Global Credit Derivative and Index Research
20 June 2023

Systematic Strategies in Corporate Credit

Volume 1: Relative Value in USD IG: From theory to practice

- We introduce the first of a new series of papers which look at systematic investing within corporate bonds. The first volume investigates Relative Value (RV) within USD IG corporate bonds and tests if we can use RV as a stand alone metric and outperform a benchmark. We compare two different metrics of RV, with a view of evaluating richness and cheapness; i) issuer curve construction (RV-IC), and ii) a regression-based approach (RV-REG).
- For our backtesting, we use a historical optimizer we have built which allows us to ensure we match the key risk characteristics of our RV strategies versus a corporate benchmark at every month-end point. In addition to risk characteristics, as shown in the final section of the paper, we can also control for annual turnover budget, number of bonds held per month and bond minimum size - which allows for more real world and realistic backtests.
- The key findings are that RV does work in a pure theoretical setting immunizing for all risk factors. Secondly, we find that we are able to trade RV as a stand alone metric after taking into account turnover constraints and transaction costs. Lastly, we also find evidence that RV-IC tends to outperform RV-REG. We do feel however that RV is most likely to benefit from being a component in a more robust investment approach which incorporates other market data and strategies.

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See page 15 for analyst certification and important disclosures.

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Introduction

We introduce the first of a new series of papers called "Systematic Strategies in Corporate Credit", which looks to provide solutions for practical problems faced by corporate bond investors. This paper digs deeper into Relative Value (RV) within USD IG. The goal of the paper is to answer two questions: i) Does RV work in USD IG in a pure theoretical setting immunizing for all risk factors? and ii) Can we trade RV as a stand alone metric after taking into account liquidity and transaction costs?

We evaluate two different RV metrics with a view of evaluating richness and cheapness within corporate bonds; i) issuer curve construction (RV-IC), and ii) a regression-based approach (RV-REG). RV-IC is an issuer curve construction methodology which was introduced by our team in our previous publication. RV-REG is a regression based approach which predicts bond spreads using bond characteristics like rating and industry sector. The RV-REG approach uses the same framework as Slimane et al. (2018). The methodologies for these metrics are contained within the appendix.

We analyse RV within IG USD denominated corporate bonds within the JP Morgan Global Corporate Index (GCI) bond dataset from December 31, 2001 to May 31, 2023. GCI contains both investment grade and high yield bonds. Summary statistics are shown in Table 1[1]. To get a sense of the benchmark through time, at every month-end point, we calculate the cross-sectional market-cap weighted duration, yield, rating, etc. We then take these time-series of values and calculate the mean, and various percentile points to give us a view on the distribution of each risk characteristic over the full sample period. For example, in USD IG, the weighted average yield of the portfolio of bonds has been below 4.6% for 75% of the sample period (conversely the yield has been above 4.6% for 25% of the time).

The results are intuitive with IG having higher average duration (+1.6) and larger average issuance (+$306mm), whilst having lower average yields (-2.1%) and credit spreads (-405bps) than HY.

Table 1: Summary statistics for JP Morgan GCI Index (USD)

	Investment Grade						High Yield					
	Mean	5%	25%	50%	75%	95%	Mean	5%	25%	50%	75%	95%
Modified duration	6.4	5.4	5.7	6.5	6.9	8.0	4.8	4.3	4.7	4.8	5.0	5.1
Yield to worst (%)	3.7	1.9	2.8	3.3	4.6	5.9	5.8	-2.6	4.5	5.9	7.3	12.3
Credit rating	6.7	5.8	6.4	6.9	7.1	7.2	13.9	13.5	13.7	13.8	14.0	14.2
Credit spread (bps)	157	90	110	140	171	271	562	313	423	503	623	1012
Face value ($ millions)	1213	1009	1156	1220	1304	1353	907	611	864	966	1008	1066
Time since issuance (years)	3.7	2.8	3.5	3.7	3.9	4.4	3.1	2.5	2.8	3.1	3.3	3.7
Time to maturity (years)	10.0	8.8	9.6	10.1	10.4	11.4	7.0	6.4	6.6	6.8	7.3	8.2

Source: J.P. Morgan. Data is from December 31, 2001 to May 31, 2023.

1. Credit rating is the average credit rating of the rating agencies S&P, Moody's, and Fitch whereby the credit ratings are converted to a numeric scale as follows: AAA = 1, AA+ = 2, AA = 3, and so on.

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Relative Value in Credit

We create a decile based study for both RV metrics: i) issuer curve construction (RV-IC), and ii) a regression-based approach (RV-REG). Each month we rank every bond in the universe to reflect it's score based on the RV measure. We then create equally weighted portfolio deciles and compare the respective returns and volatilities for each decile. The top decile has the highest 10% of ranked bonds while the bottom decile has the lowest 10% of ranked bonds. This gives us an indication of the theoretical potential of alpha capture available. In addition to this we also remove the top 2.5% of spread bonds from the universe per month to avoid spurious data.

This relatively simple setup provides promising results. We notice that for both RV metrics, we see a trend of increased returns as we go up to higher deciles. A decile of 10 is the highest RV available ("cheapest"), and a decile of 1 is the lowest RV available ("most expensive"). We see a stronger relationship between decile and returns within RV-IC than RV-REG (1.46% outperformance within decile 10, and 0.55% underperformance within decile 1) - see Figure 1. This suggests that portfolios that skew towards higher relative value achieve higher returns compared to those that have lower relative value.

Interestingly this does not come at the cost of higher volatility for higher RV deciles. The volatility of each decile is relatively stable at 4.5% suggesting that higher returns are achieved without taking on more risk. This is reflected in terms of risk-adjusted returns per decile, as we notice that the average return/vol increases as we go up the deciles for both RV metrics, rising to 1.05 and 0.79 for decile 10 in RV-IC and RV-REG respectively - see Figure 2.

Figure 1: Investment Grade USD: Average return and volatility per decile

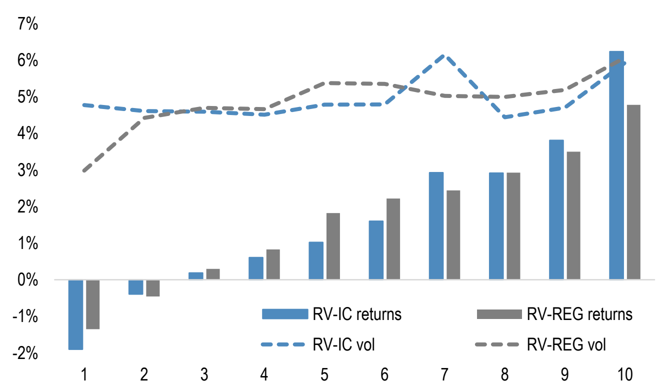
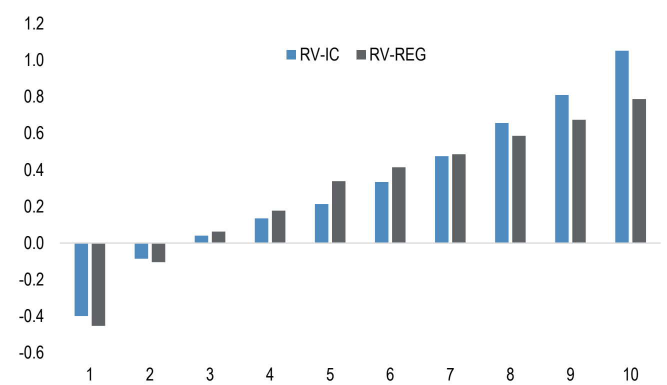


Figure 2: Investment Grade USD: Return/volatility per decile



Source: J.P. Morgan. Data is from December 31, 2001 to May 31, 2023.

The decile analysis is merely a starting point to understand the potential of RV in credit. In Table 2 we show the summary statistics of each decile for both RV metrics. We notice immediately that for both RV metrics, yield increases as the decile category increases - we observe a 0.5% and 1.6% difference in yields between decile 10 and 1 for RV-IC and RV-REG respectively. Additionally, we see the same increasing relationship of deciles with credit spread, which is as expected, as we are looking at the magnitude of difference between predicted spreads and actual spreads. Interestingly, we are also noticing evidence of a illiquidity bias, as we find that as we go up the decile categories,

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the bonds we are selecting are older - we see a difference in 3.9 years since issuance and 1.8 years since issuance between decile 10 and 1 for RV-IC and RV-REG respectively.

Table 2: Investment Grade USD: Summary statistics per decile

Deciles	1	2	3	4	5	6	7	8	9	10
					RV-IC					
Modified Duration	7.2	6.6	6.3	6.2	6.2	6.3	6.0	6.0	6.3	6.8
Yield to worst (%)	3.7	3.4	3.3	3.4	3.3	3.5	3.5	3.5	3.8	4.2
Credit Rating	6.8	6.7	6.6	6.6	6.6	6.6	6.6	6.7	6.8	6.9
Credit spread (bps)	130	126	124	124	127	131	135	143	160	206
Face value ($ millions)	813	812	798	788	782	765	762	749	720	632
Time since issuance (years)	3.1	3.1	3.2	3.3	3.4	3.6	4.0	4.5	5.4	7.0
Time to maturity (years)	11.0	9.9	9.3	9.1	9.5	9.6	8.9	8.8	9.4	10.5
					RV-REG					
Modified Duration	5.5	7.1	7.1	6.9	6.8	6.6	6.5	6.4	6.1	5.1
Yield to worst (%)	2.4	3.2	3.5	3.7	3.6	3.7	3.8	3.9	4.0	4.0
Credit Rating	6.3	7.0	7.0	6.9	6.9	6.8	6.7	6.5	6.4	6.4
Credit spread (bps)	81	112	121	128	134	141	149	159	174	208
Face value ($ millions)	715	705	715	738	763	788	814	821	816	745
Time since issuance (years)	3.2	3.2	3.4	3.7	3.8	4.1	4.4	4.7	5.0	5.0
Time to maturity (years)	8.3	11.2	11.0	10.6	10.2	9.8	9.6	9.2	8.8	7.1

Source: J.P. Morgan. Data is from December 31, 2001 to May 31, 2023.

These results help us understand some of the biases which occur when creating RV driven portfolios.

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Performance of RV strategy

Having seen the biases that arise from a RV-tilted strategy we now look at how we can correct for these and aim to extract the pure information content of the RV metrics. We do this by creating monthly portfolios by solving a linear optimization problem. Using a simple objective function where we are maximizing the differential between the spread and model predicted spread, we can avoid the challenge of estimating a covariance matrix. Our optimization problem is set such that we try to take advantage of the RV metrics, whilst immunizing for the risk factors which are listed below, this is to ensure we are not taking intentional systematic biases versus the benchmark index, this should give us a pure RV attribution to performance. We appreciate that this is a theoretical exercise and not a practical approach for implementation, given that we are so tightly wedded to the benchmark, but this is a important step to ascertain if the RV metrics work and also helps us compare the different RV metrics we are investigating.

List of risk factors which we immunize the risk for are as follows. This ensures that each portfolio is tightly aligned with the benchmark.

- Issuer;
- Duration;
- Spread;
- Yield;
- Years since issuance;
- Amount outstanding;
- Time to maturity.

For the above risk factors we allow a 0.5% of the risk factor deviation between our portfolio and benchmark. The full list of constraints are in the appendix. We plot the cumulative excess return of our portfolios through time in Figure 3 and we notice the positive information content of the RV metrics. In terms of maximum RV portfolio, both RV-IC and RV-REG strongly outperform the benchmark (64% and 49% respectively), while having near identical risk characteristics of the benchmark. With respect to the minimum RV portfolio, RV-IC and RV-REG underperform the benchmark (43% and 24% respectively). In a theoretical setting RV-IC appears to have more return potential than RV-REG.

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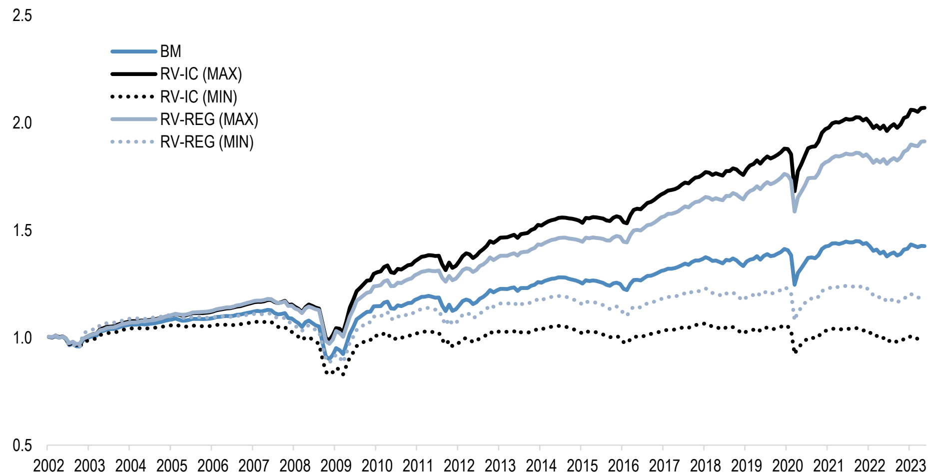
Figure 3: Investment Grade USD: Cumulative excess returns of both RV metrics



Source: J.P. Morgan. Data is from December 31, 2001 to May 31, 2023.

In Table 3 we show the summary statistics of the backtests. As expected we are matching all the risk characteristics very closely. In terms of volatility, we do not see much difference between RV-IC and the benchmark, however it seems RV-REG is performing better, having 0.4% less annualized volatility than the benchmark for the max RV portfolio, and 0.3% higher annualized volatility for the min RV portfolio. Tracking error is low across the board which is as expected given the close tracking nature.

Table 3: Investment Grade USD: Summary statistics for both RV metrics

		Max RV Portfolio		Min RV Portfolio	
	BM	RV-IC	RV-REG	RV-IC	RV-REG
Ann. Returns	1.8%	3.5%	3.1%	0.1%	0.9%
Ann. Vol	4.8%	4.7%	4.4%	4.8%	5.1%
Ret/Vol	0.37	0.75	0.72	0.02	0.18
Max Drawdown	20.3%	16.0%	17.7%	23.1%	20.5%
Tracking error		0.6%	0.7%	0.6%	1.0%
Modified Duration	6.4	6.4	6.4	6.5	6.4
Yield to worst (%)	3.7	3.7	3.7	3.7	3.7
Spread (bps)	157	158	158	156	156
Credit Rating	6.7	6.6	6.6	6.7	6.7
Face value ($ millions)	1212	1206	1206	1206	1206
Time since issuance (years)	3.7	3.7	3.7	3.7	3.7
Time to Maturity (years)	10.0	10.1	10.0	10.1	10.1
Number of Bonds	10946	1561	1561	1558	1561
Number of Tickers	1545	1545	1545	1545	1545

Source: J.P. Morgan. Data is from December 31, 2001 to May 31, 2023. All values are averages apart from number of bonds and tickers which are the latest point.

In Figure 4 we show the bond count of the strategies versus the benchmark. It is very clear that we are holding a much smaller part of the benchmark but still achieving low tracking error. As of the most recent data point, the benchmark has 10,946 bonds whereas the strategies range between 1558 and 1561 bonds. Additionally we show the most recent industry sector weight distribution in Figure 5, and as expected given it is a constraint in our setup, we have near identical weight exposure to the benchmark sector.

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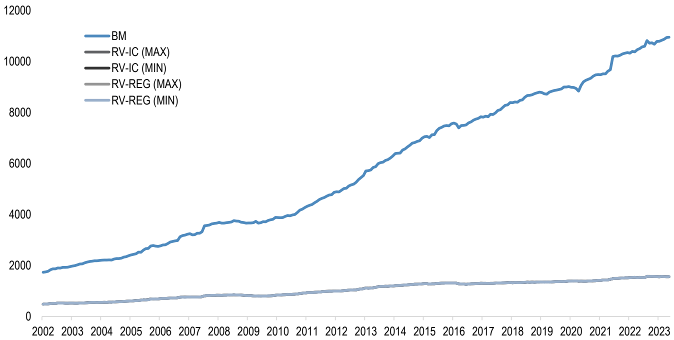
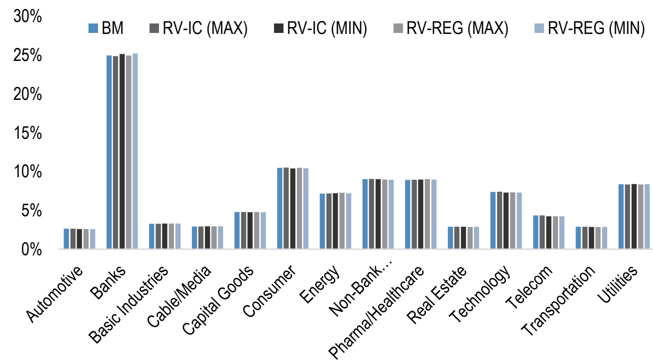
Figure 4: Investment Grade USD: Bond count



Source: J.P. Morgan. Data is from December 31, 2001 to May 31, 2023.

Figure 5: Investment Grade USD: Sector weights



Source: J.P. Morgan. Data is as of May 31, 2023.

This gives us a good theoretical standpoint on the RV metrics and the pure information content available, although we understand a few practical issues when trading these strategies. There are four potential areas which make the above more theoretical as opposed to practical:

1. Turnover - the turnover for the above strategy is very high and this would lead to very high transaction costs;
2. Number of bonds - with the number of bonds reaching 1561 as of recent, it would be helpful operationally to have a smaller list of bonds;
3. Minimum size weight - the above allows bonds which can have weights of extremely small size, and in a world of minimum pieces, this may not be practical;
4. Liquidity - we expect that for systematic managers, there maybe an interest to have a more liquid portfolio of bonds to reduce the risk of bonds not being able to transact.

We look to address these issues in the next section.

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Implementing RV in practice

Turnover is very high for the RV metrics mentioned above in its native form. Managing turnover is an important part of the RV metrics and we will address this alongside transaction costs. Additionally, we would prefer having less bonds in our portfolios to reduce the risks of some bonds not being executed and therefore the requirement of many substitute bonds having to be submitted. Thirdly, we appreciate in the previous backtest setting we allow for very small weights for some bonds, which in reality cannot be traded due to minimum piece requirement. Lastly, for a realistic backtest we ideally would prefer to have a more liquid bond portfolio to reduce the risk of bonds not transacting.

We now look at methods on how we can reduce turnover. We simply add a turnover budget within the optimization problem, this was done by Israel, et.al (2018). We have set a annual turnover budget of 100% and 150% which we think is still high versus the benchmark (~30%), but we appreciate RV is a fast moving signal. We also set a range of 300-350 for the number of bonds we can own at any time - this is made possible by turning our problem into a mixed integer problem. This allows us to reduce our portfolio holdings significantly versus the theoretical setting which reached 1561 bonds. We also set the minimum bond weight at 0.1% and set a maximum weight of 0.5%, with a issuer cap of 1%. Lastly to ensure we have higher liquidity than the benchmark, we first create a liquid subset of the benchmark which only buys and holds bonds with amount outstanding greater than $750M ("Liquid BM"). From this liquid BM, we constrain our portfolios to have 25% higher amount outstanding and to be issued in years 25% less than the liquid BM. The full list of constraints are in the appendix. Lastly - we only consider DM and senior bonds and we start the backtest from 2017, due to the path-dependent nature of including a turnover constraint.

In Figure 6 we show the cumulative excess returns of all the strategies. It is interesting to note that in a return-based setting the 150% turnover strategies tend to outperform the 100% turnover constrained strategies, which is intuitive as we are allowing the signal to work more freely. It is also interesting to note that the RV-IC tends to outperform RV-REG with a similar turnover budget.

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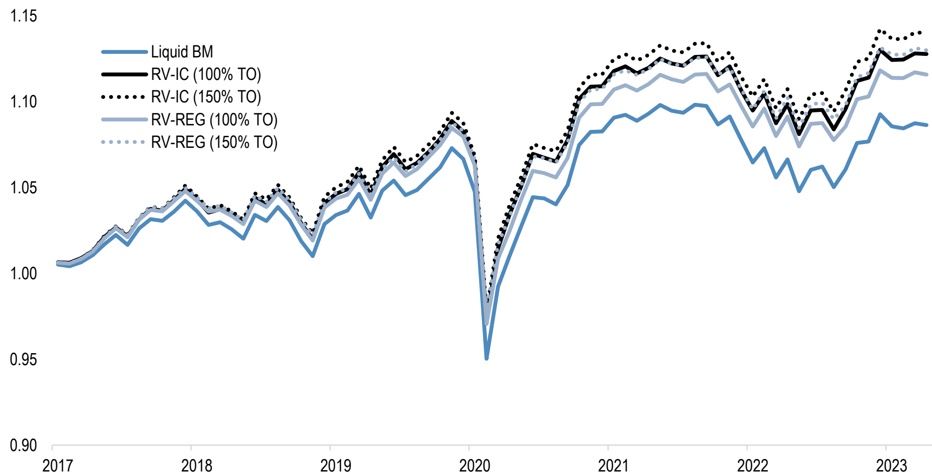
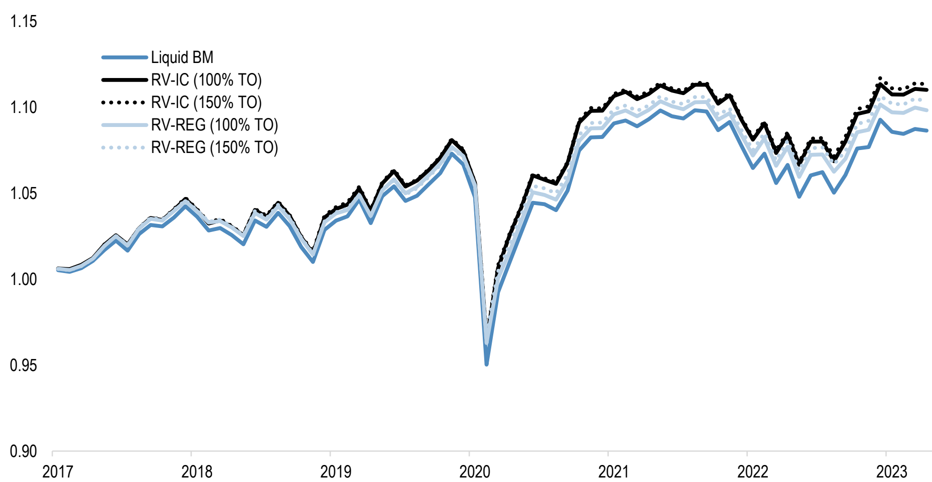
Figure 6: Investment Grade USD: Cumulative excess returns of both RV metrics with turnover budgets



Source: J.P. Morgan. Data is from December 31, 2016 to May 31, 2023.

To include transaction costs, we assume 25cents bid-ask, based on TRACE BASI Index by MarketAxess. Figure 7 shows the cumulative excess returns after transaction costs. After transaction costs have been applied, RV-IC achieves an outperformance of 2.37% and 2.7% versus the liquid benchmark for 100% and 150% turnover constrained versions respective, and for RV-REG it is slightly less at 1.19% and 1.7% for 100% and 150% turnover constrained, respectively.

Figure 7: Investment Grade USD: Cumulative excess returns of both RV metrics with turnover budgets - net of transaction costs



Source: J.P. Morgan. Data is from December 31, 2016 to May 31, 2023.

In Figure 8 we show the weighted amount outstanding of the liquid BM versus the turnover constrained RV strategies. As per construction, every month we are building portfolios which have 25% higher size than the liquid benchmark. Likewise in Figure 9 we show the weighted years since issuance of the RV strategies are 25% newer than the liquid BM.

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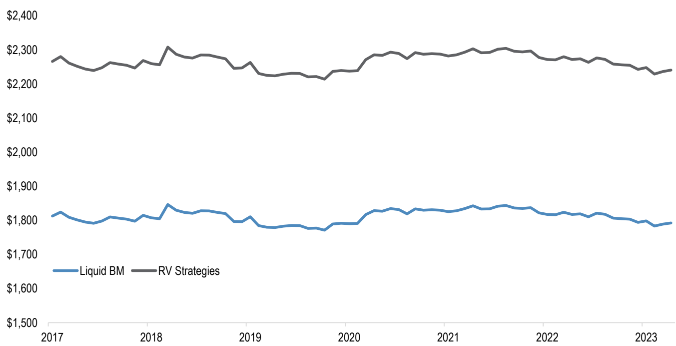
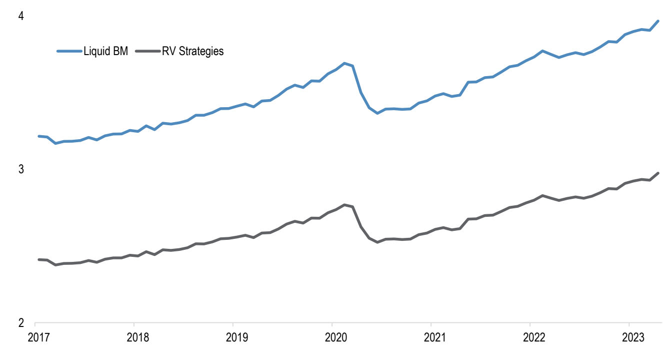
Figure 8: Investment Grade USD: Weighted amount outstanding ($ millions)



Source: J.P. Morgan. Data is from December 31, 2016 to May 31, 2023.

Figure 9: Investment Grade USD: Weighted years since issuance



Source: J.P. Morgan. Data is from December 31, 2016 to May 31, 2023.

We also show the summary statistics of the post-transaction cost for both RV metrics in Table 4. RV-IC performs slightly better than RV-REG relative to the liquid benchmark, achieving an annualized return outperformance of 0.33% and 0.37% (0.15% and 0.22% for RV-REG) for 100% and 150% turnover constraints respectively. In addition, the number of bonds in our RV portfolios is 300, as we had that as one of our parameters to control. Lastly, we also look at TRACE monthly volume data and we can confirm that our RV strategies have significantly higher volume than the liquid BM.

Table 4: Investment Grade USD: Summary statistics for both RV metrics - net of transaction costs

	Liquid BM	RV-IC (100% TO)	RV-IC (150% TO)	RV-REG (100% TO)	RV-REG (150% TO)
Ann. Returns	1.45%	1.78%	1.82%	1.60%	1.67%
Ann. Vol	5.16%	4.99%	4.97%	4.83%	4.68%
Ret/Vol	0.28	0.36	0.37	0.33	0.36
Max Drawdown	11.4%	10.8%	10.7%	10.6%	10.1%
Tracking error		0.3%	0.4%	0.4%	0.6%
Modified Duration	7.3	7.2	7.2	7.2	7.2
Yield to worst (%)	3.2	3.2	3.2	3.2	3.2
Spread (bps)	114	120	120	118	118
Credit Rating	6.9	6.5	6.5	6.7	6.7
Face value ($ millions)	1812	2265	2265	2265	2265
Time since issuance (years)	3.5	2.6	2.6	2.6	2.6
Time to Maturity (years)	10.5	10.1	10.1	10.3	10.3
Trace Average 1M volume ($)	$5,978,023	$6,958,004	$7,111,977	$6,846,441	$7,117,928
Number of Bonds	4007	300	300	300	300
Number of Tickers	573	163	159	163	161

Source: J.P. Morgan. Data is from December 31, 2016 to May 31, 2023.

In summary, we have shown how one can use RV as a stand alone strategy in a realistic setting. We do feel however that RV is most likely to benefit from being a component in a more robust investment approach which incorporates other market data and strategies. In addition, we also appreciate that RV can be slowed down even further in buy and hold mandates - where we only buy when cheap and do not necessarily sell when not cheap, and where we are not rebalancing every month.

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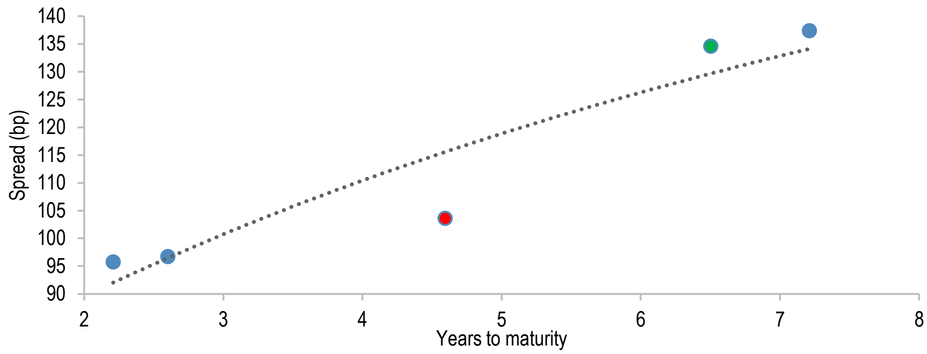
Appendix A: RV metrics

Issuer curve construction (RV-IC)

In this section, we show details on how we identify rich and cheap bonds within each issuer. We outline a methodology which we believe allows us to highlight bonds for a particular issuer that look rich or cheap relative to other bonds from the same issuer by creating an issuer bond spread curve. Figure 10 is an example of an issuer curve construction, where the x-axis is the years to maturity and the y-axis is the spread over treasury (bp).

Figure 10: Identifying Cheap and Rich Bonds - red is rich and green is cheap



Source: J.P. Morgan.

Why bond issuer curves?
Bonds come in all shapes and forms and are characterized by a variety of custom features which include coupon, maturity, seniority, and currency, to name just a few. At any point in time, a given issuer may have numerous (sometimes hundreds) of different bonds outstanding, each of which may only trade every once in a while. It is therefore a useful exercise for any credit investors to model an issuer's term structure of default by incorporating as much information from all the market-quoted bond prices as possible.

The fragmented landscape of bond issues, the lumpy style of bond trading (infrequent but large sized) and the variability of bond features turn the construction of a curve model into a practical challenge, requiring careful selection of calibration targets and robust calibration methods. The details of the issuer curve model we have used alongside the benefits are described in more detail in our previous publication.

Calibrating bond issuer curves
Since bonds come in all forms and shapes, we need to restrict ourselves to a subset of comparable bonds before calibrating a model curve for each issuer. For investment grade issuers, we only consider USD denominated bonds, bonds with maturity less than 30 years and issuers who have issued at least four bonds.

With the issuer curves built, we can investigate the bonds which are trading the furthest away from their predicted issuer model curve. We calculate the "premium" by subtracting our model predicted spread from the market spread for all bonds for each month end date.

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Regression based approach (RV-REG)

To construct the RV using a regression based approach (RV-REG), we run a cross-sectional regression of credit spreads in logarithms on amount outstanding, time to maturity (both logarithms), a boolean variable for callable, a boolean variable to determine if a bond is issued by an issuer who is either from a developed or emerging market country, subordination type alongside dummy variables on rating and industry sector. This construction is very similar to Slimane et al (2018).

Like the issuer curve construction, we can investigate the bonds which are trading the furthest away from their predicted spread. We calculate the "premium" by subtracting our model predicted spread from the market spread for all bonds for each month end date.

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Appending B: Backtest parameters

Performance of RV strategy - parameters

- Credit agency composite rating within 0.5% of benchmark;
- Duration within 0.5% of benchmark;
- Spread within 0.5% of benchmark;
- Yield within 0.5% of benchmark;
- Industry sector within 0.5% of benchmark;
- Years since issuance within 0.5% of benchmark;
- Amount outstanding within 0.5% of benchmark;
- Time to maturity within 0.5% of benchmark;
- Issuer within 0.5% of benchmark.

Implementing RV in practice - parameters

- Credit agency composite rating within 5% of liquid benchmark;
- Duration within 1% of liquid benchmark;
- Spread within 5% of liquid benchmark;
- Yield within 1% of liquid benchmark;
- Industry sector within 10% of liquid benchmark;
- Years since issuance less than 25% of liquid benchmark;
- Amount outstanding greater than 25% of liquid benchmark;
- Issuer cap of 1%;
- Number of bonds between 300 and 350;
- Bond min weight 0.1% and max weight 0.5%;
- Turnover constrained to either 100% or 150% (annual).

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