

# **iBoxx US Non-Agency RMBS Index Methodology**

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# iBoxx US Non-Agency RMBS Index

The iBoxx US Non-Agency RMBS Index family is designed to measure the performance of legacy

USD-denominated non-agency residential mortgage-backed securities (“RMBS”) originating from the US. The index family allows market participants to benchmark RMBS portfolios to indices with various deals, ratings, and collateral profiles. Investors can measure the relative performance of their assets to the overall index or relevant sub-index. Researchers can gain a better understanding of the returns available from the legacy non-agency RMBS market, and advisors and fund managers will obtain insight into the relative performance of this assets class against other fixed income markets.

All iBoxx indices are priced based on multiple data inputs. The iBoxx US Non-Agency RMBS Index family uses multi-source prices as described in the document iBoxx Pricing Methodology, available at [www.spglobal.com/spdji](http://www.spglobal.com/spdji). Additionally, the index rules and their application are governed by two Index Advisory Committees.

This document contains the index family structure, selection rules and calculation methodology for the iBoxx US Non-Agency RMBS Index.

## Structure of the Index Families

The index family comprises an overall index, and sub-indices by collateral type, collateral rate type, and deal vintage; and combinations of the above. All indices are calculated in USD.

Level 0	Level 1	Level 2	Level 3
Non Agency RMBS	Prime RMBS	Fixed Rate Collateral	Fix-Prime-2005
			Fix-Prime-2006
			Fix-Prime-2007
		Hybrid ARM Collateral	ARM-Prime-2005
			ARM-Prime-2006
			ARM-Prime-2007
	Alt-A RMBS	Fixed Rate Collateral	Fix-AltA-2005
			Fix-AltA-2006
			Fix-AltA-2007
		Hybrid ARM Collateral	ARM-AltA-2005
			ARM-AltA-2006
			ARM-AltA-2007
	Option ARMS (POA)		POA-2005
			POA-2006
			POA-2007
Subprime		Subprime-2005	
		Subprime-2006	
		Subprime-2007	

# Selection Criteria

The available universe of legacy Non-Agency RMBS is approximately 70,000 securities. S&P DJI's goal in creating the iBoxx US Non-Agency RMBS index family is to construct an index which adequately represents the major legacy sectors, excludes bespoke/unique bonds, and captures the bulk of the activity in the market. S&P DJI uses the below methodology to define the universe, sub-sectors, and eligible securities for the index.

## Defining the Universe - Level 0

### List of Eligible Deals & Bonds

- The originating entity needs to be domiciled in the United States.
- Security must reference non-agency residential mortgages as collateral.
- Deal documentation and payment info (periodic trustee reports) for the security must be publicly available.
- S&P DJI's Evaluated Pricing must have pricing information available starting from December 31st, 2011
- To avoid including "outlier" securities, the evaluated price as of April 30th, 2013 or subsequent rebalancing date must be less than 150 and greater than 10.
- Must be a "Senior" bond within deal structure at origination.

### List of Ineligible Bond & Deal Types

- Re-Remic deals are excluded
- HELOCs deals are excluded
- Closed End Section Lien transactions
- Inverse Floating Rate obligations
- Subordinate bonds are excluded
- Interest-only, principal-only, notional, and component bonds are excluded
- Exchangeable bonds are excluded (bonds that didn't exist in initial deal offering)
- Any bonds that are "wrapped" or have a 3rd party insurer are excluded
- Bonds issued via private placements are not eligible for the index

## Defining the Sectors – Levels 1, 2, & 3

There are numerous opinions on the level of granularity required to properly represent the Non-Agency RMBS universe. Our Evaluated Pricing team has over 5,000 different groupings of similar securities based on collateral type, vintage, originator, coupon types, and performance. The Non-Agency RMBS iBoxx indexes represent a simplified version of these sectors in order to ensure that the majority of bond types are represented and the concept is simple enough for portfolio managers and funds to replicate.

### Different Levels

- Level 1 indicates the different types of non-agency RMBS collateral into four distinct buckets. The specific qualitative factors defining these buckets, and their more granular sub-sectors, are

subject to interpretation, but are largely agreed upon by most market participants on a deal by deal basis. > Prime – High quality borrowers, typically with high FICO scores and loan sizes

- Alt-A – High quality borrowers with specific loan characteristics preventing them from being classified the same as “Prime” (usually documentation, property type or FICO).
  - Option Arm – Specific loan types that allow borrowers multiple payment choices – Principal & Interest, Interest-Only, or a “teaser rate” (minimum payment lower than the IO payment) – for the first few years of their mortgages. These loans have the potential to negatively amortize if borrowers choose to pay the teaser rate.
  - Sub-Prime – Lower quality borrowers, typically with lower FICO scores and smaller loan size.
- Level 2 indicates the coupon type that the underlying mortgages have. Prime and Alt-A deals are typically grouped by the rate type of the collateral (either fixed rate or an adjustable rate), whereas Option ARM and Sub-Prime deals don’t make that distinction on a deal by deal basis.
  - Level 3 indicates the year the deal was originated in. Most of the outstanding balances and pricing activity from the non-agency RMBS market are in deals originated from 2003 to 2007, but the index provides a mechanism to include future vintages should qualifying issuance rise above a specific threshold (see TBD sectors above). This is the last level of granularity applied to the creation of the sub-sectors.

### **Prime, Alt-A, & Option ARM Sectors**

The bonds included from these sectors are only “Super-Senior” bonds within the capital structure of qualifying deals. These sectors have numerous exchangeable certificates, support bonds, and “Senior Mez” bonds, all of which were excluded for the purposes of defining eligible bonds from these sectors.

### **Sub-Prime Sectors**

The bonds included from this sector are only Senior, “current-pay” securities. Senior bonds are the securities in the capital structure with the most credit enhancement. “Current pay” bonds are securities that have remaining principal balances of between 50% and 100% of the original balance (factor between 0.5 and 1), and have received a recent principal payment prior to the rebalancing date. This excludes all mezzanine certificates and numerous senior bonds that have either amortized or have not yet received any principal payments (potentially 1st pay bonds or Last Cashflow securities).

# Selection of Securities

## **Selecting Bonds to Represent Each Sector**

S&P DJI's iBoxx US Non-Agency RMBS index families are represented by a sub-set of securities from the larger universe in each sector. The index represents a large enough portion of the qualifying universe so that no single constituent can have an over-weighted effect on the performance of the index.

## **Top 80% of Each Level 3 Sector**

Prior to each rebalancing date, S&P DJI will sort all securities within each sector in descending order by the amount of principal outstanding as of the last payment date prior to the rebalancing date. The total amount of principal outstanding for all of the bonds will represent the total principal balance for that particular sector. S&P DJI will then select the minimum number of securities required, starting from the largest outstanding balance and working down the list, in order to represent 80% of the total remaining principal balance from the sector.

## **Minimum of 10 Securities per Level 3 Sector**

In order to ensure that no sector is represented by a small number of securities, S&P DJI will select at least 10 securities from each sector. If 80% of the total principal balance is represented by less than 10 securities, S&P DJI will continue down the list and select the next largest securities by outstanding balance until 10 securities from that particular sector are included in the index.

## **Final Sector List**

After applying the above tests in this order prior to each rebalancing date, S&P DJI shall have a final "Sector Constituent List", which shall represent the iBoxx US Non-Agency RMBS index families until the next Rebalancing Date.

# Rebalancing Process

The index is rebalanced on the last calendar day of each February (“Rebalancing Date”). The first “Rebalancing Date” will be April 30th, 2013.

The cut-off date for meeting the eligibility criteria is 3 business days prior to the rebalancing date.

The Sector Constituent List with the final outstanding amounts for each bond will be published 2 business days prior to the rebalancing date.

On the last business day prior to the rebalancing date, S&P DJI publishes the closing prices of all bonds in the final Sector Constituent list, at the close of business.

# Index Calculation

## **RMBS Bond Prices**

The index calculation is based on bid prices. In the event that no bid price is available for a particular date, the last available bid price will be carried forward. This might be the case in periods of market stress, or disruption as well as in illiquid or fragmented markets. If the required inputs become impossible to obtain, a decision may be taken at S&P DJI's discretion. To ensure consistency, decisions taken are made publicly available on a timely basis and S&P DJI has the ability to refer back to previous cases. New bonds enter the index on each Rebalancing Date at their respective ask prices. Bond prices in the eligible universe are provided by S&P DJI's Evaluated Pricing Service.

## **Data Source**

Cash flow payment information used for the iBoxx US Non-Agency RMBS indices is provided by S&P DJI's Reference Cashflow Database (RCD). RCD incorporates validated payment data for each security and is sourced directly from investor payment reports. Such data is used to track payments, shortfalls of interest and principal, and writedowns and writedown-reimbursements.

## **Treatment of Late or Corrected Payment Information**

Information about principal repayments and interest shortfalls may not be received until after the effective payment date. In such instances, the index assumes that no interest payments have been made and that no principal repayments have been made. The pool factor of the bond in the index remains unchanged. The information is updated on the first calculation date after the information has become available and the market value, cash and accrued interest of the bond in the index is adjusted going forward. For the avoidance of doubt – no information received is applied retroactively; this includes pool factors and accrued interest. Accrued interest is calculated daily based on the current coupon observed on each bond with respect to its specific day count convention. In the event of a corrected historical report, the same convention is applied, and the market value, cash, and accrued interest will be adjusted from the first calculation date following such correction notification.

## **Treatment of Certain Intra-month Events**

### **Treatment of Redemption Payments**

#### **Unscheduled paydowns (pre-payments):**

Unscheduled redemption payments for bonds are taken into account on the recorded date. When a bond is fully repaid intra-month, the bond is treated as cash for the remainder of the month. The accrued interest up until the redemption date is treated as an unscheduled coupon payment.

#### **Scheduled paydowns:**

Scheduled redemption payments for bonds are taken into account from the date they occur. Bonds that are fully repaid intra-month are taken into cash immediately.

### **Coupons and Redemption Payments**

Cash received from coupon or redemption payments is held as cash from payment date until the end of the month. Each month's total return is calculated using market value and redemption payments from that specific month, while cumulative total return for a series of months is calculated by also incorporating a

“Multiplier” from the end of each prior month. The multiplier accounts for both changes in market value and coupon/redemption payments for prior month(s), and effectively serves a connector between total return values for sequential months in place of reinvesting the sum of cash payments on a prorate basis. As a result, coupon and redemption payments from prior months are excluded from the base market value calculation (defined below) at the beginning of each month. Cash does not accrue interest.

### **Index History**

The Index history starts on 31 December 2011. The index has a base value of 100 on that date.

### **Settlement Conventions**

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

### **Calendar**

S&P DJI publishes an index calculation calendar available on [www.spglobal.com/spdji](http://www.spglobal.com/spdji) under *iBoxx Indices Calendars*. This calendar provides an overview of the index calculation holidays of the iBoxx bond index families each year.

### **Publication of the Index**

The index is calculated and published each day, independent of holiday conventions. An index is calculated if there is at least one bond available that matches all inclusion criteria. If no more bonds qualify for an index, then its level will remain constant. If at least one bond becomes available again, the index calculation will be resumed from the last calculated level.

S&P DJI will publish the most recently available Total Return and Price Return for all sectors (Level 0 – Level 3) on a password protected website. All market participants may request access to S&P DJI’s website by registering at [www.spglobal.com/spdji](http://www.spglobal.com/spdji).

S&P DJI will publish Total Return and Price Return for all sectors (Level 0 – Level 3) by 6pm EST on each calendar day.

# Appendix

## Index Calculus and Analytics

The following indices will be published during the initial launch phase.

- Total Return Index
- Price (Principal return) Index
- Redemption Income Index
- Total Interest Index

It is anticipated that that the Gross Price, Coupon Income, Income and Accrued Indices will be published during later phases of the project. Indices to be published during the later phase are marked with an asterisk.

## Market Value

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

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

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:

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

## Average Coupon

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

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

The yield of a bond at time t is calculated as follows:

$$(P_{i,t} + A_{i,t}) \cdot F_{i,t} = \sum_{j=1}^n CF_{i,j} \cdot (1 + y_{i,t})^{-L_{i,j}}$$

For bonds during an ex-dividend period, the future cash-flows for the yield calculation exclude the current coupon payment.

The Newton iteration method is used to solve the equation for  $y_{i,t}$ ,  $F_{i,t}$

is a redemption factor that is relevant for sinking funds, amortizing bonds and unscheduled full redemptions. For other bond types, F always equals 1. The yield is set to 0 if

$F_{i,t}$  is 0.

The true yield is calculated as follows:

$$Y_{i,t}^{\dagger} = Y_{i,t} \cdot m$$

## 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:

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

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

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

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:

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

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:

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

### Total Return Index Calculation for Liquid Indices

The main difference between the various liquid index methods is the frequency of the cash investment in the money market.

There are two main varieties of liquid indices with cash:

Liquid indices with quarterly or semi-annual rebalancing and monthly cash accrual

For non-rebalancing months, the cash is invested in the money market until the following month-end.

$$CASH_t = CV_t + CASH_{t-s} \cdot (1 + Y_{LIBID_{t-s}}^{1m} \cdot Days_{MM}(t-s, t))$$

### Cash

$$CASH_t = (CV_t - CV_{t-1}) + \sum_{t-s < j}^{t-1} [(CV_j - CV_{j-1}) \cdot (1 + Y_{LIBID_j}^{1m} \cdot days_{MM}(j, t))] + CASH_{t-s} (1 + Y_{LIBID_{t-s}}^{1m} \cdot days_{MM}(t-s, t))$$

(Tex translation failed) The cash is added to the standard formula for the indices:

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

### Daily and Month-to-Date Returns

Daily index returns are calculated for all 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:

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

### Annotations

$\Delta y$  = Parallel shift amount of the sport rate yield curve

$\Delta j_t$  = 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  $t^\wedge$  as of the calculation date

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

$C_t$  = 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 exdividend period, the value is 0

$CPI_t$  = CPI level on the calculation date

$CPI_{i,t_0}$  = 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  $\frac{1}{2}$

$Dat(C_a, C_b)$  = 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)

$FA_{t,i,t}$  = 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

$FX^{LCY/CCY}_t$  = 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

$m_1, m_2$  = Month of date  $\frac{1}{2}$

$M^-$  = 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  $t$

$\pi_t$  = 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 t  
 $SBC^s_{i,t}$  = 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  
 $SWAP_n$  = 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  $t$

$t^\wedge$  = Date of a cash flow

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

$t_0$  = Base date of an inflation linked bond

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

$t_1$  = Next coupon payment after the settlement date  $t$

$t_2$  = Next-but-one coupon payment after the settlement date  $t$

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

$TR_t$  = Total return index level at time  $t$

$TR_t^{\text{Final}}$  = Total Return index level after cost adjustment

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

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

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

$TR_{t-s}^{\text{LCY}}$  = 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

$w_i$  = Weight of bond  $i$

$w_i^+$  = Weight of bond  $i$  before rebalancing

$w_{\text{cash}}$  = Weight of cash in the index prior to the rebalancing

$w_i^+$  = Weight of bond  $i$  after rebalancing

$w_{\text{cash}}^+$  = 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  $t$

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

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

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

$w_{i,t}^{\text{MVC}}$  = 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 exdividend 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 exdividend 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  $t$

$y_1, y_2$  = 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  $t$

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

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

$Y^a_{SWAP_t}$  = Annualized value of SWAP curve at time  $t$

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

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

$Y_{LIBIDt-s}^{1m}$  = 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  $t$

# ESG Disclosures

EXPLANATION OF HOW ENVIRONMENTAL, SOCIAL & GOVERNANCE (ESG) FACTORS ARE REFLECTED IN THE KEY ELEMENTS OF THE BENCHMARK METHODOLOGY <sup>1</sup>		
1	<b>Name of the benchmark administrator.</b>	S&P Dow Jones Indices Limited
2	<b>Underlying asset class of the ESG benchmark.<sup>2</sup></b>	N/A
3	<b>Name of the S&amp;P Dow Jones Indices benchmark or family of benchmarks.</b>	<a href="#">iBoxx Benchmark Statement</a>
4	<b>Do any of the indices maintained by this methodology take into account ESG factors?</b>	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.

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