Markit iBoxx Trepp CMBS Benchmark Index Guide

October 2015

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Changes to the Markit iBoxx Trepp CMBS Benchmark Index family

2015	Launch of Markit iBoxx Trepp CMBS Index Family

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1 Markit iBoxx Trepp CMBS Benchmark Indices

The Markit iBoxx Trepp CMBS Benchmark Index family is designed to reflect the performance of USD denominated commercial mortgage backed securities which are rated as investment grade at issuance. The index rules aim to offer a broad coverage of the USD CMBS universe and in the meantime ensure minimum standards of investability and liquidity. As of 31 October 2014, the Benchmark Index tracks more than 2500 bonds with current notional of approximately USD 380 billion. The indices are an integral part of the global Markit iBoxx index families, which provide the marketplace with accurate and objective reference indices by which to assess the performance of bond markets and investments.

The Markit iBoxx Trepp CMBS Benchmark Index family is broken down into sub-indices based on eight features such as ratings, seniority, vintage, sector, top state, WAL and delinquency rate.

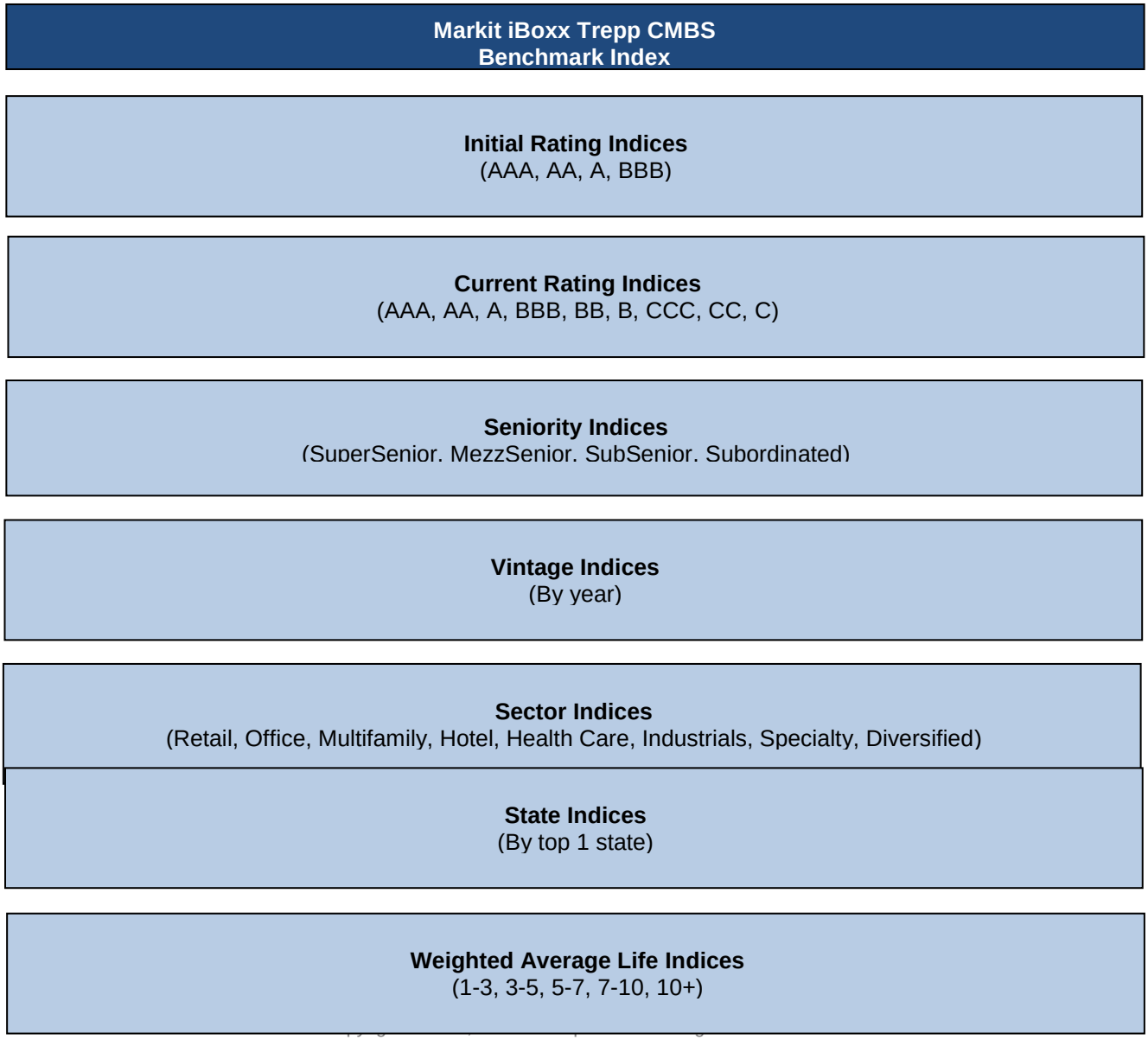
All iBoxx CMBS indices static and pricing data are provided by Trepp, LLC.

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

1.1 Index Family Structure

The Markit iBoxx Trepp CMBS Benchmark Overall Indices are aimed for a broad coverage. In order to address the different needs of investors, the Benchmark Overall Index is split into sub-indices based on eight characteristics: rating at issuance, current rating, seniority, vintage, sector, top state, weighted average life and delinquency rate. This includes various combinations of these categories, resulting in more than 500 sub-indices. The table below shows the Markit iBoxx Trepp CMBS Benchmark Index structure:

Table 1: The Markit iBoxx Trepp CMBS Benchmark Index family



Delinquency Rate Indices
(0, 0-0.01, 0.01-0.05, 0.05-0.1, 0.1+)

The Initial Rating Indices are the Benchmark Overall Index grouped by the average initial ratings that include AAA, AA, A and BBB.

The Current Rating Indices are the Benchmark Overall Index grouped by the average current ratings that include AAA, AA, A, BBB, BB, B, CCC, CC to C.

The Seniority Indices are the Benchmark Overall Index divided into indices for SuperSenior, MezzSenior, SubSenior and Subordinated bonds.

As CMBS deals revived after the crisis, some deal characteristics have changed. Hence, the Benchmark Overall Index is divided into sub-indices by year of issuance.

The Sector Indices are the Benchmark Overall Index divided into indices for CMBS bonds mainly backed by retail, office, multifamily, hotel, health care, industrials, specialty or diversified types of loans.

The State Indices are the Benchmark Overall Index divided into indices by top state of the loans supporting CMBS bonds.

The WAL Indices are the Benchmark Overall Index divided into indices for bonds with a weighted average life of 1-3, 3-5, 5-7, 7-10, 10+ years.

The Delinquency Rate Indices are the Benchmark Overall Index divided into indices for bonds with a deliquency rate of 0, 0-0.01, 0.01-0.05, 0.05-0.1 and 0.1+.

The bond classification scheme is shown in Section 3.1. Bonds are assigned to an index using the classification levels in Section 3.

1.2 Publication of the Markit iBoxx Trepp CMBS Indices

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 the 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.

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2 Bond Selection Rules

The following seven selection criteria are used to derive the Benchmark Index constituents from the USD denominated CMBS bond universe:

- Market issue
- Deal type
- Bond type
- Country
- Deal notional
- Bond notional
- Weighted average life (WAL)
- Rating

2.1 Market Issue

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

- Agency CMBS bonds
- Private placements

If 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 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 deals in the Markit iBoxx Trepp CMBS Benchmark index must have a minimum deal notional of USD 500 million at issuance and a minimum outstanding deal notional of USD 100 million on the rebalancing day.

2.6 Bond Notional

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All bonds in the Markit iBoxx Trepp CMBS Benchmark Index must have a minimum bond notional of USD 10 million at issuance and a minimum outstanding bond notional of USD 1 million on the rebalancing day.

2.7 Weighted Average Life (WAL)

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.

2.8 Credit Rating

All bonds in the Markit iBoxx Trepp CMBS Benchmark index family must have a Markit iBoxx rating of investment grade when they are issued and must be not defaulted based on Markit iBoxx Rating on the rebalancing day. Ratings from the following three credit rating agencies are considered for the calculation of the Markit iBoxx Rating:

- Fitch Ratings
- Moody's Investor Service
- Standard & Poor's Rating Services

All eligible bonds must have an investment grade Markit iBoxx rating at issuance and a Markit iBoxx Rating above D on the rebalancing day. Investment grade is defined as BBB- or higher from Fitch and Standard & Poor's and Baa3 or higher from Moody's. If a bond is rated by more than one of the above agencies, then the Markit iBoxx rating is an average of the provided ratings.

Markit iBoxx ratings are consolidated (e.g. BBB+, BBB and BBB- are consolidated to BBB; A+, A and A- are consolidated to A etc.) and determine which rating sub-index the bond belongs to. For more detail on how ratings are determined please see the Markit iBoxx Rating Methodology report on the Markit website.

Only issue ratings are considered in the bond selection process. Issuer ratings are not taken into account.

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3 Bond Classification

All bonds are classified based on the major characteristics of the deal. In addition, a bond's specific features are considered. Hence, it is possible that bonds from the same deal carry different classifications.

Where the sector classification of a specific entity is not very clear due to the diversified business of the entity, a decision will be made at Markit's discretion. Markit will assign the Markit classification according to its evaluation of the business risk presented in the security prospectus and annual reports, if available. Markit will also compare the classification to peers in the potential sectors.

The main sector classifications within the Markit iBoxx Trepp CMBS Index family are described below.

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
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	Mixed 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	1-24
	SubSenior	1-24
SUB	Subordinated	2-24

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Seniority Level 2 is derived from both sequence of payment (Seniority Level 3) and tranche names:

Seniority Level 2	
Supersenior	Eligible bonds should satisfy one of the following criteria: 1> SubLevel =1, excluding AM(or A-M) and AJ(or A-J) and AS (or A-S) by tranche name; 2> the bond is ASB (A-SB) tranche
MezzSenior	Eligible bonds should satisfy one of the following criteria: 1> By tranche name, AM(or A-M) bonds and other A- tranches with SubLevel>=2 except AJ(or A-J) and AS(or A-S); 2> the bond is ASM (A-SM) tranche
SubSenior	If not classified as “Supersenior” or “MezzSenior”: By tranche name, AJ(or A-J) and AS(or A-S) bonds, except ASB (A-SB) and ASM (A-SM) tranches
Subordinated	All others

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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, 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 appendix.

4.6 Treatment of 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 ex-dividend 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

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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

All Markit iBoxx Trepp CMBS Benchmark Indices are base-market-value weighed indices, with the bond's market value on the rebalancing day as the weighting factor. The weight of a bond is only adjusted at the monthly re-balancing at the end of each month.

4.8 Index History

The index history starts on 31 December 2006. All indices have a base value of 100 on that date.

4.9 Settlement Conventions

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

4.10 Calendar

Markit publishes an index calculation calendar which is available on the Markit website. This calendar provides an overview of the index calculation times of the Markit iBoxx bond index families in a given year.

4.11 Index Restatement

Index restatement follows the policy described in the Index restatement policy document, available on the Markit iBoxx Rules page on the Markit website in the Methodology Documentation section.

4.12 Index Review

Index methodology reviews for the indices outlined within this guide are performed on a periodic basis or when market developments occur that may warrant index rule changes. Any material changes to the methodology governing the indices are published on the Markit website.

4.13 Data Publication and Access

The table below summarises the publication of the Markit iBoxx CMBS Benchmark Indices in the indices section of the Markit website and on the FTP server.

Daily Files	**Access**
• Underlying file – Bond level • Indices files – Index level	Markit FTP Server Markit FTP Server/ Markit website/ Bloomberg for index levels only
Weekly Files	
• Previews_components	Markit FTP Server/ Markit website
Monthly files	
• End of Month Components • XREF files	Markit FTP Server/ Markit website Markit FTP Server

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5 Appendix: Index Calculation

5.1 Price and Total Return Index Calculation

5.1.1 Price 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.

CMBS Benchmark price index

$$PI_t = PI_{t-s} \frac{\sum_{i=1}^{n} P_{i,t} \cdot F_{i,t-s} \cdot N_{i,0} \cdot F_{i,t-s}^{Cap}}{\sum_{i=1}^{n} P_{i,t-s} \cdot F_{i,t-s} \cdot N_{i,0} \cdot F_{i,t-s}^{Cap}}$$

Current Factor

The current factor, $F_{i,t}$, 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.

5.1.2 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 capping factor, $F_{i,t-s}^{Cap}$ will be normally be 1, unless in cases where capping is applied.

$$MV_{i,t} = (P_{i,t} + A_{i,t}) \cdot F_{i,t} \cdot N_{i,0} \cdot F_{i,t-s}^{Cap}$$

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

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

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.[1]

Accrued interest is calculated as follows for the index history:

$$A_{i,t} = C_{i,t-s} \cdot Days_{30}(t-s, t-1) \div 360$$

Unrealized Cash

Interests accrued are usually paid days after the end of the accrual period. In between the end of the accrual period and distribution day, the accrued interests that should have been paid are recorded as unrealized cash.

[1] In calculating index history, the price that was used on a daily basis may have been inconsistent with other data used in calculations. To expand, Trepp gave Markit historical data as of each month-end for everything except prices, which were calculated every day. So for the month of July 2013 (for example), Trepp's prices would be generated using June servicer data for approximately the first half of the month. Trepp prices would be generated using July data at some point in the middle of the month and beyond. There is no way for Markit to know when this "cross-over" took place as they only have month end June and July data.

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$$UC_{i,t} = \begin{cases} 0 & \text{if t is not in ex-dividend period for bond i} \\ XD_{i,t^*} \cdot A'_{i,t^*} \cdot F_{i,t^*} \cdot N_{i,0} \cdot F_{i,t-s}^{Cap} & \text{if t is in ex-dividend period and the ex-dividend day is t*} \end{cases}$$

A'_{i,t^*} is the accrued interest for the whole month

$$UC_t = \sum_{i=1}^{n} UC_{i,t}$$

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

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:

$$BMV_{i,t-s} = (P_{i,t-s} + A_{i,t-s}) \cdot F_{i,t-s} \cdot N_{i,0} \cdot F_{i,t-s}^{Cap}$$

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

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

5.1.3 Total Return Index Calculations

Cash Payment

The cash payment for a single bond at time t is the sum of all coupon, principal and penalty payments since the last index rebalancing:

$$CV_{i,t} = CV_{i,(t-s,t)}^{\text{Coupons}} + CV_{i,(t-s,t)}^{\text{Redemptions}} + CV_{i,(t-s,t)}^{Penalty}$$

$$CV_{i,(t-s,t)}^{\text{Coupons}} = \sum_{t-s<j\le t} CV_{i,j}^{Coupons} \cdot XD_{i,j} \cdot F_{i,t^*} \cdot N_{i,0} \cdot F_{i,t-s}^{Cap}$$

$$CV_{i,(t-s,t)}^{\text{Redemptions}} = \sum_{t-s<j\le t} CV_{i,j}^{Redemptions} \cdot XD_{i,j} \cdot F_{i,t^*} \cdot N_{i,0} \cdot F_{i,t-s}^{Cap}$$

$$CV_{i,(t-s,t)}^{\text{Penalty}} = \sum_{t-s<j\le t} CV_{i,j}^{Penalty} \cdot XD_{i,j} \cdot F_{i,t^*} \cdot N_{i,0} \cdot F_{i,t-s}^{Cap}$$

Generally, it is assumed that there is only one coupon payment and one redemption payment per month.

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

$$CV_t^{\text{Coupons}} = \sum_{i=1}^{n} CV_{i,(t-s,t)}^{\text{Coupons}}$$

$$CV_t^{\text{Redemptions}} = \sum_{i=1}^{n} CV_{i,(t-s,t)}^{\text{Redemptions}}$$

$$CV_t^{\text{Penalty}} = \sum_{i=1}^{n} CV_{i,(t-s,t)}^{\text{Penalty}}$$

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

Benchmark total return Index

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

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

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$$TR_t = TR_{t-s} \cdot \frac{MV_t + UC_t + CV_t}{BMV + UC_{t-s}}$$

5.1.4 Daily and Month-to-Date Returns

Daily index returns are calculated for all Markit iBoxx benchmark indices according to the following formula:

$$R_{t-1,t} = \frac{TR_t}{TR_{t-1}} - 1$$

Month-to-date index returns are calculated as follows:

$$R_{t-s,t} = \frac{TR_t}{TR_{t-s}} - 1$$

5.2 Gross Price and Income Indices

5.2.1 Gross Price Indices

The gross price index represents the portion of the total return that is due to movements of the dirty price of the constituent bonds.

Benchmark Gross Price Indices

The benchmark gross price index is calculated as follows:

$$GI_t = GI_{t-s} \cdot \frac{MV_t + UC_t}{BMV + UC_{t-s}}$$

5.2.2 Income Indices

The income indices measure the portion of the index return that is due to actual cash payments. Interest payments are represented in the coupon income index, redemptions in the redemption income index and the total of these in the income index.

Income indices are set to 0 at the beginning of each calendar year.

Benchmark Income Indices

The benchmark coupon income index is calculated as follows:

$$IC_t = IC_{t-s} + GI_{t-s} \cdot \frac{CV_t^{\text{Coupons}} + CV_t^{Penalty}}{BMV}$$

The benchmark redemption income index is calculated as follows:

$$IR_t = IR_{t-s} + GI_{t-s} \cdot \frac{CV_t^{\text{Redemptions}}}{BMV}$$

The benchmark income index is calculated as follows:

$$IN_t = IN_{t-s} + GI_{t-s} \cdot \frac{CV_t^{\text{Coupons}} + CV_t^{Penalty} + CV_t^{\text{Redemptions}}}{BMV}$$

Or simplified:

$$IN_t = IC_t + IR_t$$

6 Appendix: Index Analytics

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6.1 Weightings for index analytics

There are four different weighting concepts for index analytics, depending on the specific analytical value being calculated.

6.1.1 Nominal value weighting

For an index of bonds, the nominal weight is the share of each bond's notional in the aggregate notional of the index:

$$w_{i,t}^{N} = \frac{F_{i,t} \cdot N_{i,0} \cdot F_{i,t-s}^{Cap}}{\sum_{i=1}^{n} F_{i,t} \cdot N_{i,0} \cdot F_{i,t-s}^{Cap}}$$

For an index of indices, the nominal weight is equal to the (fixed) weight of the sub-index in the overall index as of the last rebalancing:

$$w_{i,t}^{N} = w_{i,t-s}^{Fix}$$

6.1.2 Base market value weighting

For an index of bonds, the base market value weight is the share of each bond's base market value in the aggregate base market value of the index:

$$w_{i,t}^{BMV} = \frac{MV_{i,t-s} + XD_{i,t-s} \cdot UC_{i,t-s}}{\sum_{i=1}^{n} MV_{i,t-s} + \sum_{i=1}^{n} XD_{i,t-s} \cdot UC_{i,t-s}}$$

For an index of indices, the base market value weight is equal to the (fixed) weight of the sub-index in the overall index as of the last rebalancing:

$$w_{i,t}^{N} = w_{i,t-s}^{Fix}$$

6.1.3 Duration-adjusted market value weighting

For an index of bonds, the duration-adjusted market value weight is the adjusted share of each bonds market value in the aggregate adjusted market value of the index:

$$w_{i,t}^{D} = \frac{D_{i,t} \cdot \left(MV_{i,t} + XD_{i,t} \cdot UC_{i,t}\right)}{\sum_{i=1}^{n} D_{i,t} \cdot \left(MV_{i,t} + XD_{i,t} \cdot UC_{i,t}\right)}$$

For an index of indices, the market value weight is equal to the current weight of the sub-index in the overall index as of the last rebalancing:

$$w_{i,t}^{D} = \frac{DU_{i,t} \cdot \left(1 + r_{i,t-s,t}\right) \cdot w_{i,t-s}^{Fix}}{\sum_{i=1}^{n} DU_{i,t} \cdot \left(1 + r_{i,t-s,t}\right) \cdot w_{i,t-s}^{Fix}}$$

6.2 Index analytics

6.2.1 Average Yield

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

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

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6.2.2 Index Benchmark Spread

The index benchmark spread is calculated for all indices.

The annualized index benchmark spread at time t is:

$$BMS_t^a = \begin{cases} \sum_{i=1}^{n} BMS_{i,t}^a \cdot w_{i,t}^D & \text{Index of bonds} \\ \sum_{i=1}^{n} BMS_{i,t}^a \cdot w_{i,t}^D & \text{Index of indices} \end{cases}$$

6.2.3 Average Duration

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

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

6.2.4 Average Coupon

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

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

6.2.5 Average Weighted Average Life

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

$$WAL_t = \begin{cases} \sum_{i=1}^{n} WAL_{i,t} \cdot w_{i,t}^{N} & \text{Index of bonds} \\ \sum_{i=1}^{n} WAL_{i,t} \cdot w_{i,t}^{N} & \text{Index of indices} \end{cases}$$

6.2.6 Average Rating

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:

$$RA_t = \begin{cases} \sum_{i=1}^{n} RA_{i,t} \cdot w_{i,t}^{MV} & \text{Index of bonds} \\ \sum_{i=1}^{n} RA_{i,t} \cdot w_{i,t}^{MV} & \text{Index of indices} \end{cases}$$

6.2.7 Average Delinquency

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

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$$DL_t = \begin{cases} \sum_{i=1}^{n} DL_{i,t} \cdot w_{i,t}^{N} & \text{Index of bonds} \\ \sum_{i=1}^{n} DL_{i,t} \cdot w_{i,t}^{N} & \text{Index of indices} \end{cases}$$

6.2.8 Average Credit Enhancement

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

$$CE_t = \begin{cases} \sum_{i=1}^{n} CE_{i,t} \cdot w_{i,t}^{N} & \text{Index of bonds} \\ \sum_{i=1}^{n} CE_{i,t} \cdot w_{i,t}^{N} & \text{Index of indices} \end{cases}$$

6.2.9 Index Asset Swap Spread

$$ASW_t = \begin{cases} \sum_{i=1}^{n} ASW_{i,t} \cdot w_{i,t}^{D} & \text{Index of bonds} \\ \sum_{i=1}^{n} ASW_{i,t} \cdot w_{i,t}^{D} & \text{Index of indices} \end{cases}$$

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7 Annotations

$\Delta_{j,i}$ = Change in amount outstanding of bond j at time i

A_i = Accrued interest for bond 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

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

$A_{i,t}^R$ = 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_t^a = Annualized index benchmark spread at time t

BMS_t^S = Semi-annualized index benchmark spread at time t

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

$BMS_{i,t}^S$ = 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 = Next coupon before the coupon change

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_i^{annual} = Annual coupon of bond i

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

$C_{i,t^\wedge}^R$ = 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

CE_t = Average credit enhancement at time t

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$CE_{i,t}$ = Current credit enhancement of bond i at time t

$CF_{i,j}$ = 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

$CF_{i,j}^{k}$ = 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

$\mathrm{CP}_{\mathrm{i,t}}$ = 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

$\mathrm{CP}_{\mathrm{i,t-s}}$ = 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

CV_t = Cash payment of all bonds at time t

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

CV_t^{Coupons} = Coupon payments of all bonds i at time t

$CV_t^{\mathrm{Redemptions}}$ = Redemption payments of all bonds at time t

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

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

CV_t^{Penalty} = Penalty payments of all bonds at time t

$CV_{i,t}^{\mathrm{Penalty}}$ = Penalty payment of 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

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

DL_t = Average delinquency rate at time t

$DL_{i,t}$ = Delinquency rate of bond i at time t

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_i^{Cap} = Capping factor for bond i

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

$FA_{t,i,t}$ = 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

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

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

$FX_{t-s,t}^{LCY/CCY}$ = 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.

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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+

$IR_{i,t,t^\wedge}$ = 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

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

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

$L_{i,t,j}^{a}$ = 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

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

$LCR_{i,t}^{M}$ = 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_t^a = Average annualized modified duration at time t

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

MDU_{t}^{s} = Average semi-annualized modified duration at time t

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

$MDPU_{t}^{a}$ = Average annualized modified portfolio duration at time t

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

$MDPU_{t}^{s}$ = Average semi-annualized modified portfolio duration at time t

$MDPU_{i,t}^{S}$ = 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_{i}^{P} = 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

$N_{i,t}^{N}$ = 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

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

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

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

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$P_{i,t-s}$ = 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

$\mathrm{PV}_{\mathrm{Fixed}}$ = Present value of fixed payments

$\mathrm{PV}_{\mathrm{Floating}}$ = Present value of floating payments

$R_{i,t}$ = 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_t^H = Hedged return at time t

RA_t = Average rating at time t

$RA_{i,t}$ = Rating of bond i 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

RYP_t = Average 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

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

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

SD = Settlement date

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

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

$\mathrm{SWAP}_{\mathrm{n}}$ = Markit SWAP curve rate at the next coupon payment day

t = Time of calculation

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

$t\wedge$ = 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_t^{Final} = Total Return index level after cost adjustment

TR_t^{Ideal} = Total Return index level before cost adjustment

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

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

TR_{t-s}^{LCY} = 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

$UC_{i,t}$ = Unrealized cash of bond i at time t, the expected coupon payment for the last coupon period that has not been paid yet

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

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

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

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

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

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

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

WAL_t = Average weighted average life at time t

$WAL_{i,t}$ = Weighted average life of bond i at time t

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

$\mathrm{XD}_{\mathrm{i,t\text{-}s}}$ = 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

$Y_{i,t}^{a}$ = Annualized yield of bond i at time t

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

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

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

$Y_{\mathrm{InBM}i,t}^{a}$ = Annualized yield of the interpolated benchmark of bond i at time t

$Y_{\mathrm{InBM}i,t}^{s}$ = Semi-annualized yield of the interpolated benchmark of bond i at time t

$Y_{\mathrm{SWAP}t}^{a}$ = Annualized value of Markit SWAP curve at time t

$Y_{\mathrm{SWAP}t}^{s}$ = Semi-annualized value of Markit SWAP curve at time t

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

$\mathrm{Y}_{\mathrm{LIBID}_{t-s}}^{1m}$ = 1-month interest rate for cash at the last rebalancing

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

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8 Further Information

- Glossary of key terms is available in the Glossary document, available on www.markit.com
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