BARCLAYS

Quantitative Portfolio Strategy

9 May 2016

Relative Value Investing in Credit

- We analyze relative value investing in credit and consider security valuation while controlling for systematic credit risk.
- We introduce a measure of relative value in corporate credit, Relative Value in Spread (RVS), which is the spread unexplained by macro and fundamental risk characteristics.
- Portfolios sorted on RVS display a monotonous increase in return and information ratio as RVS increases.
- RVS ranks display slow mean-reversion, allowing investors to build relative value portfolios with moderate turnover.
- The portfolio of bonds with above median RVS scores outperformed the below median portfolio by 1.78% per year between 1993 and 2016, with an information ratio above 1.5. The outperformance has been robust across rating, industry, and liquidity subsets of the corporate bond market in different time periods.
- A portfolio designed to track Barclays US Corporate index with a relative value tilt outperformed the index by more than 1.3% per year with a tracking error volatility of 1.1% per year between 1993 and 2016.
- A systematic relative value strategy based on RVS had higher returns following periods of high dispersion in RVS. This occurred during periods of high market volatility.
- The RVS strategy exhibits low correlations with other sources of fixed income and equity risk premia.

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Introduction

Value investing has for long been popular with equity portfolio managers. Pioneered by Benjamin Graham and David Dodd, the strategy involves overweighting undervalued securities using, for example, the price-to-book (P/B) ratio[1].

Value investing can be used on a systematic basis and is often seen as part of a suite of investment styles that aim to capture thematic risk premia such as momentum, carry, and size. However, limited liquidity in credit markets makes high turnover strategies less practical and necessitates long investment horizons consistent with fundamentally driven styles such as value.

In credit, valuation measures typically include spread in addition to fundamentals often used in equity markets. In that sense, value and carry strategies are related to each other. Favouring high spread bonds has long been popular with fixed income managers, as a higher spread carry bias has indeed proved profitable over long periods. But this can entail significant market risk given that higher spread typically comes with lower credit quality and higher return volatility. Indeed, systematically overweighting high spread bonds would lead to portfolio biases in quality, sector, and maturity allocations[2].

Figure 1 shows average excess returns[3] of corporate bond portfolios versus average spreads. Bonds are grouped every month either by credit rating in Panel A or by spread deciles in Panel B. In both cases average return increases with portfolio average spread. However, this increase in return is accompanied by higher market risk as shown in Figure 2[4]. Overweighting high spread bonds relative to low spread ones is highly directional on market returns.

In order to remove this directionality, one must control for the systematic risk embedded in credit spreads. Several recent studies use this approach when introducing value investment styles in credit that resemble the factor method used by equity investors.[5] Our approach is similar in spirit. We introduce a relative value credit strategy that controls for industry, quality, duration, and issuer fundamentals, which can all affect the credit risk of an issuer. We identify relative value as the portion of excess spread over peers unexplained by fundamental factors, and call this measure Relative Value in Spread (RVS). We use RVS scores to build portfolios of "undervalued" bonds and analyse their performance and characteristics.

We show that bond portfolios with high RVS tend to outperform their peers in terms of both absolute and risk-adjusted returns. We discuss properties of RVS scores and of relative value portfolios, including directionality on other risk premia and stability of performances. We also describe portfolio applications.

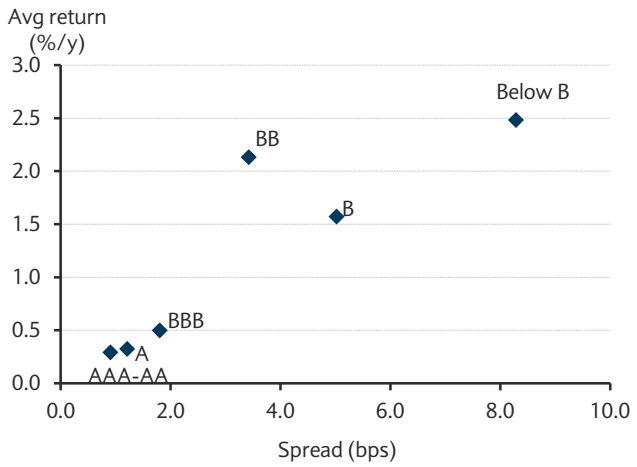
[1] Recent publications on value investing in equities and other asset classes include Asness, Frazzini and Pedersen [2014], 'Quality Minus Junk'; Koijen et al. [2015], 'Carry' and Asness, Moskowitz and Pedersen [2013], 'Value and Momentum Everywhere'.
[2] For empirical evidence of the effect of a long spread bias in active fixed income portfolios, see Desclée, Maitra, Phelps and Polbennikov, *'Fixed Income Active Returns'*, Barclays Research, 2012
[3] All returns presented in this article are in excess of duration-matched Treasury portfolios, as per Barclays index conventions.
[4] The relationship between spread and market risk is documented in 'A New Measure of Spread Exposure in Credit Portfolios' Ben Dor A., L. Dynkin, and J. Hyman, Barclays Research 2009
[5] See Houweling and Zundert [2014], 'Factor Investing in the Corporate Bond Market'; and Israel, Kang and Richardson [2015], 'Investing with Style in Corporate Bonds'.

FIGURE 1

Average return vs. average spread: US Corporate IG and HY (January 1993 to January 2016)

PANEL A

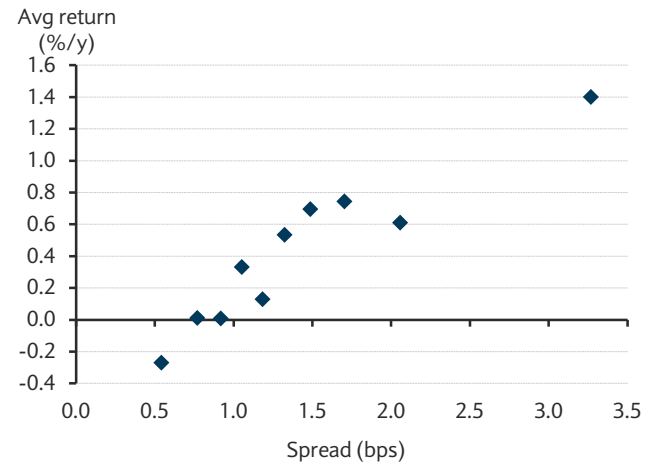
By rating



Source: Barclays Indices; Barclays Research

PANEL B

By spread deciles (Investment-Grade only)



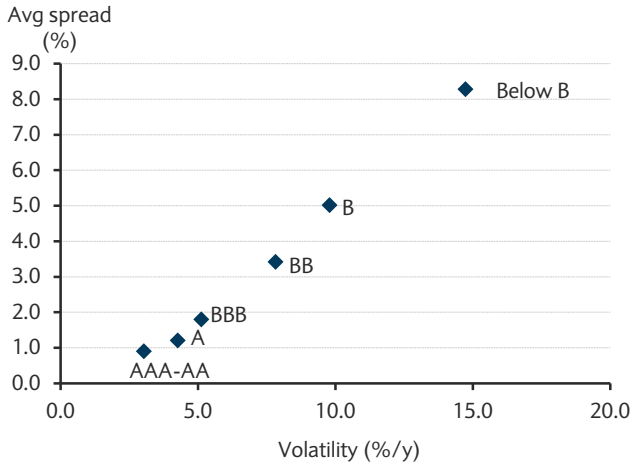
Source: Barclays Indices; Barclays Research

FIGURE 2

Average return vs. volatility: US Corporate IG and HY (January 1993 to January 2016)

PANEL A

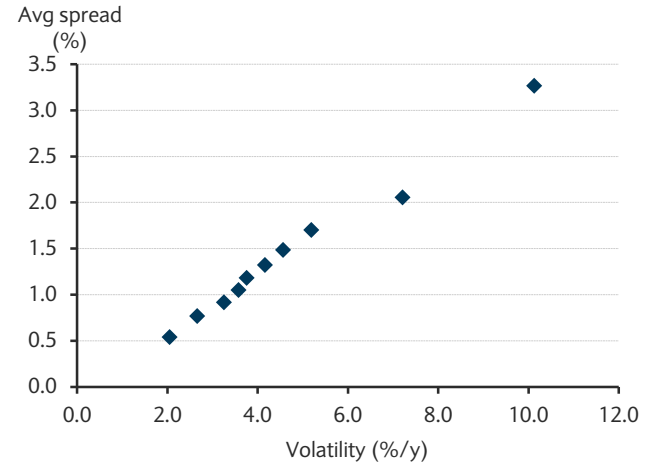
By rating



Source: Barclays Indices; Barclays Research

PANEL B

By spread deciles



Source: Barclays Indices; Barclays Research

Forming Relative Value Scores

Our analysis aims to differentiate between bonds and issuers at a given point in time on a relative basis. The methodology used to compare bonds with each other is the key to our approach. Several control mechanisms are considered to limit systematic risk exposures that typically arise when favouring high spread bonds.

Our objective is to identify securities whose spreads are not fully explained by fundamental credit risk. This can be done by attributing credit spread to a number of risk factors, including the macro environment and fundamental issuer characteristics. This attribution can be done in different ways. For example, Correia, Richardson and Tuna [2012], derive theoretical spreads of individual issuers using structural and reduced form credit default models. Excess spread

over its derived theoretical value is then used as a valuation measure. Alternatively, one can use a statistical analysis to identify relevant risk factors affecting spreads.

We adopt a practical approach by assuming that on average the corporate market is correctly priced, while individual securities can temporally deviate from their "fundamental value" and can therefore be either under or overvalued. The fundamental "theoretical" spread is represented by the peer group in our case. Consequently, we compare individual bonds with relevant peer groups, controlling for three major risk dimensions: credit quality, industry and duration. Exposures to these risk dimensions can be measured at the level of individual securities (eg, duration, rating) or at issuer level (eg, industrial sector, fundamental issuer data).

Credit rating is arguably one of the most important characteristics to control when assessing valuation, as it helps avoid systematic biases in credit risk. Indeed, rating agencies put significant resources into assessing credit risk which they then express through ratings. They extensively use accounting data as well as industry specific information as inputs for their models. Rating quality is, in our view, informative of long-term credit risk and can form a baseline for cross-sectional comparison of credit issuers.

Although controlling for rating can be a practical way to account for credit risk, it can also be combined with a direct analysis of fundamental characteristics of an issuer.[6] In our analysis, we include financial leverage[7], which is one of the important drivers of default risk.[8] We will show that controlling for financial leverage moderately improves our results relative to the rating-based approach in isolation.

Controlling for industry helps make issuers broadly homogenous in terms of business dynamics and economic fundamentals. While this comparability is far from perfect, some broad characteristics, such as exposure to economic shocks or business cycles, are often much more similar within than across industries.

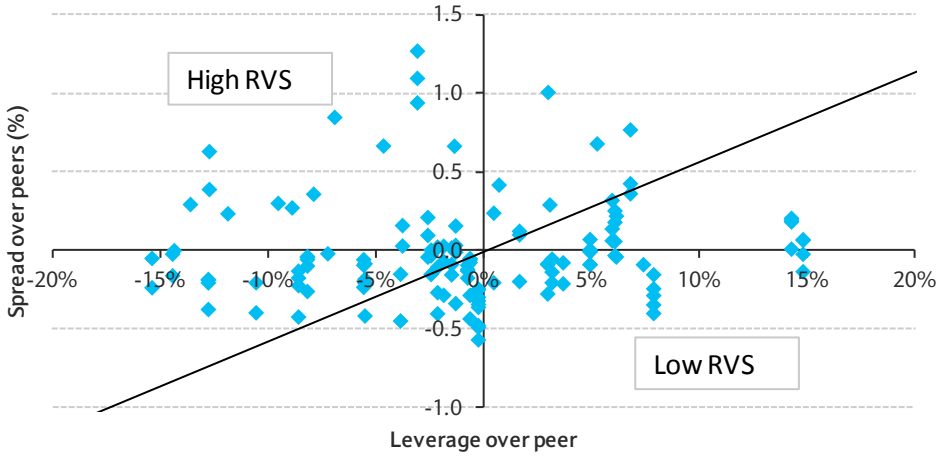
Finally, controlling for bond duration recognizes that the term structure of spread is not flat, as spreads generally increase with maturity. When assessing whether a high spread bond is undervalued, comparison should be made with bonds of similar maturities in order to avoid systematic biases in duration exposure.

For each bond from a broad index universe we produce a Relative Value in Spread (RVS) score by measuring its excess spread over its rating-industry-duration peers while also controlling for financial leverage. Figure 3 provides a crude illustration of the methodology. Excess spread is contrasted with excess leverage for Baa-rated bonds with maturities between three and seven years in the consumer non-cyclical sector. Excess spread and excess leverage are calculated over peer averages in the same rating-industry-maturity category. Bonds in the North-West part of the diagram have higher spreads relative to peers after controlling for financial leverage and are deemed good value while bonds in the South-East region are seen as relatively expensive.

[6] Rating agencies could be slow in incorporating new data into credit rating because they take a rating action only when it is unlikely to be reversed shortly afterwards (see Loffler, G., 'Avoiding the rating bounce: why rating agencies are slow to react to new information', Journal of Economic Behaviour and Organization, March 2005).
[7] Financial leverage is calculated as the book value of debt divided by the sum of the market value of equity and the book value of debt. We conservatively apply a lag of 3 months when calculating leverage.
[8] See Merton, R., 'On the Pricing of Corporate Debt: The Risk Structure of Interest Rates', Journal of Finance 29, 1974. Other metrics could be used, including quick ratio (current assets / current liabilities), coverage ratio (EBIT / Interest) and Debt/EBITDA for solvency, as well as estimates of asset volatility.

FIGURE 3

Excess spread vs. excess leverage for Consumer Non Cyclical 3-7y Baa-rated bonds (December 2015)



Source: Barclays Research

We estimate RVS scores of individual bonds on a monthly basis and construct 10 portfolios that correspond to deciles of RVS. Our analysis is based on Barclays US Corporate Bond Index filtered to retain non-callable, senior bonds that were successfully mapped to Compustat fundamental data[9]. This universe is large, with more than 2000 bonds per month on average and over 4000 in recent months.

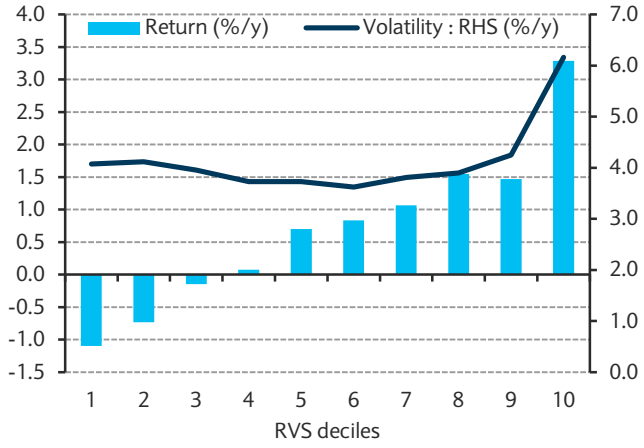
Figure 4 plots returns, volatilities and information ratios of the sorted portfolios. The relationship between RVS and return or information ratio is nearly monotonic: undervalued portfolios with higher RVS tend to deliver higher risk-adjusted performance over time. This result holds for different sub-periods.

FIGURE 4

Performance by RVS deciles (1993 to 2016)

PANEL A

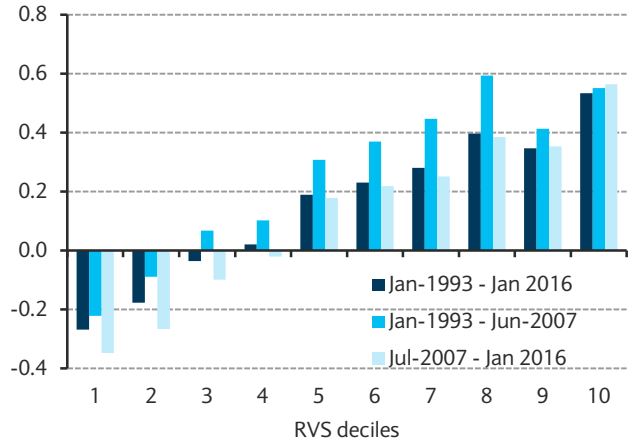
Average return and volatility (%/y)



Source: Barclays Research

PANEL B

Information ratio



Source: Barclays Research

[9] We consider all senior non-callable bonds from Barclays US IG Corporate Bond Index that can be mapped to Compustat financial accounting data. We also exclude securities with spreads in the top 0.5% of the sample to avoid extreme outliers.

To illustrate the incremental contribution of including corporate fundamentals in RVS, Figure 5 reports the performances of RVS deciles calculated with and without financial leverage. Controlling for leverage moderately helps discriminate across deciles[10].

FIGURE 5

Performance of RVS deciles controlling or not for excess leverage (1993 to 2016)

	Sector / Quality / Duration			Sector / Quality / Duration and Financial Leverage		
RVS deciles	Return (%/y)	Vol (%/y)	IR	Return (%/y)	Vol (%/y)	IR
1	-1.19	4.86	-0.24	-1.1	4.08	-0.27
2	-0.48	4.43	-0.11	-0.73	4.12	-0.18
3	-0.13	4.02	-0.03	-0.15	3.95	-0.04
4	0.13	3.67	0.04	0.08	3.73	0.02
5	0.66	3.41	0.19	0.7	3.73	0.19
6	0.66	3.23	0.21	0.83	3.62	0.23
7	0.97	3.46	0.28	1.07	3.81	0.28
8	1.21	3.61	0.34	1.55	3.9	0.4
9	1.60	4.45	0.36	1.47	4.25	0.35
10	2.63	6.28	0.42	3.29	6.16	0.53

Source: Barclays Research

Volatility and dynamics of RVS scores can affect the turnover and rebalancing costs of relative value portfolios. Indeed, volatile RVS scores could make a value strategy based on it expensive to maintain and therefore impractical. Figure 6 shows transition frequencies across RVS deciles on three- and 12-month horizons. It indicates that RVS scores tend to be relatively stable, especially for deciles with the lowest and highest scores. This suggests that portfolio turnover arising from changes in RVS is likely to be moderate. In addition, the transition matrices reveal mean-reversion in RVS as high and low scores seem to be pulled to the middle. This is consistent with mean-reversion of relative spreads which itself is the key driver of the strategy performance.

[10] Including accounting fundamentals can raise some practical challenges when comparing firms. Indeed, company management often has a degree of discretion while calculating certain entries in financial reports. This can make comparison difficult without appropriate adjustments.

FIGURE 6
Transition frequency across RVS deciles on 3- and 12-month horizons (1993 to 2016)

RVS start-of-period: RVS decile	RVS end-of-period: 1	2	3	4	5	6	7	8	9	10
3 month horizon										
1	70%	20%	5%	2%	1%	1%	1%	0%	0%	0%
2	19%	42%	23%	9%	4%	2%	1%	1%	0%	0%
3	5%	21%	33%	22%	10%	4%	2%	1%	1%	0%
4	2%	8%	21%	29%	22%	10%	4%	2%	1%	0%
5	1%	4%	9%	20%	28%	22%	10%	4%	1%	1%
6	1%	2%	4%	9%	19%	29%	22%	9%	3%	1%
7	1%	1%	2%	4%	9%	20%	32%	23%	7%	1%
8	0%	1%	1%	2%	4%	8%	21%	38%	23%	3%
9	0%	0%	1%	1%	1%	3%	6%	20%	50%	17%
10	0%	0%	0%	0%	0%	1%	1%	3%	16%	77%
12 month horizon										
1	44%	21%	12%	7%	5%	4%	3%	2%	2%	2%
2	18%	23%	18%	13%	9%	7%	5%	3%	2%	2%
3	10%	16%	18%	16%	13%	10%	7%	5%	3%	2%
4	6%	11%	15%	17%	16%	13%	10%	7%	4%	2%
5	4%	8%	11%	15%	17%	15%	13%	9%	5%	3%
6	3%	5%	8%	11%	14%	16%	16%	13%	8%	4%
7	2%	4%	6%	7%	11%	15%	19%	18%	13%	5%
8	2%	3%	4%	5%	8%	11%	16%	22%	20%	9%
9	2%	2%	2%	3%	5%	7%	11%	18%	29%	22%
10	2%	2%	1%	2%	2%	3%	4%	8%	20%	56%

Source: Barclays Research

Performance of Relative Value Investing

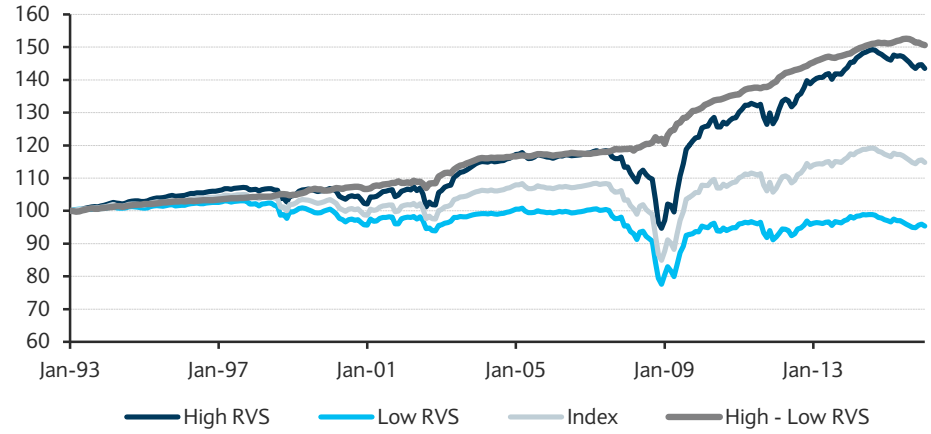
The performance of portfolios sorted on RVS (Figures 4 and 5) suggest that it is possible to build a high RVS portfolio that historically outperforms traditional corporate bond indices.

As a simple approach, we build high (low) RVS portfolios each month by selecting bonds with above (below) median RVS scores from our investment-grade index universe.

Figure 7 shows cumulative returns of high and low RVS portfolios[11], as well as of the long-short (high minus low RVS) strategy. The outperformance of the high RVS portfolio over its low RVS counterpart has been very persistent.

[11] All portfolios and market weighted. We have also tested equally weighted portfolios with one bond per issuer. The results are stronger under this specification and are available upon request.

FIGURE 7
Cumulative performance of relative value portfolios



Source: Barclays Research, Barclays Indices

Figure 8 compares the performance of high and low RVS portfolios with that of Barclays US IG Corporate Bond Index in different periods. The high RVS portfolio outperforms both the low RVS portfolio and the corporate index by 1.78 and 1.18 % per year, respectively, with information ratios above 1.2 in all periods. Return differentials of the high RVS portfolio over the low RVS portfolio and over the index show a relatively modest risk of underperformance in terms of volatility and maximum drawdown. They also show little or moderate directionality on credit market returns, as indicated by relatively low correlations with the index.

FIGURE 8
Performance of relative value investing

	High RVS	Low RVS	Index	High - Low RVS	High RVS - Index
Jan-1993 to Jan-2016					
Average (%/y)	1.56	-0.23	0.38	1.78	1.18
Volatility (%/y)	4.12	3.83	4.20	1.18	0.89
Information ratio	0.38	-0.06	0.09	1.52	1.32
Drawdown (%)	-20.1	-24.8	-24.2	-2.0	-1.2
Correlation with index	98%	99%	100%	20%	-20%
Jan-1993 to Jun-2007					
Average (%/y)	1.18	0.03	0.43	1.15	0.75
Volatility (%/y)	2.34	1.92	2.08	0.95	0.59
Information ratio	0.50	0.01	0.21	1.22	1.26
Drawdown (%)	-5.7	-8.9	-8.3	-2.0	-1.2
Correlation with index	97%	97%	100%	43%	33%
Jul-2007 to Jan-2016					
Average (%/y)	2.19	-0.66	0.28	2.85	1.91
Volatility (%/y)	6.04	5.78	6.36	1.44	1.22
Information ratio	0.36	-0.12	0.04	1.98	1.56
Drawdown (%)	-19.9	-22.6	-24.0	-1.7	-1.0
Correlation with index	98%	99%	100%	14%	-35%

Source: Barclays Research, Barclays Indices

Figure 9 shows average exposure characteristics of relative value portfolios and of the index over different periods. While the high RVS portfolio has a lower duration, higher spread and higher DTS exposure than the index, the differences are small and not sufficient to explain

the performance gain. Indeed, the average spread of the high RVS portfolio is only 17bp higher than that of the index while the difference in realised return is 118bp per year (see first row of Figure 8). The outperformance of the high RVS portfolio cannot be explained by the carry advantage alone but also requires significant mean-reversion in relative spreads. We provide a formal statistical analysis of the relationship between performance of corporate bonds and their characteristics, including RVS score, spread, duration and DTS exposure in the last section of this article.

FIGURE 9

Characteristics of relative value portfolios

	High RVS	Low RVS	Index	High - Low RVS	High RVS - Index
Jan 1993 to Jan 2016					
Spread (bp)	155	118	139	37	17
Duration	5.6	6.6	6.1	-1.0	-0.5
DTS	9.5	8.4	9.0	1.0	0.4
Average MV (USD m)	463	551	512	-89	-49
Numeric rating	7.9 (A3)	7.4 (A2)	7.6 (A3)	0.5	0.3
Jan 1993 to Jun 2007					
Spread (bp)	120	90	104	29	15
Duration	5.3	6.3	5.8	-1.1	-0.5
DTS	7.0	6.2	6.5	0.7	0.5
Average MV (USD m)	340	401	369	-61	-29
Numeric rating	7.7 (A3)	7.3 (A2)	7.5 (A3)		
Jul 2007 to Jan 2016					
Spread (bp)	216	165	196	51	20
Duration	6.3	7.0	6.7	-0.7	-0.4
DTS	13.7	12.1	13.3	1.5	0.4
Average MV (USD m)	670	805	753	-135	-83
Numeric rating	8.1 (A3)	7.8 (A3)	7.8 (A3)		

Source: Barclays Research, Barclays Indices

The outperformance of high versus low RVS portfolios holds across credit ratings and broad industry sectors. Figure 10 provides a split by rating and broad financial/non-financial industry sectors of the index. High average returns and information ratios of high over low RVS portfolios across all subsets of the market indicate that performance is not confined to a particular sector or credit quality.

FIGURE 10
Performance of High over Low RVS portfolios by quality and sector

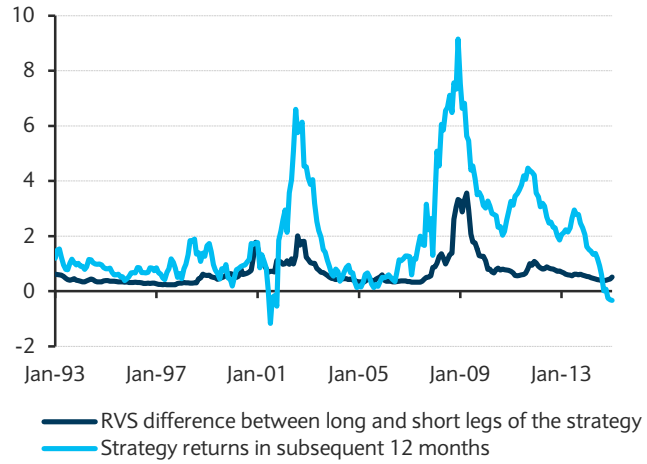
	AAA-AA	A	BBB	HY (BB/B)	Financials	Non-Financials
	Jan-1993 to Jan-2016					
Average (%/y)	1.01	1.97	1.94	3.80	2.40	1.54
Volatility (%/y)	1.17	1.28	1.85	2.61	1.98	1.08
Information ratio	**0.86**	**1.54**	**1.05**	**1.45**	**1.21**	**1.43**
Drawdown (%)	-4.26	-1.33	-5.35	-5.36	-2.60	-2.65
	Jan-1993 to Jun-2007					
Average (%/y)	0.66	0.95	1.46	3.86	1.06	1.26
Volatility (%/y)	0.62	0.68	1.92	2.73	0.98	1.05
Information ratio	**1.07**	**1.39**	**0.76**	**1.41**	**1.09**	**1.20**
Drawdown (%)	-0.80	-0.78	-5.35	-5.10	-1.25	-2.65
	Jul-2007 to Jan-2016					
Average (%/y)	1.60	3.69	2.75	3.70	4.65	2.02
Volatility (%/y)	1.73	1.80	1.71	2.40	2.89	1.11
Information ratio	**0.92**	**2.05**	**1.61**	**1.54**	**1.61**	**1.82**
Drawdown (%)	-4.26	-1.33	-3.53	-5.36	-2.60	-1.94

Source: Barclays Research

The performance of the relative value strategy tends to be stronger when cross-sectional variation (dispersion) in RVS is high. Figure 11 plots differences in RVS between high and low RVS portfolios and subsequent 12 months returns of the relative value strategy. In addition, Figure 12 shows the average return per quintile of strategy RVS differential. It is apparent that strategy returns are higher when relative spreads are higher, although the observations in the top quintile are associated with the 2008 crisis episodes when dispersion in RVS became very large.

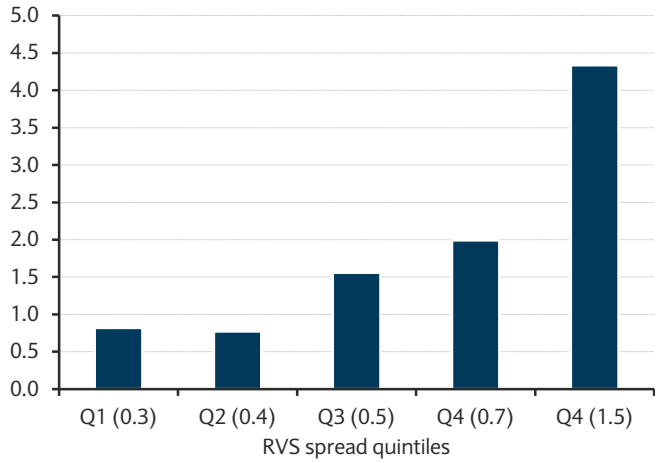
Figure 11 also shows that the strategy delivered negative 12-month returns in 2002 as well as in recent months. These episodes correspond to negative momentum in spreads, when bonds that have become high spread relative to peers keep underperforming. Again, we must emphasize that relative value investing in credit rests on mean-reversion in relative spreads.

FIGURE 11
Strategy RVS spread and subsequent return



Source: Barclays Research

FIGURE 12
Strategy return per quintile of RVS spread



Source: Barclays Research

The average outperformance of high over low RVS portfolios also holds across liquidity partition of the US corporate bond universe. We use trade efficiency scores (TES)[12] of corporate bonds to investigate how relative value performance varies across liquidity buckets. TES combines trading costs and volumes with low TES indicating high liquidity. Figure 13 reports the performance of high over low RVS portfolios for various TES quintiles starting in 2007, when TES become available. While outperformance of high RVS portfolios is strong across all liquidity buckets, information ratios are highest for buckets with lower liquidity (higher TES). This implies that high RVS portfolios could potentially pick up some illiquidity premium.

FIGURE 13

Performance of High over Low RVS portfolios by liquidity bucket (2007 to 2016)

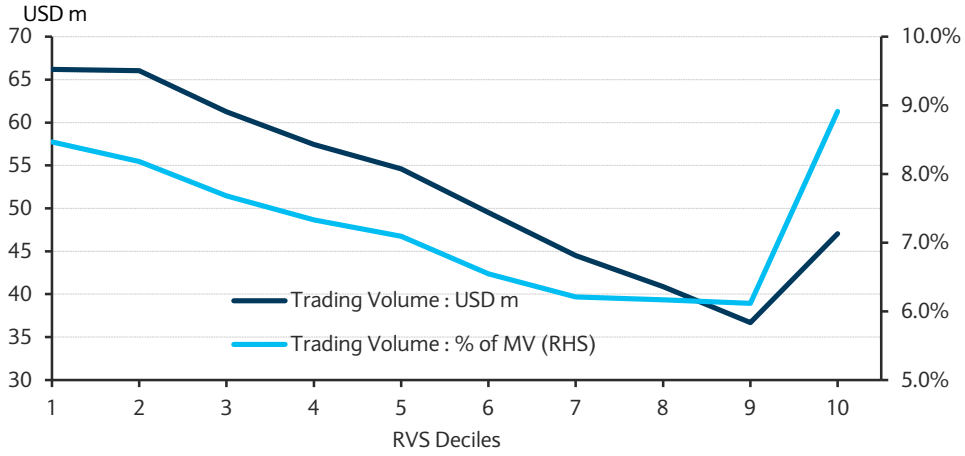
	All bonds	TES Q1	TES Q2	TES Q3	TES Q4	TES Q5
Average (%/y)	2.77	2.74	2.93	2.24	2.41	2.99
Volatility (%/y)	1.41	1.74	1.69	1.48	0.99	1.43
Information ratio	**1.96**	**1.57**	**1.73**	**1.51**	**2.43**	**2.09**
Drawdown	-1.69	-1.87	-2.29	-2.71	-0.58	-1.53

Source: Barclays Research

The relationship between liquidity and RVS is illustrated in Figure 14, which plots monthly average trading volumes across RVS deciles. Volume declines as RVS increases, but then jumps for the top RVS decile. At one extreme, bonds with low RVS are likely to be recently issued on-the-run securities with high trading volumes while, at the other extreme, bonds in the top RVS bucket may experience high trading volumes due to issuer specific events.

FIGURE 14

Monthly trading volume by RVS deciles (2007 to 2016)



Source: Barclays Research; TRACE

[12] Trade Efficiency Scores (TES) are relative bond-level measures representing an intra-market liquidity rank ranging from 1 (best) to 10 (worst). TES blends Liquidity Cost Scores and trading volume into a single rank. See Konstantinovsky V., K. Y. Ng and B. Phelps, *Measuring Bond-Level Liquidity*, Barclays Research, July 2015

Implementing a Relative Value Strategy

The high RVS portfolio outperforms the corporate index and its low RVS peer, but practical considerations such as transaction costs can reduce strategy returns in actual bond portfolios. We therefore measure turnover of the high RVS portfolio and discuss practical ways to reduce it.[13]

Column 1 of Figure 15 shows that the excess turnover of the value strategy that buys high RVS (above median) and sells low RVS (below median) bonds is 11% per month, which is quite high. However, the RVS transition matrices in Figure 6 indicate that RVS scores are relatively stable over time, especially in the top and bottom RVS categories. Indeed, more than 75% of the bonds in the top RVS decile remain in the top two deciles one year after. Similarly, more than 65% of bonds in the bottom RVS decile remain in the bottom two deciles after one year. In fact, a large part of the high RVS portfolio turnover is generated by bonds that have RVS scores close to the median. At the same time, bonds with RVS close to the median are likely to add little to the outperformance of the relative value strategy. This suggests that we could reduce turnover and enhance return of the strategy by excluding bonds with RVS scores close to the median.

We therefore propose a modification to the original strategy (long above median and short below median RVS bonds).The modified strategy buys bonds with RVS scores in the top 40% and sells when their RVS drops below the median. Otherwise bonds remain in the portfolio. A similar logic applies to the short leg of the strategy, which includes bonds when they fall in the bottom 40% of RVS and holds them until their RVS exceeds the median. This is shown in Figure 15 where the original strategy discussed so far is labelled "no buffer" while the new one is called "10% buffer". In a slightly more restrictive specification (called "15% buffer" in Figure 15), the High RVS portfolio retains bonds until they fall into the bottom 45% while the short leg of the strategy holds bonds until their RVS rank reaches the top 45%. These new strategies focus on issues with stronger relative valuation signals and tend to hold them until this signal has diminished. Note that these new strategies differ from the original one only with regard to the rebalancing logic with the RVS formulation remaining unchanged.

Columns 2 and 3 of Figure 15 indicate that the modified strategies reduce turnover from 11.2 to 5.7 and 4.3% per month, respectively. At the same time, strategy returns increase while information ratios slightly decline due to higher volatility.

FIGURE 15

Performance of relative value strategy with turnover controls (1993 to 2016)

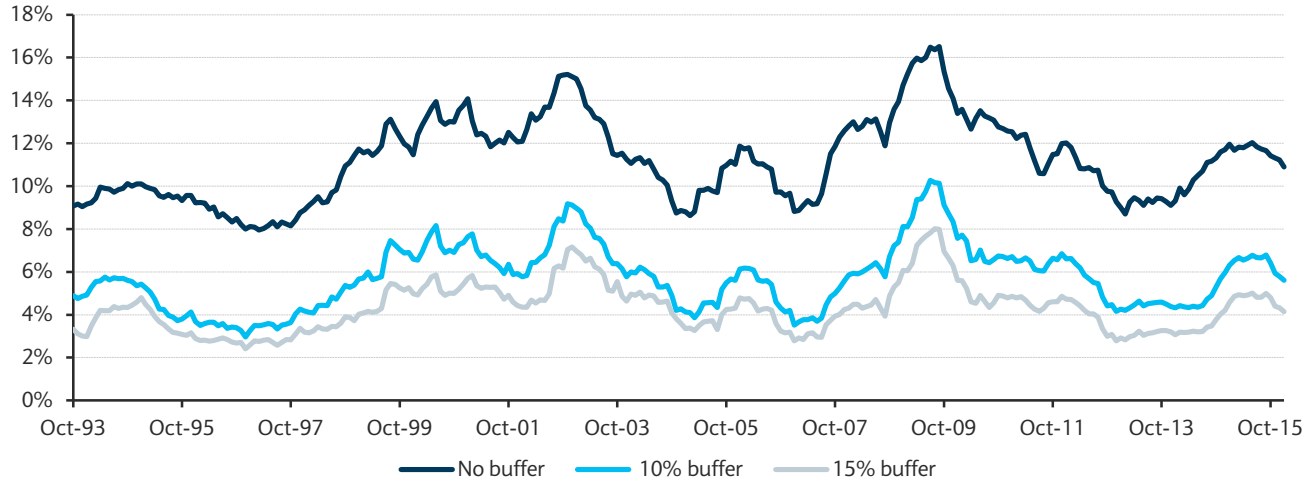
	No buffer	10% buffer	15% buffer
Average return (%/y)	1.78	1.98	1.86
Volatility (%/y)	1.18	1.52	1.56
Information ratio	**1.52**	**1.31**	**1.20**
Drawdown (%)	-2.00	-3.58	-3.68
Turnover in the High RVS portfolio (%/month)	*11.2%*	*5.7%*	*4.3%*

Source: Barclays Research

[13] We define turnover as the proportion of bonds bought by the High RVS portfolio at a price different from the index price. Existing bonds in Barclays IG Corporate Index are marked at bid according to index conventions while newly issued bonds join the index at the offer price and are subsequently marked at bid.

Figure 16 plots historical 12-month rolling turnover for the original and modified relative value strategies described above. The persistent reduction in strategy turnover is evident, although turnover varies over time and generally tends to be higher when spreads are higher.

FIGURE 16
Turnover of High RVS portfolios on a rolling 12-month window



Source: Barclays Research

Tracking Portfolios Based on Relative Value in Spread

The relative value strategy presented so far is based on Barclays US Corporate Bond Index and covers a large universe of bonds, buying all above median and selling all below medians RVS bonds. The long-short RVS portfolio is therefore highly diversified and carries little idiosyncratic risk. In most practical cases, however, implementing a relative value investment style involves a concentrated selection of over and under-weights relative to a benchmark index. For a more detailed description of selection risk, please see the Appendix.

As an example, we build tracking portfolios designed to replicate the Barclays Corporate Index while implementing an RVS tilt. Portfolios are constructed every month to maximize RVS score, while closely matching the index exposures: DTS, duration and market value contributions across eight sectors[14]. In addition, the portfolios also match the overall DTS and duration of the index. We construct tracking portfolios with 4%, 2% and 1% issue concentration limits. Ticker concentrations are fixed at double the issue concentration. The portfolios therefore range from highly concentrated (34 bonds) to diversified (more than 100 bonds). Figure 17 reports the performance of the replicating portfolios. Average returns are substantially higher than the index returns despite very similar durations, DTS and only slightly different spreads. High RVS tracking portfolios outperform the index by more than 1.2% per year with information ratios in excess of 1. The concentrated 34 bond portfolio (Portfolio 1) has a slightly higher tracking error volatility than the diversified 109 bond tracker (Portfolio 3). The risk-adjusted outperformance is robust over different horizons.

[14] We divide the corporate universe into basic industry, consumer cyclical, consumer non-cyclical, energy, TMT, utility, banks & brokerages and other financials

FIGURE 17
Performance of index tracking portfolios based on RVS

	Index	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 1 - Index	Portfolio 2 - Index	Portfolio 3 - Index
	Jan-1993 - Jan-2016						
Average (%/y)	0.38	1.75	1.73	1.59	1.37	1.36	1.22
Volatility (%/Y)	4.20	3.73	3.67	3.74	1.22	1.12	1.02
Information ratio	0.09	0.47	0.47	0.43	1.13	1.21	1.19
Drawdown (%)	-24.21	-19.39	-19.04	-20.43			
Average spread (%)	1.39	1.55	1.55	1.54	0.17	0.16	0.15
Average number of bonds		34	59	109			
	Jan-1993 - Jun-2007						
Average (%/y)	0.43	1.27	1.27	1.15	0.84	0.84	0.72
Volatility (%/Y)	2.08	2.08	2.00	2.04	0.79	0.66	0.62
Information ratio	0.21	0.61	0.63	0.56	1.06	1.27	1.16
Drawdown (%)	-8.33	-4.62	-3.92	-4.89			
Average spread (%)	1.04	1.15	1.15	1.16	0.10	0.11	0.11
Average number of bonds		34	59	109			
	Jul-2007 - Jan-2016						
Average (%/y)	0.28	2.55	2.52	2.35	2.27	2.23	2.06
Volatility (%/Y)	6.36	5.51	5.44	5.53	1.69	1.60	1.45
Information ratio	0.04	0.46	0.46	0.42	1.34	1.40	1.43
Drawdown (%)	-23.96	-19.22	-18.86	-20.25			
Average spread (%)	1.96	2.24	2.22	2.18	0.28	0.26	0.21
Average number of bonds		34	59	109			

Source: Barclays Research

Statistical Analysis of the Value Premium

The RVS strategy is constructed with controls for rating and sector. However systematic exposures might remain. Figure 9 indicates that the long-short strategy has a positive spread and a negative duration bias, although the net DTS exposure is small. We now measure the "value premium" controlling for spread, duration and sector biases. Every month, we run cross-sectional regressions[15] of individual bond excess returns against spread, duration and RVS scores in addition to sector DTS[16].This procedure allows us to calculate the return attributable to spread, duration and value exposures in isolation. The cross-sectional regressions are run each month to obtain a time series of the factor realizations. Figure 18 reports the average factor returns and associated t-statistics.

The spread factor described in isolation in the first section of Figure 18 is similar to a pure carry bias. The spread factor has a large and statistically significant premium (t-stat of 2.7). The average factor realization of 5.2bp per month (roughly 62 bp/y) can be interpreted as the average monthly return of the portfolio that goes long above median spread bonds and short below median spread bonds when controlling for risk allocation across sector.

The duration premium is negative indicating that extending duration, while keeping DTS constant, has a significant negative premium[17]. When combining spread and duration, (fourth section of Figure 18) we find that both effects are stronger and more statistically significant.

[15] We use Fama McBeth regressions. See Fama, E., and D. MacBeth, "Risk, Return, and Equilibrium: Empirical Tests", Journal of Political Economy, Vol. 81, May-June 1973, pp 607-636
[16] In these regressions, factor exposures are calculated from the percentile rank in RVS, duration and spread and vary between -1 and 1 for these three factors. For example, a financial bond that has a 60 percentile RVS score and with a median spread and duration would have a loading of 0.2 on the RVS factor and 0 on the spread and duration factors respectively. In addition the bond DTS is multiplied by the relevant sector dummy and captures the market factor.
[17] In *Structure of US Corporate Excess Returns: The Hunt for a 'Low-Risk' Anomaly*, Barclays Research, May 2014, Phelps and Ng show that increasing spreads has a positive alpha (positive incremental returns over a matched DTS portfolio) while increasing durations has a negative alpha.

Increasing spread or increasing duration, while similar from a risk perspective, have very different effects on return. Indeed, increasing spread produces higher risk and higher returns while extending duration increases risk but reduces returns controlling for DTS. The RVS factor in isolation has an average premium of 15.2bp/month (~ 1.8%/year), which is highly statistically significant (t-stat of 8.6). This is consistent with the average returns of the long-short value strategy. When we combine all three factors in our regression, the spread factor premium declines substantially and is now statistically insignificant. The RVS factor remains large and highly significant (t-stat of 8.0). This suggests that the cross section of bond returns is much better explained by differences in RVS than just differences in spreads. RVS therefore seems a better candidate to help define a relative-value based risk premium than traditional bond analytics such as spread or sector allocation.

FIGURE 18

Average risk premia for various factor exposures (Jan 1993 to Jan 2016)

	Spread		Duration		Value		Spread & Duration		All factors	
	Beta	t-stat	Beta	t-stat	Beta	t-stat	Beta	t-stat	Beta	t-stat
Market factors (bp/m/unit exposure)										
Spread	5.2	2.7					7.2	3.3	2.2	1.0
Duration			-12.2	-5.3			-14.2	-5.7	-10.9	-4.5
RVS					15.2	8.6			12.4	8.0
Sector DTS factors (bp/m/unit DTS)										
BASIC	0.0	0.0	0.5	1.1	0.1	0.2	0.4	0.8	0.3	0.6
CYC	0.0	0.0	0.5	0.8	0.0	0.0	0.3	0.5	0.2	0.4
NON CYC	0.2	0.4	0.7	1.4	0.2	0.5	0.6	1.4	0.6	1.2
ENERGY	0.1	0.3	0.6	1.3	0.2	0.4	0.5	0.9	0.4	0.8
TMT	0.1	0.1	0.5	1.0	0.1	0.2	0.4	0.7	0.3	0.6
UTILITY	-0.1	-0.2	0.3	0.6	0.1	0.1	0.2	0.3	0.2	0.4
BANKS&BROK	0.8	1.3	1.1	1.7	1.0	1.6	0.9	1.5	1.0	1.6
OTHER FINS	0.7	1.3	1.1	2.0	0.8	1.6	0.9	1.6	0.9	1.7

Source: Barclays Research

Having extracted a pure RVS factor from our regressions, we analyze the correlation of the RVS factor with other sources of risk premium such as the spread, duration and DTS factor in credit and the Fama-French factors in equity markets. The RVS factor appears to be de-correlated with other credit and equity factors and could therefore be a good diversifier in a factor portfolio.

FIGURE 19

Correlations with equity and credit risk premia sources (Jan 1993 to Jan 2016)

		Credit			Equity			
		Market	Spread	Duration	Market	Size	Value	Momentum
Credit	RVS	-24%	-7%	-22%	-27%	2%	-19%	-6%
	Market		16%	-49%	59%	29%	-4%	-27%
	Spread			-45%	12%	8%	1%	-7%
	Duration				-28%	-15%	6%	15%
Equity (F-F factors)	Market					24%	-23%	-27%
	Size						-35%	8%
	Value							-15%

Source: Barclays Research

Conclusion

We design a systematic relative value strategy in credit based on excess spreads relative to peer groups that control for fundamental and macro risk characteristics: Relative Value in Spread (RVS).

The strategy has attractive risk and performance characteristics. We find that an RVS strategy that goes long high RVS bonds and short low RVS ones performs well, with information ratio of more than 1.5 and a low correlation with the credit market returns.

The strategy performance is robust across liquidity, rating and sector partitions in different time periods. The outperformance of the RVS strategy is larger when there is a high dispersion in RVS. This is consistent with mean-reversion of relative spreads being the main driver of strategy returns.

RVS score can be used to form a relative value factor, which we show to be highly significant in explaining average corporate bond excess returns, and distinct from spread, duration and sector premia.

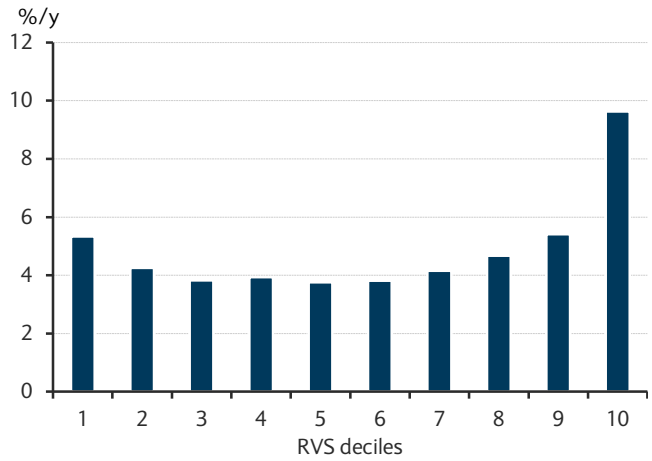
RVS scores could have several applications in portfolio management. Implementing a systematic relative value strategy based on RVS scores can help capture a thematic risk premium that is uncorrelated with the common credit beta. For asset managers seeking to outperform traditional indices, we show that index tracking portfolios that with RVS tilt can deliver a large outperformance (over 1.2% per year) with information ratio of more than 1. We also show that the strategy is robust to turnover constraints as the mean reversion in RVS scores happens relatively slowly.

Appendix: Security Selection Risk

Selection risk can be captured by the volatility of the idiosyncratic (or security-specific) returns which can be calculated by removing the effects of systematic exposures to factors such as spread, duration, RVS and sector-related DTS[18]. Figure 20 reports the average monthly security-specific volatility[19] across RVS deciles. A risk of 5% per year indicates that the return of a single bond can deviate from its peer group average with a volatility of 5%. Clearly, high RVS bonds have much higher selection risk than bonds closer to the median.

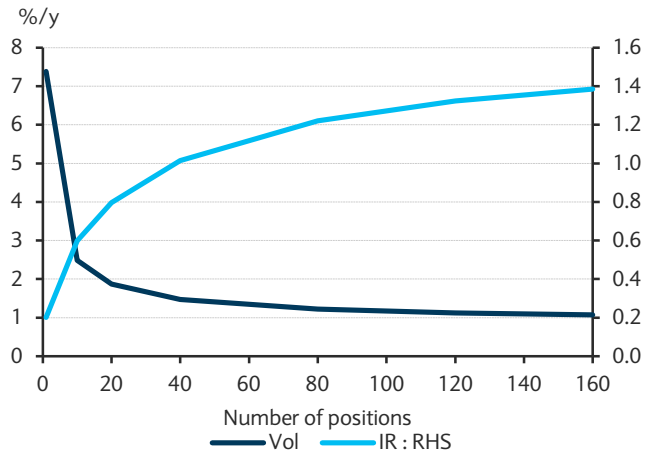
Figure 21 incorporates selection risk in a historical simulation of a concentrated long-short overlay. The simulation picks up 'n' long positions from the above median RVS portfolio and 'n' short positions from the below median portfolio for a total of '2n' positions each month. When 'n' equals the number of above median RVS bonds (approximately 2000 bonds in December 2015) in the universe, the long-short overlay is identical to the RVS strategy and there is no selection risk. As the strategy controls for spread, duration and sector DTS, the return of such an overlay is the average return of the value factor for the given month. When 'n' is small compared with the size of the universe, there can be significant issue-specific risk. Figure 21 plots modelled volatility and information ratio as a function of the number of portfolio positions. With roughly 50 positions, the selection risk is reduced substantially and the overlay achieves an information ratio close to 1.

FIGURE 20
Security-specific volatility by RVS deciles



Source: Barclays Research

FIGURE 21
Security-specific volatility and information ratio[20] as a function of portfolio concentration



Source: Barclays Research

[18] We use the residuals of the regressions shown in Figure 18 to control for DTS, spread and duration exposures.
[19] Security-specific variance is calculated as the time-average cross-sectional variance of Figure 18 regression residuals over the period considered, grouped by RVS scores.
[20] The information ratio of the strategy converges to the value premium shown in Figure 18. The asymptotic IR is close to 1.6, consistent with a t-statistic of 8.0 over 23 years.

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