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**Markit iTraxx Short Total Return
Index Guide**

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1 Introduction

This document explains the technical calculation of the iTraxx Total Return Indices:

- iTraxx Europe 5-year SHORT TOTAL RETURN INDEX
- iTraxx HiVol 5-year SHORT TOTAL RETURN INDEX
- iTraxx Crossover 5-year SHORT TOTAL RETURN INDEX

These indices measure the performance of holding the respective on-the-run iTraxx CDS contracts. The index reflects a short credit position i.e. buying protection on the iTraxx default swap indices. It therefore replicates the behaviour of a fictitious portfolio that sells one (or several if leveraged) iTraxx CDS contracts and invests the remaining notional in money market instruments. This is done on a daily basis. The portfolio is always invested in the on-the-run iTraxx series that it tracks: each time a new iTraxx series is issued, due to the regular index roll (every March and September) or due to a default in the current series, the CDS position in the reference portfolio is rolled into the on-the-run/reduced index position.

The base index level will be 100 at the launch of Series 7 of the iTraxx Europe index family (i.e., 20 March 2007).

2 Index Calculation Methodology

The indices measure the performance of holding the respective on-the-run iTraxx CDS contracts. The index buys protection on the iTraxx credit default swap indices and invests the remaining notional in money market instruments - the index return then reflects a short credit position. On the first trading day of the new on-the-run indices – on March 20 and September 20 if these days are business days, if not the next business day - the position in the off-the-run index is unwound and a position in the new series is entered into. The contracts are purchased and sold at the official End-of-day mid-spread index levels of the relevant trading day.

The index reflects a protection buyer position and therefore pays a coupon on a quarterly basis. As iTraxx CDS are generally quoted as a spread, this equates uniquely to an upfront price given the fixed deal spread for the swaps. This “price” is essentially the upfront value of entering into the credit default swap contract.

2.1 Leverage

Different levels of leverage can be applied to the index. A leverage of 1 is used in this specification. The leverage is assumed to be constant. This means that when the notional of the fictitious portfolio changes due to changes in the market value of either the position on iTraxx or the cash position, the portfolio is rebalanced to ensure that the exposure to the iTraxx index is the leverage multiplied by the new notional. This rebalancing is done at the end of each business day.

2.2 Semi-annual index roll process

The regular roll process from the off-the-run into the new in-the-run index is simple. At any one point only the most recently available index CDS return is included in any one index. The return of the index therefore reflects the value of exiting the short risk position in the old iTraxx contract and simultaneously entering the new contract at mid at the end of the first day of trading of the new contract. Note that transacting at mid means that transaction costs are not included. Therefore, the following roll transaction costs will be implemented¹:

- The roll transaction costs will be 1% of the respective “old” series coupon plus 1% of the respective “new” series coupon.

2.3 Model input factors

Credit curve: For simplicity reasons, a flat credit curve is used.

Interest rate curve: A flat interest rate curve is used. The discount factor in the model is the Euro 5year swap rate as published by ICAP.

Recovery rates: As agreed amongst the market makers for every new iTraxx index series before each index roll.

Premium payments to be incorporated into the model: Coupons that are agreed amongst the market makers for every new iTraxx index series before each index roll.

¹ The methodology of determining the roll transaction cost is subject to change by International Index Company if warranted by market conditions. This methodology will be checked on every first calendar day of the iTraxx index roll month and will only be changed if market conditions change dramatically

3 Management of defaults in the index

When credit events occur or are anticipated International Index Company (IIC) polls the market and – in the case of a positive outcome - announces that a new n-1 name contract will replace the current n name contract as the official one. IIC does not determine credit events, but effectively credit events are treated in the price indices as an early roll to this new contract.

3.1 Trigger event

In the case of deterioration in the liquidity of an index (due to the distress of an entity or an anticipated credit event in relation to an entity):

- A poll is initiated by IIC following receipt of a request from three or more market makers that a new annex be published in relation to the relevant index/indices zero weighting such entity. If the third such request is received before 12.00 midday London time, IIC will conduct a poll on that same business day. If the third such request is received later than 12.00 midday London time, the poll will take place from 11 am London time on the following business day. In either case, polling will terminate at 4 pm London on the day the poll is conducted. The result of the poll will be published by 5 pm London time on the day of the poll.
- For a poll to be valid, a majority of market makers contributing to the index roll process must participate (as determined by IIC). Of those participating, 75% must be in favour of the publication of a new annex zero weighting the relevant entity in the index/indices.
- If IIC determines that a poll is invalid, a one-week period commences (from and including that business day), during which the three market makers who initiated the poll may not nominate the same entity again for zero weighting in an index/indices. If at least three other market makers request publication of a new annex zero weighting the same entity in the relevant index/indices, a further poll is initiated by IIC in accordance with the provisions described above.
- If the result of a poll is positive (as determined by IIC), a new annex will be published by Markit Group, which will be identical to the previous annex, save for the fact that the annex date will be different and the relevant entity will have a 0% weighting.

3.2 Procedure

If result of the poll described in 3.1 is positive the index will be rolled from the “full” index that includes the defaulted name into the index that has this name reduced to a zero weighting on the second business day following the first publication of the reduced index.

The index prices at which the position of the “full” and the “reduced” index is valued are determined in the End-of-Day Fixing performed by Markit Group at 16:30 London. Mid levels are used for both indices. Transacting at mid means that transaction costs are not included. The roll transaction costs to be added up are calculated according to the following methodology²:

² The methodology of determining the roll transaction cost is subject to change by International Index Company if warranted by market conditions. This methodology will be checked on every first calendar day of the iTraxx index roll month and will only be changed if market conditions change dramatically

1. For a calculation to be valid, more than five market makers must be available for the “full” index calculation on t+2 who deliver valid bid/offers. If the calculation is invalid, the maximum roll transaction costs will be applied. The maximum roll transaction costs are: 10% of the coupon of the respective index series for the iTraxx Europe, the iTraxx HiVol and the iTraxx Crossover index.
2. If the calculation is valid, the roll transaction costs are the average bid/offer-spread determined in this index calculation if this value is lower than the maximum roll transaction costs (as described in 1.) and higher than the minimum roll transaction costs (as described in 3.)
3. The minimum roll transaction costs will be twice the “regular” roll transaction costs, i.e. 2 % of the respective “old” series coupon plus 2% of the respective “new” series coupon.

For the calculation to be valid, the average bid and offer prices should be consistent with quotations in the underlying market at the time of the fixing. The decision on the validity of the calculation will take into account whether, in the opinion of the calculation agent, participating market makers have taken due care and attention when publishing both their bid and offer prices.

4 Appendix: Price-index calculation methodology

In this appendix, S_t : is the market spread of the current iTraxx series at day t, i.e., the official iTraxx spread published by Markit Group on behalf of IIC at each closing of day t. Mid spreads are used.

4.1 Index calculation

The base index level is set to be 100 at the launch day of Series 7 of the iTraxx Europe index family (i.e., 20 March 2007).

The total return index level I_t on day t is calculated as

$$I_t = I_{t-1}(1 + R_t)$$

where R_t is the daily return on day t of the replicating portfolio, which is effectively the return on the position in the iTraxx index R_t^{CDS} plus the return on the cash position R_t^{cash} .

$$R_t = R_t^{cash} + R_t^{CDS}$$

$$R_t^{cash} = (1 + CDS_{t-1}(S_{t-1})) * t_{O/N} f_t$$

$$R_t^{CDS} = CDS_{t-1}(S_{t-1}) - CDS_t(S_t) - Coupon_t$$

where

$CDS_t(S_t)$ is the mark-to-market value of the iTraxx CDS contract on day t, i.e., the dirty price for selling protection on the iTraxx index. The calculation of CDS_t is described in section Marking CDS to Market of this appendix.

$Coupon_t$ is the coupon paid on day t by the current iTraxx index, 0 if t is not a coupon day

f_t is the day fraction between $t-1$ and t

$t_{O/N}$ is the Euro OverNight Index Average (EONIA) at day t-1, day count convention ACT/360

When t is a roll date, the return is slightly changed to account for the transaction costs during index rolls as described below.

4.2 Index Rolls

In case of the regular semi-annual index rolls and in case of a roll into a reduced contract following a liquidity poll, the portfolio is rolled over and the return on the roll date is calculated in the usual way, as specified above, and an "excess return" is added to account for Bid/Ask trading cost :

This excess return is the sum of :

- the change of value due to valuing the portfolio with the new series' price
- the cost of switching at t from the old series to the new one.

$$ExcessR_t^{CDS} = CDS_t^{oldseries}(S_t^{oldseries}) - CDS_t^{newseries}(S_t^{newseries}) + CDS_t^{newseries}(S_t^{newseries} + TC^{newseries}) - CDS_t^{oldseries}(S_t^{oldseries} - TC^{oldseries})$$

where

$S_t^{oldseries}$: the market spread of the old iTraxx series at day t

$TC^{oldseries}$: the transaction cost of rolling out of the old series, as specified in Section 2.2 and 3.2

$S_t^{newseries}$: the market spread of the new iTraxx series at the roll day t

$TC^{newseries}$: the transaction cost of rolling into the new series, as specified in Section 2.2 and 3.2

$CDS_t^{newseries}(S_t^{newseries} + TC^{newseries})$: the mark-to-market value of the new series with adjusted spread of $S_t^{newseries} + TC^{newseries}$, survival probabilities calculated using adjusted spread

$CDS_t^{oldseries}(S_t^{oldseries} - TC^{oldseries})$: the mark-to-market value of the old series with adjusted spread of $S_t^{oldseries} - TC^{oldseries}$, survival probabilities calculated using adjusted spread

Note that on the roll date t the R_t^{CDS} is calculated using the mark-to-market value of the old iTraxx series at day t-1 and day t, and on date t+1 the R_{t+1}^{CDS} is calculated using the mark-to-market value of the new iTraxx series at day t and day t+1.

4.3 Daily Rebalancing to Maintain Constant Leverage

The exposure to the iTraxx index and cash is rebalanced at each end of day to maintain a constant leverage on the iTraxx index.

Suppose on day t-1 a notional of 1 was invested with leverage of 1 on iTraxx, i.e., to buy protection on notional of 1 on iTraxx for $-CDS_{t-1}(S_{t-1})$ and invest $1 + CDS_{t-1}(S_{t-1})$ in the cash. On the end of day t, the mark-to-market value of the portfolio is $1 + R_t$. To maintain the leverage of 1, the exposure on iTraxx will need to be adjusted to the new notional of $1 + R_t$, with a value of $-(1 + R_t) * CDS_t(S_t)$, while $(1 + R_t) * (1 + CDS_t(S_t))$ will be invested in cash.

To give a numeric example: on day t-1 an investor buys protection on a notional of 1 on iTraxx. This results in an upfront payment on the iTraxx position of 0.05, whilst the remaining 0.95 are invested in cash. On the end of day t, the mark-to-market value of the iTraxx contract increases by 0.02 to 0.07, while the cash account returns 0.01. Thus the total market value of the portfolio is now 1.03. To maintain the leverage of 1, the exposure on iTraxx needs to be adjusted to the new notional of 1.03 with a value of 0.0721 (i.e. $1.03 * 0.07$), while $1.03 * (1 - 0.07)$ is invested in cash.

4.4 Marking CDS to Market³

The mark-to-market value of an iTraxx CDS contract is the difference between the present value of contingent payments on defaults minus the present value of all future fixed rate payment, i.e.,

$$CDS_t(S_t) = PV(\text{Contingent Leg}) - PV(\text{Fee Leg})$$

Where,

$$\begin{aligned} PV(\text{Contingent Leg}) &= \frac{1}{2}(1-\delta)\sum_{i=2}^n (Z_i + Z_{i-1})(P_{i-1} - P_i) \\ PV(\text{Fee Leg}) &= C\left(\tau_1 Z_2 + \sum_{i=2}^n \tau_i Z_i P_i\right) + C\sum_{i=2}^n \frac{\tau_i}{2} \frac{(Z_{i-1} + 2Z_i)}{3} (P_{i-1} - P_i) \\ &= C\left[\tau_1 Z_2 + \sum_{i=2}^n \frac{\tau_i}{6} [6Z_i P_i + (Z_{i-1} + 2Z_i)(P_{i-1} - P_i)]\right] \end{aligned}$$

T_i : T_0 is the previous coupon date, T_1 is the day after the valuation date⁴, T_2 to T_n are the coupon payment dates

τ_i : Day count factor of period T_{i-1} to T_i , i.e., τ_1 is from the previous coupon date to T_1 , τ_2 is from T_1 to the next coupon date, τ_3 to τ_n are the next coupon periods. The day count convention is ACT/365.

Z_i : Yield curve discount factor at time T_i , the day fraction is from the valuation date to T_i

calculated as E30/360. $Z_0 = 1$

P_i : Survival Probability to time T_i , $P_0 = P_1 = 1$

δ : Recovery rate

C is the fixed coupon of the iTraxx® index

Assuming a flat credit curve which is equal to the market spread S of the iTraxx® index, the Survival Probabilities P_i at each coupon payment date (from T_2 on) are calculated as

$$P_n = \frac{3(1-\delta)\left[\sum_{i=2}^{n-1} (Z_{i-1} + Z_i)(P_{i-1} - P_i) + (Z_{n-1} + Z_n)P_{n-1}\right] - S\left[\sum_{i=2}^{n-1} \tau_i [6Z_i P_i + (Z_{i-1} + 2Z_i)(P_{i-1} - P_i)] + \tau_n (Z_{n-1} + 2Z_n)P_{n-1}\right]}{3(1-\delta)(Z_{n-1} + Z_n) + S\tau_n(4Z_n - Z_{n-1})}$$

We can interpolate the survival probability at any other date by taking logs and linearly interpolating.

³ This methodology is a property of Markit Group Limited.

⁴ To take into the fact that a trade executed at day T is effective only from day T+1.

5 Further information

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