The Audacity of Automation

CLO Investing Reimagined

- How can automation match (or seek an alternative) risk/reward in CLOs? As it just isn't possible to buy the CLOIE Index (6,094 bonds, and counting) with our index colleagues we create, rebalance, and benchmark baskets – just like in other markets.
- We use automatic bond selection, bringing momentum (the market's tendency to trend in a given direction) to CLOs by profiling bonds (risk, duration, margin, etc) into momentum baskets. Momentum is based on price signals (link). A 3M lookback seems to indicate forward 1M directionality in CLOs, which we look to refine.
- As sourcing is a hurdle and selecting based on only momentum results in high turnover, we introduce two scenarios: buy and hold (natural turnover for pay downs), and using signal threshold to drop negative momentum bonds (slightly higher turnover). When sourcing the strongest signal isn't possible, the algorithm can at least be used as a tool to source within select categories.
- Consider an example in mezzanine (CLOIE BBB Index: ~62% return since April 2012). A momentum algo rebalancing 100 BBBs matching the index (reinvestment/margin) in a buy and hold outperformed (~67%). A momentum algo that incorporates a signal threshold slightly underperformed (~58%) but had less volatility and lower max drawdown. Clearly, there are limits given data issues and CLO structural nuances, though early results do seem promising.
- But why, some say, defy convention of manager selection? And they may well ask, why seek the best returns, or, why does technology advance? We choose to consider a possible future, to make CLOs more accessible with market growth (~$800bn size), and look forward to profiling strategies in our CLOIE Monitor.

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See page 13 for analyst certification and important disclosures.

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The Audacity of Automation: CLO Investing Reimagined

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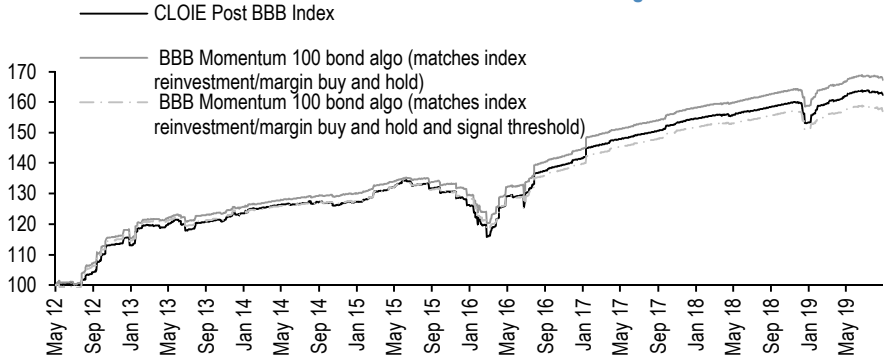
The Audacity of Automation: CLO Investing Reimagined

How can simple automation match (or seek an alternative) risk/reward in CLOs? As it just isn't possible to buy the CLOIE Index (6,094 bonds, and counting) we create, rebalance, and benchmark baskets just like in other markets. We use automatic bond selection, bringing momentum (the market's tendency to trend in a given direction) to CLOs by profiling bonds (risk, duration, margin, etc) into momentum baskets. Momentum is based on price signals (link). A 3M lookback seems to indicate forward 1M directionality in CLOs, which we look to refine. As sourcing is a hurdle and selecting based on only momentum results in high turnover, we introduce two scenarios: buy and hold (natural turnover for pay downs), and using signal threshold to drop negative momentum bonds (slightly higher turnover). When sourcing the strongest signal isn't possible, the algorithm can at least be used as a tool to suggest sourcing within select categories. Consider an example in CLOIE BBB Index: ~62% return since April 2012. A momentum algo rebalancing 100 BBBs matching the index (reinvestment/margin) in a buy and hold scenario outperformed (~67%). A momentum algo that incorporates a signal threshold slightly underperformed (~58%) but had less volatility and lower max drawdown. Clearly there are limits given data issues and CLO structural nuances, though early results do seem promising. But why, some say, defy convention of manager selection? And they may well ask, why seek the best returns, or even, why does technology advance?[1] We choose to consider a possible future to make CLOs more accessible with market growth (~$800bn current size) and look forward to profiling strategies in our *CLOIE Monitor*.

Exhibit 1: Cumulative Return of CLOIE BBB Index versus selected algorithms



Source: J.P. Morgan. Gross returns excluding transaction cost.

Exhibit 2: Statistics from Exhibit 1

Bond Basket	Ytd Rtn %	Cum Rtn %	Max 1m Drawdown	Annualized Return %	Annualized Vol %	Sharpe Ratio	Avg. Turnover %
BBB Momentum 100 bond algo (matches index reinvestment/margin buy and hold)	5.42	67.26	-4.62	10.16	4.67	2.18	4.31
BBB Momentum 100 bond algo (matches index reinvestment/margin buy and hold and signal threshold)	3.98	57.01	-4.48	8.86	4.85	1.83	6.89
CLOIE Post BBB Index	5.93	62.28	-5.34	9.54	5.18	1.84	5.33

Source: J.P. Morgan.

[1] Inspired by "We choose to go to the moon", President Kennedy address on September 12, 1962, at Rice University.

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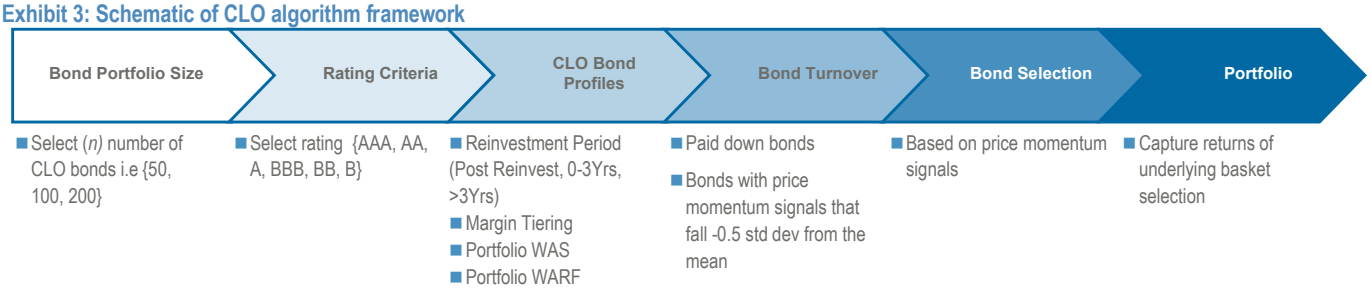
Exhibit 3: Schematic of CLO algorithm framework



Source: J.P. Morgan.

Replication

We begin by showing that it is possible to replicate smaller, less unwieldy baskets from an index (CLOIE: 2,249 bonds at inception, 6,094 bonds today) with manageable tracking error. The point is, as in other markets index-benchmarking strategies can work. In order to replicate the CLOIE into actual baskets, we simulate random selection. We select 25, 50, 100, 250 (*n*) bonds to see if smaller baskets can achieve similar performance. We begin at inception (January 2012) by selecting *n* number of bonds, rebalancing monthly only if a bond has paid down (e.g. 2 bonds pay down in a given month, randomly select 2 more bonds at the end of that month). In a Monte Carlo, we run each basket 1,000 times and compare average risk/reward of the results. As shown, it is feasible to replicate benchmark index returns with smaller baskets of bonds (Exhibit 4). The point is not to propose random selection, just to show the simplest way. The turnover here is a buy and hold scenario, but we also show how to practically automate the construction and rebalancing of a CLO portfolio using momentum signals, while incorporating additional turnover.

Exhibit 4: Hypothetical index replication example based on CLOIE BBB

Bond Count	Rating	Simulation Times	Weight	Ytd Rtn %	Cum Rtn %	Max 1M Drawdown	Annualized Return %	Annualized Std Dev Vol %	Sharpe Ratio
25	BBB	1000 times	Mkt Val	5.7%	94.3%	-5.5%	9.3%	5.3%	1.76
50	BBB	1000 times	Mkt Val	5.8%	94.2%	-5.6%	9.3%	5.3%	1.76
100	BBB	1000 times	Mkt Val	5.8%	94.3%	-5.7%	9.3%	5.3%	1.75
250	BBB	1000 times	Mkt Val	5.9%	94.2%	-6.4%	9.3%	5.4%	1.72
Index	BBB	INDEX	Mkt Val	6.6%	90.2%	-10.8%	9.0%	6.1%	1.49

Source: J.P. Morgan. Based on the J.P Morgan CLOIE Total BBB index. As of July 31st, 2019.

Practicality

We introduced momentum signal analysis as a proof of concept in our prior research. There are practical limitations to automating the selection of CLO bonds with only momentum, rating and weighting (market or equal) constraints. We address some of these limitations by introducing traditional selection assumptions in our momentum signal analysis. We do so by profiling CLO bonds based on risk measures: deal reinvestment period and bond margin in a first iteration, and then, portfolio Weighted Average Spread (WAS) and Weighted Average Rating Factor (WARF) in a second iteration. The target allocation to each category is based on the index market value weights. This is a standard approach we apply to allocate more bonds to larger parts of the market, however, it is flexible based on category outperformance, relative value, or investor preference. These metrics are recalculated based on statistics of bonds with available price signals at the monthly rebalance, and act as the selection target for the algorithm.

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How does the algorithm decide which bonds to select within each category? This is where we step into factor-investing and select the highest momentum price signals in each of the target categories. To explain, in say a 100 bond BB portfolio, at the monthly rebalance we have two bonds that paid down. To replace our bonds, we assess the categories needed to target the index weighting for reinvestment period buckets and margin and select the two bonds with the highest momentum price signals in the targeted category. Despite setting it as a target, the selection portfolio will not exactly mimic the index weights as our buy and hold strategy creates a natural drift over time with fewer bonds to replace to better hit the target matrix.

Exhibit 5: CLOIE BBB 100 bond portfolio: Current Selection Target Matrix

		Margin Tiering		
Years to Reinvestment Period		Tier 1 (0-33rd percentile)	Tier 2 (34-67th percentile)	Tier 3 (68-100th percentile)
	Post Reinvest	2.83%	3.89%	2.82%
	< 3 Years	10.58%	9.50%	18.20%
	≥ 3 Years	25.83%	15.86%	10.50%

Source: J.P. Morgan. As of 7/31/2019. Based on CLOIE BBB 100 Bond portfolio targeting month end market weights for years to reinvestment period and tiering of margin.

Exhibit 6: CLOIE BBB 100 bond portfolio: Current Selection Target Matrix

		Weighted Average Rating Factor (WARF)	
Weighted Average Spread (WAS)		Tier 1 (below average)	Tier 2 (above average)
	Tier 1 (above average)	21.8%	29.1%
	Tier 2 (below average)	27.0%	22.1%

Source: J.P. Morgan, INTEX. As of 7/31/2019. Based on CLOIE BBB 100 Bond portfolio targeting month end market weights for portfolio WAS and Portfolio WARF. This scenario is based on fewer bonds in CLOIE as it is limited to deals with WAS and WARF metrics reported on a monthly basis.

Sourcing specific bonds for selection is still one of the key limitations given the buy and hold nature of the CLO market. In dropping/adding bonds based on price signals in addition to pay downs, we come to terms with the fact that turnover will be higher than the CLOIE index as our goal is to use factor investing to automate allocation. In our efforts, turnover is moderate. Also, there is already turnover in an index and we just propose simple limits that are in fact flexible. For example, the CLOIE BBB index monthly turnover[2] is an average 5.3% based on market weight. And, secondary CLO bond trading turnover[3] is an average 1% on BWICs each month, varying by year and rating (mezz is higher 4.2% but remains lower than HG/HY flow credit). It is worth noting, BWICs may not capture all trades in secondary, though it is a more conservative approach to using TRACE volumes (which include non-CLO trading volumes), and bond selection can occur in the primary market (either through a new

[2] We calculate index turnover for the CLOIE as the absolute value of market and par weight change in current month versus prior month. Constituents of CLOIE index will be re-balanced on the end of every month.
[3] We calculate CLO, HY, and HG trading turnover ratio as trading volume each day divided by the amount outstanding on a bond level and then aggregate to arrive at a market figure. A 1% monthly turnover means it will take 100 months to buy 100% of a given bond.

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issue or refi/reset). While we acknowledge that sourcing the suggested bonds remains a limitation, we therefore target a turnover that closely mimics the natural turnover of the market (using CLOIE index as our proxy) and note the flexibility of signal thresholds depending on turnover preference or capabilities. Also, by incorporating bond profiles, in a scenario, where sourcing the bonds with the strongest price signals may not be possible, the algorithm can be used as a tool to target bonds of a similar profile or momentum price signal strength.

Exhibit 7: Average Monthly Trading Turnover Ratio

Monthly Turnover	CLO	HG	HY
2014	1.21%	6.16%	10.78%
2015	1.35%	5.72%	10.56%
2016	0.92%	5.72%	11.66%
2017	0.80%	5.50%	11.66%
2018	0.74%	5.72%	11.66%
2019	1.22%	6.82%	13.42%
Long-Term Average	1.04%	5.94%	11.62%

Source: J.P. Morgan, TRACE. CLO based on BWIC volumes. HG/HY based on TRACE data (see here for more details).

Exhibit 8: CLO Average Monthly Trading Turnover Ratio by rating

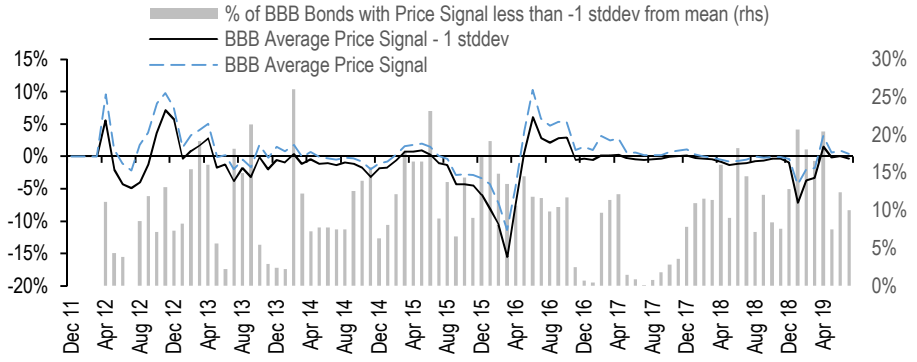
	2019	2018	2017	2016	2015	2014	Average
AAA	0.76%	0.51%	0.39%	0.50%	1.02%	0.69%	**0.65%**
AA	1.79%	0.97%	1.03%	1.22%	1.38%	1.17%	**1.26%**
A	2.56%	1.07%	1.24%	1.13%	1.26%	1.72%	**1.50%**
BBB	2.31%	1.13%	1.72%	1.65%	2.03%	2.05%	**1.82%**
BB	3.35%	1.89%	2.30%	2.53%	2.83%	2.56%	**2.58%**
B	5.95%	3.14%	4.39%	3.77%	4.11%	3.86%	**4.20%**
EQ	1.99%	1.11%	1.52%	1.38%	2.02%	1.78%	**1.64%**
Total	1.22%	0.74%	0.80%	0.92%	1.35%	1.21%	**1.04%**

Source: J.P. Morgan. CLO based on BWIC volumes.

Automation

We have automated the portfolio construction to decrease portfolio turnover. First, a signal threshold function more practically rebalances the portfolio. We drop/replace bonds that pay down and only additionally turnover the portfolio if a bond has a momentum price signal below -0.5 standard deviation from the average of all signals (Exhibit 9). In the CLOIE BBB Index, an average 10.5% of bonds have a momentum price signal below -0.5 standard deviation from the mean in a given month, though this fluctuates as dispersion increases.

Exhibit 9: Visualizing Signal Thresholds (CLOIE BBB Index)



Source: J.P. Morgan.

Second, as discussed earlier, the algorithm automatically targets the index weights. To accomplish this, we use the largest remainder algorithm[4] to determine the number

[4] In simple terms, suppose you have two different categories, Category 1 and Category 2, with weights of 50.8% and 49.2%, respectively. For simplicity, we assume each bond has a weight of 1%. To get an even 100 bonds, we round out the weight of both categories to 50% and 49%, respectively. We assign the remaining 1 bond to the category with the largest remainder, which in this case is 0.8% or the first bucket. In the end, we end up with a weight of 100% with 51 bonds in Category 1 and 49 bonds in Category 2.

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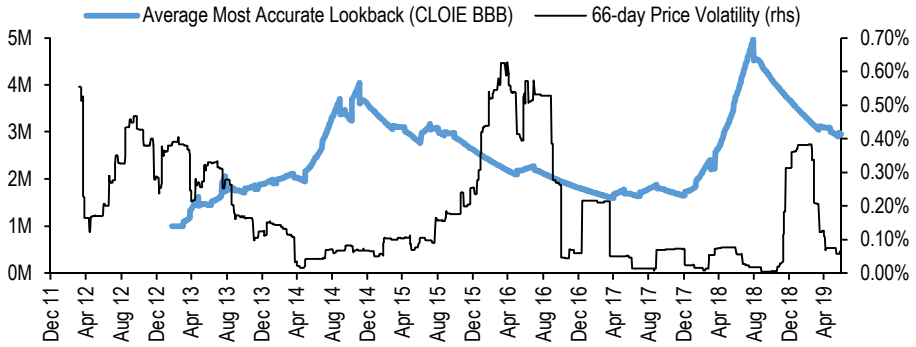
of bonds to select in each category. Then bonds with the highest momentum price signal in the determined category will be selected and if bonds in the target category are not available, the algorithm defaults to selecting the highest momentum signal in any category.

Combing both automatic approaches, the algorithm will drop bonds that are considered a tail risk (tail risk is defined in this scenario as bonds with the most negative momentum price signals) and reallocate to bonds with strong positive price momentum. As a result, turnover will automatically be higher in more volatile periods as increased percentage of bonds are likely to fall below our signal threshold. In periods of more stable price volatility, the algorithm reverts back to a lower turnover and a higher percentage of buy and hold.

How did we determine the best lookback for our signals? Previously we simply assumed 6M, but found 3M to be a stronger predictor of forward 1M price signals (link). With more analysis we have found that the most accurate momentum signal can vary across market regimes and volatility; however, the long-term average is ~3M (Exhibit 10).

Exhibit 10: 3M momentum lookback is most accurate in the long run (CLOIE BBB example)



Source: J.P. Morgan. Accuracy is the number of days in which a positive lookback signal (1M, 3M, 6M, 9M, and 12M) successfully predicts a positive price return in the next one month, or a negative lookback signal successfully predicts a negative price return in the next one month. We then select the current most accurate signal and average with the last 22 days most accurate signals. Price volatility is the standard deviation of daily returns on a rolling 22-day basis.

Results and Conclusion

Consider an example around the CLOIE BBB index (~62% return since April 2012). A momentum algo rebalancing 100 BBBs matching the index (reinvestment/margin) in a buy and hold outperformed (~67%). A momentum algo that additionally incorporates a signal threshold slightly underperformed the index (~58%), but has less volatility and lower max drawdown. Appendix A shows the full list of results and Exhibits 11 onwards the descriptive statistics. In conclusion, it was key to address limitations such as bond sourcing and lack of traditional CLO metrics in our introduction to systematic investing. Incorporating signal thresholds (drop bonds that have weak momentum signals), automating turnover or lookbacks based on market conditions (price volatility and signals accuracy), and other enhancements help make the algorithm more dynamic. However, we also made the algorithm more 'human-like' as a way to compromise, meaning we introduce traditional CLO selection to our automatic allocation based on factor-investing. While not the ultimate goal of an automated approach, we find usefulness in the technology even if as a tool for investors to find value away from traditional selection. Our current approach targets the index but note the flexibility in this approach (based on relative value or investor preference). There is room for improvement in automating even further such as

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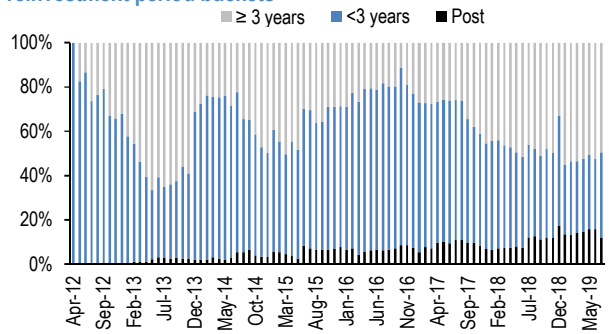
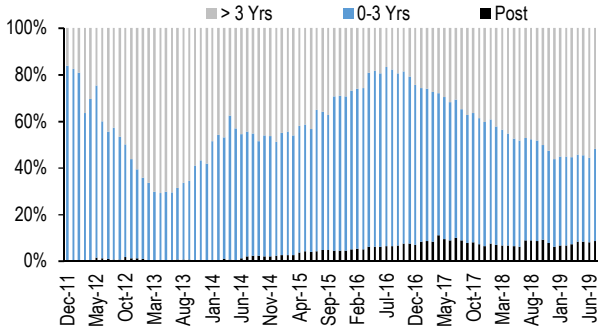
incorporating macro moves (however, we found a weak relationship; see Exhibit 23 in the appendix), or selecting categories based on outperformance. At this time, there are limitations in CLOs (shorter data history, transparency, etc.) compared to what is available in more liquid markets, such as equities, where factor-investing is much more common.

Exhibit 11: 100 CLO BBB Bond portfolio – Years to reinvestment period buckets



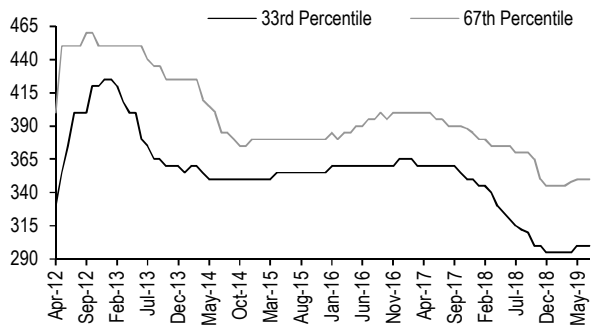
Source: J.P. Morgan. From April 2012 to July 2019.

Exhibit 12: CLOIE Index historical constituents – Years to reinvestment period buckets



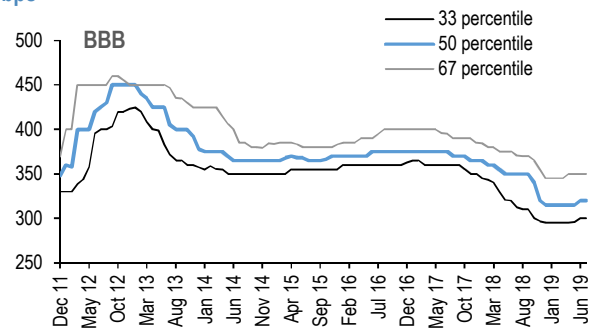
Source: J.P. Morgan. From inception to July 2019.

Exhibit 13: 100 CLO BBB Bond portfolio margin tiering bps



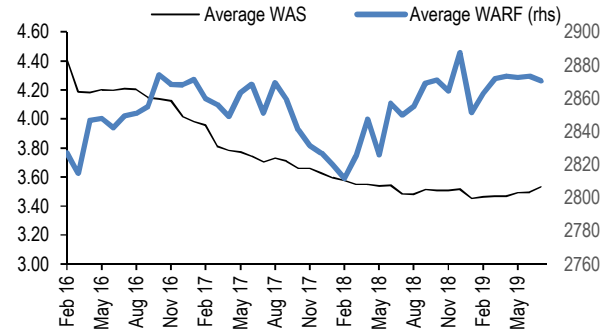
Source: J.P. Morgan. From April 2012 to July 2019.

Exhibit 14: CLOIE BBB historical constituents margin tiering bps



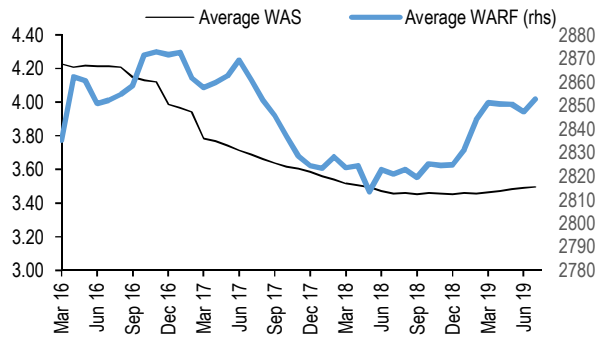
Source: J.P. Morgan. From inception to July 2019.

Exhibit 15: 100 CLO BBB Bond portfolio WAS and WARF



Source: J.P. Morgan. March 2016 to July 2019. Based on a subset of CLOs in CLOIE that have both WAS and WARF available in a given month.

Exhibit 16: CLOIE BBB historical constituents margin tiering bps



Source: J.P. Morgan. March 2016 to July 2019. Based on a subset of CLOs in CLOIE that have both WAS and WARF available in a given month.

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Appendix A

Exhibit 17: Results for matching Reinvestment Periods and Margin to the index

Bond Count	Rating	Selection	Turnover	Signal Threshold	Weight	Cum Rtn %	Max 1m Drawdown	Annualized. Return %	Annualized Vol %	Sharpe Ratio	Avg. Turnover %
100	AA	Momentum/Match to Index (Reinvest/margin)	Buy and Hold	No	Mkt Val	30.83	-0.93	5.19	1.66	3.12	4.42
100	AA	Momentum/Match to Index (Reinvest/margin)	Buy and Hold	Yes (-0.5 from Mean)	Mkt Val	27.88	-1.31	4.74	1.99	2.38	10.76
Index	AA	INDEX	INDEX	INDEX	Mkt Val	27.28	-1.21	4.64	1.90	2.45	5.48
100	BBB	Momentum/Match to Index (Reinvest/margin)	Buy and Hold	No	Mkt Val	67.26	-4.62	10.16	4.67	2.18	4.31
100	BBB	Momentum/Match to Index (Reinvest/margin)	Buy and Hold	Yes (-0.5 from Mean)	Mkt Val	57.01	-4.48	8.86	4.85	1.83	6.89
Index	BBB	INDEX	INDEX	INDEX	Mkt Val	62.28	-5.34	9.54	5.18	1.84	5.33
100	BB	Momentum/Match to Index (Reinvest/margin)	Buy and Hold	No	Mkt Val	105.50	-7.03	14.52	6.82	2.13	4.31
100	BB	Momentum/Match to Index (Reinvest/margin)	Buy and Hold	Yes (-0.5 from Mean)	Mkt Val	78.01	-8.00	11.46	6.53	1.76	10.47
Index	BB	INDEX	INDEX	INDEX	Mkt Val	93.56	-7.89	13.23	7.20	1.84	5.37

Source: J.P. Morgan. Results from April 2012 to July 2019.

Exhibit 18: Results for matching Portfolio WAS and WARF to the index

Bond Count	Rating	Selection	Turnover	Signal Threshold	Weight	Cum Rtn %	Max 1m Drawdown	Annualized. Return %	Annualized Vol %	Sharpe Ratio	Avg. Turnover %
100	AA	Momentum/Match to Index (WAS/WARF)	Buy and Hold	Yes (-0.5 from Mean)	Mkt Val	16.02	-0.96	6.03	1.49	4.04	1.37
Index	AA	INDEX	INDEX	INDEX	Mkt Val	17.12	-1.21	6.43	1.68	3.84	5.48
100	BBB	Momentum/Match to Index (WAS/WARF)	Buy and Hold	Yes (-0.5 from Mean)	Mkt Val	35.73	-2.66	12.80	4.43	2.89	1.86
Index	BBB	INDEX	INDEX	INDEX	Mkt Val	39.94	-4.02	14.17	4.80	2.95	5.33
100	BB	Momentum/Match to Index (WAS/WARF)	Buy and Hold	Yes (-0.5 from Mean)	Mkt Val	68.96	-2.81	22.98	6.06	3.79	2.21
Index	BB	INDEX	INDEX	INDEX	Mkt Val	78.89	-3.96	25.77	6.35	4.06	5.37

Source: J.P. Morgan. Results from April 2012 to July 2019.

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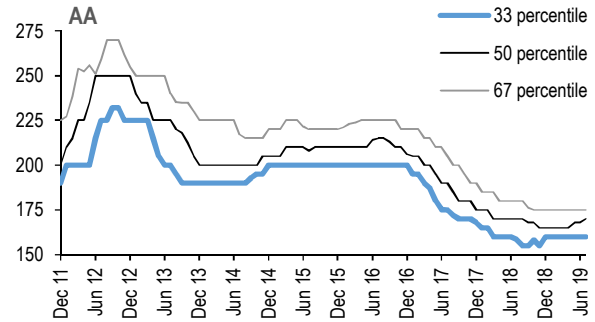
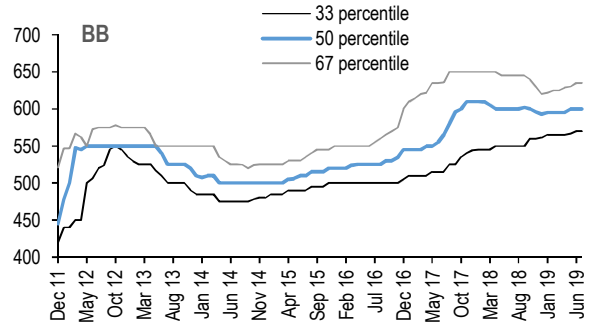
Exhibit 19: CLOIE historical constituents – Margin tiering for CLOIE AA index (bps)



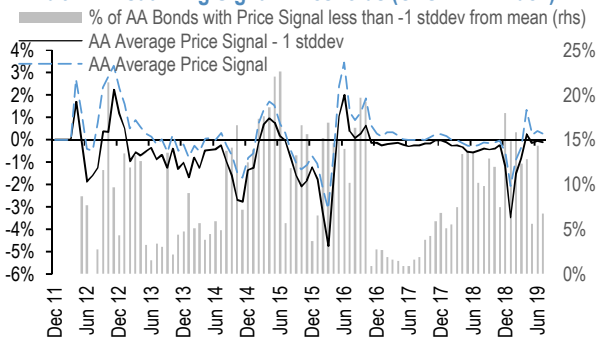
Source: J.P. Morgan.

Exhibit 20: CLOIE historical constituents – Margin tiering for CLOIE BB index (bps)



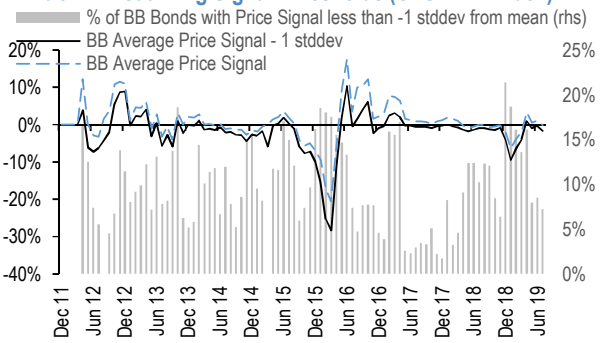
Source: J.P. Morgan.

Exhibit 21: Visualizing Signal Thresholds (CLOIE AA Index)



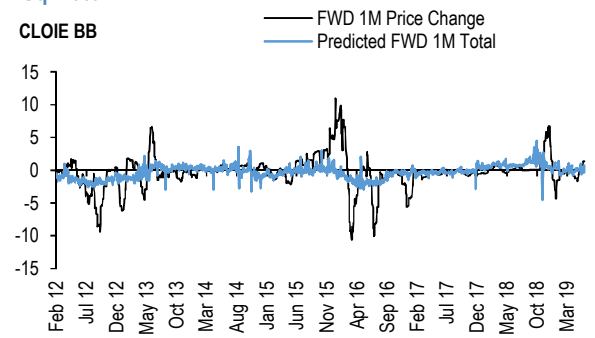
Source: J.P. Morgan.

Exhibit 22: Visualizing Signal Thresholds (CLOIE BB Index)



Source: J.P. Morgan.

Exhibit 23: Y-variable: Fwd 1M Price Change; X-Variables: 3M lookback, 1M Loan spread change, 10 Tsy
R-Sq: 40%



Source: J.P. Morgan.

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Appendix B

Exhibit 1: Global CLO spreads & recommendations (bp)

Sector	Current WAL (yrs)	Current Spread	Change vs 09/13	Change YTD	Rec*
US 3.0					
AAA	4.0-5.5	122	*(3)*	*(18)*	N
AA	5.5-7.0	188	0	*(22)*	N
A	6.5-8.0	252	0	*(53)*	N
BBB	7.0-8.5	368	0	*(42)*	N
BB	7.5-9.0	725	**5**	*(50)*	N
B	8.0-9.5	1025	**10**	**25**	N
US New Issue					
AAA	5-6	131-145	0	**2**	N
AA	6-8	175-210	*(3)*	*(18)*	N
A	6-9	245-305	*(5)*	*(35)*	N
BBB	7-9	385-425	*(3)*	*(3)*	N
BB	7-9	690-800	*(5)*	*(18)*	N
B	7-9	875-1000	0	*(163)*	N

Sector	Current WAL (yrs)	Current Spread	Change vs 09/13	Change YTD	Rec*
EUR 2.0					
AAA	4-5	130	*(5)*	**5**	N
AA	6-7	173	*(5)*	*(13)*	N
A	6-7	225	*(5)*	*(10)*	N
BBB	6-7	358	*(5)*	*(5)*	N
BB	7-8	658	0	**8**	N
B	7-8	873	**10**	**23**	N
EUR New Issue					
AAA	5-6	97	*(2)*	*(6)*	N
AA	7-8	175	*(3)*	*(15)*	N
A	7-8	245	0	*(10)*	N
BBB	7-8	398	0	**28**	N
BB	8-9	670	0	*(5)*	N
B	8-9	950	0	**75**	N

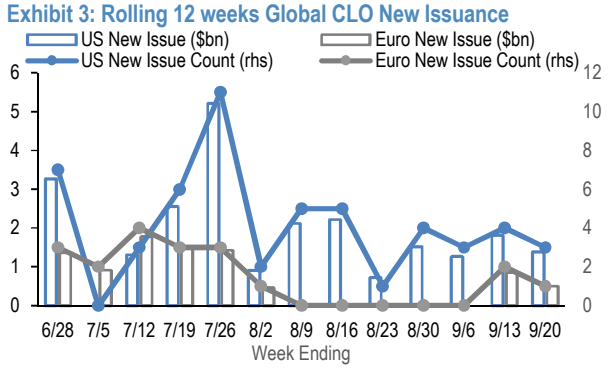
Source: J.P. Morgan. Spread to Libor or Euribor (bp) for originally-rated categories. *Rec shows recommendations where OW is Overweight, N is Neutral, and UW is Underweight. US New issue spreads represent a range of spreads to indicate manager tiering. All secondary spreads represent 'mid-quality' of secondary levels of CLOs. US 3.0 spreads represent US CLOs issued after 2013 and EUR 2.0 spreads represent CLOs issued Post-Crisis. EUR new issue does not reflect positive impact of EURIBOR floors on spreads.

Exhibit 2: CLO annual issuance totals

		2013	2014	2015	2016	2017	2018	YTD18	YTD19	YoY Change
US Issuance ($bn)	Total	87.28	131.46	109.59	113.47	284.73	278.84	213.18	120.81	-43%
	New	86.08	124.10	99.07	72.42	118.07	129.68	98.06	86.11	-12%
	Refi/Reset/Re-Issue	1.20	7.35	10.53	41.05	166.66	149.16	115.12	34.70	-70%
Euro Issuance (€bn)	Total	7.77	14.49	13.86	21.03	45.10	43.21	33.27	27.41	-18%
	New	7.77	14.49	13.56	16.82	19.12	27.27	20.35	20.98	3%
	Refi/Reset/Re-Issue	0.00	0.00	0.31	4.21	25.98	15.94	12.92	6.43	-50%
Global Issuance ($bn)	Total	97.61	150.57	124.95	136.51	335.81	329.82	253.31	151.63	-40%
	New	96.42	143.21	114.07	90.97	139.81	161.84	122.80	109.75	-11%
	Refi/Reset/Re-Issue	1.20	7.35	10.87	45.54	196.00	167.98	130.51	41.88	-68%

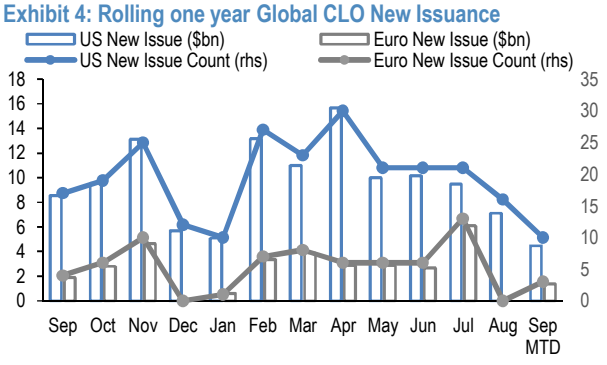
Source: J.P. Morgan.

Exhibit 3: Rolling 12 weeks Global CLO New Issuance



Source: J.P. Morgan. Data excludes refinanced, reset, re-issued and repriced CLOs.

Exhibit 4: Rolling one year Global CLO New Issuance



Source: J.P. Morgan. Data excludes refinanced, reset, re-issued and repriced CLOs.

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Exhibit 5: CLOIE simple average and portfolio discount margin (bps)

Simple Avg. Discount Margin	Current	1m Δ	YTD Δ	1yr Δ
Total CLOIE	189	0	(24)	30
AAA	120	(1)	(26)	12
AA	180	(0)	(26)	22
A	257	(1)	(25)	59
BBB	378	8	(28)	85
BB	721	4	(6)	198
B	983	4	45	238
Pre-Crisis CLOIE	224	0	30	46
AAA	0	0	(53)	(53)
AA	76	0	(28)	(8)
A	95	0	(16)	(23)
BBB	185	0	(30)	(7)
BB	398	0	(1)	9
Post-Crisis CLOIE	189	0	(24)	31
AAA	120	(1)	(26)	12
AA	180	(0)	(26)	22
A	257	(1)	(25)	59
BBB	378	8	(29)	84
BB	722	4	(7)	198
B	983	4	45	238

Portfolio Discount Margin	Current	1m Δ	YTD Δ	1yr Δ
Total CLOIE	225	2	(6)	41
AAA	124	0	(22)	14
AA	183	0	(24)	25
A	260	(1)	(26)	61
BBB	381	10	(26)	94
BB	725	4	(9)	154
B	985	4	43	225
Pre-Crisis CLOIE	234	11	(2)	25
AAA	0	0	(54)	(55)
AA	78	0	(20)	(8)
A	95	0	1	(4)
BBB	190	(0)	(31)	3
BB	385	0	(6)	(0)
Post-Crisis CLOIE	225	2	(6)	41
AAA	124	0	(22)	14
AA	183	0	(24)	25
A	260	(1)	(26)	61
BBB	381	10	(26)	93
BB	725	4	(9)	154
B	985	4	43	225

Source: J.P. Morgan.

Exhibit 6: CLOIE total returns, Simple Avg. Yield, Coupon, and Margin

Total Returns (%)	MTD	QTD	YTD2019	YTD2018
Total CLOIE	0.24%	0.64%	4.25%	2.18%
AAA	0.20%	0.81%	3.64%	1.85%
AA	0.23%	0.82%	4.58%	2.08%
A	0.31%	0.19%	5.23%	2.31%
BBB	0.40%	(0.32%)	6.29%	2.78%
BB	0.46%	(0.36%)	7.58%	5.02%
B	0.58%	0.55%	6.87%	7.82%
Pre-Crisis CLOIE	0.27%	1.04%	3.39%	2.36%
AAA	0.00%	0.00%	0.94%	1.72%
AA	0.23%	0.79%	2.53%	1.66%
A	0.19%	0.75%	2.11%	1.85%
BBB	0.24%	0.74%	3.20%	2.70%
BB	0.34%	1.58%	4.84%	4.53%
Post-Crisis CLOIE	0.24%	0.64%	4.25%	2.18%
AAA	0.20%	0.81%	3.64%	1.85%
AA	0.23%	0.82%	4.58%	2.08%
A	0.31%	0.19%	5.23%	2.32%
BBB	0.40%	(0.33%)	6.31%	2.78%
BB	0.46%	(0.37%)	7.60%	5.02%
B	0.58%	0.55%	6.87%	7.82%

	Simple Avg. Yield	Portfolio Yield	Coupon	Margin (bps)
Total CLOIE	3.63%	3.88%	4.01%	172
AAA	2.97%	2.87%	3.45%	116
AA	3.47%	3.44%	3.96%	167
A	4.26%	4.23%	4.53%	224
BBB	5.48%	5.46%	5.55%	326
BB	8.94%	8.97%	8.32%	603
B	11.61%	11.64%	9.74%	746
Pre-Crisis CLOIE	4.20%	4.22%	4.25%	198
AAA	0.00%	0.00%	0.00%	0
AA	2.89%	2.85%	2.64%	36
A	2.80%	2.80%	2.98%	70
BBB	3.74%	3.72%	3.72%	145
BB	5.92%	5.75%	6.14%	388
Post-Crisis CLOIE	3.63%	3.88%	4.01%	172
AAA	2.97%	2.87%	3.45%	116
AA	3.47%	3.44%	3.96%	167
A	4.26%	4.23%	4.53%	224
BBB	5.48%	5.46%	5.56%	327
BB	8.95%	8.98%	8.33%	604
B	11.61%	11.64%	9.74%	746

Source: J.P. Morgan.

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