S&P Dow Jones Indices

A Division of S&P Global

Markit iBoxx Trepp CMBS Liquid Index Guide

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1) Markit iBoxx Trepp CMBS Liquid Index

The Markit iBoxx Trepp CMBS Liquid Index is designed to reflect the performance of USD denominated commercial mortgage backed securities which are rated as AAA at issuance and maintain a current rating of A or higher. The index rules aim to cover the investable and liquid USD CMBS universe, which is an integral part of the Markit iBoxx Trepp CMBS Benchmark Index. As of 31 October 2014, the Liquid Index tracks around 120 bonds with current notional of approximately USD 78 billion.

All iBoxx CMBS indices static and pricing data are provided by Trepp, LLC.

This document covers the index family structure, rules and calculation methodology.

2) Bond Selection Rules

The following selection criteria are used to derive the index constituents for the Markit iBoxx Trepp CMBS Liquid universe:

- Market issue
- Deal type
- Bond type
- Country
- Deal notional
- Bond notional
- Rating
- Seniority
- Weighted Average Life
- Geographic Concentration
- Loan Concentration
- Deal Concentration
- Real Estate Type Concentration

2.1) Market Issue

For liquidity reasons, the following market types are excluded from the bond universe:

- Agency CMBS bonds
- Private placements

If IHS Markit has reasonable cause to believe that a bond is a retail bond or private placement and is unable to determine otherwise from the issuer or lead manager(s), the classification of a bond as a retail bond or private placement will be made at IHS Markit's discretion based on information available at the time of determination.

2.2) Deal Type

For liquidity reasons, only conduit deals with public information available are eligible. The following deal types are specially excluded:

- Large loan
- Single-borrower/Single-asset

2.3) Bond Type

General inclusion criteria:

- Pass-through CMBS bonds without pre-determined prepayment schedule are eligible for the indices

In particular, the following bond types are eligible:

- Fixed-rate bonds
- WAC/pass-through bonds

The following bond types are specially excluded:

- Bonds that have ever been floating-rate
- Planned Amortization Class (PAC) bonds
- Interest-only (IO) bonds
- Principal-only (PO) bonds
- Modeling bonds
- Non-pooled single-asset bonds
- Accretion (Z) bonds
- Non-floater variable bonds, including PEZ, PEX, PST, EC tranches
- Bonds secured by underlying assets that are credit-linked notes, synthetic CDOs or any similar synthetic obligations

2.4) Country

All constituents should be bonds in US conduit deals and denominated in USD.

2.5) Deal Notional

All bonds in the Markit iBoxx Trepp CMBS Liquid Index must have a minimum deal notional of USD 500 million at issuance and a minimum outstanding deal notional of USD 300 million on the rebalancing day.

2.6) Bond Notional

All bonds in the Markit iBoxx Trepp CMBS Liquid index must have a minimum bond notional of USD 100 million at issuance and a minimum outstanding bond notional of USD 10 million on the rebalancing day.

2.7) Credit rating

All bonds in the Markit iBoxx Trepp CMBS Liquid Index must have an iBoxx Rating of investment grade. Ratings from the following three credit rating agencies are considered for the calculation of the iBoxx Rating:

- Fitch Ratings
- Moody's Investor Service
- S&P Global Ratings

Investment grade is defined as BBB- or higher from Fitch Ratings and S&P Global Ratings and Baa3 or higher from Moody's Investor Service.

If a bond is rated by more than one of the above agencies, then the iBoxx rating is the average of the provided ratings. The rating is consolidated to the nearest rating grade. Rating notches are not used. For more information on how the average rating is determined, please refer to the *iBoxx Rating Methodology* document. The methodology can be found on www.ihsmarkit.com under *Methodology*.

2.8) Seniority

To be included in the Markit iBoxx Trepp CMBS Liquid Index, all bonds must be super senior classes in the deal. Given the constraints on both credit rating and seniority, all bonds in the Index are ERISA eligible.

2.9) Weighted Average Life

For liquidity reasons, all bonds in the Markit iBoxx Trepp CMBS Benchmark Index must have a minimum weighted average life of 1 year on the rebalancing day. If the weighted average life of a constituent falls below 1 year during the month, the constituent will be removed from the index on the next rebalancing day. If the weighted average life of the bond goes above 1 year afterwards, it is eligible to come back to the index on the next rebalancing day if the bond satisfies all other criteria.

2.10) Geographic Concentration

The commercial properties that secure any bond in the Markit iBoxx Trepp CMBS Liquid Index must be sufficiently geographically diverse so that properties in one state in the United States do not represent more than forty percent (40%) of the aggregate value of the properties securing the CMBS Offering.

2.11) Loan Concentration

The loans that secure any bond in the Index must be sufficiently diverse so that the Top 10 loans do not represent more than fifty percent (50%) of the aggregate value of the loans securing the CMBS Offering.

2.12) Deal Concentration

To ensure the CMBS deals from which bonds are selected are sufficiently diverse, in each deal that satisfies all other eligibility rules, only one bond could be picked from each iBoxx current rating category (AAA, AA+, AA, AA-, A+, A, A-). If there is more than one eligible bond with the same rating in a deal, the tranche with the most credit enhancement (and among tranches with equal credit enhancement, the tranche which has the longest weighted average life; and among tranches with equal weighted average life, the tranche which has the largest original balance) should be selected.

2.13) Real Estate Type Concentration

No single real estate type (multi-family, office, etc) can represent more than sixty percent (60%) of the aggregate value of the properties securing the CMBS Offering. Bonds secured by one hundred percent (100%) multi-family loans are excluded.

3) Bond classification

All bonds are classified based on the principal activities of the issuer and the main sources of the cash flows used to pay coupons and redemptions. In addition, a bond's specific collateral type or legal provisions are evaluated. Hence, it is possible that bonds issued from different subsidiaries of the same issuer carry different classifications.

The issuer classification is reviewed regularly based on updated information received by IHS Markit, and status changes are included in the index at the next rebalancing if necessary.

Where the sector classification of a specific entity is not very clear due to the diversified business of the entity, decision will be made at IHS Markit's discretion. IHS Markit will assign the IHS Markit classification according to its evaluation of the business risk presented in the security prospectus and annual reports, if available. IHS Markit will also compare the classification to peers in the potential sectors and may consult with the Index Advisory Committees. Membership lists including classification are published on the FTP server and in the *Indices* section on www.ihsmarkit.com for registered users.

3.1) Overall Bond Classification Scheme

The following classification scheme is used for the bonds:

- Level 0: USD
- Level 1: D
- Level 2: Non-Treasuries
- Level 3: Collateralized
- Level 4: CMBS
- Level 5: Dominant/Diversified
  - > Dominant: when the most concentrated real estate type in the deal is not lower than 50%
    - − Level 6-8: Top 1 real estate type
  - > Diversified: when the most concentrated real estate type in the deal is lower than 50%
    - − Level 6-8: Top 3 real estate types which are higher than 10%

Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8
USD	D	Non-Treasuries	Collateralized	CMBS	Dominant	Retail	Retail	Retail Anchored
USD	D	Non-Treasuries	Collateralized	CMBS	Dominant	Retail	Retail	Retail Unanchored
USD	D	Non-Treasuries	Collateralized	CMBS	Dominant	Office	Office	*
USD	D	Non-Treasuries	Collateralized	CMBS	Dominant	Residential	Multifamily	*
USD	D	Non-Treasuries	Collateralized	CMBS	Dominant	Travel & Leisure	Hotel	Hotel Full
USD	D	Non-Treasuries	Collateralized	CMBS	Dominant	Travel & Leisure	Hotel	Hotel Limited
USD	D	Non-Treasuries	Collateralized	CMBS	Dominant	Travel & Leisure	Hotel	Hotel Other

Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8
USD	D	Non-Treasuries	Collateralized	CMBS	Dominant	Health Care	Health Care	*
USD	D	Non-Treasuries	Collateralized	CMBS	Dominant	Industrials	Industrials	*
USD	D	Non-Treasuries	Collateralized	CMBS	Dominant	Speciality	Speciality	Credit Tenant Loan (CTL)
USD	D	Non-Treasuries	Collateralized	CMBS	Dominant	Speciality	Speciality	Mobile Home
USD	D	Non-Treasuries	Collateralized	CMBS	Dominant	Speciality	Speciality	Mobile Use
USD	D	Non-Treasuries	Collateralized	CMBS	Dominant	Speciality	Speciality	Others
USD	D	Non-Treasuries	Collateralized	CMBS	Diversified	Diversified	A combination of 2-3 sectors out of level 7 sectors under "Dominant"	*

The following seniority classification scheme is used for bonds:

Seniority Level 1	Seniority Level 2	Seniority Level 3 (sequence of payment)
SEN	Supersenior	1
	MezzSenior	2-18
	SubSenior	2-18
SUB	Subordinated	2-18

4) Index Calculation

4.1) Static Data

Information used in the Markit iBoxx Trepp CMBS index calculation, including bond/deal static data and payment information, is sourced from Trepp, LLC.

4.2) Bond Prices

Bond price information used in the Markit iBoxx Trepp CMBS indices is sourced from Trepp, LLC. Ask prices are derived from Trepp, LLC, bid prices by applying a bid-ask spread provided by Markit's Pricing Data service.

4.3) Rebalancing Process

All Markit iBoxx Trepp CMBS indices are rebalanced monthly at the month-end ("rebalancing day"). Classifications are determined four business days before the end of the month. Except ratings, changes to bond reference data such as notional outstanding are only taken into account if they are publicly known three business days before the end of the month. Any changes after the index cut-off day (t-3) will not be considered in this re-balancing process, but will become effective at the end of the following month. Rating cut-off day for index membership is two business days before the end of the month (t-2). New bonds issued are taken into account if they are publicly known to close three business days before the last calendar day of the month, inclusive, and if their rating and amount outstanding has become known at least three business days before the end of the month.

Two business days before the end of the month the final index membership list for the following month is published at the close of business.

On the last business day of each month, IHS Markit publishes the final membership with closing prices for the bonds, and various bonds analytics based on the index prices of the bonds.

4.4) Index Data

Calculation occurs on a daily basis as soon as Trepp, LLC, prices are available. Price quotes are provided and the indices calculated every day in the SIFMA calendar and for the last calendar day of each month. Index calculation is based on bid quotes. New bonds are included in the indices at their respective ask prices when they enter the index family. In the event that no new quotes for a particular bond are received, the index will continue to be calculated based on the last available Trepp, LLC, prices. This might be the case in periods of market stress, or disruption as well as in illiquid or fragmented markets.

All bonds are assigned to sub-indices according to their classification. The assignment of a bond to a certain maturity bucket is based on its expected remaining life. All bonds remain in their maturity bucket for the entire month.

4.5) Index Calculus

Cash received from interest payment, principal payment or prepayment will not be reinvested into the index until the end of month (next rebalancing day). For specific index formulae please see the appendix.

4.6) Treatment of the special intra-month events

4.6.1) Missing Prices and Analytics

There are several circumstances that some bonds may stop being priced for a few days by data providers. To avoid unnecessary turnover, for index membership, Markit iBoxx Trepp CMBS Benchmark Indices can use prices and analytics carried forward for at most seven business days. If a bond has been included in the index and does not have prices during the month, the latest price will be carried forward until the earlier of a) next rebalancing for index calculation b) when the bond resumes being priced. The bond will be excluded for index analytics calculations such as yield, spread and duration during the month.

4.6.2) Newly Issued Bonds

In normal cases, accrued interests and unrealized cash are calculated using the bond coupon rate at the last exdividend day. For newly issued bonds, the coupon rate at the last ex-dividend day is not available, so the first available coupon rate is used instead for the first accrual period.

4.6.3) Distressed Bonds

Distressed bonds are defined as bonds with bid prices lower than 10. Markit iBoxx Trepp CMBS Benchmark Indices do not include distressed bonds. If a constituent turns into a distressed bond during the month, it will be excluded from index analytics calculations such as yield, spread and duration during the month and removed from the index on the next rebalancing day.

Distressed bonds that satisfy all other criteria will enter a separate distressed bond index, which will not provide index analytics except price.

4.7) Index Weighting

Markit iBoxx Trepp CMBS Liquid Index is base-market-value weighed, with the bond's market value on the rebalancing day as the weighting factor. To ensure sufficient diversification, the Liquid Index weight is subject to a vintage cap of 30% and a shelf cap of 5%. The weight of a bond is only adjusted in the monthly re-balancing process at the end of each month.

4.8) Index history

The Index history starts on 31 December 2006. The index has a base value of 100 on that date.

4.9) Settlement conventions

All iBoxx indices are calculated using the assumption of T+0 settlement days.

4.10) Calendar

IHS Markit publishes an index calculation calendar in the *iBoxx Calendars* section of the iBoxx Documentation page on www.ihsmarkit.com. This calendar provides an overview of the index calculation holidays of the iBoxx bond index families in a given year.

4.11) Publication of the Markit iBoxx Trepp CMBS Liquid Index

All indices are calculated at the end of each business day and are re-balanced at the end of each month. The indices are calculated on the basis of end-of-day Trepp prices on each trading day defined in the iBoxx CMBS Index calculation calendar. The index calculation calendar is available on IHS Markit website. Index data and bond price information are also available from the main information vendors.

The index calculation calendar conforms to the recommendations of the Securities Industry and Financial Markets Association (SIFMA):

- The indices are calculated on each SIFMA recommended US trading day and on the last calendar day of each month.

Prices for all bonds are taken at 4pm EST. Following collection of prices, price consolidation and index and analytics calculations take place. Index data is published and distributed approximately 2 hours after price delivery.

4.12) Data publication and access

The table below summarizes the publication of the Markit iBoxx Trepp CMBS Liquid Index in the *Indices* section of the IHS Markit website www.ihsmarkit.com for registered users and on the FTP server.

Table 1: Publication types and access

Frequency	File Type	Access
Daily	Underlying files – Bond level	IHS Markit FTP Server
	Indices files – Index level	IHS Markit FTP Server / IHS Markit website/ Bloomberg for index levels only
Daily from the 6th calendar day of the month (or the next index publication day if the 6th calendar day falls on a non-business day)	Forward Files	IHS Markit FTP Server
Monthly	End of Month Components	IHS Markit FTP Server / IHS Markit website
	XREF files	IHS Markit FTP Server

4.13) Index review

The rules for the Index are reviewed on a periodic basis during the public review and consultation process to ensure that the index provides a balanced representation of the EUR denominated debt market. Decisions made following feedback from market participants, the index review and External Advisory Committees (EAC) will be published on www.ihsmarkit.com shortly after the EACs have been held. The publication will contain a detailed overview and timelines for implementation of any rules changes.

5) Appendix:

5.1) Index Calculation

All iBoxx indices are basket indices that express relative changes in value compared to the beginning of the respective period. The composition and weightings of the index are adjusted at the beginning of each period. Accordingly, adjustments to index-tracking portfolios are only needed at the end of each period.

Benchmark price index

$$PI_t = PI_{t-s} \cdot \frac{\sum_{i=1}^{n} P_{i,t} \cdot F_{i,t-s} \cdot N_{i,t-s} \cdot F_{i,t-s}^{Cap}}{\sum_{i=1}^{n} P_{i,t-s} \cdot F_{i,t-s} \cdot N_{i,t-s} \cdot F_{i,t-s}^{Cap}}$$

Current Factor

The current factor, Fi,t , is a mix of real current factor and projected factor throughout a month. For each bond, from the start of each accrual period to the day before next distribution day, projected factor is used; for the rest, real current factor is used. The indices are based on consolidated bid quotes. Bonds not currently in the iBoxx universe enter the indices at the next rebalancing and are included in the index calculation at the beginning of the next period using the closing ask prices from the last trading day of the previous period.

Total Return Index Components

Nominal Value

The nominal value of the index is the sum of the individual bond nominal values and is calculated as follows:

$$NV_t = \sum_{i=1}^{n} F_{i,t-s} \cdot N_{i,t-s} \cdot F_{i,t-s}^{Cap}$$

Market Value

The market value of a single bond at time t is calculated as follows:

$$MV_{i,t} = [P_{i,t} + (A_{i,t} + XD_{i,t-s} \cdot CP_{i,t}) \cdot FA_{i,t}] \cdot F_{i,t} \cdot N_{i,t-s} \cdot F_{i,t-s}^{Cap}$$

The capping factor,

$$F_{i,t-s}^{Cap}$$

will normally be 1, unless in cases where capping is applied.

The market value of the index is the sum of the market values of all bonds at time t and is calculated as follows:

$$MV_t = \sum_{i=1}^{n} MV_{i,t}$$

Base Market Value

The base market value is the market value of the bond calculated at the rebalancing date (t-s); it also does not take cash payments into account. The base market value of a single bond at time t is calculated as follows:

$$BMV_{i,t-s} = (P_{i,t-s} + A_{i,t-s} \cdot FA_{i,t-s} \cdot N_{i,t-s} \cdot F_{i,t-s}^{Cap})$$

The base market value of the index is the sum of the base market values of all bonds and is calculated as follows:

$$BMV_{t-s} = \sum_{i=1}^{n} BMV_{i,t-s}$$

Accrued Interest

Interests accrued are calculated and provided by trepp daily. For index history, it was assumed that all bonds accrued during the calendar month preceding the actual bond payment and pay on a 30/360 basis.

Accrued interest for the first coupon period:

$$A_{i,t} = \frac{days_{30}(FSD, t)}{360} \cdot C \cdot FA_{t,i,t}$$

Accrued interest for the 2nd and subsequent coupon periods:

The days between the settlement date and the last coupon date are calculated as follows:

$$A_{i,t} = \frac{days_{30}(Dat(C_{i-1}), t)}{360} \cdot C \cdot FA_{t,i,t}$$

Cash Payment

The cash payment for a single bond at time t is the sum of all coupon and scheduled redemption payments since the last index rebalancing plus the redemption value if the bond has already been fully redeemed:

$$CV_{i,t-s} = CV_{i,t-s}^{Coupons} + CV_{i,t}^{Redemptions}$$

$$CV_{i,t}^{Coupons} = \sum_{t-s<j\leq t} G_{i,j} \cdot XD_{i,j-1} \cdot F_{i,j-1} \cdot FA_{t,i,j} \cdot N_{i,t-s} \cdot F_{i,t-s}^{Cap}$$

$$CV_{i,t}^{Redemptions} = \sum_{t-s<j\leq t} R_{i,j} \cdot RP_{i,j} \cdot FA_{t,i,j} \cdot N_{i,t-s} \cdot F_{i,t-s}^{Cap}$$

Generally, it is assumed that there is only one coupon payment and one redemption payment per calculation period. The XD factor only applies for the first coupon payment in the given period. In situations where this is not the case, special cash payments are dealt with as follows:

$$CV_{i,t-s<j\leq t} = (XD_{i,t-s} \cdot G_{i,t1} \cdot FA_{t,i,t1} \cdot F_{i,t1-1} + \sum_{t1<j\leq t}^{n} G_{i,j} \cdot F_{i,j-1} \cdot FA_{t,i,j} + \sum_{t-s<j\leq t}^{n} R_{i,j} \cdot RP_{i,j} \cdot FA_{t,i,j}) \cdot N_{i,t-s} \cdot F_{i,t-s}^{Cap}$$

The different adjustment factors

$$F_{i,t}, F_{i,t-s}$$

are used for sinking funds, amortizing bonds, pay-in-kind bonds, and unscheduled full redemptions. For other bond types, F always equals 1.

The cash payment of all bonds in an index is calculated as follows:

$$CV_t = \sum_{i=1}^{n} CV_{i,t}$$

Benchmark total return Index

The calculation of the local currency total return index is below.

The total return index can be expressed in terms of market values and cash:

$$TR_t = TR_{t-s} \cdot \frac{MV_t + CV_t}{BMV_{t-s}}$$

Benchmark Income Indices

The benchmark coupon income index is calculated as follows:

$$IC_t = IC_{t-s} + GI_{t-s} \cdot \frac{CV_{i,t}^{Coupons}}{BMV_{t-s}}$$

The benchmark redemption income index is calculated as follows:

$$IR_t = IR_{t-s} + GI_{t-s} \cdot \frac{CV_{i,t}^{Redemptions}}{BMV_{t-s}}$$

The benchmark income index is calculated as follows:

$$IN_t = IN_{t-s} + GI_{t-s} \cdot \frac{CV_{i,t}^{Coupons} + CV_{i,t}^{Redemptions}}{BMV_{t-s}}$$

Or simplified:

$$IN_t = IC_t + IR_t$$

5.2) Index Analytics

The average annual yield is calculated by weighting the yield of each bond with the corresponding market capitalization and duration of the respective bond.

$$RY_t = \begin{cases} \sum_{i=1}^{n} Y_{i,t}^{a} \cdot W_{i,t}^{D} Index of bonds \\ \sum_{i=1}^{n} RY_{i,t} \cdot W_{i,t}^{D} Index of indices \end{cases}$$

The average duration is weighted by the market capitalization of the respective bonds.

$$DU_t = \begin{cases} \sum_{i=1}^{n} D_{i,t} \cdot W_{i,t}^{MV} Index of bonds \\ \sum_{i=1}^{n} DU_{i,t} \cdot W_{i,t}^{MV} Index of indices \end{cases}$$

The average portfolio duration is calculated as follows:

$$DPU_t = \begin{cases} \sum_{i=1}^{n} D_{i,t} \cdot W_{i,t}^{MVC} Index of bonds \\ \sum_{i=1}^{n} DPU_{i,t} \cdot W_{i,t}^{MV} Index of indices \end{cases}$$

The average coupon is nominally weighted. For bonds with a multi-coupon schedule, the current coupon is included.

$$CO_t = \begin{cases} \sum_{i=1}^{n} C_{i,t} \cdot W_{i,t}^{N} Index of bonds \\ \sum_{i=1}^{n} CO_{i,t} \cdot W_{i,t}^{N} Index of indices \end{cases}$$

The average weighted average life (WAL) for CMBS bonds is weighted by nominal value of the respective bonds.

$$CO_t = \begin{cases} \sum_{i=1}^{n} WAL_{i,t} \cdot W_{i,t}^{N} Index of bonds \\ \sum_{i=1}^{n} WAL_{i,t} \cdot W_{i,t}^{N} Index of indices \end{cases}$$

The average rating calculation requires that the ratings first be converted to numbers according to iBoxx Rating Methodology, then weighted by market value of the respective bonds and converted from numbers to ratings. The average rating is calculated as follows:

$$CO_t = \begin{cases} \sum_{i=1}^{n} RA_{i,t} \cdot W_{i,t}^{MV} Indexofbonds \\ \sum_{i=1}^{n} RA_{i,t} \cdot W_{i,t}^{MV} Indexofindices \end{cases}$$

The average delinquency rate for CMBS bonds is weighted by nominal value of the respective bonds.

$$CO_t = \begin{cases} \sum_{i=1}^{n} DL_{i,t} \cdot W_{i,t}^{N} Indexofbonds \\ \sum_{i=1}^{n} DL_{i,t} \cdot W_{i,t}^{N} Indexofindices \end{cases}$$

The average credit enhancement rate for CMBS bonds is weighted by nominal value of the respective bonds.

$$CO_t = \begin{cases} \sum_{i=1}^{n} CE_{i,t} \cdot W_{i,t}^{N} Indexofbonds \\ \sum_{i=1}^{n} CE_{i,t} \cdot W_{i,t}^{N} Indexofindices \end{cases}$$

Index Asset Swap Spread

$$CO_t = \begin{cases} \sum_{i=1}^{n} ASW_{i,t} \cdot W_{i,t}^{D} Indexofbonds \\ \sum_{i=1}^{n} ASW_{i,t} \cdot W_{i,t}^{D} Indexofindices \end{cases}$$

5.3) Annotations

Δy = Parallel shift amount of the sport rate yield curve

Δj,t = Change in amount outstanding of bond j at time i

$A_{i,t}$ = Accrued interest of bond i at time t

$A_{i,t-s}$ = Accrued interest of bond i at the last rebalancing

$A^{N}_{i,t}$ = Nominal accrued interest for bond i at date t

$A^{R}_{i,t}$ = Real accrued interest for bond i at date t

$ASW_{i,t}$ = Asset swap spread of a bond i at time t

bdays = Business Days

BMS^{a}_{t} = Annualized index benchmark spread at time t

BMS^{S}_{t} = Semi-annualized index benchmark spread at time t

$BMS^{a}_{i,t}$ = Annualized benchmark spread of bond i at time t

$BMS^{s}_{i,t}$ = Semi-annualized benchmark spread of bond i at time t

BMV_{t-s} = Base market value of the index at the rebalancing

$BMV_{i,t-s}$ = Base market value of bond i at the rebalancing

C = Annual Coupon

C_{a} = Accrued interest for bond i

C_{b} = Next coupon after the coupon change

C_{i} = (Next) coupon payment

$C_{i,t}$ = Current coupon of bond i at time t

C_{i+1} = Coupon payment in the period of the coupon change

C^{annual}_{i} = Annual coupon of bond i

$C^{N}_{i,t,t^{\wedge}}$ = Nominal coupon payment for bond i payable at t^ as of the calculation date

$C^{R}_{i,t^{\wedge}}$ = Real coupon payment for bond i payable at t^

C_{t} = Coupon payment

$CASH_{t}$ = Cash at time t

$CASH_{t-1}$ = Cash at the previous trading day

$CASH_{t-s}$ = Cash at the end of the last month

$CF_{i,j}$ = Cash flow of bond i in the jth period

$CF_{i,t}$ = Cash-flow of bond i at date t quoted to a notional of 100

$CF^{K}_{i,j}$ = Cash flow of a bond

CO_{t} = Average coupon at date t

$CO_{i,t}$ = Average coupon for bond i at time t

Cost = Cost factor

$CP_{i,t}$ = Value of the next coupon payment of bond i during an ex-dividend period (because the next coupon is separated from the bond during the ex-dividend period). Outside the ex-dividend period, the value is 0

$CP_{i,t-s}$ = Value of the next coupon payment of bond i (at the last rebalancing) during an ex-dividend period (because the next coupon is separated from the bond during the ex-dividend period). Outside the ex-dividend period, the value is 0

CPI_t = CPI level on the calculation date

$CPI_{i,t0}$ = CPI level on the base date of bond i

$CPI_{t(y-1)}$ = CPI level one year prior to the calculation date

CV_t = Cash payment of all bonds at time t

$CV_{i,t}$ = Cash payment of bond i at time t

$CV^{Coupons}_{\ t}$ = Coupon payments of all bonds i at time t

$CV^{Redemptions}_{\ t}$ = Redemption payments of all bonds at time t

$CV^{Coupons}_{\ i,t}$ = Coupon payment of bond i at time t

$CV^{Redemptions}_{\ i,t}$ = Redemption payment of bond i at time t

$CX^{a}_{\ i,t}$ = Annual convexity of bond i at time t

$CX_{i,t}$ = Convexity of bond i at time t

$CX^{S}_{\ i,t}$ = Semi-annualized convexity of bond i at time t

$CXPU^{S}_{\ t}$ = Average semi-annualized portfolio convexity at time t

$CXPU^{S}_{\ i,t}$ = Average semi-annualized portfolio convexity for bond i at time t

$CXPU^{a}_{\ t}$ = Average annual portfolio convexity at time t

$CXPU^{a}_{\ i,t}$ = Average annual portfolio convexity for bond i at time t

$CXU^{S}_{\ t}$ = Average semi-annualized convexity at time t

$CXU^{S}_{\ i,t}$ = Average semi-annualized convexity for bond i at time t

$CXU^{a}_{\ t}$ = Average annual convexity at time t

$CXU^{a}_{\ i,t}$ = Average annual convexity for bond i at time t

$D_{i,t}$ = Duration of bond i at time t

d1,d2 = Day of date ½

$Dat(C_{a,}C_b)$ = Date of coupon change

$Dat(C_i)$ = Date of *i*-th coupon payment

$Dat(C_{i+1})$ = Date of the (next) coupon payment

$Dat(C_F)$ = Fictitious coupon date one exact coupon period before the first coupon payment date

$Dat(C_{F-1})$ = Fictitious coupon date one exact coupon period prior to $Dat(C_F)$

days(date1,date2) = Function to calculate the number of days between two dates for the ACT/ACT day count convention

$days_{ACT}$ = Day count fraction using the actual number of days in the period

$days_{MM}(t-s,t)$ = Day count fraction between dates t-s and t according to the prevailing money market day count

DP = Dirty Price

DPU_t = Average portfolio duration at time t

$DPU_{i,t}$ = Average portfolio duration for bond i at time t

DU_t = Average duration at time t

$DU_{i,t}$ = Average duration for bond i at time t

f_i = Amount invested for bond i

f_i^+ = Amount invested per bond after the rebalancing

f_{i^-} = Amount invested per bond before the rebalancing

$F_{i,t}$ = The product of the redemption adjustment and the pay-in-kind adjustment factors for bond i at date t

$F_{i,j-1}$ = The product of the redemption adjustment and the pay-in-kind adjustment factors for sinking funds, amortizing and pay-in-kind bonds of fully redeemed bond i at date j-1, i.e. one day before j

$F_{i,t-s}$ = The product of the redemption adjustment and the pay-in-kind adjustment factors for bond i at the last rebalancing

$F^{Cap}_{\ i}$ = Capping factor for bond i

$F^{Cap}_{\ i,t-s}$ = Capping factor for bond i at the last rebalancing

$FA_{i,t}$ = Flat of accrued flag of bond i and date t (0 if the bond is trading flat of accrued, 1 otherwise)

$FA_{i,t-s}$ = Flat of accrued flag of bond i at the last rebalancing (0 if the bond is trading flat of accrued, 1 otherwise)

$FA_{i,i,t}$ = Flat of accrued flag of bond i and date t that is valid on date t (0 if the bond is trading flat of accrued, 1 otherwise)

FSD = First settlement date

$FX^{LCY/CCY}_{\ t}$ = Spot exchange rate at t (rebalancing)

$FX^{LCY/CCY}_{t-s}$ = Spot exchange rate at t-s (last rebalancing)

$FX^{LCY/CCY}_{t-s,t}$ = Forward exchange rate at t-s for the period t-s, t

$G_{i,j}$ = Coupon payment received from bond i between the day of the payment and month-end. If none the value is set to 0.

$G_{i,t}$ = Value of any coupon payment received from bond i at time t. If none the value is 0.

$G_{i,t1}$ = Value of any coupon payment received from bond i at the first payment date. If none the value is 0.

GI_t = Gross price index at date t

GI_{t-s} = Gross price index at the last rebalancing before t

IC_t = Coupon income index at date t

IC_{t-s} = Coupon income index at the last rebalancing before t

IN_t = Income index at date t

IN_{t-s} = Income index at the last rebalancing before t

IR_t = Redemption income index at date t

IR_{t-s} = Redemption income index at the last rebalancing before t

$IR_{i,t}$ = Index ratio applicable to bond i on the calculation date

$IR_{i,t,t+}$ = Index ratio based on the most recently published CPI level on the calculation date applicable to t+

$IR_{i,t,t^}$ = Index ratio applicable to the cash flow at t* for bond i estimated as of the calculation date t

IV_t = Index market value at time t

IV^{Hedge}_{t-s} = Hedged index market value at the rebalancing

$IV^{HedgedPortion}_{t}$ = Hedged portion of the index market value at time t

$IV^{UnhedgedResidual}_{t}$ = Unhedged portion of the index market value at time t

LXR^{LCY}_{t} = Local currency index return level at time t

LXR^{LCY}_{t-s} = Local currency index return level at the last rebalancing, can apply to both total return and price return

LXR^{H}_{t} = Hedged index returns at time t, can apply to both total return and price return

LXR^{U}_{t} = Unhedged index returns at time t, can apply to both total return and price return

$L^{a}_{i,t,j}$ = Time in years for bond i between date t and the jth cash flow

$L_{i,t,j}$ = Time in coupon periods for bond i between date t and the jth cash flow

$L_{t,j}$ = Time difference in coupon periods between t and j

L_t = Number of days between floating rate payments

$LCR^D_{i,t}$ = Daily local index return for bond i at time t

$LCR^M_{i,t}$ = Daily local index return for bond i at time t

$LF_{i,t}$ = Expected remaining life of bond i at time t; average life for amortizing bonds and sinking funds

LFU_t = Average expected remaining life at time t

$LFU_{i,t}$ = Average expected remaining life for bond i at time t

m = Number of coupon payments per year

m1,m2 = Month of date ½

M^- = Market value of portfolio before rebalancing

$MD_{i,t}$ = Modified duration of bond i at time t

MDU^a_t = Average annualized modified duration at time t

$MDU^a_{i,t}$ = Average annualized modified duration for bond i at time t

MDU^s_t = Average semi-annualized modified duration at time t

$MDU^s_{i,t}$ = Average semi-annualized modified duration for bond i at time t

$MDPU^a_t$ = Average annualized modified portfolio duration at time t

$MDPU^a_{i,t}$ = Average annualized modified portfolio duration for bond i at time t

$MDPU^s_t$ = Average semi-annualized modified portfolio duration at time t

$MDPU^s_{i,t}$ = Average semi-annualized modified portfolio duration for bond i at time t

M^+_I = Market value of portfolio after rebalancing based upon index prices

M^+_P = Market value of portfolio after rebalancing based upon transaction prices

$MV_{i,t}$ = Market value of bond i at date t

MV_t = Market value of all bonds in the index at time t

$MV_{i,t-s}$ = Base market value of bond i at the last rebalancing

MV_{t-s} = Base market value of the index at the last rebalancing

MV^{P}_{i} = Market value of bond i referring to transaction prices

MV^{I}_{i} = Market value of bond i referring to index price

n = Number of bonds (number of future cash flows in the index)

$N_{i,t}$ = Adjusted amount issued of bond i at date t

$N_{i,t-s}$ = Notional of bond i at the last rebalancing = (a) Notional amount outstanding of bond i at the last rebalancing = (b) Fictitious nominal of bond i (substitutes) = (c) Zero (0) for dropped bonds

$MV^{N}_{i,t}$ = Inflation-adjusted notional for bond i on the calculation date

NV_t = Nominal value at date t

π_t = Assumed annual inflation on the calculation date

$OAS_{i,t}$ = is the OAS of a bond i at time t

$P_{i,t}$ = Clean price of bond i at time t

P^{I}_{i} = Index price of bond i

$P^{N}_{i,t}$ = Nominal clean price for bond i on the calculation date

P^{P}_{i} = Portfolio price of bond i

$P^{R}_{i,t}$ = Real clean price for bond i on the calculation date

$P_{i,t-s}$ = Closing price of bond i on the last trading day of the previous month

PI_t = Price index level at time t

PI_{t-s} =Closing price index level on the last calendar day of the previous month

PV_{Fixed} = Present value of fixed payments

$PV_{Floating}$ = Present value of floating payments

PV_t = Present value of the bond at time t

PV_- = Present value of the bond after yield curve shifting by $-\Delta y$

PV_+ = Present value of the bond after yield curve shifting by $+\Delta y$

$R_{i,t}$ = Redeemed portion of the issue (in % of par) of bond i at date t

$R_{i,j}$ = Redeemed portion of the issue (in % of par) of bond i in the jth period

R_i = Index return for bond i

$R_{t-1,t}$ = Daily index return

$R_{t-s,t}$ = Month-to-date index return

$r_{i,t-s,t}$ = Total return of sub-index i from the last rebalancing (t-s) to t

r^{H}_{t} = Hedged return at time t

RMU_t = Value of the real monetary unit on the calculation date

$RP_{i,t}$ = Redemption price of a redeemed portion of bond i at date t

$RP_{i,j}$ = Redemption price of a redeemed portion of bond i in the jth period

$RYPS_t$ = Average semi-annual portfolio yield at time t

RYS_t = Average semi-annual yield at time t

$RYS_{i,t}$ = Average semi-annual yield for bond i at time t

RY_t = Average annual yield at time t

s = Time since last rebalancing

$SBC^{a}_{i,t}$ = Annual spread to benchmark curve of bond i at time

$SBC^{s}_{i,t}$ = Semi-annual spread to benchmark curve of bond i at time t

SD = Settlement date

$SLC^{a}_{i,t}$ = Annual spread to LIBOR curve of bond i at time t

$SLC^{s}_{i,t}$ = Annual spread to LIBOR curve of bond i at time t

$SWAP_n$ = Markit SWAP curve rate at the next coupon payment day

t = Time of calculation

t* = Date of the coupon payment t* in the same month as the settlement date t, but before or at t

t^ = Date of a cash flow

t+ = Calculation date for which most recently published CPI is valid

t0 = Base date of an inflation linked bond

t(y-1) = One year prior to the calculation date

t1 = Next coupon payment after the settlement date t

t2 = Next-but-one coupon payment after the settlement date t

ti = Date t_i (the date of the i-th cash flow)

TR_t = Total return index level at time t

TR^{Final}_{t} = Total Return index level after cost adjustment

TR^{Ideal}_{t} = Total Return index level before cost adjustment

$TR^{LCY}_{i,t}$ = Local currency total return index level for bond i at time t

TR^{LCY}_{t} = Local currency total return index level at time t

TR^{LCY}_{t-s} = Local currency total return index level at the last rebalancing

TR_{t-s} = Total Return index level after rebalancing / adjustment from the end of last month

t-s = Date of last rebalancing

w_i = Weight of bond i

w^{-+}_{i} = Weight of bond i before rebalancing

w^{-}_{cash} = Weight of cash in the index prior to the rebalancing

w^{+}_{i} = Weight of bond i after rebalancing

w^{+}_{cash} = Weight of cash in the index after the rebalancing

$w^{D}_{i,t}$ = Duration weight of bond i at time t

$w^{N}_{i,t}$ = Nominal weight of bond i at time t

$w^{Fix}_{i,t-s}$ = Fixed weight of bond i at the last rebalancing

$w^{BMV}_{i,t}$ = Base market value weight of bond i at time t

$w^{MV}_{i,t}$ = Market value weight of bond i at time t

$w^{MVC}_{i,t}$ = Market value weighting adjusted for cash of bond i at time t

$XD_{i,t}$ = Variable indicating whether bond i entered the index at the last rebalancing (t-s) during its ex-dividend period

$XD_{i,t-s}$ = 0, if the bond enters the index at the ex-dividend period (to ensure that the next coupon payment is excluded from the total return calculation)

= 1, if (a) coupon payments are not ex-dividend, (b) has not entered the index during an ex-dividend period, or (c) entered the index during a previous ex-dividend period

$XD_{i,j-1}$ = The ex-dividend factor of bond i at date j-1, i.e. one day before j. = 0, if the bond enters the index at the ex-dividend period (to ensure that the next coupon payment is excluded from the total return calculation) = 1, if (a) coupon payments are not ex-dividend, (b) has not entered the index during an ex-dividend period, or (c) entered the index during a previous ex-dividend period

XR_t = Rebalancing flag. It is linked to whether an index rebalancing occurs on the day. It is 1 on calculation days where the index re-balances and zero elsewhere. XR applies to full rebalancings as well as partial rebalancings (e.g. month-ends between quarters for liquid indices).

$Y_{i,t}$ = Yield of bond i at time t

y1,y2 = Year of date 1/2

$Y^a_{i,t}$ = Annualized yield of bond i at time t

$Y^s_{i,t}$ = Semi-annualized yield of a bond at time

$Y^a_{BM(i),t}$ = Annual benchmark yield of bond i at time t

$Y^s_{BM(i),t}$ = Semi-annual benchmark yield of bond i at time t

$Y^a_{InBMi,t}$ = Annualized yield of the interpolated benchmark of bond i at time t

$Y^s_{InBMi,t}$ = Semi-annualized yield of the interpolated benchmark of bond i at time t

Y^a_{SWAPt} = Annualized value of Markit SWAP curve at time t

Y^s_{SWAPt} = Semi-annualized value of Markit SWAP curve at time t

$Y_{2i,t}$ = Semi-annual yield of bond i at time t

$Y_{LIBIDt\text{-}s}{}^{1m}$ = 1-month interest rate for cash at the last rebalancing

$Z_t(L)$ = the function constructed by natural splines with defined knots

$Z\text{-}Spread_{i,t}$ = is the Z-spread of a bond i at time t

6) Governance and regulatory compliance

IHS Markit Benchmark Administration Limited (IMBA UK) is the Index Administrator of iBoxx indices. Information on IMBA UK's governance and compliance approach can be found here. This document covers:

- Governance arrangements, including external committees
- Input data integrity
- Conflicts of interest management
- Market disruption and Force Majeure
- Methodology changes and cessations
- Complaints
- Errors and restatements
- Reporting of infringements and misconduct
- Methodology reviews
- Business continuity

More details about IMBA UK can be found on the Administrator's website.

7) Changes to the Markit iBoxx Trepp CMBS Liquid Index family

31 Mar 2021	Governance and Regulatory Compliance section added
31 Oct 2015	Launch of the Markit iBoxx Trepp CMBS Liquid Index Family

8) Further information

Glossary of key terms

The Markit iBoxx Glossary document of key terms is available in the *Methodology* section of the iBoxx *Documentation* page on www.ihsmarkit.com.

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A) ESG Disclosures

EXPLANATION OF HOW ENVIRONMENTAL, SOCIAL & GOVERNANCE (ESG) FACTORS ARE REFLECTED IN THE KEY ELEMENTS OF THE BENCHMARK METHODOLOGY [1]		
1	**Name of the benchmark administrator.**	IHS Markit Benchmark Administration Limited (IMBA)
2	**Underlying asset class of the ESG benchmark. [2]**	N/A
3	**Name of the S&P Dow Jones Indices benchmark or family of benchmarks.**	iBoxx Benchmark Statement
4	**Do any of the indices maintained by this methodology take into account ESG factors?**	No
Appendix latest update:		May 2023
Appendix first publication		May 2023

[1] The information contained in this Appendix is intended to meet the requirements of the European Union Commission Delegated Regulation (EU) 2020/1817 supplementing Regulation (EU) 2016/1011 of the European Parliament and of the Council as regards the minimum content of the explanation of how environmental, social and governance factors are reflected in the benchmark methodology and the retained EU law in the UK (The Benchmarks (amendment and Transitional Provision) (EU Exit) Regulations 2019.

[2] The ‘underlying assets’ are defined in European Union Commission Delegated Regulation (EU) 2020/1816 supplementing Regulation (EU) 2016/1011 of the European Parliament and of the Council as regards the explanation in the benchmark statement of how environmental, social and governance factors are reflected in each benchmark provided and published.

Disclaimer

Performance Disclosure/Back-Tested Data

Where applicable, S&P Dow Jones Indices and its index-related affiliates ("S&P DJI") defines various dates to assist our clients in providing transparency. The First Value Date is the first day for which there is a calculated value (either live or back-tested) for a given index. The Base Date is the date at which the index is set to a fixed value for calculation purposes. The Launch Date designates the date when the values of an index are first considered live: index values provided for any date or time period prior to the index's Launch Date are considered back-tested. S&P DJI defines the Launch Date as the date by which the values of an index are known to have been released to the public, for example via the company's public website or its data feed to external parties. For Dow Jones-branded indices introduced prior to May 31, 2013, the Launch Date (which prior to May 31, 2013, was termed "Date of introduction") is set at a date upon which no further changes were permitted to be made to the index methodology, but that may have been prior to the Index's public release date.

Please refer to the methodology for the Index for more details about the index, including the manner in which it is rebalanced, the timing of such rebalancing, criteria for additions and deletions, as well as all index calculations.

Information presented prior to an index's launch date is hypothetical back-tested performance, not actual performance, and is based on the index methodology in effect on the launch date. However, when creating back-tested history for periods of market anomalies or other periods that do not reflect the general current market environment, index methodology rules may be relaxed to capture a large enough universe of securities to simulate the target market the index is designed to measure or strategy the index is designed to capture. For example, market capitalization and liquidity thresholds may be reduced. In addition, forks have not been factored into the back-test data with respect to the S&P Cryptocurrency Indices. For the S&P Cryptocurrency Top 5 & 10 Equal Weight Indices, the custody element of the methodology was not considered; the back-test history is based on the index constituents that meet the custody element as of the Launch Date. Back-tested performance reflects application of an index methodology and selection of index constituents with the benefit of hindsight and knowledge of factors that may have positively affected its performance, cannot account for all financial risk that may affect results and may be considered to reflect survivor/look ahead bias. Actual returns may differ significantly from, and be lower than, back-tested returns. Past performance is not an indication or guarantee of future results.

Typically, when S&P DJI creates back-tested index data, S&P DJI uses actual historical constituent-level data (e.g., historical price, market capitalization, and corporate action data) in its calculations. As ESG investing is still in early stages of development, certain datapoints used to calculate certain ESG indices may not be available for the entire desired period of back-tested history. The same data availability issue could be true for other indices as well. In cases when actual data is not available for all relevant historical periods, S&P DJI may employ a process of using "Backward Data Assumption" (or pulling back) of ESG data for the calculation of back-tested historical performance. "Backward Data Assumption" is a process that applies the earliest actual live data point available for an index constituent company to all prior historical instances in the index performance. For example, Backward Data Assumption inherently assumes that companies currently not involved in a specific business activity (also known as "product involvement") were never involved historically and similarly also assumes that companies currently involved in a specific business activity were involved historically too. The Backward Data Assumption allows the hypothetical back-test to be extended over more historical years than would be feasible using only actual data. For more information on "Backward Data Assumption" please refer to the FAQ. The methodology and factsheets of any index that employs backward assumption in the back-tested history will explicitly state so. The methodology will include an Appendix with a table setting forth the specific data points and relevant time period for which backward projected data was used. Index returns shown do not represent the results of actual trading of investable assets/securities. S&P DJI maintains the index and calculates the index levels and performance shown or discussed but does not manage any assets.

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