Modelling high yield bond spreads

Mike Kessler
+44 (0)20 7773 7232
michael.kessler@barclays.com

Darpan Harar
+44 (0)20 7773 1694
darpan.harar@barclays.com

To augment the analysis done by our fundamental credit analysts, we have developed a framework for assessing the relative cheap/richness of high yield bond spreads. The model is also useful in measuring how the market prices various risk factors dynamically across time. Historical performance suggests that our measure of relative valuation is a strong predictor of future returns, making it a useful complement to fundamental views on individual credits. Cross-referencing with ratings from our analysts, we present a list of long and short candidates that our model suggests are currently positioned for significant out/underperformance.

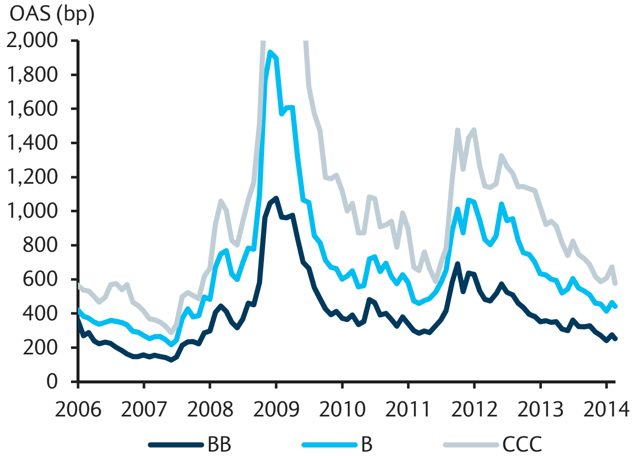
With correlations declining as the macro backdrop slowly improves, we continue to expect 2014 to be a year in which industry and single-name credit selection plays a key role in driving relative performance. While picking credits based purely on fundamentals can feel challenging when spreads are compressed across the credit spectrum (Figure 1), we believe many fundamental, valuation-driven opportunities still exist in the current market. Indeed, spread dispersion is currently near a multi-year high when measured relative to overall spread levels (Figure 2). To facilitate relative value comparisons across the diverse European high yield universe, where many risk factors are in play simultaneously, we present a model for credit spreads that can be used in any market environment, including this one.

A summary of the model's current recommendations, described in full in Figures 15 and 16, is as follows:

Longs: € MDMFP 9% '20, € WINDIM 7.375% '18, $ WINDIM 7.25% '18, € SUNCOM 8.75% '19, $ NEWLOK 8.375% '18, $ FNCIM 6.25% '19, € SMCPFP 8.875% '20, £ NEWLOK 8.75% '18, £ FNCIM 8% '19, € FIAT 6.625% '18, € LGFP 6.75% '19, € FIAT 6.75% '19, € LGFP 6.25% '18, € SNAIM 7.625% '18, € LGFP 6.625% '18, € FIAT 7.375% '18.

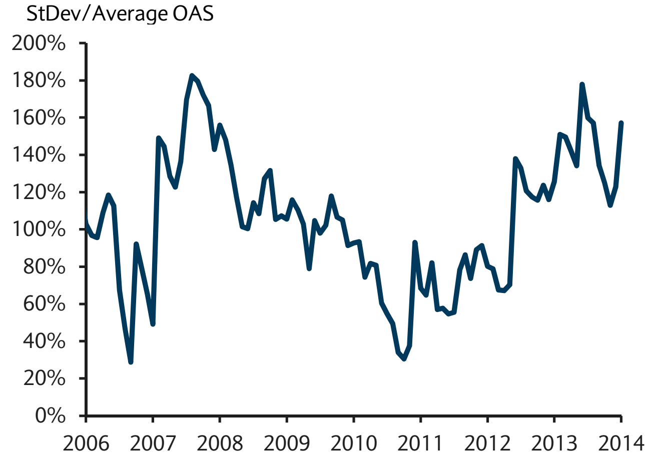
Shorts: € EOFP 8.75% '19, € UNITY 9.625% '19, € PEUGOT 6.875% '16, € PEUGOT 5% '16, € UNITY 9.5% '21, € PEUGOT 5.625% '15, € STENA 6.125% '17, € HEIGR 3.25% '20, € STENA 5.875% '19, € SHAEFF 6.75% '17, € SDFGR 3.125% '18, € HEIGR 4% '16, $ HEIGR 6.125% '16, € CLNVX 5.625% '17, € CLNVX 5.625% '17, € EOFP 9.375% '16.

FIGURE 1
Although high yield spreads are increasingly compressed…



Source: Barclays Research

FIGURE 2
… dispersion is above average relative to spread levels



Source: Barclays Research

Deconstructing the spread of a high yield bond

The spread of a high yield bond compensates investors for bearing several different types of risk, including the bond's fundamental credit risk, its underlying duration profile, and its liquidity characteristics. By selecting variables that proxy for these major risk categories, we can construct a cross-sectional regression model that explains a significant portion of high yield bond spreads at any point in time. The specific variables in our model are as follows:

Credit risk

Rating Factor: As a proxy for credit risk, we transform the Barclays index rating[1] for each bond into the associated Moody's Weighted Average Rating Factor (WARF). The advantage of using WARF is that it increases exponentially as a bond moves out along the credit spectrum. This is reflective of spread differences between ratings notches, which become much larger as credit quality deteriorates. For example, the average difference in OAS between Ba1 and Ba2 credits in the Barclays Pan Euro High Yield ex-Fin Index is currently 22bp, while the average difference between B2 and B3 credits is nearly 70bp. WARF captures this dynamic much more effectively than linear credit rating scales. Note that WARF increases as credit rating decreases, so this variable always has a positive coefficient in our regression output.

Peripheral Domicile: We add a dummy variable to reflect whether or not the bond's issuer is domiciled in a peripheral European country, to reflect the increased credit risk associated with slower growing peripheral economies. While the peripheral premium has shrunk dramatically over the past two years, it still accounts for a non-trivial portion of peripheral high yield spreads (for details on our outlook for European peripheral credits in 2014, see *Peripheral vision*). As such, this variable still retains a positive coefficient, as it has throughout the post-crisis period.

Duration risk

Option Adjusted Duration (OAD): This measures the duration of a bond, adjusted based on the presence of call features as well as the likelihood of any call options being exercised by the issuer. Credit curves are typically upward sloping, so this variable usually has a positive coefficient.

Option Adjusted Duration Squared (OAD^2): This measures a bond's squared duration, to capture the fact that high yield credit curves usually become flatter as one moves farther out the curve. As a result, this variable usually has a negative coefficient.

Callability: We add a dummy variable to reflect whether or not the bond is callable. Callable bonds have greater reinvestment risk than bullets and should therefore trade with a spread premium, all else being equal. As such, this variable usually has a positive coefficient, particularly in high price environments like the current market, where issuer calls are in the money and callable bonds carry extension risk relative to bullets of the same nominal duration.

Liquidity risk

Size (measured by par amount outstanding): All else being equal, smaller bond issues should command a higher liquidity premium than larger benchmark deals. As a result, this variable usually has a negative coefficient, since larger bonds trade at lower spreads. The exception was during the 2008-09 financial crisis, when larger bonds' relatively greater liquidity worked against them, as smaller, less liquid bonds stopped trading entirely.

[1] For split-rated credits, Barclays uses the median of three ratings, or the lower of two. While this introduces a slight downward bias to our proxy for credit risk, we find that the model does not perform materially differently when the average credit rating is used instead.

Currency: We add dummy variables for USD and GBP, the two major non-euro currencies used by European high yield issuers, to measure the differences in overall liquidity across the EUR, GBP, and USD markets. Given its much smaller size, the GBP market has historically been less liquid, so the coefficient for our GBP dummy variable is usually positive. Relative liquidity between the EUR and USD markets has varied over time as the dominant sources of perceived systemic risk have migrated from the US to Europe, and the coefficient for our USD dummy variable has fluctuated accordingly.

Combining all of these, we are left with four "betas" and four "dummy variables" to use as independent variables in a cross-sectional regression model, with option-adjusted spread (OAS) as the dependent variable.

Relative value, not absolute value

It is important to emphasise that while our cross-sectional regression approach has significant explanatory power for assessing the relative cheap/richness of any given bond at a particular point in time, it does not allow us to make claims as to whether a bond (or the market overall) is under/overvalued in an absolute sense. This is because risk premia, represented in our model by the betas and dummy variables, are dynamic across time. The current coefficients, along with illustrative examples of bonds that are fairly valued, overvalued, and undervalued, according to the model, appear in Figure 3.

FIGURE 3

Current regression model parameters with three illustrative examples of modeled vs market spreads

		Fairly Valued Bond		Undervalued Bond		Overvalued Bond	
Current Regression Parameters		VMED 5.5 21 £		WINDIM 7.25 18 $		UNITY 9.625 19 €	
Variable	Coeff.	Bond Metric	OAS Contrib	Bond Metric	OAS Contrib	Bond Metric	OAS Contrib
Intercept	36.58		36.6		36.6		36.6
WARF	0.11	1766 (Ba3)	195.8	1350 (Ba2)	149.6	3490 (B3)	386.9
OAD	23.70	5.9	138.8	1.6	38.6	0.8	18.0
OAD^2	-1.47	34.3	-50.3	2.6	-3.9	0.6	-0.8
Size (€-eq mn par)	-0.03	763	-20.0	945	-24.7	665	-17.4
Peripheral	42.30	No	0.0	Yes	42.3	No	0.0
Callable	13.99	No	0.0	Yes	14.0	Yes	14.0
USD	-13.27	No	0.0	Yes	-13.3	No	0.0
GBP	4.30	Yes	4.3	No	0.0	No	0.0
R-squared	66%						
Modeled Spread			305.2		239.2		437.2
Market Spread			310.0		407.2		322.6
Cheap/(Rich)ness			4.8		168.0		-114.6

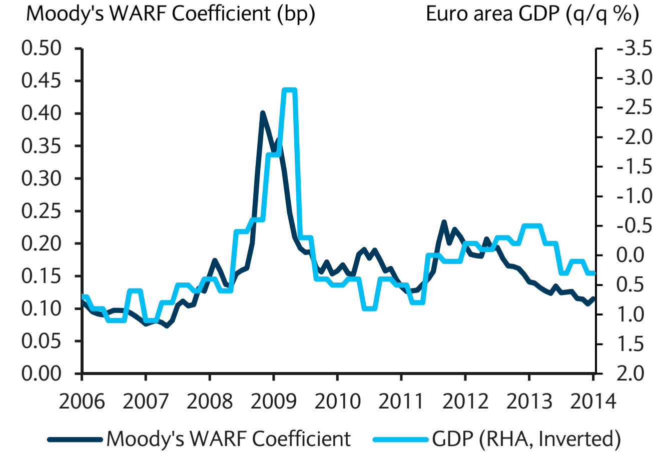
Source: Moody's, Barclays Research

How do the components of spread vary over time?

Beyond the relative cheap/richness of individual bonds, an added benefit of a cross-sectional approach is that it allows us to assess the influence (and market price) of various risk sources across time. Using monthly snapshots of our cash universe (subject to the restrictions described in the Appendix), we can plot the evolution of the factor coefficients in various market environments by re-running the regression. While there is a large degree of continuity over short time periods (ie, the factors are relatively consistent as long as general market conditions are stable), several of the coefficients have varied significantly over multi-year time horizons, reflecting underlying economic and market developments.

FIGURE 4

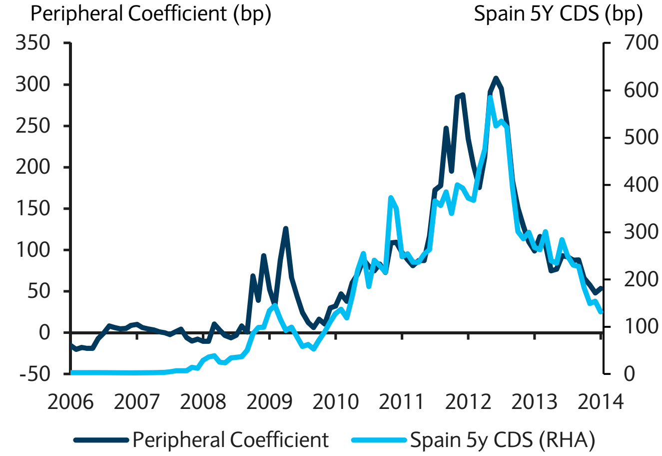
The marginal impact of ratings is highest during recessions, when investors are more sensitive to downgrade/default risk



Source: Moody's, Barclays Research

FIGURE 5

The peripheral premium has fluctuated dramatically over the past five years, similar to Spain 5y CDS



Source: Barclays Research

Changes in these coefficients can be interpreted as dynamic market prices for different risk sources, and their marginal influence over spreads.

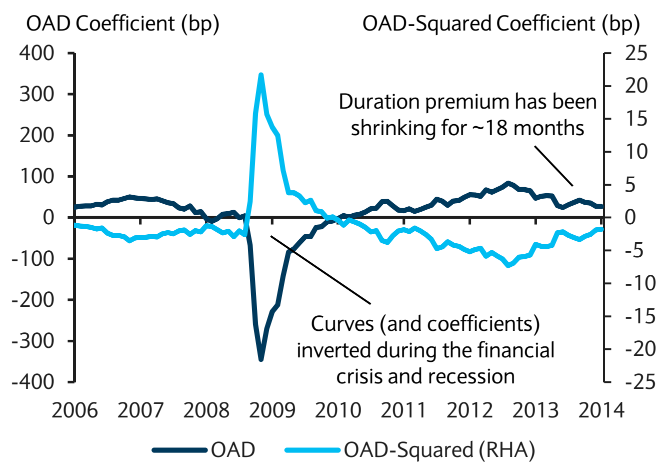
Credit risk

Ratings: Not surprisingly, spread compensation for credit rating deterioration (as reflected by the WARF coefficient in our regression) is highly sensitive to the economic cycle (Figure 4). During recessions, investors are much more sensitive to downgrade and default risk and thus require significantly more incremental spread per marginal unit of WARF. As growth has picked up in Europe, the influence of this factor has declined to mid-2007 levels.

Peripherals: Compensation for an issuer's peripheral status has also varied dramatically over the past few years, but unlike credit ratings, the peripheral coefficient in our regression does not particularly track GDP. Instead, it closely mimics movements in peripheral sovereign CDS levels, including Spain (Figure 5). As the market's assessment of eurozone breakup risk has diminished, the peripheral coefficient has returned to early 2010 levels.

FIGURE 6

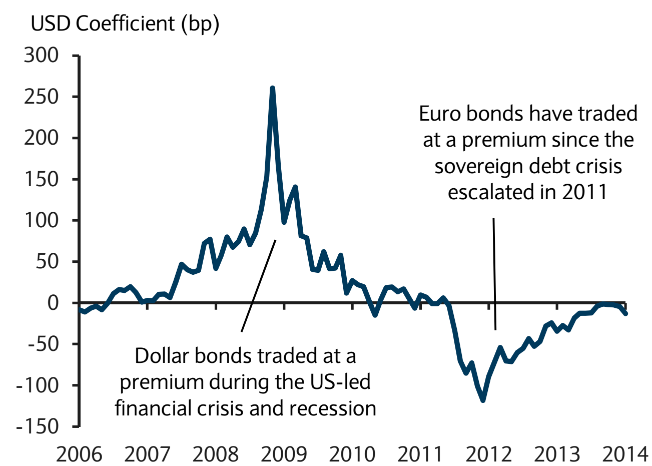
The duration premium has been shrinking for the past 18 months



Source: Barclays Research

FIGURE 7

EUR bonds are at a slight premium to USD, all else equal, but this relationship has varied dramatically across time



Source: Barclays Research

Duration risk

OAD and OAD-squared: In normal markets, the OAD coefficient is positive and the OAD-squared coefficient is negative, reflecting high yield credit curves which are generally upward sloping but also flatter in the back end rather than in the front. The exception to this was during the 2008-09 financial crisis and recession, when curves (and our regression coefficients) were inverted (Figure 6). More recently, the OAD coefficient has been declining, as investors have accepted progressively less spread compensation for extending out the curve.

Liquidity risk

Currency premiums: Relative to euro-denominated bonds, the coefficient for sterling has been consistently positive over time, owing to that market's generally lower liquidity. In contrast, the coefficient for dollar-denominated bonds has fluctuated widely, reflecting changes in the perceived source of systemic risks (Figure 7). During and after the financial crisis, dollar bonds traded wider than euros (all else being equal), but this relationship reversed sharply in the second half of 2011, leaving euro-denominated bonds with a significant spread premium. The coefficient has slowly retraced toward zero over the past two years, such that euro bonds currently offer only a slight premium to dollars when all other factors are held constant.

Historical performance of the model

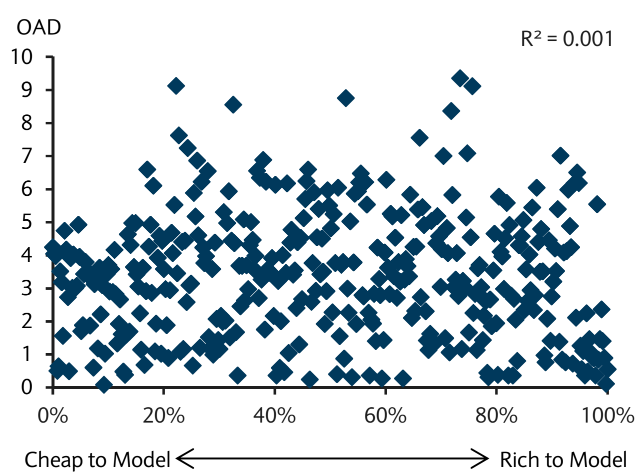
While the evolution of risk factors is useful for strategic portfolio construction decisions, our model's value will ultimately be determined by its ability to correctly identify individual bonds (or sectors) that will subsequently out/underperform the market. The explanatory power of the regression has remained reasonably high over time, with R-squared ranging from 0.32 to 0.73 across eight years of monthly data. Not surprisingly, the model is especially strong in lower volatility markets (like the present one), as risk factors are more consistently priced across credits.

To validate further the model's usefulness in this regard, we subjected it to three tests:

1. Does the model have any systematic biases in identifying cheap or rich names?
2. Do bonds identified by the model as cheap/rich subsequently out/underperform the market on average over a reasonable time horizon?
3. Does a long/short basket of cheap/rich names outperform the market over time when adjusted for volatility?

FIGURE 8

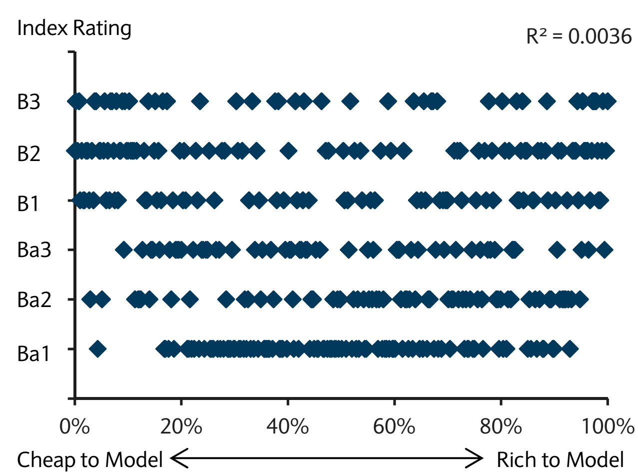
The model's cheapness or richness of the bond is not correlated with the bond's duration…



Source: Barclays Research

FIGURE 9

… nor does the model identify rich/cheap bonds based on their credit rating.



Source: Barclays Research

Checking for bias

The objective of our model is to select under/overvalued credits from across the high yield universe, rather than emphasising any particular subset of the market. As Figures 8 and 9 demonstrate, the model's assessment of the relative richness or cheapness of a bond appears to have no relationship with the bond's rating or duration. Scatter plots of residuals versus our other independent variables produce similar results. As a result, we are confident that the extra spread premium in bonds identified as cheap is not due to being lower rated, longer duration, or peripheral credits, just as any missing spread in rich bonds is not attributable to higher ratings, lower duration, or core credit status. Rather, the model effectively identifies bonds that are wide (tight) *relative* to their current rating, duration, and other risk factors.

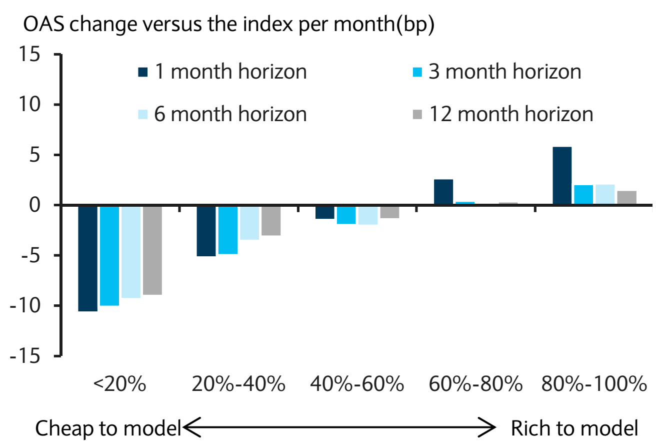
Bond-level out/underperformance

For individual bonds, we find the model's assessment of cheap/richness to be a strong predictor of future performance relative to the index. To illustrate the model's effectiveness in this regard, we computed the difference between model-implied and traded spreads for all BB and B rated bonds in the Barclays Pan European High Yield ex-Fin Index for each month since the start of 2010[2]. For each month, we then grouped the index into quintiles ranked by their excess market spread versus the model. The lowest quintile represents bonds that are cheapest relative to the market according to the model, while the highest quintile represents the richest bonds. Although the dividing lines are admittedly somewhat arbitrary, the quintiles can generally be thought of as follows:

- 0-20% quintile: bonds that are significantly undervalued relative to the market
- 20-40% quintile: bonds that are slightly undervalued relative to the market
- 40-60% quintile: bonds that are approximately fairly valued relative to the market
- 60-80% quintile: bonds that are slightly overvalued relative to the market
- 80-100% quintile: bonds that are significantly overvalued relative to the market

FIGURE 10

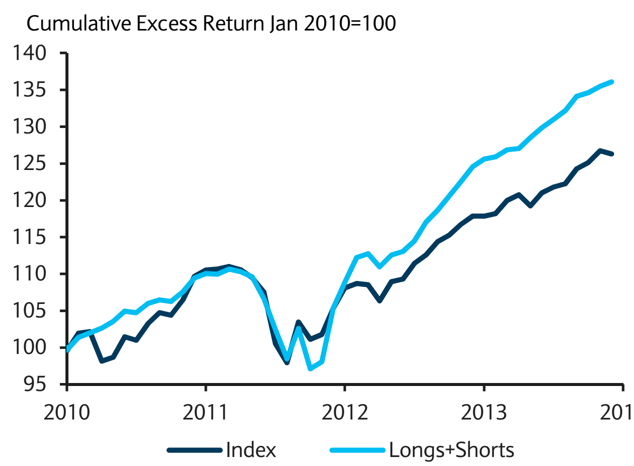
Bonds identified as cheap by the model tend to outperform over all time horizons, while rich bonds underperform



Note: Based on median OAS change relative to index. Total spread changes over the entire period are divided by the number of months in the period to normalise results across different time horizons. Source: Barclays Research

FIGURE 11

The long/short strategy has outperformed the comparable index during the post-crisis period



Source: Barclays Research

[2] While the multiple-Rs of the model are still fairly strong pre-crisis, we focus our analysis on 2010 and beyond partly because extreme valuations during 2008-09 cause the model to lose some of its predictive power, and also to remove the impact of small sample set problems during the pre-crisis period when the European high yield market was a fraction of its current size.

To gauge subsequent performance, we then calculated median excess returns and spread changes for each quintile over the following month, quarter, six-month, and 12-month periods. As Figure 10 shows, bonds which are identified as cheap by the model tend to tighten relative to the index over all time horizons, while bonds identified as rich tend to widen. Moreover, subsequent relative performance is strictly related to our measure of cheap/richness across all quintiles, ie, the model has predictive value even for slightly under/overvalued bonds, not just at the extremes.

It is obvious from Figure 11, however, that the model is slightly more effective at picking undervalued longs than overvalued shorts, as the 0-20% ("significantly undervalued") quintile typically experiences more relative tightening than the 80-100% (significantly overvalued") quintile widens. Since the model is designed to identify bonds with the most excess spread given their credit, duration, and liquidity risk profiles, it will naturally assess many of the widest trading names as being the cheapest, while the tightest trading names are likely to be deemed the richest. There is effectively no limit to how wide a bond's spread can go – it can reach very cheap levels that position it for substantial outperformance as spreads eventually converge to fair value. Conversely, there is an effective cap on how tight bond spreads can go (eg, high yield bonds usually will not trade through investment grade spread levels, all else being equal), meaning they can only get so rich, which puts a tighter limit on subsequent underperformance from fair value convergence.

An illustrative trading strategy

To further test the model's predictive power, we devised an illustrative systematic trading strategy. Based on the output of the model each month, we construct the following baskets:

- Starting with the sample set described in the appendix, we also exclude the top/bottom 1% widest/tightest trading names in absolute OAS terms, to avoid biasing the results with outliers and/or index data issues.
- From the remainder, we take the 0-20% (significantly undervalued) quintile as our "Long Basket" and the 80-100% (significantly overvalued) quintile as our "Short Basket".
- We measure the median excess return of the long and short baskets over the following month, then rebalance the baskets based on a new regression output.
- The longs are assessed as a standalone strategy. An equal-weighted combination of the long and short baskets is also evaluated as an alternative strategy.

FIGURE 12

Performance statistics of each of the systematic baskets

	Index*	Longs Only	Longs + Shorts
Annualised excess return	6.08	11.07	7.96
Annualised vol	6.82	11.42	6.83
Sharpe Ratio	0.89	0.97	1.16
VAR	-2.44	-5.31	-3.44
cVAR	-4.33	-7.36	-4.37

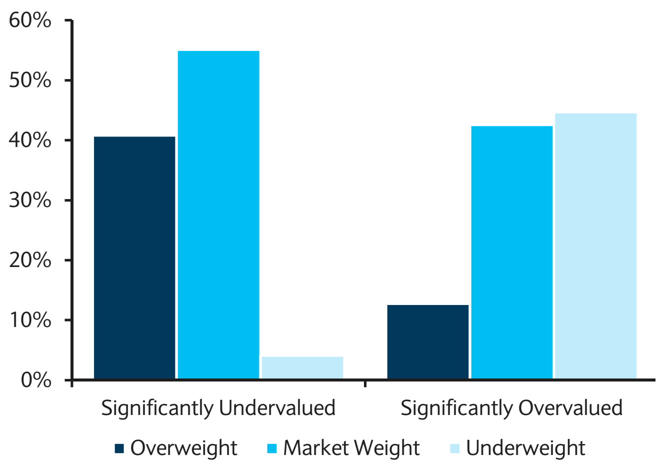
Note: *Index based on median returns of the BB and B names in the Barclays Pan Euro High Yield ex-Financials/ex-Subordinated index. VAR based on 5% level. Source: Barclays Research

Not surprisingly, the longs-only strategy has realised the highest returns over the past four years, driven by its unhedged exposure to wide-trading credits during a broad-based rally in the high yield market. However, this incremental return was accompanied by significantly more volatility and dramatically increased tail risk relative to the index or the long/short strategy, as represented by the strategy's much higher VAR and cVAR.

The results in Figures 11 and 12 clearly indicate that the long/short strategy has produced higher returns compared to the comparable index with similar levels of overall volatility, delivering a superior Sharpe ratio. Further, the increased return has not been associated with incremental tail risk, as the cVAR between the long/short strategy and the index are broadly similar. As such, although individual bond performance suggests that the model is better at identifying undervalued longs than overvalued shorts, we believe the results of our illustrative trading strategy demonstrate that avoiding (or shorting) bonds identified as rich can still add significantly value to overall portfolio construction.

FIGURE13

The model tends to agree with our analysts' ratings



Source: Barclays Research

FIGURE 14

There is not a material difference in the durations or ratings between the current cheapest and richest quintiles

Average Statistics	Significantly Undervalued	Significantly Overvalued
Option Adjusted Duration	3.07	2.87
Index Rating	BA3/B1	B1
Current OAS	473	272
Implied Spread Change	-154	75

Source: Barclays Research

Current recommendations

Applying our spread model to today's cash market allows us to identify attractive long and short candidates at current levels. To augment this systematic approach with a fundamental overlay, we limit our list of recommendations to only include bonds that are officially rated by our analysts. Our confidence in the model's current output is reinforced by the fact that our analysts' fundamental ratings are broadly in sync with the model. The cheapest quintile ("significantly undervalued") contains 41% analyst Overweights, 55% Market Weights, and only 4% Underweights. Meanwhile, the richest quintile ("significantly overvalued") contains 45% Underweights, 42% Market Weights, and 13% Overweights (Figure 13).

As a final check for systematic biases, we also calculate the average duration, rating, and spread for our lists of recommended longs and shorts. As Figure 14 shows, there is no material difference in the duration or ratings of the quintiles at the opposite ends of the model's relative value spectrum. There is, however, a significant difference in average OAS, and in the spread change that would be required in order to bring market levels in line with our model. This result suggests that the model is effectively identifying wide- and tight-trading names without relying on systematic risk factors as a source of spread pickup.

In Figure 15 below, we list the bonds that are currently in the cheapest quintile (significantly undervalued) and carry an Overweight rating from our fundamental analysts as our recommended long basket. Figure 16 details our recommended short basket, made up of bonds in the richest quintile (significantly overvalued) that carry an Underweight rating from our analysts.

FIGURE 15
Bonds that are in the cheapest quintile and carry Overweight recommendations from our fundamental analysts

Ticker	Cpn	Maturity	Crncy	Index Rating	Sector	Mid OAD	Mid Price	Mid OAS	Implied Change	Analyst Rating
MDMFP	9.000	01/08/20	EUR	B2	RETAILERS	4.51	104.38	685	-298	OW
WINDIM	7.375	15/02/18	EUR	BA2	WIRELESS	1.37	105.53	440	-224	OW
WINDIM	7.250	15/02/18	USD	BA2	WIRELESS	1.24	105.63	384	-176	OW
SUNCOM	8.750	15/03/19	EUR	B3	WIRELESS	0.65	103.75	535	-134	OW
NEWLOK	8.375	14/05/18	USD	B2	RETAILERS	2.54	106.50	509	-133	OW
FNCIM	6.250	15/07/19	USD	BA1	AEROSPACE/DEFENCE	4.60	105.50	348	-116	OW
SMCPFP	8.875	15/06/20	EUR	B3	TEXTILE	3.93	108.00	584	-111	OW
NEWLOK	8.750	14/05/18	GBP	B2	RETAILERS	2.06	108.25	428	-100	OW
FNCIM	8.000	16/12/19	GBP	BA1	AEROSPACE/DEFENCE	4.71	113.13	339	-88	OW
FIAT	6.625	15/03/18	EUR	BA3	AUTOMOTIVE	3.45	110.25	319	-85	OW
LGFP	6.750	16/12/19	EUR	BA1	BUILDING_MATERIALS	4.97	116.70	249	-85	OW
FIAT	6.750	14/10/19	EUR	BA3	AUTOMOTIVE	4.76	111.75	334	-83	OW
LGFP	6.250	13/04/18	EUR	BA1	BUILDING_MATERIALS	3.58	112.23	240	-73	OW
SNAIM	7.625	15/06/18	EUR	B3	ENTERTAINMENT	3.43	104.50	567	-71	OW
LGFP	6.625	29/11/18	EUR	BA1	BUILDING_MATERIALS	4.19	115.50	229	-68	OW
FIAT	7.375	09/07/18	EUR	BA3	AUTOMOTIVE	3.72	113.55	322	-64	OW

Note: Based on Index price data. Levels indicative only, Source: Bloomberg, Barclays Research

FIGURE 16
Bonds that are in the richest quintile and carry Underweight recommendations from our fundamental analysts

Ticker	Cpn	Maturity	Crncy	Index Rating	Sector	Mid OAD	Mid Price	Mid OAS	Implied Change	Analyst Rating
EOFP	8.750	15/06/19	EUR	B3	AUTOMOTIVE	1.34	113.88	270	162	UW
UNITY	9.625	01/12/19	EUR	B3	MEDIA_CABLE	0.73	109.75	285	140	UW
PEUGOT	6.875	30/03/16	EUR	B1	AUTOMOTIVE	1.90	109.75	185	102	UW
PEUGOT	5.000	28/10/16	EUR	B1	AUTOMOTIVE	2.51	107.00	196	94	UW
UNITY	9.500	15/03/21	EUR	B3	MEDIA_CABLE	2.12	115.63	353	82	UW
PEUGOT	5.625	29/06/15	EUR	BA3	AUTOMOTIVE	1.28	105.38	141	80	UW
STENA	6.125	01/02/17	EUR	B2	TRANSPORTATION_SERVICES	2.69	108.50	274	77	UW
HEIGR	3.250	21/10/20	EUR	BA2	BUILDING_MATERIALS	5.99	102.25	163	69	UW
STENA	5.875	01/02/19	EUR	B2	TRANSPORTATION_SERVICES	4.32	109.00	306	64	UW
SHAEFF	6.750	01/07/17	EUR	BA3	AUTOMOTIVE	0.34	106.85	147	63	UW
SDFGR	3.125	06/12/18	EUR	BA1	CHEMICALS	4.48	105.05	121	60	UW
HEIGR	4.000	08/03/16	EUR	BA2	BUILDING_MATERIALS	1.92	104.75	144	56	UW
HEIGR	6.125	15/08/16	USD	BA2	BUILDING_MATERIALS	2.32	110.13	142	52	UW
CLNVX	5.625	24/01/17	EUR	BA1	CHEMICALS	2.75	111.75	114	50	UW
CLNVX	5.625	24/01/17	EUR	BA1	CHEMICALS	2.75	111.75	114	50	UW
EOFP	9.375	15/12/16	EUR	BA3	AUTOMOTIVE	2.50	119.70	180	50	UW

Note: Based on index price data. Source: Bloomberg, Barclays Research

Appendix

Regression model specifications

Dependent Variable: Option-Adjusted Spread (OAS)

Betas: Credit Rating (WARF), Duration (OAD), Duration-Squared (OAD^2), and Size (par)

Dummy Variables: Peripheral Issuer, Callable Bond, USD-denominated, GBP-denominated

$$OAS_t = \alpha_t + \ \beta_1 WARF_t + \beta_2 OAD_t + \beta_3 OAD_t^2 + \beta_4 Size_t + $$
$$+\gamma_1 Peripheral_t + \gamma_2 Callable_t + \gamma_3 USD_t + \gamma_4 GBP_t$$

R-squared: 66%

Restricting the sample

To maximise the explanatory power of the model, we restrict our regression dataset to bonds with the following characteristics:

Rated between Baa1 to B3: CCC (and lower) rated names are excluded from our analysis due to the small sample set and the highly idiosyncratic nature of these credits. As credits approach distressed levels, the influence of systematic risk factors is diminished and the model loses predictive power. Conversely, BBB rated credits are included in our data to give us a larger historical sample, allowing us to assess systematic risk factors more effectively.

Currency: We include all EUR, USD, and GBP bonds that fulfil our other criteria in order to maximise sample size, and to capture evolving differences in risk premia across currencies.

Industry/structure: We exclude financials and corporate hybrids from the analysis due to their structural differences compared to more traditional "regular way" high yield bonds.

Duration: We exclude bonds with durations of more than 10 years. These bonds represent a very small part of the HY universe, and their inclusion can have distortionary effects on the OAD and OAD^2 coefficients, making the model less accurate for bonds that fall into more traditional high yield duration buckets.

Deeply call constrained bonds: We remove any bonds trading with a negative OAS to eliminate any potential distortions caused by deeply call constrained bonds.

Analyst Certification

We, Darpan Harar and Mike Kessler, 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.

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