CDX Tranches in bond portfolios

Comparing the returns and risks of CDX tranches to Bond markets highlights a compelling opportunity

- We believe that outright (i.e. not-delta hedged) positions in CDX index tranches have a place in cash portfolios due to significantly higher spreads and low default exposure (outside of equity tranches).
- Historically (since 2008 when they began trading) there has not been a credit loss in a HG or HY CDX tranche outside of Equity, including over the GFC period.
- A key pushback against mezzanine tranches is their higher return volatility compared to similar maturity bond portfolios. This higher volatility comes with significantly higher spreads and return potential, however.
- Investors are regularly choosing longer duration and/or lower credit quality exposures to increase spreads/yields in the current environment. Choosing to accept higher volatility for higher returns is another way to adapt to today's low yields.
- In periods when markets are weak and mezzanine tranches have underperformed cash portfolios, the tranche returns have historically quickly rebounded. This is due to the tranches' higher carry, slide and roll down.
- In this note, we review the historical returns and the volatility of returns for HG and HY tranches outright (excluding equity tranches) compared with bond portfolios of similar maturity.
- We also compare CDX tranches to CLOs. HY Super Senior returns have been the best match to AAA CLOs, and HY Senior mezzanine tranches have best matched CLO BBBs. These tranches are logical hedging instruments to CLOs.
- Tranche trading volumes have grown 8% over past year (mid-2019 vs 2018) and 87% over the past two years (mid-2019 vs 2017). The majority is still delta-hedged activity but outright positions from asset managers are growing and we believe will continue to increase.

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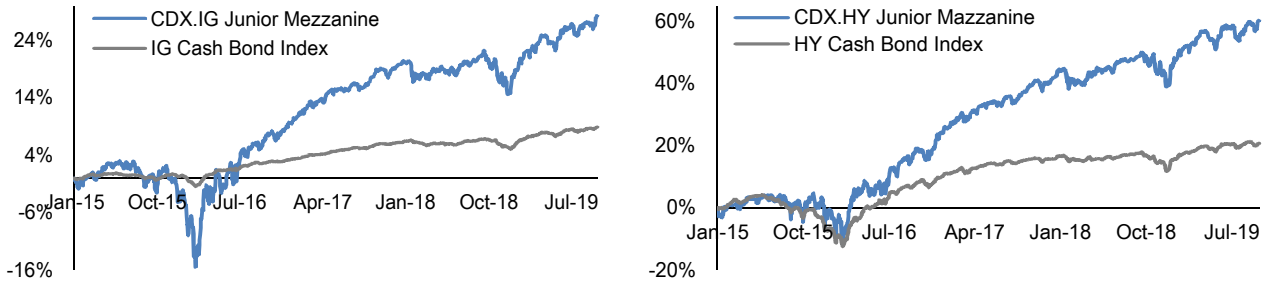
Cumulative excess returns of IG and HY Junior Mezzanine tranches versus Cash Bonds highlights the strong outperformance of tranches over past 5 years



Source: J.P. Morgan

See page 19 for analyst certification and important disclosures.

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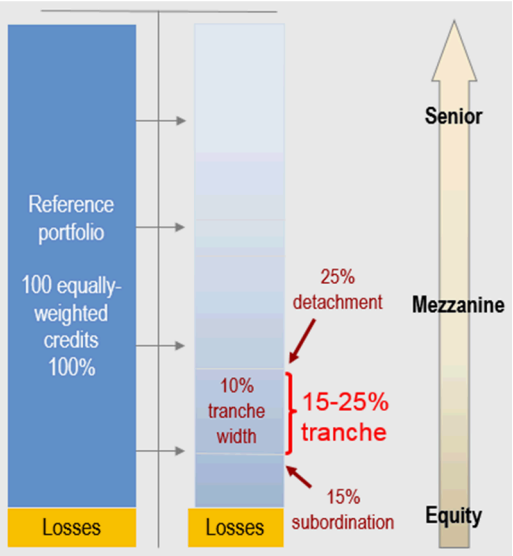
In a mutual fund all investors share in the gains and losses of the assets in the fund or portfolio equally – hence the name "Mutual" fund. In a Tranche structure this is not the case – gains and losses are not shared equally. Some investors, called the equity investors, agree to take the risk of all the losses in the portfolio up to a certain level. In the case of CDX.IG tranches the 'equity' portion is 0-3%, i.e. the first 3% of portfolio losses will be borne by the equity investor. As an example, if the portfolio experiences losses of 1.5%, then the equity investors will have lost ½ of their investment (excluding coupons). The spread that investors in equity tranches earn is high, as any loss in the portfolio is likely to cause a significant impairment to their initial investment. The tranche above equity is called the Junior Mezzanine tranche. For CDX.IG this is the 3-7% tranche. In the example above, if the CDX.IG portfolio has 1.5% of losses, then the junior mezzanine tranche has had no losses, as the portfolio losses have not reached the 3% "lower attachment point" of the tranche. If instead the portfolio experiences 5% losses, then the equity investor will have lost all her investment (as portfolio losses exceed 3%) and the junior mezzanine investor will have lost ½ of her position as well (5% is halfway between the 3% lower attachment point and 7% upper attachment point of the tranche). Note that losses in a CDX portfolio are calculated as defaults less recovery. For example, if there are two defaults in the CDX.IG portfolio over its 5yr life, and each one has a recovery rate of 40%, then the total loss is 60% x 2 losses equals 1.2%. The tranche above Junior Mezzanine is called Senior Mezzanine. Its attachment points for CDX.IG are 7-15%, and then Super Senior is the least risky tranche, which absorbs losses above 15%. In CDX.HY the equity tranche is 0-15%, Junior Mezzanine is 15%-25%, Senior Mezzanine is 25%-35% and Super Senior is 35%-100%. The following exhibit presents an illustration of a tranche structure.

Exhibit 1: The capital structure



Source: J.P. Morgan

We believe that outright (i.e. not-delta hedged) positions in CDX index tranches have a place in cash portfolios due to significantly higher spreads and low default exposure, outside of equity tranches. This is an underappreciated opportunity, in our view. As spreads and yields continue to narrow with loose monetary policy and QE globally, the search for spread and yield is likely to stay strong. Tranches of CDX index provide significant spread pickup over bond positions and, while past performance is not necessarily indicative of future returns,

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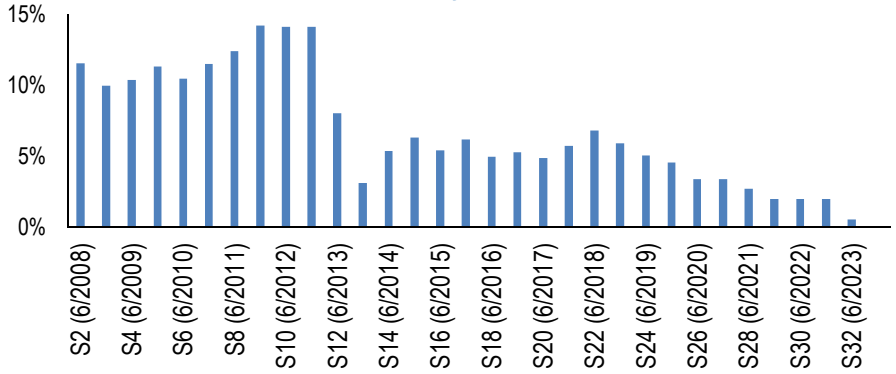
historical data shows very low (actually zero) actual losses in any tranche above equity. The key negative is significant return volatility, especially in junior mezzanine tranches. Over the past few years investors have often stretched their duration and credit rating targets to improve the spread and yields at which they invest. Taking on more return volatility in exchange for higher returns is another variable at investors' disposal to adapt to the low yield environment that exists in the US and globally. CDX tranches have received less focus from asset managers compared with positions in CLOs in recent years, yet the basic structure of the products are similar. We believe both bond investors and CLO investors will increasingly see the value in outright CDX tranche positions over time.

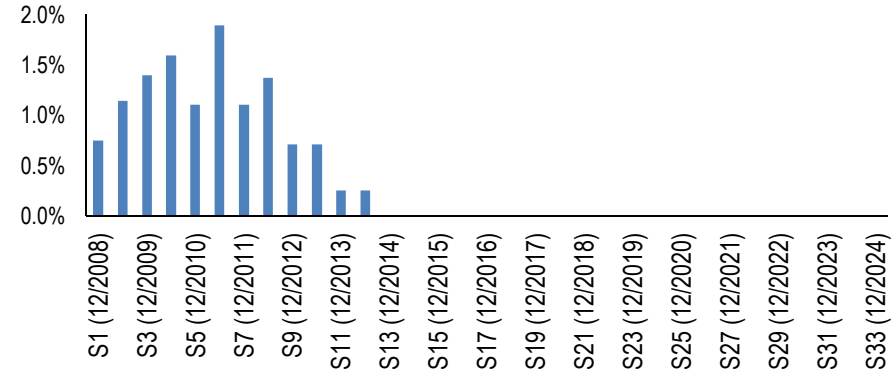
Historically (since 2008 when they began trading) there has not been a loss in a HG or HY CDX tranche outside of Equity, yet tranches above equity still pay a significant spread premium over outright cash positions. This historical period includes the Financial crisis and the significant stress and defaults experience that accompanied it. The maximum loss in any HG series since 2009 was 1.9% for the S6 series (03/20/2006-06/20/2011) and in HY it was 14.21% in the S9 Series (09/27/2007-12/20/2012). HG Equity tranches absorb losses up to 3% and HY Equity tranches up to 15%. With historical losses not having exceeded these thresholds, there have not been losses above the equity tranche. The following exhibits present the historical realized loss for CDX.IG and CDX.HY indices by series.

Exhibit 2: Historical realized loss for CDX.HY (5-yr) series



Source: J.P. Morgan Note: Maturity dates are in parentheses

Exhibit 3: Historical realized loss for CDX.IG (5-yr) series



Source: J.P. Morgan Note: Maturity dates are in parentheses

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Our focus in this note is unhedged mezzanine tranches in both HG and HY, as they provide significant spread pickup to cash markets, without having experienced losses. The average annual return of junior mezzanine HG tranches over the past 5 years has been 6%. This is 3.3 times the average annual excess return of similar maturity HG bonds. Junior Mezzanine HY tranches have had an average annual return of 12% over the past 5 years, compared with 4% annual excess return for similar maturity HY bonds.

A key pushback against mezzanine Tranches is the higher return volatility compared to similar maturity bond portfolios. This is true – they are higher beta products. IG junior mezzanine tranches have provided 3.6 times the average daily return of cash bonds over the last 3 years, with daily return volatility 6.4 times greater (so a worse Sharpe ratio). For HY junior mezzanine tranches average daily returns have been 3.4 times that of bonds, with 3.5 times daily return volatility over the past 3 years. However, we show that over a rolling 3-month period, junior mezzanine tranches have outperformed bonds 71% of the time for HG and 84% of the time for HY since 2015. Over a 6m period the outperformance percentages rise to 74% and 96% for HG and HY respectively. The higher carry and faster roll down of Tranches has, historically, quickly reversed tranche underperformance versus bond positions.

CDX tranches and CLOs are both tranches of credit portfolios, but there are significant differences in structure. Both CLO and CDX.HY tranches are actively traded markets and both products have exposure to risky corporate credits, so a comparison is logical. However, there are many differences between the two products which make their risk/return profiles different. CLO tranches are managed with reinvestment periods (usually) while CDX tranches are static portfolios. CLOs reference portfolios of actual loans which are callable while CDX tranches reference fixed maturity CDS on bonds. CDX tranches pay fixed coupons while CLOs pay floating rate coupons. The risk roll down in CDX.HY tranches is faster than roll down in CLO tranches, because of the re-investment period for the CLO tranches. CLOs are less actively traded than CDX tranches, so it is more difficult to model the volatility of returns when holding them. Still, a review of the return profile of the CLOs and CDX tranches shows some similarities, which makes tranches good hedging candidates for the less liquid CLO positions. These comparisons are reviewed below.

CDX Tranche trading volumes are growing and we believe this will continue. CDX tranche trading volumes have been growing quickly. CDX tranches have traded an average of $0.3bn/day in 2019. This compares to $24.4bn of HG bonds, $12.4bn of HY bonds, and $47.1bn of CDX outright (HG + HY) and $10.8bn of CDX options. The following exhibit presents the y/y percentage growth of average daily volumes since 2016 until mid-year 2019.

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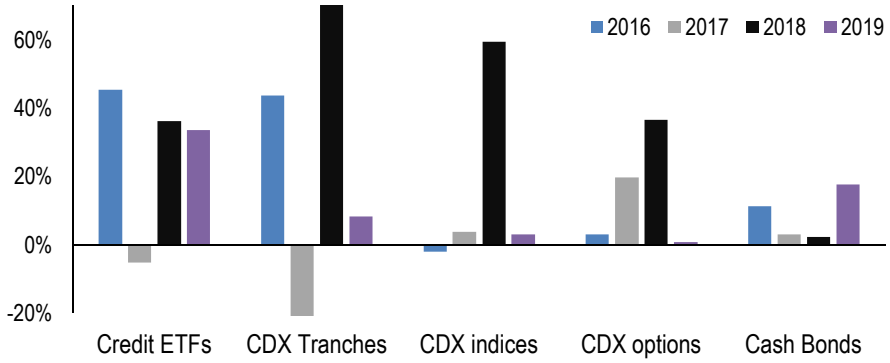
Exhibit 4: Y/Y percentage growth of average daily volumes of Credit ETFs, CDX tranches, CDX indices, CDX options and cash bonds (2016 to mid-2019)



Source: J.P. Morgan. Note that Series 9 of CDX tranches is excluded because volumes in Series 9 were unusually high in 2015 and 2016 and it distorts the historical comparison

The structure of this note is to compare the historical performance and volatility of returns of HG and HY CDX tranches versus the JULI (3-5yr HG) and the JPM HY bond index (4-7yr). We exclude equity tranches from the analysis. When analyzing historical tranche data above the equity tranche there have been no losses in the sample, and CDX tranches are not rated, so historical default or ratings comparisons are not logical. Instead, our approach is to compare returns and return volatility of the tranches to other credit products. The bond returns and volatility used for the analysis are based on excess returns (i.e. excluding the UST portion) to be comparable to CDX tranche returns and volatility which are unfunded positions.

The summary of the analysis is that the returns of CDX tranches, particularly junior mezzanine, have historically been significantly higher than in bonds, and the volatility of these returns has been significantly higher as well. Investors over the past couple of years of low yields and spreads have often been in a position to stretch their duration and credit rating thresholds to increase spreads and yields. Tranches offer an opportunity to pick up significant yield and spread vs bonds without taking more default risk (based on historical patterns) and not taking direct leverage. We also compare the performance of CDX.HY tranches with that of CLO tranches.

In order to carry out the analysis, we use the daily return data. The equity tranche is left out from the performance comparison analysis against cash indices because of the high exposure to default risk as well as historical realized losses. The following section provides a discussion on HG and HY CDX tranche performance.

CDX IG Tranches compared to IG Bonds

Junior Mezzanine tranches (3-7%) have shown superior performance compared to the JULI (3-5yr) Index except during distressed time periods. The higher return of the junior mezzanine tranche comes with the price of higher volatility of returns. Meanwhile, senior mezzanine tranche (7-15%) performance usually has been similar to that of the JULI (3-5yr) Index. Super senior tranche offered the lowest return due to the fact that this tranche carries the lowest risk among tranches.

From 2014 until now the cumulative total return of the junior mezzanine tranche has been 33% while for 3-5yr HG bonds it has been 10%. Over this 6-

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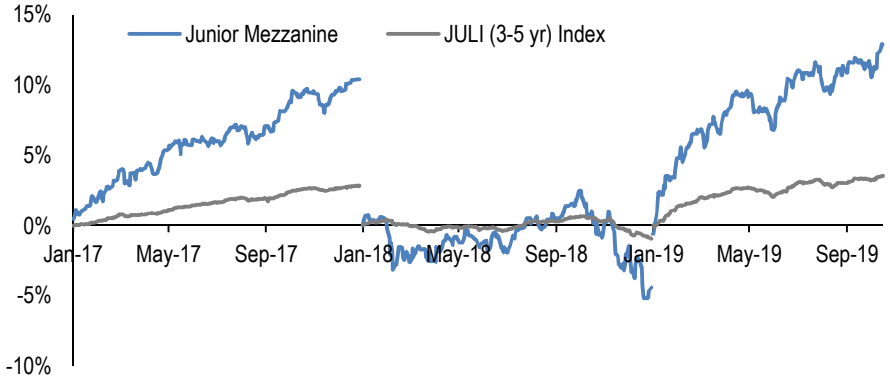
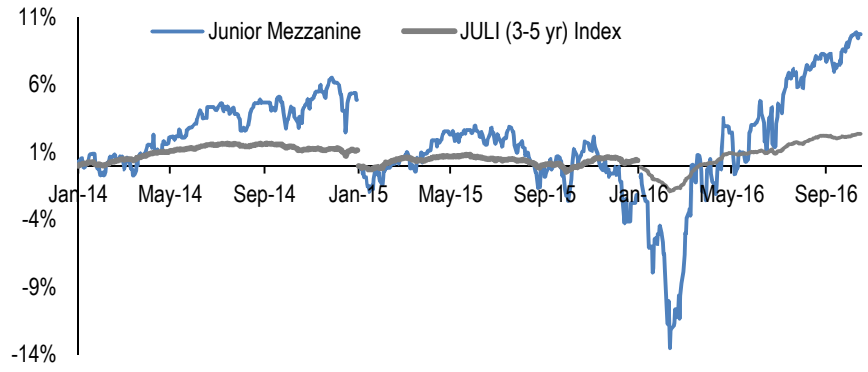
year period the tranche outperformed strongly in four years, underperformed strongly in 2018 and underperformed modestly in 2015. The following exhibits show the annual cumulative return for the CDX.IG junior mezzanine tranche as well as annual cumulative excess return for JULI (3-5yr) index since 2014. It should be mentioned that the returns of the on-the-run tranches are used to have a fair comparison against the JULI (3-5yr) index, according to the fact that index gets rebalanced on a monthly basis and its duration does not decay over time. We are comparing excess bond returns to tranche returns, as the tranches are not funded positions.

Exhibit 5: 2017-2019 Annual Cumulative return of the CDX.IG junior mezzanine tranche and JULI (3-5yr) index; junior mezzanine tranche outperformed the index except during 2018 and 2015



Source: J.P. Morgan

Exhibit 6: 2014-2016 Annual Cumulative return of the CDX.IG junior mezzanine tranche and JULI (3-5yr) index; junior mezzanine tranche outperformed the index except during 2018 and 2015



Source: J.P. Morgan

From 2014 until now the cumulative total return of the senior mezzanine tranche has been 13% while for 3-5yr HG bonds it has been 10%. The following exhibits show the annual cumulative return for CDX.IG senior mezzanine and super senior tranches as well as annual cumulative excess return for JULI (3-5 yr) index since 2014.

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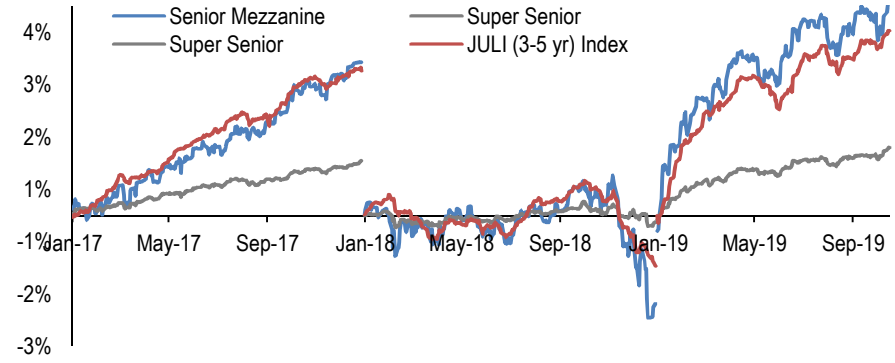
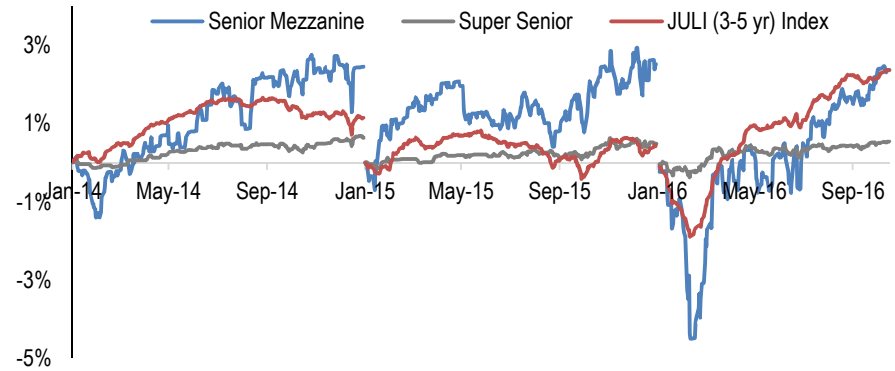
Exhibit 7: 2017-2019 – performance of the CDX.IG senior mezzanine tranche and JULI (3-5yr) index during last few years has been similar



Source: J.P. Morgan

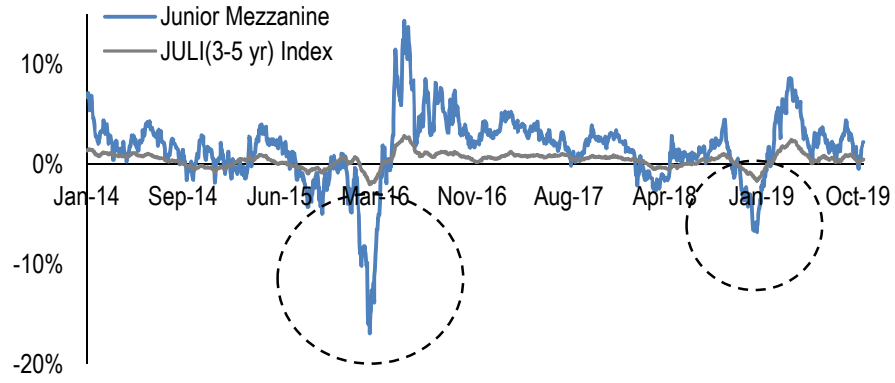
Exhibit 8: 2014-2016 CDX.IG senior mezzanine and super senior tranches performance versus JULI (3-5yr) index; Senior Mezzanine outperformed in 2014-2015



Source: J.P. Morgan

As can be seen in the exhibits above, except in 2018 and 2016, the junior mezzanine tranche consistently outperformed similar maturity HG bonds. This was accompanied by higher volatility during these time periods. The underperformance of the junior mezzanine tranche during stressed time periods can be observed more clearly on a 3-month rolling cumulative return basis as presented in the following exhibit.

Exhibit 9: Rolling 3-month cumulative return of junior mezzanine tranche versus HG bonds



Source: J.P. Morgan

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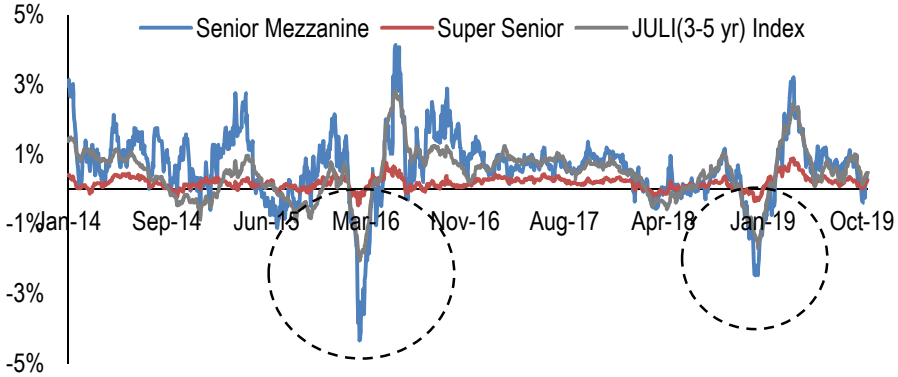
The super senior tranche offered the highest return during the distressed periods, as presented in the following exhibit, but low returns overall.

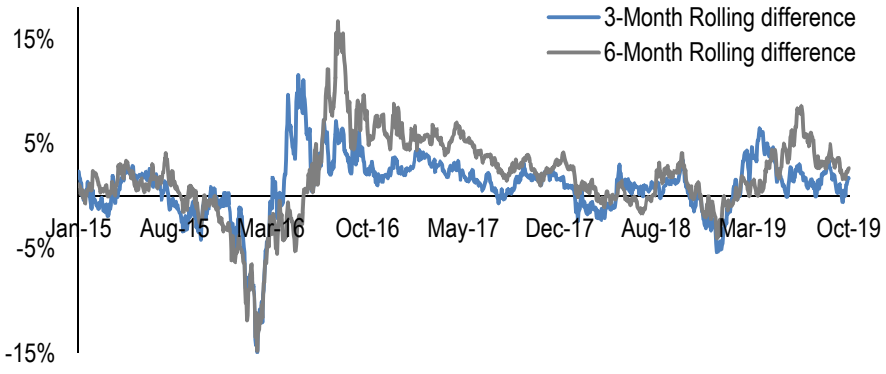
Exhibit 10: Rolling 3-month cumulative return of senior mezzanine and super senior tranches versus the index; super senior outperformed index in distressed periods, with lower overall returns



Source: J.P. Morgan

The time series of difference between the 3-month and 6-month rolling cumulative excess return of CDX.IG junior mezzanine tranche and JULI (3-5yr) index is presented in the following exhibit. It shows significant volatility in the difference in returns. It also shows that the line is usually above zero, i.e. on a 3-month basis junior mezzanine tranches have usually outperformed cash bonds. The 6-month line shows a similar pattern with even fewer periods of tranche underperformance. These rare periods of underperformance have been significant, however. The 3-month line has been above zero 71% of the time since 2015 and the 6-month line has been above 74% of the time.

Exhibit 11: Difference of 3-month and 6-month rolling cumulative returns of junior mezzanine tranche and JULI (3-5yr) index



Source: J.P. Morgan

On a 3-month rolling cumulative basis, junior mezzanine, senior mezzanine and super senior tranches outperformed the JULI (3-5yr) Index 71%, 55% and 31% of the time since 2015. On the same basis, junior mezzanine and senior mezzanine tranche returns show 90% and 83% correlation with the cash index, while super senior shows 75% correlation with the cash index during the same time period.

In order to take into account the higher volatility of tranches, we take a closer look at return and risk of tranches in the following tables. The volatility of daily

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returns presented below for YTD, last 3 years (2017-2019) and last 5 years (2015-2019) shows that the junior mezzanine tranche daily returns have been much more dispersed than that of index, while super senior tranche has been the least volatile.

Exhibit 12: Standard deviation of daily excess returns of JULI (3-5yr) index and CDX.IG tranches

Time Window	Junior Mezzanine	Senior Mezzanine	Super Senior	JULI (3-5yr) Index
YTD	0.35%	0.13%	0.03%	0.06%
Last 3 years	0.32%	0.12%	0.03%	0.05%
Last 5 years	0.47%	0.17%	0.04%	0.05%

Source: J.P. Morgan

As mentioned before, higher volatility has been accompanied by higher returns for the junior mezzanine tranche. As shown in the table below, the average daily returns of the junior mezzanine tranche have been highest among the tranches as well as against the index, while senior mezzanine and index have had similar returns. For example, YTD, the volatility of daily returns of junior mezzanine tranche has been 5.6 times that of the index, while average daily return of the tranche has been 3.7 times the excess return of the index. During the same time period, senior mezzanine and super senior tranches offered 1.2 and 0.4 times average daily return respectively, while they have been 2 and 0.5 times more volatile than the index.

Exhibit 13: Average of daily excess returns of JULI (3-5yr) index and CDX.IG tranches

Time Window	Junior Mezzanine	Senior Mezzanine	Super Senior	JULI (3-5yr) Index
YTD	0.064%	0.020%	0.006%	0.017%
Last 3 years	0.027%	0.008%	0.003%	0.007%
Last 5 years	0.023%	0.009%	0.003%	0.007%

Source: J.P. Morgan

Sharpe ratios, presented below, summarize the risk and return tradeoff of tranches. As can be seen, the super senior tranche outperformed other tranches in spite of lower returns, while junior mezzanine and senior mezzanine tranches look more attractive from the absolute return standpoint.

Exhibit 14: Sharpe ratios (annualized)

Time Window	Junior Mezzanine	Senior Mezzanine	Super Senior	JULI (3-5yr) Index
YTD	2.89	2.55	3.53	4.41
Last 3 years	1.33	1.04	1.77	2.39
Last 5 years	0.79	0.83	1.24	2.15

Source: J.P. Morgan

As mentioned above, one of the advantages of investment in tranches is the strong risk roll down of tranches. This is clearer when looking at the spread difference of on-the-run and off-the-run tranches. With the passage of time a holder of a tranche profits from the spread tightening of tranches in addition to collecting the annual coupon. The following exhibit shows the time series of spreads of CDX.IG junior mezzanine tranches for on-the-run Series 33 (12/20/2024 maturity date) and off-the-run Series 31 (12/20/2023 maturity date), 29 (12/20/2022 maturity date) and 27 (12/20/2021 maturity date).

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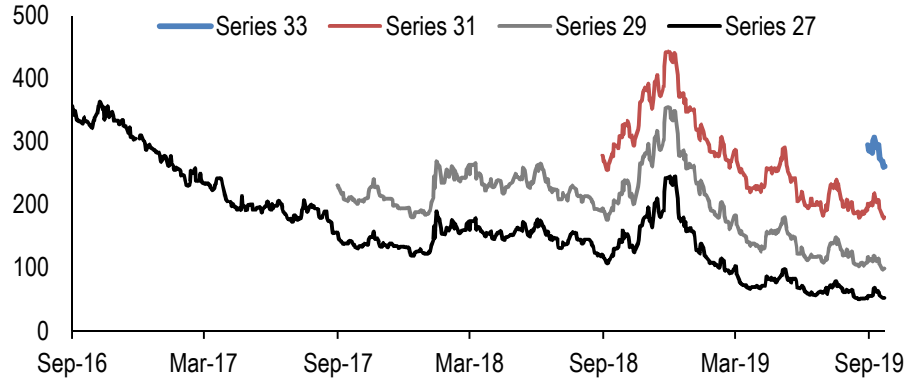
Exhibit 15: Junior Mezzanine tranche roll down contributes to the strong returns



Source: J.P. Morgan

To have a better understanding of the roll down of tranches, we take a closer look at the carry plus roll down value of outright tranches versus the JULI index. Carry of a tranche is the spread and the roll down value is the slide (i.e. change in spread as a result of 1 year passage of time, equivalent to one year less time to maturity) weighted by risky annuity (i.e. value of a 1bp coupon paid on the premium leg of a tranche). The roll down of the index is calculated as index slide multiplied by the modified duration of the index. The following table shows the spread (carry), slide and roll down value for the CDX.IG tranches as well the JULI (3-5yr) Index. The sum of the spread carry and roll down is the time value which is the return one would earn if, after one year, market levels across all the products were unchanged and all that happened was that positions were one year shorter.

Exhibit 16: Carry and roll down of CDX.IG tranches versus the JULI (3-5yr) Index

Tranche	Spread(bp)	Slide(bp)	Roll Down Value(ct)	Time Value
Junior Mezzanine	261	81	397	6.58%
Senior Mezzanine	67	24	121	1.88%
Super Senior	16	7	33	0.49%
JULI(3-5 yr) Index	95	13	51	1.46%

Source: J.P. Morgan

As can be seen, the junior mezzanine tranche offers the highest combined carry and roll down. It is interesting to see that JULI (3-5yr) offers higher spread compared to senior mezzanine tranche (i.e. 95bp versus 67bp); however, the senior mezzanine offers higher roll down value (i.e. 121ct) compared to the index (i.e. 51ct). Also, the contribution of roll down in tranches spreads decreases for riskier tranches. The 81bp slide of the junior mezzanine tranche accounts for 31% of the 261bp spread, while slide accounts for 36% and 41% of the spreads of senior mezzanine and super senior tranches. Meanwhile, the JULI (3-5yr) Index loses 14% of it spread because of one year of less time to maturity.

Our European colleagues wrote about tranche carry and roll down recently in this note (link to note).

CDX HY Tranches compared to HY Bonds

A comparison of annual cumulative excess return of HY Domestic (4-7yr) Index versus the CDX.HY tranches tells the same story as high grade tranches – higher returns with higher volatility. From 2014 until now the cumulative total

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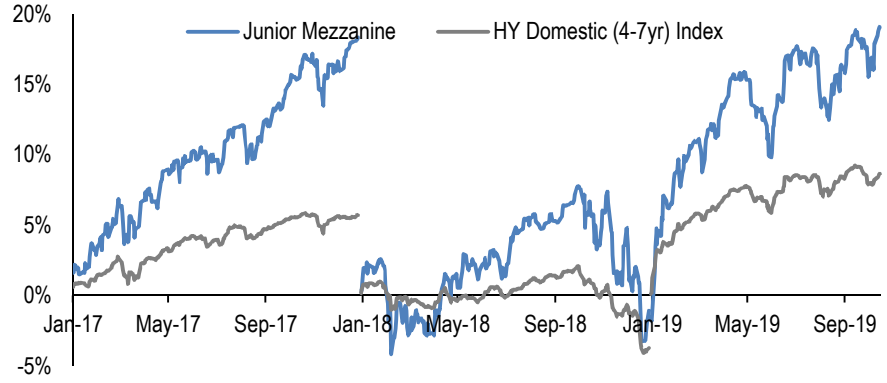
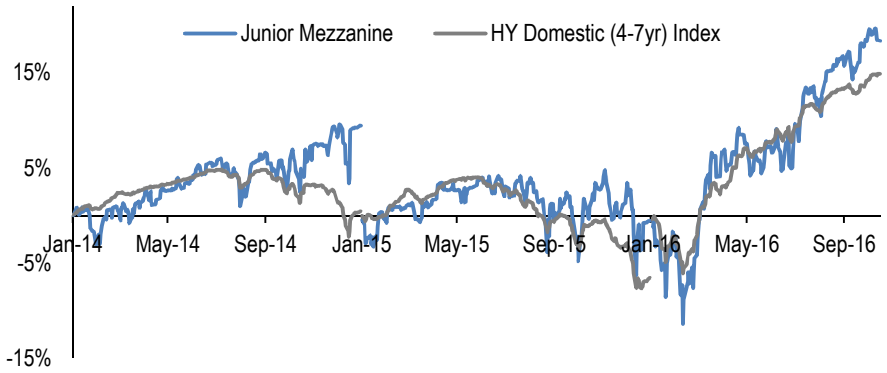
return of the junior mezzanine tranche has been 70% while for 5yr (4-7yr) HY bonds it has been 21%. Over this 6-year period the tranche outperformed the index every year: strongly in four years, and modestly in 2015 and 2018. The following exhibits show the annual cumulative return for CDX.HY mezzanine tranche as well as annual cumulative excess return for the HY Domestic (4-7yr) Index since 2014.

Exhibit 17: Outperformance of junior mezzanine tranche versus the HY Domestic (4-7yr) Index since 2017



Source: J.P. Morgan

Exhibit 18: Outperformance of junior mezzanine tranche versus the HY Domestic (4-7yr) Index



Source: J.P. Morgan

From 2014 until now the cumulative total returns of the senior mezzanine and super senior tranches have been 43% and 18% respectively, while for 5yr (4-7 years) HY bonds it has been 21%. Since 2014, the senior mezzanine tranche (25-35%) usually outperformed the index, however it strongly underperformed the index in 2016. Super senior (35-100%) strongly underperformed the index in 2016, 2017 and YTD 2019. The following exhibits show the annual cumulative return for CDX.HY senior mezzanine and super senior tranches as well as annual cumulative excess return for HY Domestic (4-7yr) Index since 2014.

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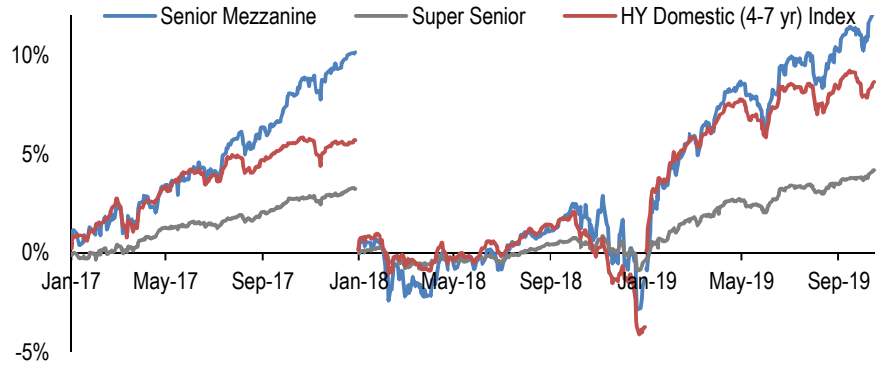
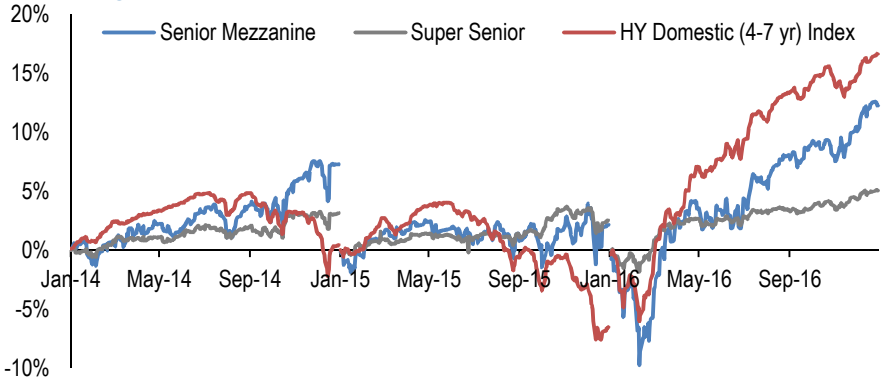
Exhibit 19: Senior mezzanine, super senior and HY Domestic bond index (4-7yr) annual cumulative excess return for the past 3 years



Source: J.P. Morgan

Exhibit 20: Senior mezzanine, super senior and HY Domestic (4-7yr) annual cumulative excess returns during 2014-2017 period



Source: J.P. Morgan

On a 3-month rolling cumulative basis, as presented below, the junior mezzanine tranche outperformed the HY Domestic (4-7yr) cash index most of the time (i.e. 84%) since 2015, while on a 6-month rolling window scale the junior mezzanine outperformed the index 96% of the time. Senior mezzanine and super senior outperformed the HY Domestic (4-7yr) Index 71% and 37% of the time based on a 3-month rolling window. They outperformed the index 83% and 41% of the time (i.e. since 2015) respectively on a 6-month rolling window. The following exhibit presents the 3-month rolling cumulative return of CDX.HY tranches and excess return of HY Domestic (4-7yr) Index since 2015. The CDX.HY tranches outperformed the index during the commodities selloff and offered lower returns once the market bounced back.

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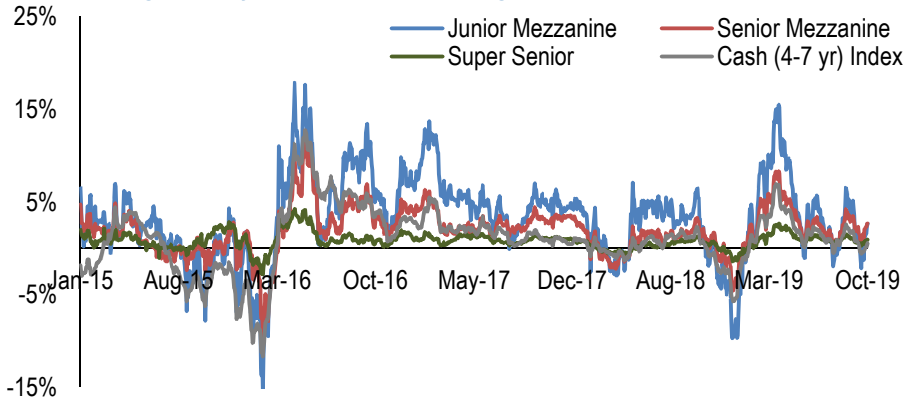
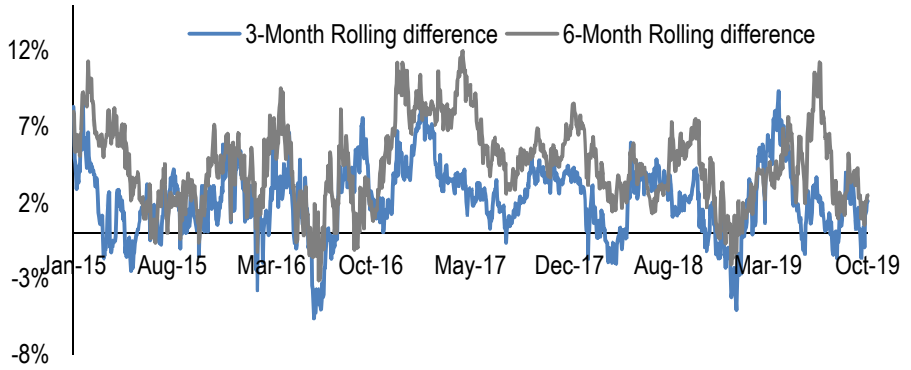
Exhibit 21: 3-month rolling cumulative return of CDX.HY tranches and HY Domestic index since 2015; shows high volatility of the index returns during the commodities selloff



Source: J.P. Morgan

To make it clearer, the following exhibit presents the difference between the 3-month and 6-month rolling cumulative excess return of CDX.HY junior mezzanine tranche and the HY Domestic (4-7yr) index since 2015. The 6-month line is above zero almost all the time, except during distressed time periods.

Exhibit 22: Difference of 3-month and 6-month rolling cumulative return of junior mezzanine tranche and the index since 2015



Source: J.P. Morgan

As mentioned before, the higher historical return of the junior mezzanine tranche has been compensated with higher return volatility. In order to consider volatility and return in the same framework, annualized Sharpe ratios are presented in the following table for different time periods. The Sharpe ratio of the mezzanine tranche calculated using excess returns is 2.24 YTD while it is 3.36 for the index.

Exhibit 23: Shape Ratios (annualized)

Time Window	Junior Mezzanine	Senior Mezzanine	Super Senior	HY (4-7yr) Index
YTD	2.24	2.98	3.02	3.36
Last 3 years	1.34	1.54	1.57	1.37
Last 5 years	1.02	1.11	1.21	1.14

Source: J.P. Morgan

As can be seen in the table above, super senior has been the optimal position to hold among the tranches for last few years from the Sharpe ratio perspective. However,

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for investors looking for yields, junior mezzanine tranches offered the highest average daily return. The average daily excess return of junior mezzanine tranche has been 2.2 times that of the index YTD. Senior mezzanine and super senior tranches offered 1.4 and 0.5 times average daily return versus the index during the same time period.

Exhibit 24: Average return of Mezzanine tranche makes it an attractive option for investors looking for higher yields

Time Window	Junior Mezzanine	Senior Mezzanine	Super Senior	HY (4-7yr) Index
YTD	0.09%	0.06%	0.02%	0.04%
Last 3 years	0.05%	0.03%	0.01%	0.02%
Last 5 years	0.05%	0.03%	0.01%	0.02%

Source: J.P. Morgan

The standard deviation of CDX.HY tranches shows the magnitude of difference of volatilities of tranches returns against the HY Domestic (4-7yr) index. The volatility of daily excess returns of the junior mezzanine, senior mezzanine and super senior tranches have been 3.3, 1.6 and 0.5 times that of the index. The following exhibit presents the standard deviation of daily excess returns for the HY tranches and HY Domestic (4-7yr) for different time periods.

Exhibit 25: Standard deviation of daily return of CDX.HY tranches and HY Domestic (4-7yr) index

Time Window	Junior Mezzanine	Senior Mezzanine	Super Senior	HY (4-7yr) Index
YTD	0.67%	0.32%	0.11%	0.20%
Last 3 years	0.62%	0.31%	0.10%	0.18%
Last 5 years	0.78%	0.42%	0.16%	0.24%

Source: J.P. Morgan

CDX HY Tranches compared to CLOs

Both CLOs and CDX.HY tranches are tranched exposures to HY issuers, so a comparison is logical. However, there are many differences between the two products which make their risk/return profiles different. CLO tranches are managed with reinvestment periods (usually) while CDX tranches are static portfolios. CLOs reference portfolios of actual loans which are callable while CDX tranches reference fixed maturity CDS on bonds. CLOs pay floating rate coupons while CDX tranches pay fixed coupons. The risk roll down in CDX.HY tranches is faster than roll down in CLO tranches, because of the re-investment period for the CLO tranches. The risk does not roll down until the end of re-investment period. CLOs are less actively traded than CDX tranches, so it is more difficult to model the volatility of their returns.

The attachment points for CLOs are different from CDX tranches as well. The table below shows the attachment points for CDX HG and HY tranches, and typical attachment points for CLOs. For the CDX tranches these attachment points are standard and fixed, while for CLOs they tend to vary somewhat deal by deal.

In addition, to have a fair comparison of tranches and CLOs with different underlying instruments, we calculated an adjusted CDX.HY tranche structure. In this structure we simply assume that the CDX.HY underlyings are loans instead of bonds. We adjust the attachment points of CDX.HY using the ratio of long-term recoveries of bonds (i.e. 41%) to long-term recoveries of loans (i.e. 66%). For example, to adjust the attachment point of CDX.HY mezzanine tranche, the original

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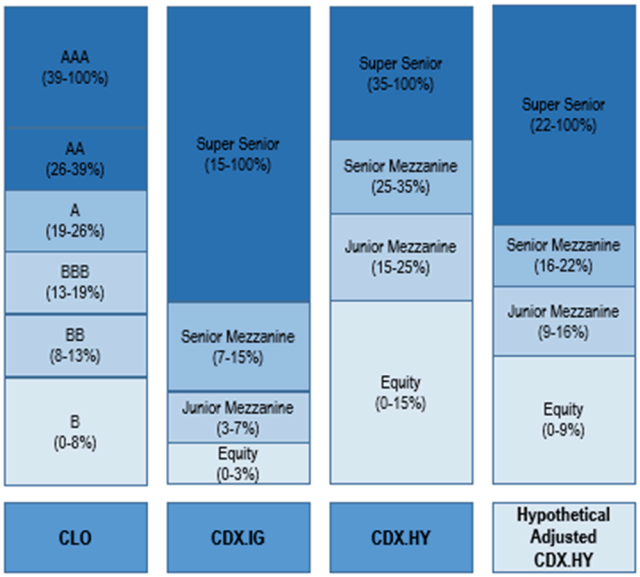
attachment point of 15% is adjusted by the ratio of 41%/66% to have the adjusted attachment point at 9%. Roughly speaking, the adjusted CDX.HY equity, junior mezzanine, senior mezzanine and super senior tranches can be mapped to B rated tranches, combined BB rated and BBB rated tranches, A rated tranches, and combined AA rated and AAA rated tranches in the CLO structure, respectively.

Exhibit 26: CLO, CDX.HY, CDX.IG and adjusted CDX.HY tranche structures



Source: J.P. Morgan

When comparing CLOs to CDX tranches a key question to answer is which CLO tranche is best compared to a specific CDX tranche. CLOs are portfolios of HY loans while CDX IG and HY are portfolios of CDS, so there are differences in their underlying. The attachment points are different as well, as shown in the table above. Also, CLOs are generally more diverse portfolios with on average 450-550 underlying credits, while CDX IG and HY tranches reference 125 and 100 credits, respectively. As mentioned before, CLOs are managed and have reinvestment periods, they have floating coupons, and they are funded products as well. CDX tranches trade actively and exhibit significant MTM volatility. CLOs trade less actively in the secondary market and the historical volatility is much lower. So there are many differences between the two products. In the following section, we present a couple of cases where CLO and CDX tranches have offered similar return profiles over the past few years.

The best comparison to AAA CLO tranches is the HY Super Senior CDX tranche, based on historical performance. YTD AAA CLOs have had excess returns of 4% while HY Super Senior has returned 4%. Average annual returns since 2017 have been 3% for AAA CLOs and 2% for HY Super senior. From 2014 to 2017 return performance was not as similar, with average annual returns for CLO AAA at 2% and HY Super Senior at 4%. The volatility of HY Super senior has been significantly higher, however. The volatility of daily returns has been 5 times higher for HY super senior than for AAA CLOs for 2014-2017 time period. Over the past six years HY super senior has delivered 1.2 times more in cumulative return than our AAA CLO index (18% vs 15%) but with 4.4 times more daily return volatility. As noted above however, CLOs trade less actively in the secondary market, so measuring daily return volatility is difficult.

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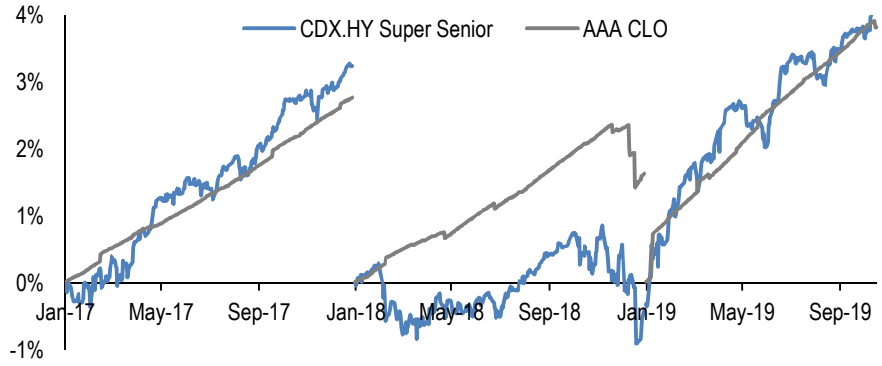
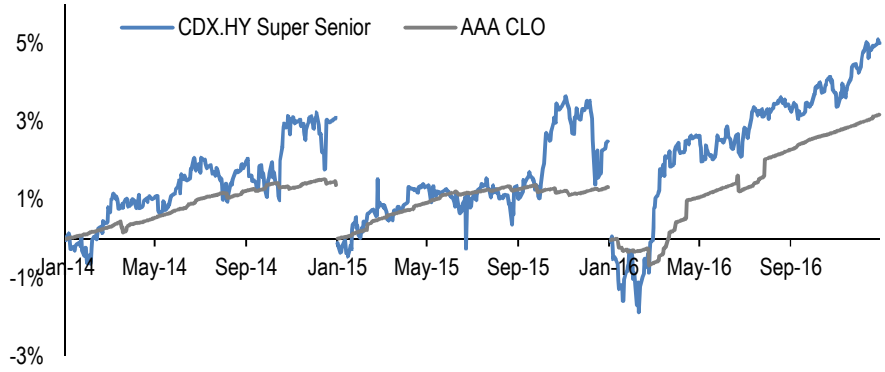
Over the last 6 years, with the exception of 2018, CDX.HY super senior outperformed AAA CLO tranche. In the early 2016, the HY super senior tranche showed worse performance compared to AAA CLO; however, it recovered quickly and outperformed by the end of 2016.The following exhibits show the cumulative annual returns of CDX.HY and CDX.IG super senior tranches as well as the AAA CLO since 2014.

Exhibit 27: Annual Cumulative return of the CDX.HY super senior tranche versus the AAA CLO tranche (2017-2019); HY Super senior outperformed except in 2018



Source: J.P. Morgan

Exhibit 28: Annual Cumulative return of the CDX.HY super senior tranche versus the AAA CLO tranche (2014-2016)



Source: J.P. Morgan

On 3-month rolling cumulative return basis, it is more obvious that CDX.HY Super Senior underperformed AAA CLOS in early 2016 and during recent selloff. The following exhibit shows the 3-month rolling cumulative returns for AAA CLOs and HY super senior tranches since 2015.

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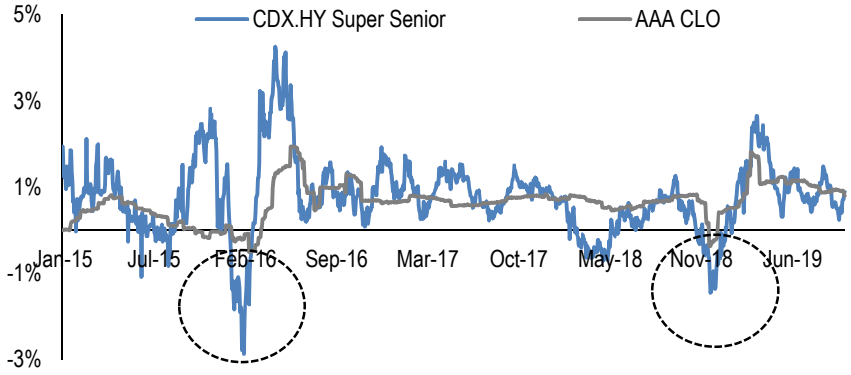
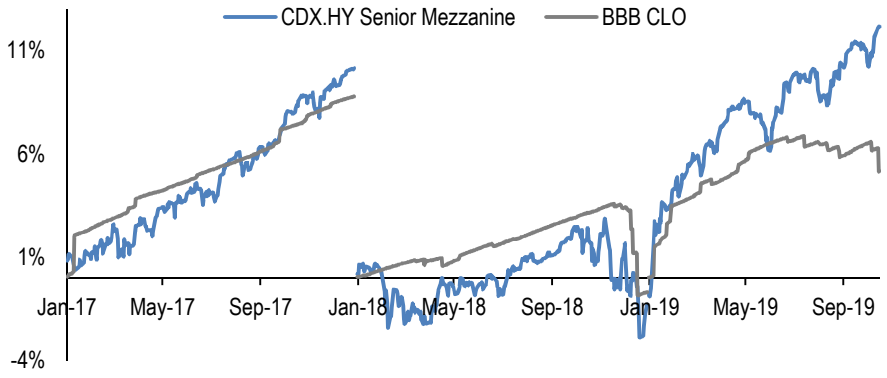
Exhibit 29: 3-month rolling cumulative return of CDX.HY and CDX.IG super senior tranches versus the AAA CLO tranche since 2015



Source: J.P. Morgan

The best comparison to BBB CLOS is the HY Senior Mezzanine CDX tranche, based on historical performance. From 2014 until now the cumulative total return of the HY of senior mezzanine has been 43%, while for BBB CLO it has been 31%. The CDX.HY senior mezzanine tranche and BBB CLOs show close cumulative returns over time. The following exhibits show the annual cumulative return of the BBB CLO and HY senior mezzanine since 2014. The HY senior mezzanine slightly underperformed the BBB CLO in 2018 and 2016, however outperformed in the rest of the years.

Exhibit 30: Annual Cumulative return of the CDX.HY senior mezzanine tranches versus the BBB CLO tranche (2017-2019)



Source: J.P. Morgan

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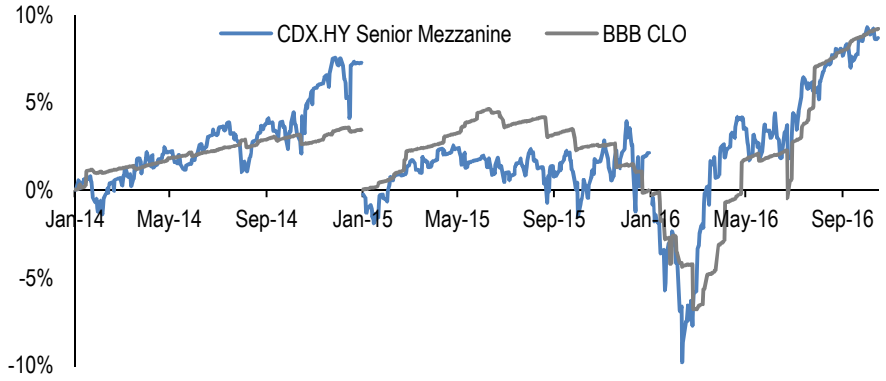
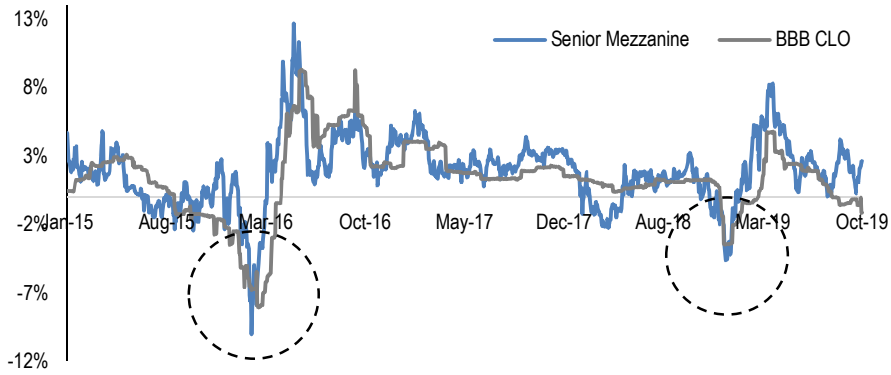
Exhibit 31: Annual Cumulative return of the CDX.HY senior mezzanine tranches versus the BBB CLO tranche (2014-2016)



Source: J.P. Morgan

BBB CLO and senior mezzanine tranches performed similarly during distressed periods of commodities selloff and recent late 2018 market selloff. As can be seen in the rolling 3-month cumulative return in the following exhibit, performance of both tranches dropped with market selloff, almost with the same magnitude since 2015.

Exhibit 32: BBB CLO and senior mezzanine tranches reacted similarly during distressed periods



Source: J.P. Morgan

Because measurable return volatility of CLOs is so much lower than in tranches it is not possible to do an accurate risk/return analysis between tranches and CLOs, as we attempted to do above between tranches and bonds. For CLO investors the historical data suggests which tranches would make good hedging vehicles, and also what the best hedging ratios might be. For investors in CLOs who are already familiar and comfortable with tranched credit products, we believe the additional opportunities offered by CDX tranches are worth exploring.

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