J.P.Morgan

iTraxx Alpha Strategies

Following the returns of standardised credit derivatives in DataQuery

European Credit Derivatives Strategy

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Our *iTraxx Alpha Strategies* track the return from investing in standardised credit products, including:

- **iTraxx Index Returns**
  Selling protection on CDS indices.
- **iTraxx Option Indices (VICI)**
  Selling credit volatility via CDS options and delta hedging.
- **iTraxx Tranches Indices (TRACI)**
  Selling protection on CDS tranches, with or without delta.
- **iTraxx Curve Indices (CURSTI)**
  Steepeners and flatteners on CDS Indices.

These indices track the P&L from systematic long-term strategies based on each of these products. These indices can be used to establish the historical return of credit strategies and to track how relative value trades have performed between different indices and products.

These indices are now available to view and download in *DataQuery*. This piece aims to give a brief introduction to these indices and explains how they are calculated.

Figure 1: Location of iTraxx Alpha Strategies within DataQuery

Source: J.P. Morgan.

See page 15 for analyst certification and important disclosures.

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iTraxx Index Returns

One of the simplest portfolio overlays that can be added to a portfolio using standardised credit products is just to buy or sell protection outright on a CDS index. For example, an investor who was aiming to increase their long risk exposure could sell iTraxx Main protection.

Our *iTraxx Index Return* indices track the performance of selling protection on a continuous basis on the current on-the-run series. At the index roll, the indices automatically switch into the new series. Any costs associated with the roll are ignored.

The daily return from an outright long/short position in a CDS index is relatively straightforward to calculate. The expression for the daily return is shown in Equation 1.

Equation 1: Daily return from selling protection on CDS index.

$$Daily\ Return_t = Dirty\ Price_t - Dirty\ Price_{t-1} + Coupons_t$$

Here the *Dirty Price* refers to the price of a CDS contract expressed in a bond format. For example, if the CDS contract was trading with an upfront of 5% (which the buyer paid to the seller) then the dirty price would be 95.

In keeping with the other strategies discussed in this piece, the daily return is expressed as a percentage of notional.

The *Coupons* term refers to any coupons paid out on that particular date (which will be matched by a corresponding drop in the dirty price as the accrued interest resets to zero).

Handing of default events

These indices take default events into account through any changes in the dirty price. On the day of the auction the return is calculated using the dirty price of Version 1 of the index at the close of the day, as shown in Equation 2. This dirty price will take any default payouts and accrued interest on default into account.

Equation 2: Daily return from selling protection on CDS index on CDS Auction date *t*

$$Daily\ Return_t = Dirty\ Price_t^{V1} - Dirty\ Price_{t-1}^{V1} + Coupons_t$$

From the next day onwards, the daily return is now calculated using the dirty prices of the Version 2 index, as shown in Equation 3.

Equation 3: Daily return from selling protection on CDS index on day following CDS Auction date.

$$Daily\ Return_{t+1} = Dirty\ Price_{t+1}^{V2} - Dirty\ Price_t^{V2} + Coupons_{t+1}$$

At each point in time the P&L is calculated as a % of the remaining index notional outstanding.

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Historical Performance

The historical CDS index returns available in *DataQuery* allow us to ascertain the performance of buying or selling protection on CDS indices since their inception.

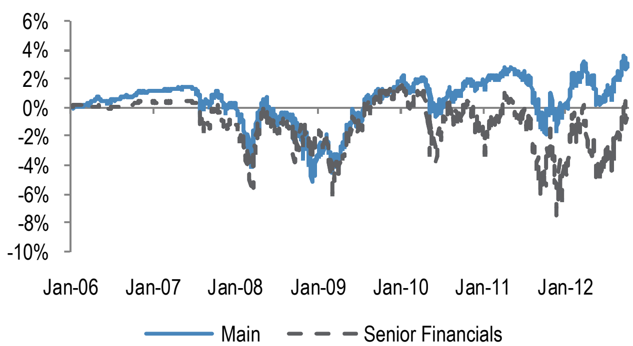
Over the course of the past six years selling protection on iTraxx indices has yielded additional returns to a varying degree of success across different indices. iTraxx Crossover has been the best performer, returning 40.0% since the start of 2006 (an annualised return of 5.9%) which equates to an information ratio of 0.64. The performance of iTraxx Crossover can be seen in Figure 3.

Selling protection on iTraxx Main has returned a small positive return over the past six years (annualised 0.4%) but this return has been quite volatile as shown in Figure 2 and Table 1. However, in strong years long risk strategies on iTraxx Main have returned in the region of 3-5%, proving an attractive bullish overlay if added in the right environment.

A long risk strategy on iTraxx Senior Financials over the past six years is currently flat overall but has seen large volatility over this time period as a result of the financials-based nature of recent crises. The performance of a long risk-strategy on the financials index can be seen in Figure 2.

Figure 2: Historical performance of selling protection on iTraxx Main and Senior Financials indices

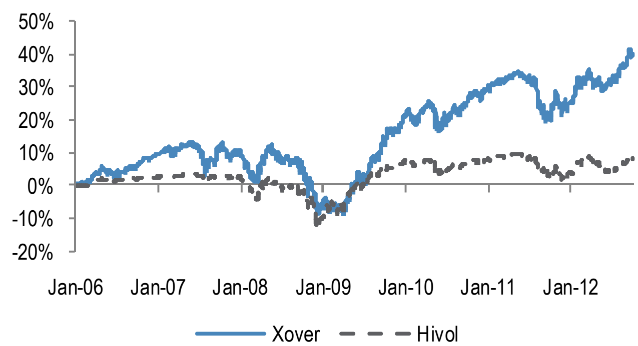
P&L as % of Notional



Source: J.P. Morgan.

Figure 3: Historical performance of selling protection on iTraxx Crossover and Hivol indices

P&L as % of Notional



Source: J.P. Morgan.

Table 1: Annual P&L from selling protection on CDS indices.

P&L as % of Notional. 5y tenor.

Index	2006	2007	2008	2009	2010	2011	2012	Total	Average annual return	Information Ratio
Main	1.1%	-0.8%	-3.6%	5.1%	-0.1%	-1.5%	2.8%	3.0%	0.4%	0.16
Xover	9.4%	1.5%	-16.5%	26.7%	8.3%	-4.3%	14.9%	40.0%	5.9%	0.64
Fin Senior	0.4%	-1.3%	-1.4%	3.6%	-3.3%	-2.2%	3.5%	-0.6%	-0.1%	0.01
Hivol	2.7%	0.1%	-12.4%	17.1%	0.3%	-3.6%	3.9%	8.1%	1.2%	0.26
Non-Fin	1.2%	-0.6%	-5.0%	5.8%	0.2%	-1.8%	2.9%	2.7%	0.4%	0.20
Fin Sub	0.5%	-2.0%	-2.9%	6.9%	-6.9%	-2.8%	9.0%	1.9%	0.3%	0.06

Source: J.P. Morgan.

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iTraxx Option Indices

Volatility In Credit Indices (VICI)

The VICI indices measure the return from selling volatility on iTraxx indices on a rolling basis. The underlying strategy involves selling ATM straddles and delta hedging on a regular basis. The straddles are then either rolled when they expire or when they reach a certain time until their expiration date.

On a day by day basis, the daily return of these indices can be expressed based on the change in option price, the size of the delta hedge and the performance of that delta hedge. This is shown in Equation 4.

Equation 4: Daily return of VICI indices.

$$Daily\ Return_t = Straddle\ Price_{t-1} - Straddle\ Price_t + \ Delta\ Hedge\ \%_{t-1}\ \times Index\ Return_t$$

The *Delta Hedge %* represents the size of the delta hedge being used on each day, ranging from +100% to -100%. The strategies available in *DataQuery* are based either on daily delta hedging or delta hedging whenever the net delta reaches 10, 25 or 50%.

VICI indices in *DataQuery* also cover different expiries, namely:

- 0-1 months   Selling a 1 month straddle and holding to expiry.
- 0-3 months   Selling a 3 month straddle and holding to expiry.
- 3-6 months   Selling a 6 month straddle and rolling 3 months later.

VICI indices are calculated for the following iTraxx indices:

- iTraxx Main
- iTraxx Crossover
- iTraxx Senior Financials

VICI indices in *DataQuery* also include the option to include or exclude bid-offer costs. Both the costs of delta-hedging and option bid-offer are included.

The VICI indices are explored in more detail in *Credit Volatility Indices*, D. White, 30th March 2011.

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Historical Performance

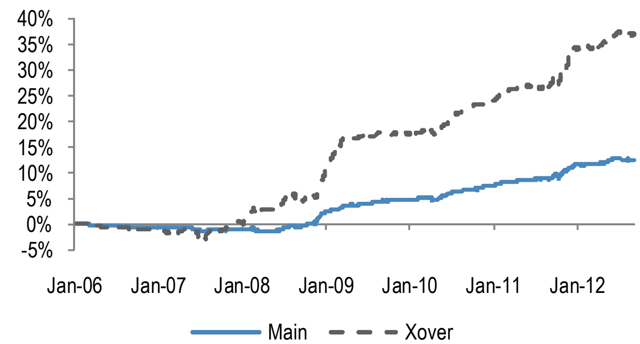
VICI indices allow us to track the historical P&L from buying and selling volatility on a delta neutral basis. In particular, the different expiry lengths covered by these indices allow investors to observe the performance of buying and selling gamma (i.e. short dated volatility) and vega (longer dated volatility).

The performance of selling 1 month volatility and delta hedging daily can be seen in Figure 4. Historically selling short dated volatility has been a very profitable strategy due to the large premium of implied over realised; we have previously highlighted this theme in a number of publications[1].

Selling long-dated volatility has given a less stable return, as shown in Figure 5.

Figure 4: Historical performance of selling 1 month volatility on iTraxx Main and Crossover and delta-hedging daily.

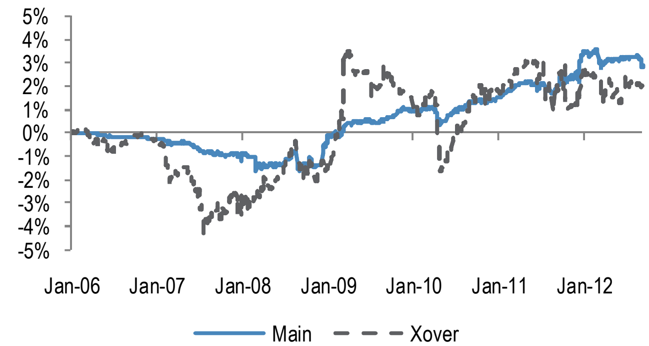
P&L as % of Notional



Source: J.P. Morgan.

Figure 5: Historical performance of selling 6 month volatility on iTraxx Main and Crossover and delta hedging daily.

P&L as % of Notional



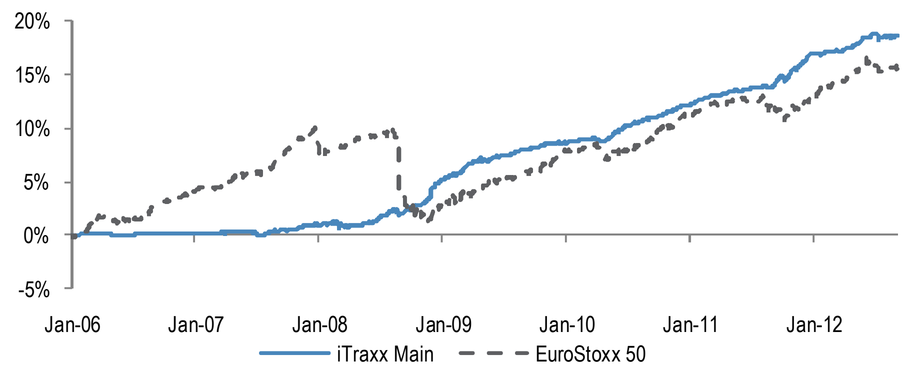
Source: J.P. Morgan.

Volatility trading across asset classes

The VICI indices also allow us to compare the profitability of buying and selling volatility in credit to other asset classes. For example, Figure 6 compares the return from selling volatility on iTraxx Main and on the EuroStoxx 50. Both strategies have performed well, but short vol strategies on iTraxx have a much smaller drawdown during periods of very high volatility.

Figure 6: Comparison of P&L from selling volatility on iTraxx Main and selling volatility on EuroStoxx 50

P&L as % of Notional. 1 Month Straddles. Bid-offer costs not included.



Source: J.P. Morgan.

[1] *Credit Volatility Indices*, 30th March 2011 and *CD Player*, 27th September 2012.

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iTraxx Tranche Indices

TRAnched Credit Indices (TRACI)

J.P. Morgan clients will now be able to access tranche daily returns on *DataQuery*. Using historical data since March-2005, we have created tranche return indices covering all the traded series, tenors and tranches.

In particular, *DataQuery* provides, for a given series/tenor/tranche, daily returns and return indices on:

- **Delta-hedged tranche trades**, where the index delta is rebalanced daily or when it changes by 10, 25 and 50% respectively. The ability to include the bid-ask costs on the delta rebalancing is also included.
- **Outright long risk tranches**.
- **Outright long risk index**, which allows investors to compare tranche returns (outright or delta-hedged) with index returns for the same series and tenor.

The returns are available as a % of both the tranche notional and the index notional (by dividing the tranche daily return by its previous day's delta). When analysing outright tranche returns vs. index returns, expressing tranche returns as a % of index notional allows us to compare the returns of two positions with similar exposure to index spread movements. The return index series is computed by adding the daily returns over the specified period of time.

The daily mark-to-market of a delta-hedged tranche position can be expressed as the sum of the tranche and delta-hedge mark-to-markets, the values of which are shown in Equation 5 and Equation 6.

Equation 5: Tranche MTM (long risk)

$$T_{MtM} = \left(UF_0^T \cdot F_0^T - UF_1^T \cdot F_1^T\right) + \left(C_0^T \cdot F_0^T \cdot days_{0-1} / 360\right) + \left(C_0^T \cdot F_0^T - C_1^T \cdot F_1^T\right) \cdot RA_1^T$$

where T stands for tranche, UF for upfront, F for factor, C for coupon, RA for risky annuity, 0 and 1 for day 0 and day 1 and $days_{0-1}$ for the number of calendar days between the two business days.

Equation 6: Ref MTM (long risk)

$$R_{MtM} = \left(UF_0^R \cdot F_0^I - UF_1^R \cdot F_1^I\right) + \left(C_0^I \cdot F_0^I \cdot days_{0-1} / 360\right)$$

where R stands for *Ref*, I for index, UF for upfront, F for factor, C for coupon, 0 and 1 for day 0 and day 1 and $days_{0-1}$ for the number of calendar days between the two business days.

We include a much more detailed explanation of the tranche return calculations in the *Appendix*.

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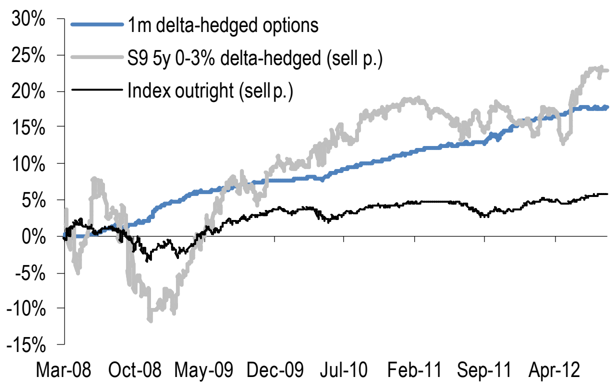
Historical Performance

Historical returns of selling Jun-13 S9 equity protection

On a delta-hedged basis, the returns of selling equity protection are comparable in magnitude to (although more volatile than) the returns of selling short dated Main volatility, as Figure 7 shows. Figure 8 shows the return of an outright Jun-13 equity long vs. an outright Jun-13 index long; in order for both series to be comparable, we adjust the higher leverage of the equity tranche by dividing its returns by the tranche delta. The equity tranche has generated higher returns than the index by taking more exposure to the index first loss risk (and less to the index "senior or systemic" risk).

Figure 7: Delta-hedged options and tranches vs. Index returns

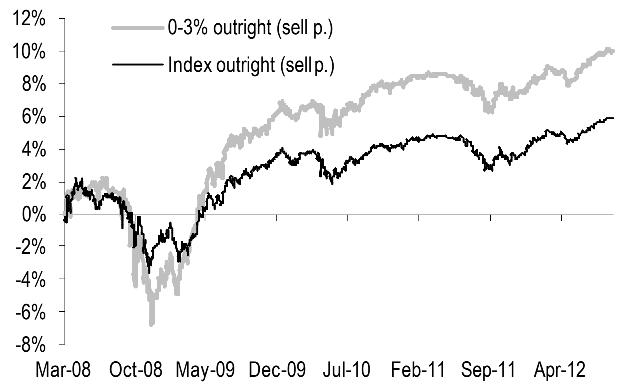
Cumulative sum of daily returns as % of instrument notional (option, tranche, index respectively).



Source: J.P. Morgan. Index bid-ask spreads not considered. Option and tranches are delta-hedged daily (sell options / sell tranche protection respectively). Index and tranche returns are on Main Series 9; option returns are on Main on-the-run.

Figure 8: Outright S9 Jun-13 equity vs. index returns

Cumulative sum of daily returns as % of index equivalent notional (i.e. we divide the daily tranche returns by the previous day's tranche delta).



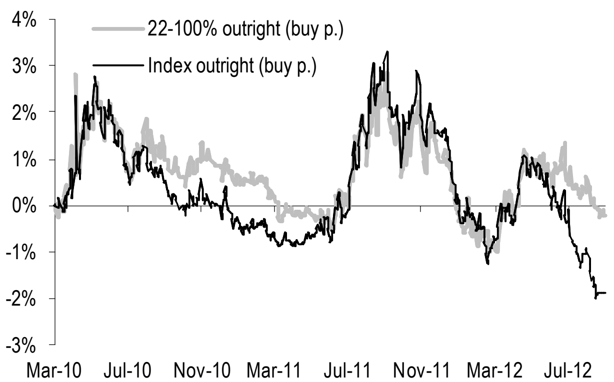
Source: J.P. Morgan.

Historical returns of buying Jun-15 S9 super senior protection

Buying outright super senior protection has been a popular trade for investors looking for "tail-hedges". Figure 9 compares the returns of buying Jun-15 super senior and index protection (again adjusting the different leverage of the super senior tranche by dividing its returns by the tranche delta) and Figure 10 shows the returns of a delta-hedged short super senior position. Both figures show that a super senior short has done slightly better than an index short since Mar-10.

Figure 9: Outright S9 Jun-15 super senior vs. index returns

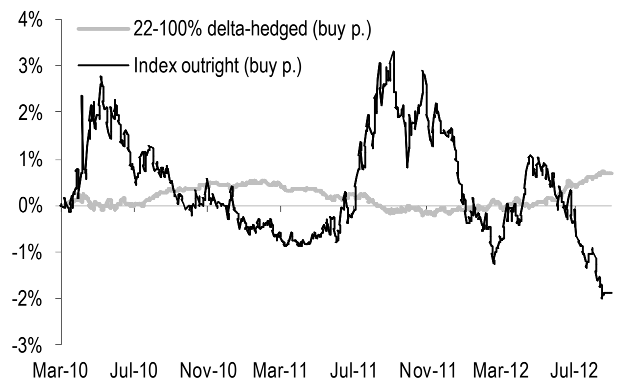
Cumulative sum of daily returns as % of index equivalent notional (i.e. we divide the daily tranche returns by the previous day's tranche delta).



Source: J.P. Morgan.

Figure 10: Delta-hedged super senior equity vs. index

Cumulative sum of daily returns as % of instrument notional (tranche and index respectively). Tranches are delta-hedged daily.



Source: J.P. Morgan.

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iTraxx Curve Indices

CURve Steepener Indices (CURSTI)

CURSTI indices measure the return from curve trades on iTraxx indices. These curve trades can be broken down into steepeners and flatteners, either in an equal-notional or duration-weighted format.

Equal Notional

Equal notional curve trades allow investors to take views on forward CDS levels; entering a 3s5s equal notional flattener is (almost) equivalent to selling protection on a 3y5y forward CDS contract. As such, equal notional flatteners are generally long risk trades (profiting from the forward spread tightening) and steepeners are short risk trades.

For equal notional trades, the daily return of a steepener trade can be calculated using the daily return of each index leg, as shown in Equation 7. Here the *Index Return* refers to the daily return from selling index protection, as discussed in the *iTraxx Index Returns* section.

Equation 7: Daily return from equal notional steepener

$$Daily\ Return_t = Index\ Return_t^{Shorter\ Maturity} - Index\ Return_t^{Longer\ Maturity}$$

This *Daily Return* is expressed as a % of notional, in keeping with all other indices discussed in this piece. The daily return from an equal notional flattener trade is simply the negative of the daily return from a steepener trade; we do not include bid-offer costs in these calculations (as the bid-offer cost from entering the position is usually small and rebalancing is infrequent).

Duration Weighted

Duration-weighted curve trades are weighted according to the duration of each leg, such that the overall exposure to parallel shifts in spreads is negligible. For example, in a 3s5s curve trade the duration of the 5y leg is higher than that of the 3y leg, so the 3y leg will have a larger notional to compensate. Duration-weighted steepeners are generally regarded to be long risk trades as they typically have positive time value and curves have historically steepened as spreads have tightened.

For these trades, the daily return is calculated using the index returns and the duration of each leg from the previous day. Using the previous day's duration assumes that the trade is rebalanced at the close of every day to ensure it stays duration-neutral. The daily return from a duration-weighted steepener trade is shown in Equation 8

Equation 8: Daily return from duration-weighted steepener.

$$Daily\ Return_t = Index\ Return_t^{Shorter\ Maturity} - \frac{Duration_{t-1}^{Shorter\ Maturity}}{Duration_{t-1}^{Longer\ Maturity}} \times Index\ Return_t^{Longer\ Maturity}$$

In our CURSTI indices, the return from a duration-weighted curve trade is always expressed as a % of the notional of the shorter leg.

As with equal-notional trades, the return for a duration-weighted flattener is equal to the negative of the daily return of a duration-weighted steepener.

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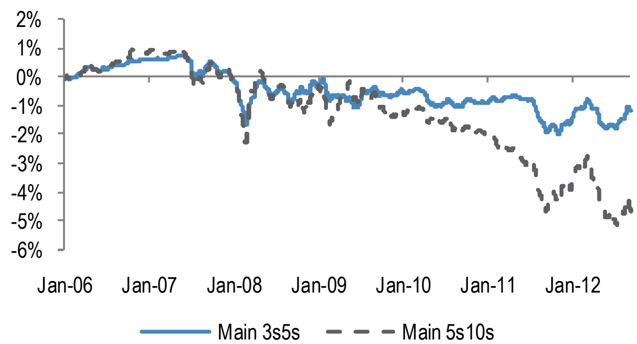
Historical Performance

Equal Notional

Figure 11 and Figure 12 show the historical return from equal notional flatteners in both the 3s5s and 5s10s tenors for iTraxx Main and Crossover. Broadly speaking, in iTraxx Main equal notional flatteners have not performed well in recent years; the bulk of any improvement in credit quality has been focused in the short end while forward spreads have remained high.

Figure 11: Historical return from Main 3s5s and 5s10s Equal Notional Flatteners

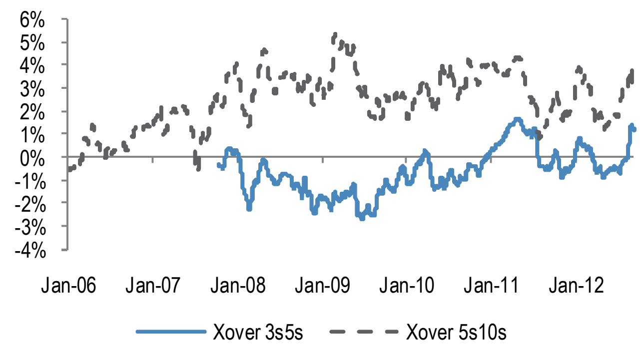
P&L as % of notional of shorter dated leg.



Source: J.P. Morgan.

Figure 12: Historical return from Xover 3s5s and 5s10s Equal Notional Flatteners

P&L as % of notional of shorter dated leg.



Source: J.P. Morgan.

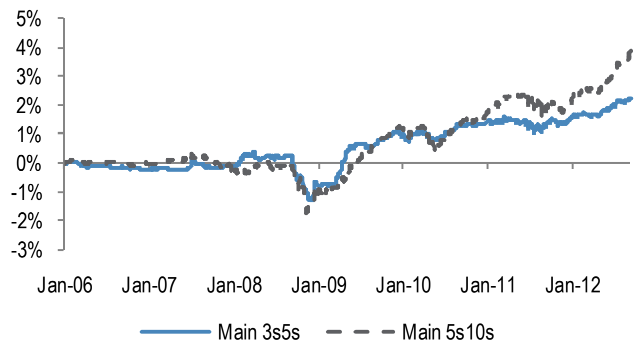
Duration Weighted

Duration-weighted steepeners performed badly during 2008 as fears of short-term defaults spiked but since have benefited from the steepening trend of the past few years.

The P&L for duration-weighted steepeners for iTraxx Main and Crossover is shown in Figure 13 and Figure 14 respectively.

Figure 13: Historical return from Main 3s5s and 5s10s Duration Weighted Steepeners

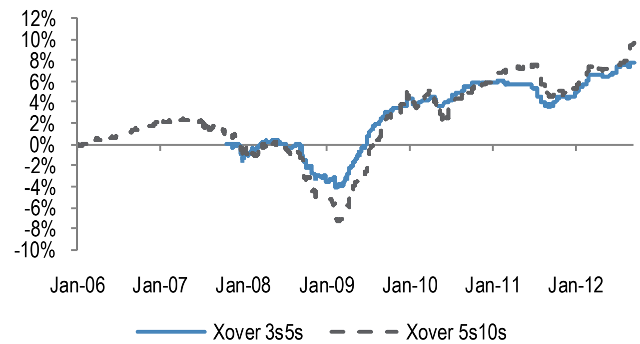
P&L as % of notional of shorter dated leg.



Source: J.P. Morgan.

Figure 14: Historical return from Xover 3s5s and 5s10s Duration Weighted Steepeners

P&L as % of notional of shorter dated leg.



Source: J.P. Morgan.

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Appendix I: Tranche Return Calculations

Read at your own risk…

In this Appendix we describe the how we compute the tranche delta hedged returns available in *DataQuery*.

Tranche and index factors

In the tranche daily return calculations outlined below we take into account the default losses in tranches and indices as well as tranche and index notional factors (in order to express the returns as a % of the tranche original notional). We next briefly explain, with a simple illustration, how these factors are computed given the index losses and the number of defaults.

The factor on a tranche or an index is the % of the original notional which is currently outstanding. For example, in an index of 125 equally weighted credits where there have been 4 defaults with a total index loss of 1% (e.g. assuming a 68.78% recovery rate for each credit):

- The index loss is 1% and the index factor is 96.8% (= 121/125). Notice that the index factor does not take into account recovery rates, while the index loss does.
- The 0-3% tranche loss is 33.3% (= index loss of 1% / 3% tranche width) and the 0-3% factor is 66.6% (= initial notional of 100% minus tranche loss of 33.3%).
- Non-super senior tranches have a tranche factor equal to 100% minus the tranche loss. Non-super senior tranches attaching above the current index loss would have a 0% loss and a 100% factor.
- The super-senior (22-100%) tranche has experienced a 0% loss but its outstanding notional has decreased. Expressed in % of the original index notional, the super-senior attachment is still 22% but its detachment is 97.8% (= the index 96.8% factor plus the index 1% losses)[2]. Thus, with a current width of 75.8% (= 97.8% - 22%) vs. an original width of 78% (= 100% - 22%), the tranche factor is equal to 97.18% (= 75.8% / 78%).[3]

If an investor sells 100€ protection on a tranche or index with an Y% factor trading with a Z% upfront, the notional at risk will be 100×Y€ and the investor will receive 100×Y×Z € upfront.

Tranche and index losses and factors will change due to defaults in the index.[4]

Delta-hedged tranche daily return

Return = MtM + Default settlement

The total daily return on a tranche trade (delta-hedged or not) is the sum of two components which we refer to as MtM and default settlement. We calculate the returns from a tranche protection seller point of view and initially assume the tranche

[2] Potentially, if all the remaining 121 credits default with 0% recovery rate, the index loss would reach 97.8%.

[3] Essentially, the super-senior outstanding notional goes down in line with the difference between the reduction in the index factor (from 100% to 96.8%) and the index losses (1%).

[4] In general, tranche losses and factors will change after the recovery rate is determined in the CDS auction. For the index, the loss will similarly change after the recovery rate is determined; the factor, however, will only change after the auction for bankruptcy and failure to pay credit events - for restructurings the factor will change on the credit event date.

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is delta-hedged daily. We will always assume that the investor can trade the tranche at mids; for the index rebalancing, we initially assume the investor trades at mids but we later take into account bid-offer costs. We compute the return between two consecutive business days, which we label as 0 and 1. In *DataQuery* we have access to COB data and, as a consequence, we assume the investor trades at the COB each day.

Delta-hedged MtM

We first compute the following two expressions:

- **Tranche MtM (long risk, outright)**

  The tranche MtM can be expressed as a function of the tranche upfronts, factors and coupons, as shown in Equation 9

  Equation 9: Tranche MTM (long risk)

  $$T_{MtM} = \left(UF_0^T \cdot F_0^T - UF_1^T \cdot F_1^T\right) + \left(C_0^T \cdot F_0^T \cdot days_{0-1}/360\right) + \left(C_0^T \cdot F_0^T - C_1^T \cdot F_1^T\right) \cdot RA_1^T$$

  where T stands for tranche, UF for upfront, F for factor, C for coupon, RA for risky annuity, 0 and 1 for day 0 and day 1 and $days_{0-1}$ for the number of calendar days between the two business days.

  Essentially, the tranche MtM is computed as the change in upfront times the carry (first and second terms); the third term will only be different from zero for tranches traded on a full running (i.e. par) basis, which used to be the case for senior tranches before trading with upfront and fixed coupons for all CDS instruments was introduced (in this case, the first term will be zero given that upfronts will be zero). All the upfronts and coupons are multiplied by the tranche factors which, as we explained above, will only change with defaults.

  Tranche upfronts/spreads quoted by traders assume, unless otherwise stated, that the trade is delta-hedged and the delta, i.e. index, is traded at what we call the "Ref" level (which is essentially a flat spread). Generally, the "Ref" level is fixed in the morning and kept constant during the day. As a consequence, the "Ref" level will usually coincide with the index opening spread but may be different from the index COB spread.

- **"Ref" MtM (long risk)**

  This is the MtM on a long risk index position assuming the investor trades the delta amount entered at on day 0 at the "Ref" level (on both days).

  Equation 10: Ref MTM (long risk)

  $$R_{MtM} = \left(UF_0^R \cdot F_0^I - UF_1^R \cdot F_1^I\right) + \left(C_0^I \cdot F_0^I \cdot days_{0-1}/360\right)$$

  where R stands for *Ref*, I for index, UF for upfront, F for factor, C for coupon, 0 and 1 for day 0 and day 1 and $days_{0-1}$ for the number of calendar days between the two business days.

  As we explain next, if the tranche delta changes from day 0 to day 1, the investor will not be able to trade out of the full (initial) delta at the "Ref" level and will have to trade a residual amount at the "Index" level. We will make an adjustment for this.

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We initially assume the investor sells delta-hedged tranche protection and rebalances the delta daily, i.e. if the delta changes the investor adjusts the index notional by selling/buying an extra amount of index protection. This extra amount of index protection, given by the change in the delta, is traded at the COB index spread, which can be different from the "Ref" spread for that day and which will involve the investor paying bid-offer spread (although for illustration purposes we initially assume the investor can trade the index at mids).

We compute the daily MtM assuming the investor opens a delta-hedged tranche position on day 0 and closes it on day 1 (including the potential residual index position due to changes in the tranche delta). The sequence of events is as follows:

- On day 0, the investor sells one unit of tranche protection with an upfront UF^T_0 and buys index protection on an amount equal to the tranche delta D_0 with an upfront UF^R_0 (i.e. the one implied by the "Ref" level at day 0).
- On day 1:
  - The investor buys one unit of tranche protection with an upfront UF^T_1 and sells index protection on an amount equal to the tranche delta D_1 with an upfront UF^R_1 (i.e. the one implied by the "Ref" level at day 1).
  - The investor is left with a residual index position equal to the change in the tranche delta from day 0 to day 1. In particular, if the tranche delta has increased (i.e. $D_1 > D_0$), the investor has a residual net long risk position on the index with a notional of $D_1 - D_0$. The investor would need to buy index protection at the index upfront level, which we refer to as UF^I_1, to close this residual position.

In order to compute the MtM of this trade, we look separately at the tranche (outright) and the index component:

- The MtM of the tranche position is given by the T_{MtM} expression we outlined above.
- To compute the MtM on the index position, we look at the cash flows involved:
  - On day 0, the investor pays the upfront on the (short risk) index position entered into when selling delta-hedged tranche protection, using the "Ref" level, with a notional equal to the tranche's delta on day 0, i.e. $-D_0 \cdot UF^R_0 \cdot F^I_0$.
  - On day 1:
    - The investor pays, on an index notional equal to the tranche's delta on day 0, the coupon for the calendar days between day 0 and day1, i.e. $-D_0 \cdot C^I_0 \cdot F^I_0 \cdot days_{0-1} / 360$.
    - The investor receives the upfront on the (long risk) index position entered into when buying delta-hedged tranche position, using the "Ref" level, with a notional equal to the tranche's delta on day 1, i.e. $+D_1 \cdot UF^R_1 \cdot F^I_1$.
    - The investor pays/receives the upfront on the index position entered into when unwinding the residual index position derived from buying protection on day 0 with a notional equal to the tranche's delta on day 0

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and selling protection on day 1 with a notional equal to the tranche's delta on day 1. This upfront will be equal to $-\left(D_1 - D_0\right) \cdot UF_1^I \cdot F_1^I$.

The total MtM of the entire position is given by the outright tranche MtM minus the initial delta times the MtM on the "Ref" (as computed above) plus a term which captures the residual index exposure the investor is entered into if the delta of the tranche changes from day 0 to day 1 as shown in Equation 11.

Equation 11: MtM of combined tranche and ref position.

$$MtM = T_{MtM} - D_0 \cdot R_{MtM} + \left(D_1 - D_0\right) \cdot (UF_1^R - UF_1^I) \cdot F_1^I$$

Several of the assumptions made to compute the MtM above can be changed:

- In order to consider the index bid-offer paid when rebalancing the delta, we need to take into account the residual index notional traded each day, which is given by the change in the tranche delta and (half of) the index bid-offer. In particular, the bid-offer cost is given by the expression shown in Equation 12.

  Equation 12: Bid-offer costs

  $$BidOfferCosts = Abs\left(D_1 - D_0\right) \cdot F_1^I \cdot \left(Bid - offer_{Index} / 2\right) \cdot RA_{Index}$$

  where *RA* stands for risky annuity.

- We also consider the possibility of rebalancing the index delta only when it changes more than X% (as opposed to rebalancing it every day). In this case, we would only include the residual "Ref"/index component of the MtM above (last term) on the days where the delta is rebalanced.

Delta hedged default settlement

We compute the cash flow of a delta-hedged tranche position opened on day 0 and closed on day 1 due to default settlement payments as follows:

Equation 13: MtM of combined tranche and ref position.

$$NetDefaulPayment = -\left(L_1^T - L_0^T\right) + D_0 \cdot \left(L_1^I - L_0^I\right)$$

where L^I_d and L^T_d represent the cumulative index and tranche losses on day *d* respectively.

For an X-Y% tranche the loss is given by the expression shown in Equation 14.

Equation 14: Tranche loss

$$L_d^T = \min\left\{L_d^I, Y\right\} - \min\left\{L_d^I, X\right\}.$$

We add the default settlement cash flow to the MtM computed above in order to compute the daily tranche return.

The returns are all expressed as a % of the original tranche notional. If the tranche factor is lower than one, the notional at risk will be lower than the original index notional. In order to express this return as % of the notional at risk, we would

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divide the daily returns as % of the original tranche notional by the tranche factor on the previous day. Tranche factors are available in *DataQuery* (iTraxx tranche menu).

What is available in *DataQuery*?

DataQuery provides daily returns, and return indices, for:

- Delta-hedged tranche trades, where the index delta is rebalanced daily or when it changes by 10, 25 and 50% respectively. The delta being used on each of these strategies is also provided. There is an option to include the bid-ask cost of rebalancing the delta position.
- Outright long risk tranche trades assuming the investor can trade the tranches on a no-delta basis at the same upfront as the one used when tranches are traded on a delta-hedged basis (this is the T_{MtM} expression computed above plus the tranche default settlement).
- Outright long risk index position (using mid levels), using the same formula we used above to compute R_{MtM} but using the index (as opposed to the "Ref") upfronts (plus the index default settlement). This allows investors to compare tranche returns (outright or delta-hedged) with index returns. In the *DataQuery* menu, this option is chosen by selecting "*Index*" in the box entitled "*Instrument*".

The returns are available as a % of the tranche notional and as a % of the index notional (by dividing the tranche daily return by its previous day's delta). By adjusting the tranche return by its delta, it makes it more comparable to the index return. In the *DataQuery* menu, this option is chosen by selecting "*Index*" in the box entitled "*Notional*".

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