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Systematic Investing in CLOs

Introducing Momentum Algorithms

- We appreciate your support in in the 2019 Institutional Investor Global Fixed-Income Research survey: voting.institutionalinvestor.com.

- As we anticipate a global CLO market of $800bn by end-2019 ($760bn currently), broader acceptance of the product may entail more automation, such as the use of systematic strategies. While we don't see CLO market convention of manager/transaction analysis fully replaced in the future, we can imagine investors using predictive tools such as algorithms. With J.P. Morgan Global Index Research, we begin the conversation by introducing momentum allocation to the CLO market.

- Momentum is a part of factor investing, which employs factors (momentum, value, margin, size, etc) to determine an allocation strategy to outperform beta (in corporate credit, see Fact or Fiction by Saul Doctor). Simply, we consider going long momentum baskets of CLOs using trending prices to overweight past winners and underweight past losers.

- Using our CLOIE index as a benchmark, we begin with sub-indices then move to bond-level, applying momentum signal investing to select actual baskets of bonds catering to investor preferences (rating constrained or unconstrained).

- Back-testing suggests investing based on momentum signals can outperform the CLOIE by both capturing trends and spotting inflection points around market bottoms, even with constraints (not just allocating to riskier bonds). However, the relatively high sharpe ratios need to be taken with caution, resulting from lower volatility (less liquidity/more buy-and-hold nature in CLOs). Strategies also have practical limitations (sourcing, tiering, turnover, risk capital etc).

- We introduce 30 bond-level momentum algos in the Appendix and will expand the CLOIE Monitor to enhance transparency in this space.

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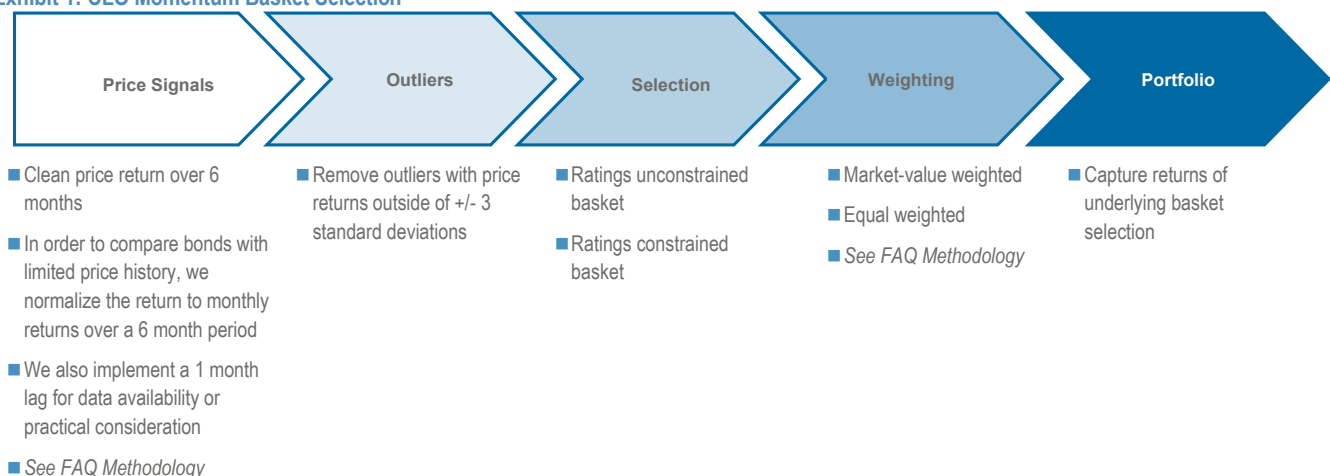(1-212) 834-2349
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Systematic Investing in CLOs

Introducing Momentum Algorithms

As we anticipate a global CLO market of $800bn by end-2019 ($760bn currently), broader acceptance of the product may entail more automation such as the use of systematic strategies. We showed how to incorporate CLOs to portfolios here and now, introduce more automated allocation. While we don't see market convention of manager/transaction analysis fully replaced, we can imagine investors using predictive strategies to manage risk/reward. Investing using algorithms is already here more broadly (link) and with Global Index Research, we begin the conversation on factor investing in CLOs as a systematic strategy, introduce momentum allocation as an initial example, and track performance. Momentum is a part of factor investing, which employs factors (momentum, value, margin, size, etc) to determine an allocation strategy to outperform beta (see Fact or Fiction by Saul Doctor). Simply, we consider going long momentum baskets of CLOs to extract any uncorrelated risk premia associated with momentum versus just holding the market portfolio of CLOs, using trending prices to overweight past winners and underweight past losers.

Using our CLOIE index as a benchmark, we begin with sub-indices then move to bond-level, applying momentum signal investing to select actual baskets of bonds catering to investor preferences. Exhibit 1 illustrates our momentum basket construction, where we calculate and rank signals based on price changes. Momentum specifically and factor investing broadly is relatively untested in CLOs. Back-testing suggests investing based on momentum signals can outperform the CLOIE by both capturing trends and spotting inflection points around market bottoms, even with constraints (not just allocating to riskier bonds). However, the relatively high sharpe ratios in both the benchmark and the strategies need to be taken with caution as they result from lower volatility (less liquidity/more buy-and-hold nature in CLOs). Strategies also have practical limitations (sourcing, tiering, turnover, risk capital etc). We introduce 30 bond-level momentum algos in the Appendix and look forward to expanding our CLOIE Monitor to enhance market transparency.

Exhibit 1: CLO Momentum Basket Selection

Price Signals	Outliers	Selection	Weighting	Portfolio
■ Clean price return over 6 months	■ Remove outliers with price returns outside of +/- 3 standard deviations	■ Ratings unconstrained basket	■ Market-value weighted	■ Capture returns of underlying basket selection
■ In order to compare bonds with limited price history, we normalize the return to monthly returns over a 6 month period		■ Ratings constrained basket	■ Equal weighted	
■ We also implement a 1 month lag for data availability or practical consideration			■ *See FAQ Methodology*	
■ *See FAQ Methodology*				

Source: J.P. Morgan.

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Momentum algorithm performance

Index-level strategic allocation

As it may be more intuitive for CLO investors to understand allocating between rating classes, we begin with sub-index level results to introduce the concept of momentum and some constraints that can be applied. Using our six CLOIE sub-indices (AAA, AA, Single-A, BBB, BB, Single-B), we ran 36 combinations (though there are more) based on relative momentum signals over a 6 month lookback period (with a 1 month lag) since 2012 and assumed different rating constraints to mimic investor segmentation. We tested both equal and market value weights of the sub-indices (see the FAQ later in this publication). The momentum signal for each CLOIE sub-index is measured by the percent change of the average index clean price over a 6 month period with a 1 month lag, put simply, the strongest 6-month signal will suggest allocation to that tranche (or tranches, depending on constraints).

Exhibit 2: Top 3 CLOIE sub index-level allocation strategy performance versus CLOIE Total BB-B index, Loan index, HY index
Gross Returns, Monthly Rebalance
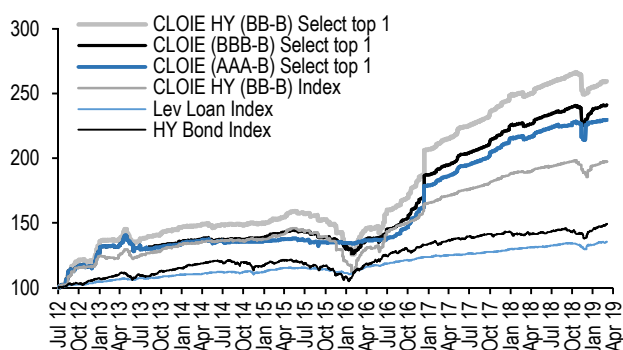
Source: J.P. Morgan. The performance of the 3 index-level strategies are the same for both market and equal weight because there is no weighting necessary given these strategies select the top 1 sub-index. As of May 9th, 2019.

Exhibit 3: Top 3 CLOIE sub index-level allocation strategy risk metrics versus CLOIE Total BB-B, Loan index, HY index

Strategy/Index	Max 1M Drawdown	Std Dev 1M	Annualized Vol %
CLOIE HY (BB-B) Select top 1	-6.75	3.28	8.79
CLOIE (BBB-B) Select top 1	-6.39	2.54	8.23
CLOIE (AAA-B) Select top 1	-6.39	2.25	7.97
CLOIE BB-B Index	-7.44	2.80	6.66
Leveraged Loan Index	-2.31	0.73	1.39
HY Bond Index	-2.97	1.50	4.15

Source: J.P. Morgan. See Appendix A for additional risk/return metrics and calculation methodologies. As of May 9th, 2019.

On a sub-index level, it's unsurprising the top performing strategies tend to favor riskier mezzanine tranches as more levered tranches tend to experience larger price swings. We'd also note that riskier strategies entail heavier one month return drawdowns (-6.75 for Select Top 1 HY (BB-B) versus -2.95 for Select Top 1 IG (AAA-BBB)), higher annualized return volatility (8.79 for Select Top 1 HY (BB-B) versus 3.66 for Select Top 1 IG (AAA-BBB)) and rebalancing cost would probably be more onerous (bid/ask, liquidity) (See Appendix A, Exhibit 1). But it's important to understand that momentum algos can also be useful for risk-constrained investors. In another example, selecting just the top 1 signal in CLOIE IG-ratings (AAA-BBB) outperformed the CLOIE Total. In Appendix A, Exhibit 1, we list 36 sub-index level results. Index-level approaches can be useful for relative value purposes across the CLO capital structure in addition to alternative approaches (such as risk/reward or Modern Portfolio Theory), but are unlikely to be applied in the real world.

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Bond-level strategic allocation

To put this into practice, we turn to bond-level strategies which are truly momentum-based algos, but are more complex given all of the possible preferences (rating constraints, stop-loss preferences, weighting methodology, market exposure, etc.). To consider different capabilities in this introductory report, the algo we focus on selects bonds with momentum signals in the top decile for each rating basket (IG, HY, and AAA-B) and applies an equal weight (ignores market value) to the bonds in each respective basket with no rating constraints. Recall that momentum signals are based on a 6 month lookback of clean price changes (with a 1 month lag). Again, the top performing allocations are in favour of mezzanine tranches, but also, each strategy results in outperformance of the respective standard CLOIE sub-indices (IG, HY, and total (Exhibit 4)). We note each of these strategies require high turnover rates, which average 90% for CLOIE (AAA-B), 93% for IG and 102% for HY on a monthly basis which we acknowledge can be challenging to source bonds and pay bid/offer. Investment styles may vary, and our selections aim to maximize returns in each rating category for the top decile of bonds, but we consider other approaches, including maximizing risk/reward (sharpe ratio) or minimizing turnover which suggest allocations to market weight positive momentum IG (AAA-BBB) and equal weight positive momentum CLOIE (AAA-B), respectively (see additional 30 bond-level allocation strategies and results summarized in Appendix A, Exhibit 2).
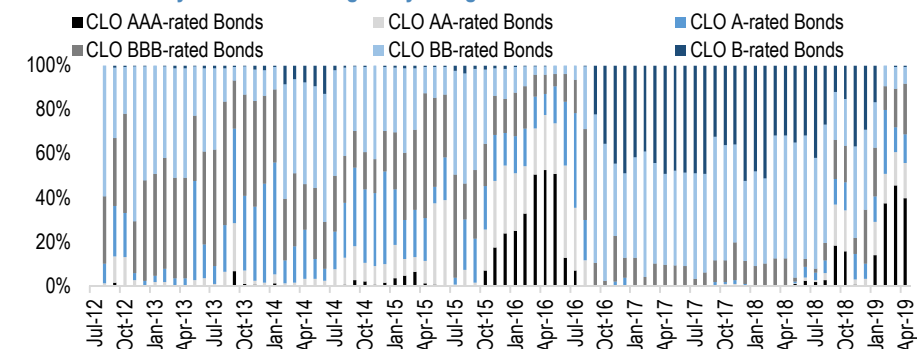
Exhibit 4: Bond-level allocation strategy performance versus CLOIE sub-indices
Gross Returns, Monthly Rebalance
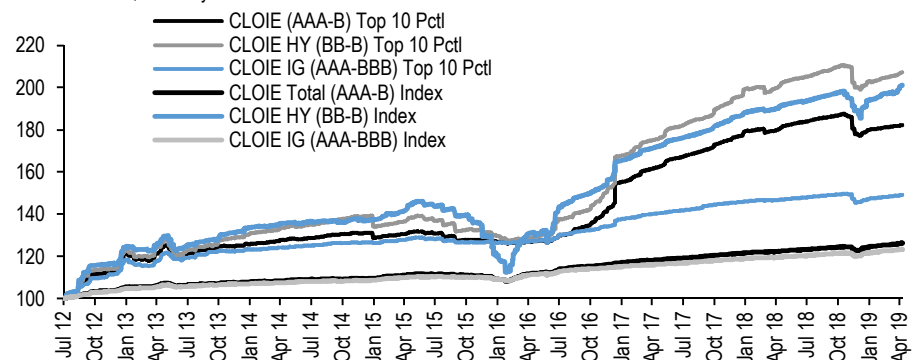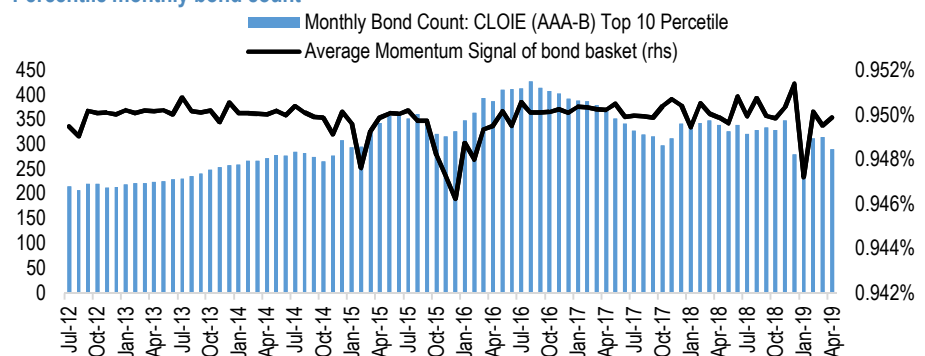

Source: J.P. Morgan. As of May 9TH, 2019.

Exhibit 5: Select bond-level strategy equal weight, rating unconstrained, CLOIE (AAA-B) Top 10 Percentile monthly bond basket weights by rating

Source: J.P. Morgan. As of May 9TH, 2019.

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The example strategy for selecting an equal weight basket based on the top decile of bonds with no rating constraints in CLOIE (AAA-Single-B) means the algo selects the top 10% count of bonds based on the strongest momentum signals each month, disregarding market value or rating. Given the heavy exposure to mezzanine tranches in this 'borderless' approach (Exhibit 5), two alternative approaches to reduce this exposure would be to apply a market value weight (versus equal weight) which would allocate more to bonds larger in size (such as AAA-rated bonds, is ~68% of the market) or to apply rating constraints, requiring the allocations to select bonds within each tranche. We also note the bond count fluctuates at the rebalance depending on the count of bonds in our overall CLOIE index. To give a sense of the monthly average price signal of our example strategy, Exhibit 6, has bond count allocation and average momentum signals of our selected bond basket.
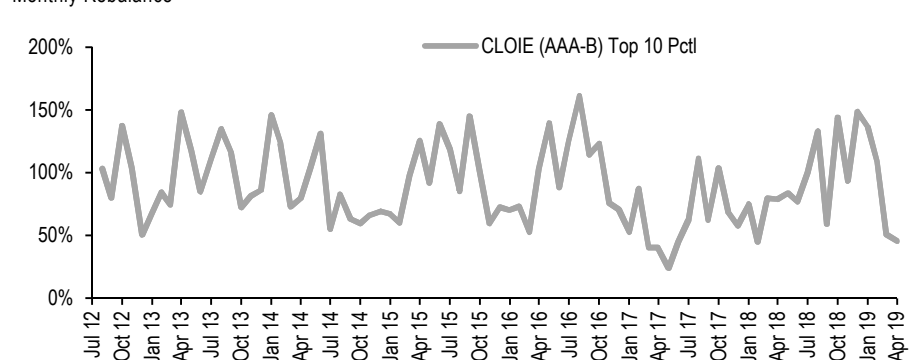
Exhibit 6: Select bond-level strategy equal weight, rating unconstrained, CLOIE (AAA-B) Top 10 Percentile monthly bond count

Source: J.P. Morgan. As of May 9th, 2019

Exhibit 7: Select bond-level strategy equal weight, rating unconstrained, CLOIE (AAA-B) Top 10 Percentile monthly portfolio turnover ratio
Monthly Rebalance

Turnover Ratio is calculated as the sum of absolute value weight changes between two periods. As of May 9th, 2019.Conclusion and future considerations.

In summary, the sub-index level is useful to introduce the concept of automated allocation and consider relative value under different investor preferences, but in practice the bond-level approach is more likely to be applied in trading portfolios. There are other considerations such as liquidity, turnover (we set an unconstrained monthly rebalance), transaction costs (we only have access to bid prices), portfolio size (our allocation strategies grow in size with the CLOIE index), vintage diversification, structure (calls, duration, vintage, risk retention, etc) or allocating to primary (as this is based on a 6 month historical prices). We also plan to consider

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factors beyond momentum (i.e. size, margin, value etc). Momentum, specifically, and factor investing, broadly, is in our view relatively untested in CLOs. Our goal is to begin the conversation on factor investing in CLOs, introduce the various possibilities for momentum allocation as an initial example, and track performance.

FAQ: Momentum signal and weighting methodology

How do you calculate the signal and over what time horizon?
The momentum signal is measured by the percentage change of the average clean price over a period of N months. The formula is (Clean Price $_T$ / Clean Price $_{T-N}$) − 1, where N is the lookback period in months. For the purpose of this analysis, we use a 6 month period but other common options are 1 month, 3 month, and 12 months. We also implemented a 1 month lag to account for any delays in data availability or practical considerations, such as sourcing bonds in the secondary market. For example, if today is 5/31, we would arrive at a signal based on the price change from 10/31 to 4/30. We also considered how the 1 month lag impacts performance by back testing each strategy with no lag in the signal. While we found that no lag was most efficient from a return perspective, suggesting that the most recent valuation history helps identify future trends, we decided to highlight only scenarios with a 1 month lag as rebalancing a portfolio in one day is unrealistic.

Why can time horizons for lookback periods matter for the signal?
Understanding how the signal for each asset changes over time informs the weights and bond basket selection. Simply, lengthening the time horizon of the look back period reduces the average volatility of the signal (as expected) which could be beneficial if looking to minimize turnover, but also means minimizing the potential to capture short-term swings. Exhibits 8-9 looks at the average price and standard deviation of monthly signal by bond rating and time horizon. Results are adjusted to monthly periods to provide standardization. For example, 6M CLO BBB-rated bonds has an average monthly momentum signal of 0.27%, or in other words, the average 1 month price percent change for CLO BBB-rated bonds is +0.27% (1.62% standardized to 6 months), with a 1.00% monthly standard deviation of momentum signals (6.00% standardized to 6 months).

Exhibit 8: Average momentum signal by lookback period and credit bucket

%	1M	3M	6M	9M	12M
AAA	0.05	0.04	0.04	0.05	0.05
AA	0.13	0.13	0.13	0.14	0.13
A	0.20	0.18	0.18	0.20	0.20
BBB	0.31	0.27	0.27	0.29	0.29
BB	0.37	0.29	0.29	0.31	0.31
B	0.24	0.19	0.22	0.27	0.32

Source: J.P. Morgan. As of May 9th, 2019. Returns are adjusted to monthly returns to compare returns over different time horizons.

Exhibit 9: Standard deviation of momentum signal by lookback period and credit bucket

%	1M	3M	6M	9M	12M
AAA	0.84	0.30	0.17	0.13	0.11
AA	0.82	0.53	0.42	0.37	0.32
A	1.36	0.80	0.62	0.53	0.47
BBB	2.33	1.31	1.00	0.85	0.73
BB	3.96	2.20	1.65	1.36	1.15
B	4.97	3.36	2.74	2.39	2.10

Source: J.P. Morgan. As of May 9th, 2019. Returns are adjusted to monthly returns to compare returns over different time horizons.

What do momentum signals suggest in our CLOIE sub-indices?
Using the average monthly price signals above, we've ranked the momentum signals of each rating bucket using various lookback horizons (i.e. 1 month, 3 month, 6 month, etc.). From the table below, signals suggest increasing exposure to CLO BBB/BB bonds and reducing allocations to CLO AAA/AA bonds. In terms of the

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time horizon, there are some differences in the cusps. For example, in the 6 month look back period, we would generally add exposure to CLO BBBs and CLO BBs, but in the twelve month look back scenario we would add exposure to CLO single-Bs instead of BBBs.

Exhibit 10: Relative Ranking of Average Price Signals (1=Reduce Weight, 6 = Add Weight)

	1M	3M	6M	9M	12M
AAA	⬇ 1	⬇ 1	⬇ 1	⬇ 1	⬇ 1
AA	⬇ 2	⬇ 2	⬇ 2	⬇ 2	⬇ 2
A	➡ 3	➡ 3	➡ 3	➡ 3	➡ 3
BBB	⬆ 5	⬆ 5	⬆ 5	⬆ 5	➡ 4
BB	⬆ 6	⬆ 6	⬆ 6	⬆ 6	⬆ 5
B	➡ 4	➡ 4	➡ 4	➡ 4	⬆ 6

Source: J.P. Morgan.

How do we translate signals into selecting bonds for a basket?

There are two main ways to select bonds based on the signal: absolute and relative.

Absolute momentum strategies use an indicator to determine price trends of each asset and select based on a specific return threshold over a specified period of time. For example, go long an asset with positive momentum signals (a 0% price return threshold) over N months. In Appendix A, Exhibit 2, see positive momentum signal strategy results. However, in a month where all return signals are negative, how to allocate? We look forward to exploring more on absolute weights as we analyze on a bond level in future research.

Relative momentum employs trend indicators to rank assets. An example of this is use the past N months return to rank assets based on momentum signals and then go long a portfolio of the top-performing assets. We use this approach in the majority of our strategy allocations, where we select the top decile, quartile, etc. of performing bonds within defined constraints.

How do we apply weights to each bond? Equal or market value?

Bond basket allocation can be based on equal or market value weights. Our strategies require exposure to a fluctuating number of bonds as CLOIE and the market grows by bond count, however the suggested weight allocation suggestions can be applied to any portfolio size. When considering portfolio fund size, we generally think market weight is more practical given it takes into account the size of the market, whereas equal weight could be challenging to attain in some cases (i.e. AAA and Single-B which account for 68.4% and 0.7% of the market, respectively). However, as majority of the market is CLO AAA, equal weight strategies tend to outperform market weight strategies in CLOs given return performance and momentum signals tend to favor mezzanine tranches. In other words, equal weights would apply higher allocation to riskier, smaller tranches.

In an idealized example, we explain how to weight each bond. Suppose you have a basket of three assets, where Bond A is $100mn, Bond B is $200mn and Bond C is $300mn. If you decide to use market value weights, then the largest asset receives a larger exposure – so Bond C of $300mn will have a weight of 300 / 600 = 50%, but the smallest weight will belong to Bond A (100 / 600 = 17%). This is the typical

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weighting methodology for most benchmarks, and assuming the returns of 6% for Bond A, 3% for Bond B, and 1% for Bond C the portfolio return would be 2.51%. An alternative weighting methodology is equal weighted, which applies the same weight to all assets in the basket, regardless of their size. So in the above example, even though Bond C is the largest, it would be weighted the same as the smallest bond. Effectively, this strategy allocates a higher exposure to smaller, typically riskier bonds and the portfolio return would be a higher 3.30%.

Exhibit 11: Idealized Example of market versus equal weight allocation

Bond	Size ($mn)	Market Weight	Equal Weight	Difference	Return
A	100	17%	33%	17%	6%
B	200	33%	33%	0%	3%
C	300	50%	33%	-17%	1%
Total	**600**	**100%**	**100%**	**0%**	

Source: J.P. Morgan.

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Appendix A: CLO Momentum Results in Detail

In Exhibits 1 and 2, we summarize allocation strategy results with risk and return details. We provide Gross YTD returns, Gross cumulative returns since the first rebalance July 31st, 2012. Also, Max 1M drawdown is the maximum price drop within a month for the specified index or bond basket, Std Dev 1M is the monthly volatility of momentum signals, Sharpe Ratio is Annualized Rtn % / Annualized Vol % and average turnover ratio is calculated as the sum of absolute value weight changes between two periods.

Exhibit 1: 36 Index-level allocation strategy performance versus comparable CLOIE indices

Rating Strategy	Sub-Index Selection	Weight	YTD Rtn %	Cumulative Rtn %	Max 1M Drawdown	Std Dev 1M	Annualized Rtn %	Annualized Vol %	Sharpe Ratio
HY (BB-B)	Select top 1	Equal	5.73	163.93	-6.75	3.28	22.94	8.79	2.61
HY (BB-B)	Select top 1	Mkt Val	5.73	163.93	-6.75	3.28	22.94	8.79	2.61
BBB-B	Select top 1	Equal	6.10	143.89	-6.39	2.54	20.89	8.23	2.54
BBB-B	Select top 1	Mkt Val	6.10	143.89	-6.39	2.54	20.89	8.23	2.54
BBB-B	Select top 2	Equal	5.92	131.50	-4.99	2.54	19.55	6.35	3.08
CLOIE (AAA-B)	Select top 1	Mkt Val	2.19	130.44	-6.39	2.25	19.44	7.97	2.44
CLOIE (AAA-B)	Select top 1	Equal	2.19	130.44	-6.39	2.25	19.44	7.97	2.44
HY (BB-B)	Select top 2	Equal	6.75	126.22	-9.29	3.46	18.97	8.33	2.28
CLOIE (AAA-B)	Select top 2	Equal	2.60	117.57	-4.67	1.99	17.99	5.45	3.30
HY (BB-B)	Select top 2	Mkt Val	7.40	109.10	-7.44	3.01	16.99	6.92	2.45
BBB-B	Select top 3	Equal	6.53	107.15	-7.06	2.85	16.76	6.59	2.54
BBB-B	Select top 2	Mkt Val	6.45	106.41	-4.87	2.25	16.67	5.43	3.07
CLOIE HY (BB-B)	INDEX	Mkt Val	7.40	100.98	-7.44	2.80	16.01	6.66	2.40
CLOIE (AAA-B)	Select top 3	Equal	3.10	92.30	-4.97	1.78	14.93	4.54	3.28
CLOIE (AAA-B)	Select top 2	Mkt Val	2.31	91.92	-3.09	1.65	14.88	4.02	3.70
BBB-B	Select top 3	Mkt Val	6.71	88.18	-5.19	2.27	14.40	5.16	2.79
CLOIE (AAA-B)	Select top 4	Equal	3.84	82.09	-4.20	1.58	13.60	3.92	3.47
CLOIE (AAA-B)	Select top 5	Equal	4.22	77.85	-3.55	1.67	13.03	3.73	3.50
CLOIE (AAA-B)	Select top 6	Equal	4.80	65.56	-4.08	1.70	11.32	3.83	2.96
CLOIE (AAA-B)	Select top 3	Mkt Val	2.45	64.00	-4.06	1.40	11.10	3.33	3.33
IG (AAA-BBB)	Select top 1	Equal	2.19	56.44	-2.95	1.34	9.99	3.66	2.73
IG (AAA-BBB)	Select top 1	Mkt Val	2.19	56.44	-2.95	1.34	9.99	3.66	2.73
CLOIE (AAA-B)	Select top 4	Mkt Val	2.70	53.68	-3.08	1.12	9.57	2.61	3.67
IG (AAA-BBB)	Select top 2	Equal	2.60	49.07	-2.42	1.08	8.87	2.81	3.15
IG (AAA-BBB)	Select top 2	Mkt Val	2.31	48.17	-2.33	0.97	8.73	2.49	3.50
CLOIE (AAA-B)	Select top 5	Mkt Val	2.82	47.74	-2.37	1.00	8.66	2.24	3.86
IG (AAA-BBB)	Select top 3	Equal	3.10	45.61	-1.93	0.94	8.32	2.28	3.66
IG (AAA-BBB)	Select top 3	Mkt Val	2.45	40.73	-1.79	0.81	7.54	1.95	3.86
IG (AAA-BBB)	Select top 4	Equal	3.84	40.39	-2.08	0.89	7.49	2.12	3.53
AAA-A	Select top 1	Equal	2.19	37.22	-1.89	0.70	6.96	2.28	3.06
AAA-A	Select top 1	Mkt Val	2.19	37.22	-1.89	0.70	6.96	2.28	3.06
AAA-A	Select top 2	Equal	2.60	35.50	-1.42	0.66	6.68	1.80	3.70
AAA-A	Select top 2	Mkt Val	2.31	34.42	-1.40	0.63	6.50	1.71	3.79
AAA-A	Select top 3	Equal	3.10	31.02	-1.47	0.61	5.92	1.60	3.71
CLOIE (AAA-B)	Select top 6	Mkt Val	2.96	27.38	-1.25	0.54	5.28	1.26	4.19
CLOIE (AAA-B)	INDEX	Mkt Val	2.96	26.29	-1.25	0.51	5.09	1.19	4.27
IG (AAA-BBB)	Select top 4	Mkt Val	2.70	24.22	-1.08	0.43	4.72	1.06	4.45
CLOIE IG (AAA-BBB)	INDEX	Mkt Val	2.70	23.27	-1.08	0.41	4.55	1.00	4.56
AAA-A	Select top 3	Mkt Val	2.45	21.60	-0.87	0.36	4.25	0.93	4.55

Source: J.P. Morgan. As of May 9th, 2019.

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Exhibit 2: 30 bond-level allocation strategy performance

Rating Strategy	Bond Selection	Rating Constraint	Weight	YTD Rtn %	Cumulative Rtn %	Max 1M Drawdown	Std Dev 1M	Annualized Rtn %	Annualized Vol %	Sharpe Ratio	Average Turnover %
HY (BB-B)	top 25 Percentile	Unconstrained	Equal	4.37	107.71	-6.00	2.29	16.06	6.26	2.57	0.77
HY (BB-B)	top 10 Percentile	Unconstrained	Equal	3.88	107.24	-5.84	2.24	16.01	6.31	2.54	1.03
HY (BB-B)	top 25 Percentile	Unconstrained	Mkt Val	4.58	96.88	-6.06	2.23	14.80	5.89	2.51	0.80
HY (BB-B)	top 25 Percentile	Constrained	Equal	4.60	96.24	-6.00	2.27	14.72	5.80	2.54	0.80
HY (BB-B)	top 10 Percentile	Constrained	Equal	4.00	93.60	-5.87	2.18	14.41	5.83	2.47	1.02
HY (BB-B)	positive momentum signal	Unconstrained	Equal	3.27	92.41	-5.31	1.97	14.26	4.86	2.94	0.63
HY (BB-B)	top 10 Percentile	Unconstrained	Mkt Val	3.68	91.81	-5.83	2.17	14.19	5.93	2.39	1.05
HY (BB-B)	top 25 Percentile	Constrained	Mkt Val	4.70	87.69	-6.06	2.14	13.69	5.37	2.55	0.80
HY (BB-B)	top 10 Percentile	Constrained	Mkt Val	4.10	86.31	-5.85	2.02	13.52	5.33	2.54	1.02
CLOIE (AAA-B)	top 10 Percentile	Unconstrained	Equal	2.79	82.23	-4.80	1.79	13.00	4.68	2.78	0.90
HY (BB-B)	positive momentum signal	Unconstrained	Mkt Val	3.34	82.06	-5.37	1.90	12.98	4.61	2.81	0.62
CLOIE (AAA-B)	top 25 Percentile	Unconstrained	Equal	2.68	71.65	-3.51	1.43	11.64	3.51	3.32	0.61
CLOIE (AAA-B)	top 10 Percentile	Unconstrained	Mkt Val	2.13	66.89	-4.47	1.56	11.00	3.96	2.78	1.01
CLOIE (AAA-B)	top 25 Percentile	Unconstrained	Mkt Val	2.13	59.50	-3.02	1.20	9.98	2.91	3.43	0.72
IG (AAA-BBB)	top 10 Percentile	Unconstrained	Equal	2.37	48.95	-2.53	1.11	8.46	2.85	2.96	0.93
CLOIE (AAA-B)	top 25 Percentile	Constrained	Equal	3.00	45.78	-2.41	0.97	7.98	2.39	3.35	0.66
IG (AAA-BBB)	top 25 Percentile	Unconstrained	Equal	2.46	45.20	-2.30	0.93	7.89	2.37	3.34	0.63
IG (AAA-BBB)	top 10 Percentile	Unconstrained	Mkt Val	1.94	44.61	-2.23	1.01	7.80	2.54	3.07	1.03
CLOIE (AAA-B)	top 10 Percentile	Constrained	Equal	2.73	43.77	-2.99	1.00	7.68	2.41	3.18	0.88
CLOIE (AAA-B)	positive momentum signal	Unconstrained	Equal	2.94	43.58	-3.43	0.85	7.65	2.00	3.82	0.54
IG (AAA-BBB)	top 25 Percentile	Unconstrained	Mkt Val	2.05	39.71	-2.15	0.83	7.05	2.10	3.35	0.74
IG (AAA-BBB)	top 25 Percentile	Constrained	Equal	2.58	34.16	-1.58	0.67	6.17	1.73	3.56	0.66
IG (AAA-BBB)	positive momentum signal	Unconstrained	Equal	2.68	33.54	-2.07	0.61	6.07	1.51	4.03	0.55
IG (AAA-BBB)	top 10 Percentile	Constrained	Equal	2.35	32.88	-2.15	0.70	5.96	1.80	3.31	0.90
CLOIE (AAA-B)	top 25 Percentile	Constrained	Mkt Val	2.24	24.06	-1.26	0.42	4.49	1.06	4.25	0.67
CLOIE (AAA-B)	top 10 Percentile	Constrained	Mkt Val	2.05	23.11	-1.36	0.45	4.33	1.14	3.79	0.87
CLOIE (AAA-B)	positive momentum signal	Unconstrained	Mkt Val	2.40	23.04	-1.99	0.43	4.31	1.00	4.30	0.59
IG (AAA-BBB)	top 25 Percentile	Constrained	Mkt Val	2.10	21.41	-1.09	0.34	4.03	0.89	4.52	0.68
IG (AAA-BBB)	positive momentum signal	Unconstrained	Mkt Val	2.23	21.07	-1.24	0.33	3.97	0.85	4.70	0.60
IG (AAA-BBB)	top 10 Percentile	Constrained	Mkt Val	1.92	20.83	-1.10	0.36	3.93	0.94	4.19	0.89

Source: J.P. Morgan. As of May 9th, 2019.

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Appendix B: CLO Weekly Updates

Exhibit 1: Global CLO spreads & recommendations (bp)

Sector	Current WAL (yrs)	Current Spread	Change vs 05/03	Change YTD	Rec*	Sector	Current WAL (yrs)	Current Spread	Change vs 05/03	Change YTD	Rec*
US 3.0						**EUR 2.0**					
AAA	4.0-5.5	123	0	(17)	N	AAA	4-5	98	0	(28)	N
AA	5.5-7.0	180	0	(30)	N	AA	6-7	153	0	(33)	N
A	6.5-8.0	230	0	(75)	N	A	6-7	220	0	(15)	N
BBB	7.0-8.5	325	0	(85)	N	BBB	6-7	313	0	(50)	N
BB	7.5-9.0	645	(5)	(130)	N	BB	7-8	550	0	(100)	N
B	8.0-9.5	950	(5)	(50)	N	B	7-8	800	(63)	(50)	N
US New Issue						**EUR New Issue**					
AAA	5-6	132-149	(1)	**4**	N	AAA	5-6	111	0	**9**	N
AA	6-8	185-215	0	(10)	N	AA	7-8	185	**3**	(5)	N
A	6-9	255-310	**5**	(28)	N	A	7-8	270	0	**15**	N
BBB	7-9	365-415	**3**	(18)	N	BBB	7-8	390	0	**20**	N
BB	7-9	675-750	0	(50)	N	BB	8-9	650	(10)	(25)	N
B	7-9	850-950	0	(200)	N	B	8-9	953	0	**78**	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 AAA-Single-A do 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 ($bn)	Total	87.28	131.46	109.59	113.47	284.73	277.62	98.45	61.37	-38%
	New	86.08	124.10	99.07	72.42	118.07	129.68	45.85	46.78	2%
	Refinance/Reset/Re-Issue	1.20	7.35	10.53	41.05	166.66	147.94	52.60	14.59	-72%
Euro Issuance (€bn)	Total	7.77	14.49	13.86	21.00	45.10	42.89	15.92	11.75	-26%
	New	7.77	14.49	13.56	16.78	19.12	26.95	9.15	10.23	12%
	Refinance/Reset/Re-Issue	0.00	0.00	0.31	4.21	25.98	15.94	6.77	1.52	-78%
Global Issuance ($bn)	Total	97.61	150.57	124.95	136.51	335.81	328.23	117.90	74.60	-37%
	New	96.42	143.21	114.07	90.97	139.81	161.47	57.08	58.35	2%
	Refinance/Reset/Re-Issue	1.20	7.35	10.87	45.54	196.00	166.76	60.83	16.25	-73%

Source: J.P. Morgan.

Exhibit 3: Rolling 12 weeks Global CLO New Issuance
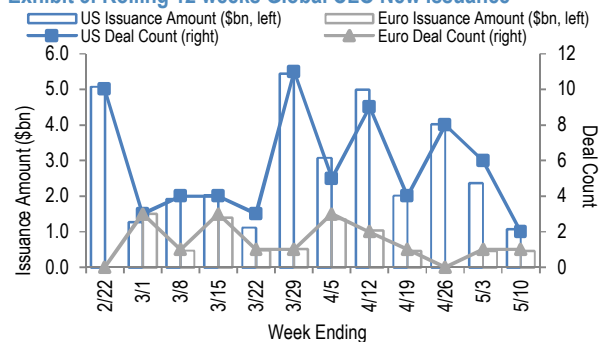
Source: J.P. Morgan. Data excludes refinanced, reset, re-issued and repriced CLOs.

Exhibit 4: Rolling one year Global CLO New Issuance
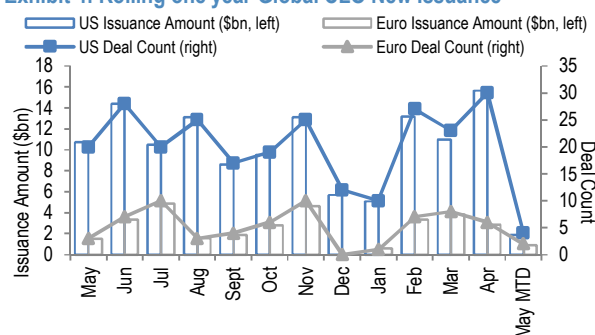
Source: J.P. Morgan. Data excludes refinanced, reset, re-issued and repriced CLOs.

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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	186	(3)	(27)	35
AAA	124	(1)	(22)	25
AA	181	(3)	(25)	27
A	244	(6)	(38)	55
BBB	337	(16)	(69)	45
BB	659	(13)	(69)	142
B	917	(12)	(21)	176
Pre-Crisis CLOIE	237	17	43	79
AAA	0	(54)	(53)	(54)
AA	77	(13)	(27)	(1)
A	95	(10)	(16)	(16)
BBB	223	(0)	8	20
BB	406	1	7	22
Post-Crisis CLOIE	186	(3)	(27)	35
AAA	124	(1)	(22)	25
AA	181	(3)	(25)	27
A	244	(6)	(38)	54
BBB	337	(16)	(70)	44
BB	660	(14)	(69)	142
B	917	(12)	(21)	176

Portfolio Discount Margin	Current	1m Δ	YTD Δ	1yr Δ
Total CLOIE	209	(4)	(22)	19
AAA	127	(2)	(19)	25
AA	182	(3)	(25)	28
A	244	(5)	(41)	50
BBB	338	(16)	(69)	49
BB	663	(14)	(71)	103
B	922	(12)	(19)	170
Pre-Crisis CLOIE	252	0	16	56
AAA	0	(54)	(54)	(55)
AA	80	(2)	(17)	(3)
A	95	3	1	(8)
BBB	236	1	15	32
BB	397	1	6	10
Post-Crisis CLOIE	209	(4)	(22)	19
AAA	127	(2)	(19)	25
AA	182	(3)	(25)	28
A	244	(5)	(41)	49
BBB	338	(16)	(69)	48
BB	663	(15)	(71)	102
B	922	(12)	(19)	170

Source: J.P. Morgan.

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

Total Returns (%)	MTD	QTD	YTD2019	YTD2018
Total CLOIE	0.18%	0.70%	2.96%	0.93%
AAA	0.12%	0.53%	2.19%	0.81%
AA	0.12%	0.66%	3.01%	0.86%
A	0.19%	0.86%	4.09%	0.97%
BBB	0.47%	1.40%	6.10%	0.94%
BB	0.78%	1.94%	7.62%	2.27%
B	0.39%	2.08%	5.88%	2.96%
Pre-Crisis CLOIE	0.13%	0.34%	1.53%	1.05%
AAA	0.00%	0.14%	0.94%	0.76%
AA	0.10%	0.16%	1.21%	0.62%
A	0.09%	(0.03%)	0.87%	0.89%
BBB	0.12%	0.41%	1.54%	1.17%
BB	0.18%	0.57%	2.26%	2.33%
Post-Crisis CLOIE	0.18%	0.70%	2.96%	0.93%
AAA	0.12%	0.53%	2.19%	0.81%
AA	0.12%	0.66%	3.02%	0.86%
A	0.19%	0.86%	4.10%	0.97%
BBB	0.47%	1.40%	6.12%	0.93%
BB	0.78%	1.95%	7.65%	2.27%
B	0.39%	2.08%	5.88%	2.96%

	Simple Avg. Yield	Portfolio Yield	Coupon	Margin (bps)
Total CLOIE	4.26%	4.45%	4.32%	172
AAA	3.63%	3.60%	3.76%	116
AA	4.18%	4.18%	4.27%	167
A	4.86%	4.82%	4.82%	222
BBB	5.85%	5.79%	5.83%	323
BB	9.06%	9.09%	8.57%	597
B	11.69%	11.75%	10.00%	740
Pre-Crisis CLOIE	4.87%	5.00%	4.60%	202
AAA	0.00%	0.00%	0.00%	0
AA	3.30%	3.32%	2.94%	35
A	3.38%	3.38%	3.29%	70
BBB	4.75%	4.84%	4.25%	167
BB	6.56%	6.45%	6.51%	393
Post-Crisis CLOIE	4.26%	4.45%	4.32%	172
AAA	3.63%	3.60%	3.76%	116
AA	4.18%	4.18%	4.27%	167
A	4.86%	4.82%	4.82%	222
BBB	5.85%	5.80%	5.84%	324
BB	9.07%	9.10%	8.58%	598
B	11.69%	11.75%	10.00%	740

Source: J.P. Morgan.

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