays Bank PLC. It is being made available primarily to persons who are investment professionals as that term is defined in Article 19 of the Financial Services and Markets Act 2000 (Financial Promotion) Order 2005. It is directed at, and therefore should only be relied upon by, persons who have professional experience in matters relating to investments. The investments to which it relates are available only to such persons and will be entered into only with such persons. Barclays Bank PLC is authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and the Prudential Regulation Authority and is a member of the London Stock Exchange.

The Corporate and Investment Banking division of Barclays undertakes U.S. securities business in the name of its wholly owned subsidiary Barclays Capital Inc., a FINRA and SIPC member. Barclays Capital Inc., a U.S. registered broker/dealer, is distributing this material in the United States and, in connection therewith accepts responsibility for its contents. Any U.S. person wishing to effect a transaction in any security discussed herein should do so only by contacting a representative of Barclays Capital Inc. in the U.S. at 745 Seventh Avenue, New York, New York 10019.

Non-U.S. persons should contact and execute transactions through a Barclays Bank PLC branch or affiliate in their home jurisdiction unless local regulations permit otherwise.

Barclays Bank PLC, Paris Branch (registered in France under Paris RCS number 381 066 281) is regulated by the Autorité des marchés financiers and the Autorité de contrôle prudentiel. Registered office 34/36 Avenue de Friedland 75008 Paris.

This material is distributed in Canada by Barclays Capital Canada Inc., a registered investment dealer and member of IIROC (www.iroc.ca).

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 Zaimukyokuchō (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.

© Copyright Barclays Bank PLC (2015). All rights reserved. No part of this publication may be reproduced or redistributed in any manner without the prior written permission of Barclays. Barclays Bank PLC is registered in England No. 1026167. Registered office 1 Churchill Place, London, E14 5HP. Additional information regarding this publication will be furnished upon request.

