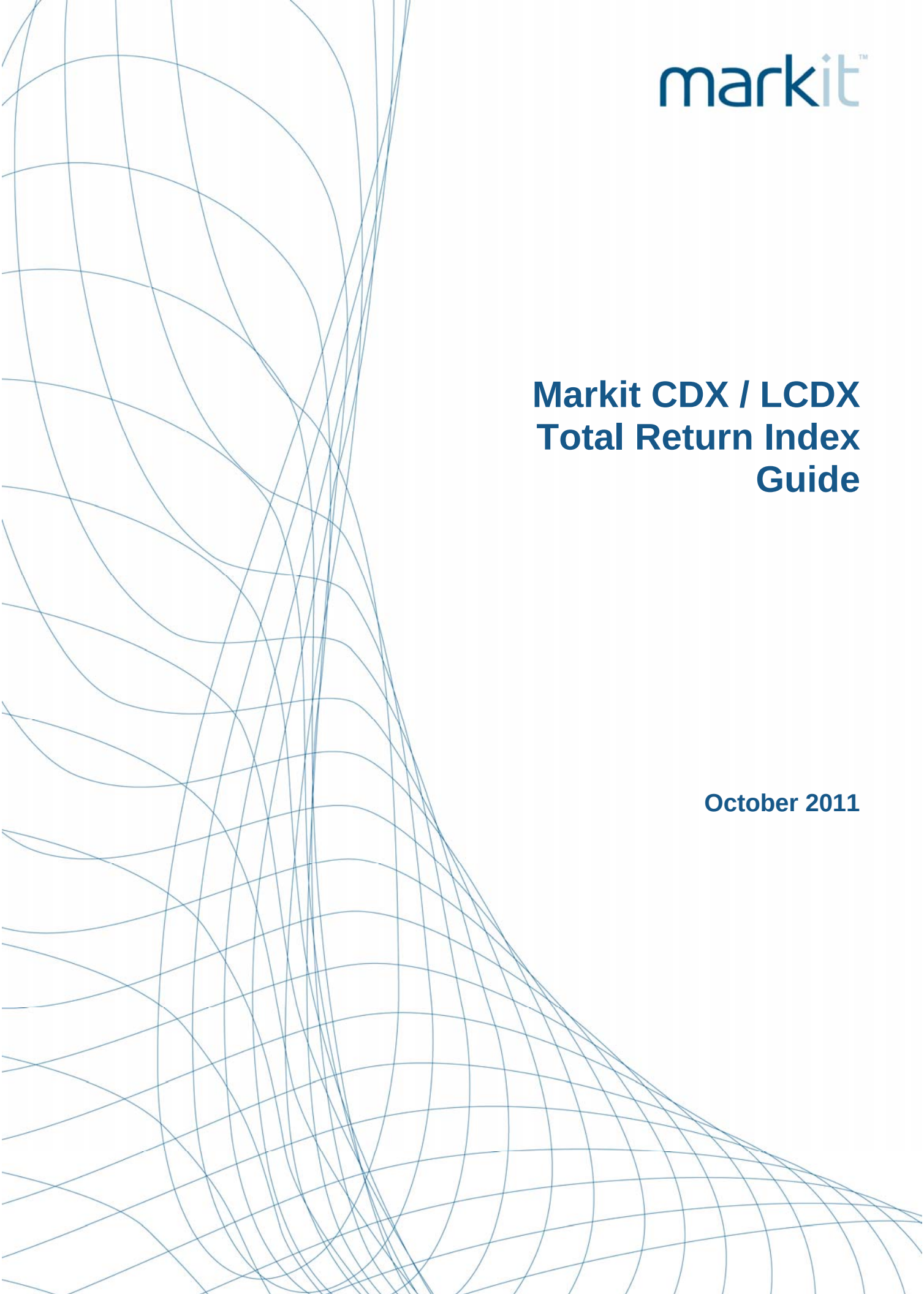

Markit CDX / LCDX Total Return Index Guide

October 2011

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1 Introduction

This document explains the technical calculation of the CDX / LCDX Total Return Indices:

Markit CDX.NA.IG 5-year TOTAL RETURN INDEX

Markit CDX.NA.HY 5-year TOTAL RETURN INDEX

Markit CDX.EM 5-year TOTAL RETURN INDEX

Markit LCDX 5-year TOTAL RETURN INDEX

These indices measure the performance of holding the respective on-the-run CDX / LCDX index contracts. The index reflects a long credit position i.e. selling protection on the CDX / LCDX default swap indices. It therefore replicates the behavior of a fictitious portfolio that buys one (or several if leveraged) CDX / LCDX index 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 CDX / LCDX series that it tracks - each time a new CDX / LCDX series is issued, due to the regular index roll (every March and September) or due to a credit event 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 is set to be 100 at the launch day of Series 8 of the CDX.NA.IG index (i.e., 20 March 2007) for the Markit CDX.NA.IG 5-year TOTAL RETURN INDEX, set to be 100 at the launch day of Series 8 of the CDX.NA.HY index (i.e., 27 March 2007) for the Markit CDX.NA.HY 5-year TOTAL RETURN INDEX, set to be 100 at the launch day of Series 7 of the CDX.EM index (i.e., 20 March 2007) for the Markit CDX.EM 5-year TOTAL RETURN INDEX and 100 at the launch day of Series 14 of the LCDX index (i.e., 5 April 2010) for the Markit LCDX 5-year TOTAL RETURN INDEX.

2 Index Calculation Methodology

The indices measure the performance of holding the respective on-the-run CDX / LCDX CDS contracts. The index sells protection on the CDX / LCDX credit default swap indices and invests the remaining notional in money market instruments - the index return then reflects a long credit position. On the first trading day of the new on-the-run indices – on March 20 and September 20 for the for the CDX.NA.IG and CDX.EM indices (on March 27 and September 27 for the for the CDX.NA.HY index, on April 3 and October 3 for the for the LCDX index), 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 sold and purchased at the official End-of-Day mid-spread (for the CDX.NA.IG index) or mid-price (for the CDX.NA.HY, CDX.EM and LCDX indices) levels of the relevant trading day.

The index reflects a protection seller position and therefore receives a coupon on a quarterly basis. Any coupons paid are reinvested immediately into the respective index on the day they are paid.

The CDX.NA.IG index is quoted as a spread which 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.

The CDX.NA.HY, CDX.EM and LCDX indices are quoted in the market directly in price terms.

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 CDX / LCDX or the cash position, the portfolio is rebalanced to ensure that the exposure to the CDX / LCDX 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 on-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 long risk position in the old CDX / LCDX 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 implemented:

- The roll transaction costs for the CDX.NA.IG 5-year TOTAL RETURN INDEX will be 1% of the respective “old” series coupon plus 1% of the respective “new” series coupon
- The roll transaction costs for the CDX.NA.HY 5-year TOTAL RETURN INDEX will be a flat 0.15% for the “old” and “new” series
- The roll transaction costs for the CDX.EM 5-year TOTAL RETURN INDEX will be a flat 0.25% for the “old” and “new” series
- The roll transaction costs for the LCDX 5-year TOTAL RETURN INDEX will be a flat 0.25% for the “old” and “new” series

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 US Dollar 5year swap rate as published by ICAP.

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

3 Management of defaults in the index

When credit events occur, Markit announces that a new "reduced" contract will replace the current "full" contract as the official one. Markit does not determine credit events, but effectively credit events are treated in the Total Return Indices as an early roll to this new contract.

3.1 Trigger event

Following a credit event in a constituent of the CDX indices, the ISDA Determinations Committee votes to decide if a credit event has occurred for the entity and if an auction for the defaulted entity is to be held. If the outcome of this vote is positive, Markit publishes a new version of the index annex zero weighting the relevant entity i.e. the "reduced" index.

Following a credit event in a constituent of the LCDX index, the Eligible LCDX Members vote to decide if a credit event has occurred for the entity and if an auction for the defaulted entity is to be held. If the outcome of this vote is positive, Markit publishes a new version of the index annex zero weighting the relevant entity i.e. the "reduced" index.

3.2 Procedure

For the Total Return Indices, the date on which the indices are rolled from the "full" index (with the defaulted name) to the "reduced" index (without the defaulted name) is usually done on the business day following the auction date, but will be decided by Markit on the basis of liquidity.

The CDX and LCDX 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 18:30 New York and at 16:00 New York respectively. Mid levels are used for both indices. Transacting at mid means that transaction costs are not included. If the End-of-Day fixing level is not available for the "full" version of the index, Markit will use a model price for roll cost calculation. The roll transaction costs to be added up are calculated according to the following methodology:

1. For a calculation to be valid, more than five market makers must be available for the "full" index calculation who delivers 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 CDX.NA.IG index, 0.6% flat for the respective index series for the CDX.NA.HY index, 1.0% flat for the respective index series for the CDX.EM index and 1.0% flat for the respective index series for the LCDX 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 CDX.NA.IG index, 0.3% flat for the each of the "old" and "new" series for the Markit CDX.NA.HY index, 0.5% flat for the each of the "old" and "new" series for the Markit CDX.EM index and 0.5% flat for the each of the "old" and "new" series for the Markit LCDX index..

For the calculation to be valid, the average bid and offer spreads / 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 spreads / prices.

4 Appendix: CDX / LCDX Total Return Indices calculation methodology

In this appendix, S_t is the market spread of the current CDX.NA.IG series at day *t*, i.e., the official CDX.NA.IG spread published by Markit Group at each closing of day *t*, and P_t is the market price of the current CDX.NA.HY, CDX.EM or LCDX series at day *t*, i.e., the official CDX.NA.HY, CDX.EM or LCDX price published by Markit Group at each closing of day *t* Mid spreads and prices are used.

4.1 Index calculation

The base index level is set to be 100 at the launch day of Series 8 of the CDX.NA.IG index (i.e., 20 March 2007) for the Markit CDX.NA.IG 5-year TOTAL RETURN INDEX, set to be 100 at the launch day of Series 8 of the CDX.NA.HY index (i.e., 27 March 2007) for the Markit CDX.NA.HY 5-year TOTAL RETURN INDEX, set to be 100 at the launch day of Series 7 of the CDX.EM index (i.e., 20 March 2007) for the Markit CDX.EM 5-year TOTAL RETURN INDEX and 100 at the launch day of Series 14 of the LCDX index (i.e., 5 April 2010) for the Markit LCDX 5-year TOTAL RETURN INDEX.

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 CDX / LCDX index R_t^{CDS} plus the return on the cash position R_t^{cash}.

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

$$R_t^{cash} = \begin{cases} (1 + CDS_{t-1}(S_{t-1})) * t_{O/N}\, f_t & for\ the\ CDX.NA.IG\ index \\ (1 + (1 - [P_{t-1} + AC_{t-1}])) * t_{O/N}\, f_t & for\ the\ CDX.NA.HY, CDX.EM, LCDX\ index \end{cases}$$

$$R_t^{CDS} = \begin{cases} CDS_{t-1}(S_{t-1}) - CDS_t(S_t) + Coupon_t & for\ the\ CDX.NA.IG\ index \\ (P_t + AC_t - 1) - (P_{t-1} + AC_{t-1} - 1) + Coupon_t & for\ the\ CDX.NA.HY, CDX.EM, LCDX\ index \end{cases}$$

where

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

P_t is the market price of the current CDX.NA.HY, CDX.EM or LCDX series at day *t* i.e. $1 - P_t$ is the clean price for buying protection on the CDX.NA.HY, CDX.EM or LCDX index.

AC_t is the Accrued Coupon till day *t* from the last coupon day.

$Coupon_t$ is the coupon paid on day *t* by the current CDX / LCDX 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 Federal Funds Rate 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 roll 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, 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:

For the CDX.NA.IG 5-year TOTAL RETURN INDEX, 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.

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

where

$S_t^{oldseries}$: the market spread of the old CDX.NA.IG 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 CDX.NA.IG 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

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

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

For CDX.NA.HY 5-year TOTAL RETURN INDEX, CDX.EM 5-year TOTAL RETURN INDEX and LCDX 5-year TOTAL RETURN INDEX the excess return is the sum the cost of switching at *t* from the old series to the new one

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

where

$TC^{oldseries}$ is the transaction cost of rolling out of the old series / version

$TC^{newseries}$ is the transaction cost of rolling into the new series / version

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

4.3 Daily Rebalancing to Maintain Constant Leverage

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

Suppose on day *t-1* a notional of 1 was invested with leverage of 1 on the CDX.NA.IG index, i.e., to sell protection on notional of 1 on the CDX.NA.IG index 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 the CDX.NA.IG index 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 sells protection on a notional of 1 on the CDX.NA.IG index. This results in an upfront payment on the CDX.NA.IG index 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 CDX.NA.IG index 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 the CDX.NA.IG index 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 Market[1]

The mark-to-market value of an CDX.NA.IG index 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.,

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

where,

$$\text{PV(Contingent Leg)} = \frac{1}{2}(1-\delta)\sum_{i=2}^{n}(Z_i + Z_{i-1})(\pi_{i-1} - \pi_i)$$

$$\text{PV(Fee Leg)} = C\left(\tau_1 Z_2 + \sum_{i=2}^{n}\tau_i Z_i \pi_i\right) + C\sum_{i=2}^{n}\frac{\tau_i}{2}\frac{(Z_{i-1}+2Z_i)}{3}(\pi_{i-1}-\pi_i)$$

$$= C\left[\tau_1 Z_2 + \sum_{i=2}^{n}\frac{\tau_i}{6}\left[6Z_i\pi_i + (Z_{i-1}+2Z_i)(\pi_{i-1}-\pi_i)\right]\right]$$

T_i: T_0 is the previous coupon date, T_1 is the valuation date[2], 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.

$Z_0 = 1$

π_i: Survival Probability to time T_i, $\pi_0 = \pi_1 = 1$

δ: Recovery rate

C is the fixed coupon of the CDX.NA.IG index

Assuming a flat credit curve which is equal to the market spread S of the CDX.NA.IG index, the Survival Probabilities π_i at each coupon payment date (from T_2 on) are calculated as

[1] This methodology is a property of Markit Group Limited.

[2] To take into account the fact that a trade executed at day *T* is effective only from day *T+1*.

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

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

5 Further information

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