# MSCI Fixed Income Data Methodology

February 2022

# Contents

# 1 MSCI Fixed Income Data Methodology Overview

This document provides information regarding the fixed income data, models, methods, formulas, and statistics that are used in the construction of fixed income universe supporting MSCI products such as the MSCI Fixed Income Indexes.

The following list outlines each section and gives a basic overview of the topics covered.

**Opportunity Set and Eligibility Criteria**: this section introduces the key attributes of the various fixed income instruments that are considered when classifying and defining their eligibility in each relevant MSCI fixed income universe.

**Asset Pricing:** this section summarizes the pricing models, both bond and option pricing, used across the various asset types.

**Reference curves**: this section details the various interest rate reference curves required by the pricing models and used for the calculation of Single Security Analytics (SSAs). These curves are also used in the MSCI quality assurance processes.

**Single Security Analytics (SSA):** this section provides an overview of the security level statistics computed by MSCI's RiskServer calculation engine using best practice modeling defined by the MSCI Pricing and Model Validation Research team. Statistics such as duration, convexity, option-adjusted spread, accrued interest, and yield are detailed in this section.

**Corporate Events:** the handling of corporate events and all changes in terms and conditions is critical for the maintenance of the opportunity set and universe selection. Information regarding how daily changes to corporate structures are reflected and their impact to issued bonds is described in this section.

**Forward Looking Information:** covers prospective corporate events that result in an asset status change or amount outstanding change for all active assets received from vendor in the MSCI fixed income universe.

**Additional Published Reference Data:** covers additional reference data points including derived methodology supporting index calculations.

**Market Conventions**: information regarding the calendars and settlement conventions which impact cashflows and return calculations is covered in this section, as well as details about data collection times for different markets and regions.

**Data Sources and Quality Assurance:** this section describes the methodology and rules governing the daily review of reference and terms and conditions as well as pricing data.

**Data Governance:** provides information on the committees helping oversee the Fixed Income Data Methodology.

# 2 Opportunity Set and Eligibility Criteria

This section introduces the key attributes of the various instruments that are considered when classifying and defining their eligibility in each relevant MSCI Fixed Income Universe referred to as “Index Universe”.

## 2.1 Currency

The currency of denomination for a bond’s principal and interest payments is a key characteristic used by investors to segment the global fixed income market. Within the Index Universe it is used not only for defining the eligibility of a bond, but also to identify the relevant interest rate reference curves (Government, Swap and At-the-Money Swaption) used to compute all the single security analytics of a security.

Dual currency bonds are not considered as eligible assets for the Index Universe.

## 2.2 Asset Classification

Fixed income assets can be classified into 5 broadly accepted asset categories. They reflect the different characteristics of the assets as well as the investment processes, allocation decisions and specialization of investors within the respective categories.

- Sovereign bonds
- Sub-sovereign bonds[1]
- Supranational bonds
- Corporate bonds
- Securitized Products

MSCI currently considers Sovereign, Supranational and Corporate bonds as eligible assets for the Index Universe. Bonds issued by sub-sovereign entities such as government agencies, non-U.S. municipalities and provinces are considered eligible. Bonds issued by U.S. municipalities are excluded from the Index Universe.

## 2.3 Credit Quality

Rating agencies are the main providers of credit ratings, which are commonly used to define credit quality. There is usually a clear distinction between investment grade bonds (BBB-/Baa3 and above) and High Yield bonds (BB+/Ba1 thru C-/C3) reflected in asset allocation decisions, as well as investment management specialization. These two credit

[1] Sub-sovereign entities include government agencies and sub-national political entities, including municipalities and provinces.

rating categories also require different pricing quality assurance methods as detailed in section 10.2 Pricing Data Quality Assurance.

MSCI currently uses Standard and Poor's Rating Services (S&P) and Moody's Investor Service (Moody's) as the two credit ratings agencies to determine the MSCI Average Rating which is a key criterion in defining the eligibility of an asset in the Index Universe.

MSCI uses the lower of the two credit ratings between the two agencies to determine the eligibility of an asset in the Index Universe. If the bond is rated by only one agency, that rating is used as the minimum rating available.

Eligible bonds are required to be rated, with the exception of government bonds issued by sovereign entities in local currency. These bonds are considered eligible regardless of whether they are rated as long as the sovereign issuer is rated by either S&P or Moody's. Bonds not rated by either S&P or Moody's are excluded from the Index Universe. Please refer to 12.1 MSCI Issuer Rating Methodology for more details on sovereign entities and local currencies supported.

MSCI currently publishes issuer level ratings for government bonds issued by sovereign entities in local currency only. The Moody's Long-Term Issuer Rating (or Moody's Long-Term Issuer Rating if the former is not available) and the Standard and Poor's Long-Term Issuer Rating are used to determine the issuer level ratings for sovereign entities. The lower of the two credit ratings between the two agencies is used to determine eligibility. If the issuer is rated by only one agency, then that rating is used as the minimum rating available.

See 12.1 MSCI Rating Methodology for more details on composite rating.

## 2.4 Seniority

Seniority types cover 2 components:

- A ranking indicator: senior, subordinated (junior included).
- A collateral indicator: secured vs unsecured.

The ranking indicator defines the priority at which debt holders must be repaid in a bankruptcy event. Senior debt has a higher ranking compared to subordinated. As such, senior debt of an issuer is considered lower risk than subordinated debt.

The collateral indicator indicates whether the debt is backed or secured by the pledge of collateral, mortgage, or other lien in which case it is defined as a secured debt. Secured debt holders have a priority on claims of assets over unsecured debt holders in a bankruptcy event and are protected with specific collateral. Therefore, secured debt is considered lower risk than unsecured debt.

With the exception of the seniority types listed in Section 12.7.2, all issuances irrespective of their ranking indicator or collateral indicator are eligible assets for the Index Universe.

## 2.5 Bonds and Coupon Types

### 2.5.1 Eligible Bond Types

The following bond types are currently considered eligible for the Index Universe:

- Fixed-rate coupon bonds
- Fixed-to-Floating Rate bonds are eligible for inclusion during their fixed-rate term only
- Step-up/Step-down coupons
- Puttable and callable bonds
- Bullet bonds
- Regulation S securities (RegS) [2]
- Private placements
- Equity Clawbacks
- Hybrid securities with deferrable interest payments that *have not* been deferred

### 2.5.2 Non-Eligible Bond Types

The following bond types are not currently eligible for the Index Universe:

- Floating-rate coupon bonds
- Zero-coupon bonds
- Defaulted bonds
- Inflation protected bonds
- Perpetual Bonds [3]
- Payment-in-Kinds (PIKs) and sinking funds
- Strips (Interest Only/Principal Only)
- Hybrids including bonds with equity features (convertible, warrants, preferred) [3]
- Hybrid securities whose interest payments *have been* deferred by the issuer
- Exchange-traded notes

[2] RegS issuances are treated as totally independent from their corresponding 144A issuances as their terms, corporate events and pricing might differ

[3] CAD denominated perpetual Non-viability Contingent Convertibles (NVCCs) are eligible

- Dual currency
- Excluded instrument types[4]
- Excluded seniority types[5]

## 2.6 Amount Outstanding

### 2.6.1 Issuer Amount Outstanding Calculation

The issuer amount outstanding is an important statistic to quantify the size of an issuer. In addition, it serves as a proxy measure for the liquidity of assets associated with an issuer. These are two important considerations for defining inclusion in the Index Universe.

The calculation of the issuer amount outstanding is performed at the issuer level and takes into account all the active outstanding bonds of the issuer using the issuer (entity) to issue mapping provided by the reference data vendor. This calculation only includes bonds for which terms and conditions data is available but excludes assets in the securitized products and bank loan asset categories. The issuer amount outstanding will be calculated for all issuers in the Index Universe. It includes all issuer debt in the calculation regardless of whether the debt meets the eligible universe criteria or not. In this calculation, Regulation S (RegS) issues are excluded to avoid double counting, whereas private placements are included. Strips that consist of the interest or principal component only are also excluded. The issuer amount outstanding is accrued by currency. This means, for instance, that the issuer amount outstanding in USD for an entity will accrue debts in USD only, without considering debts in other currencies listed under this entity.

### 2.6.2 Minimum Issue Outstanding

A minimum amount for issue amount outstanding is required for inclusion in the Index Universe in order to obtain appropriate price coverage from vendors, adequate liquidity to investors as well as a critical issuance size for investment suitability.

The minimum amount for issue amount outstanding is defined for various markets, regions or currencies and asset classifications respectively, as detailed in *the* table below.

[4] Excluded instrument types can be found in Section 12.7.1

[5] Excluded seniority types can be found in Section 12.7.2

| Currency / Market | Minimum Issue Outstanding |
|---|---|
| USD | USD 100 Million |
| EURO | EUR 100 Million |
| GBP | GBP 100 Million |
| CAD | CAD 100 Million |

### 2.6.3 Country of Domicile

Issuer country of domicile is the current country of the issuer's principal executive offices. Assets from countries including but not limited to all Developed Markets, Emerging Markets and Frontier Markets are considered eligible for Index Universe.

# 3 Asset Pricing

A pricing model is required to compute single security analytics (SSAs), such as spread over riskless curve for fixed-rate bonds, option-adjusted spread (OAS) for callable bonds and statistics such as duration and convexity. We can separate the pricing components into the price of a non-callable bond and the price of a bond option, where the price of a callable bond is equal to the price of a non-callable bond minus the price of the call option.

## 3.1 Bond Pricing Model

Non-callable bonds are priced by discounting cash-flows using a suitable interest rate curve.

Using this pricing model, the (dirty) model value of a bond can be expressed as:

$$P_{model} = \sum_{i}^{m} K_i D(r_i, t_i) \tag{1}$$

Where:

$m$ = remaining scheduled payments (including coupon payments and principal)
$K_i$ = flow amount at each payment time $t_i$
$D$ = discount factor for discount rate $r_i$ at time $t_i$
$r_i$ = discount rates corresponding to each payment time $t_i$
$t_i$ = payment time $i = 1, \dots, m$

## 3.2 Option Pricing Model

Bonds with embedded optionality are priced using the Hull-White One-Factor (HW1F) model, which assumes that the interest rate curve is driven by a stochastic short rate that is normally distributed and mean-reverting. The model is calibrated using liquid swaption prices and involves two parameters: the short rate volatility σ, and the mean reversion rate α. Both the short rate volatility σ, and the mean reversion rate α are calibrated to a set of swaption prices in a given currency. The model can be calibrated to exactly reproduce the expected discounted cashflows for bonds without embedded optionality and is therefore able to consistently model both callable and non-callable bonds.

# 4 Reference Curves and Reference Rates

The reference interest rate curves required by the bond pricing model and option pricing model, in each currency, are:

- Zero-Coupon Government Curve
- Zero-Coupon Swap CurveAt-the-Money (ATM) Swaption Surface

These reference curves are a critical component for:

- Computing accurate SSAs, such as option-adjusted spread (OAS), effective duration, effective convexity, etc.
- Our Quality Assurance process, for assessing vendor price stability and validity

Please see 12.3 Currency Specific Model Definitions & Reference Curves for details and curves characteristics market-by-market.

## 4.1 Zero-Coupon Government Curve

The zero-coupon government curve in a given currency determines the risk-free rate used in the bond pricing model. The constituent basket of bonds used in the estimation of a government curve consists of any government issued fixed-coupon bond with the following properties:

- Not inflation linked
- Not callable
- Not the On-the-Run

## 4.2 Zero-Coupon Swap Curve

A zero-coupon swap curve, determined by currency and reference rate, is necessary for the accurate pricing of fixed-to-floating rate bonds. The curve is used to establish a forward-looking expectation for the floating coupon payments which impact the pricing of fixed-to-float bonds.

#### 4.2.1 Reference Rates

For fix-to-float bonds referencing an overnight indexed rate that settles in arrears, such as SOFR, the reference rate time series over the interest period is required to determine the average of the rate over the interest period.

### 4.3 At-the-Money Swaption Implied Volatility Surface

The At-the-Money (ATM) Swaption Implied Volatility Surface is used in the pricing of bonds with embedded optionality such as Puttable and Callable bonds. It is the volatility series used to calibrate the short rate volatility and the mean reversion speed parameters of the Hull-White One-Factor (HW1F) option pricing model.

When an ATM swaption surface is not available the zero-coupon swap curve time series is used to calibrate the short rate volatility and the mean reversion speed parameters of the option pricing model.

## 5 Single Security Analytics

The Single Security Analytics (SSAs) are computed by MSCI's RiskServer Calculation engine using best practice modeling defined by the MSCI Pricing and Model Validation Research team.

### 5.1 Price

#### 5.1.1 Present Value

The Present Value is the present value (dirty price) of a bond on the analysis date. See Eq. (1) for the (dirty) model value of a bond.

#### 5.1.2 Clean Present Value

The Clean Present Value is the present value (clean price) of a bond on the analysis date, equal to Present Value minus Accrued Interest. See Eq. (1) for the (dirty) model value of a bond and 5.6 Accrued Interest.

#### 5.1.3 Settlement Price

The Settlement Price is the present value (dirty price) of a bond on the settlement date (analysis date plus settlement period). See Eq. (1) for the (dirty) model value of a bond.

### 5.2 Yield

The compounding frequency for all yield analytics is annual.

### 5.2.1 Yield-to-Maturity

Yield-to-maturity is obtained by calibrating $y$ to the price of the bond $P$ according to the formula below:

$$P = \sum_{i=1}^{N} D(y, t_i) c_i \tag{2}$$

Where:

$c_i = \text{cashflow at time } t_i$

$D = \text{discount factor for discout rate } y \text{ at time } t_i$

$P = \text{clean price}$

$t_i = \text{time to coupon / principal payment}$

$y = \text{yield-to-maturity}$

Yield-to-maturity assumes that the bond is held to maturity and all coupon payments are reinvested at the interest rate equal to the yield-to-maturity.

### 5.2.2 Yield-to-Worst

The yield at which a callable or puttable bond is most likely to be redeemed. It is the lower of the yield-to-call/put (see below) and the yield-to-maturity (see 5.2.1 Yield-to-Maturity). An optionable bond can be redeemed on any redemption payment date established in the contract and will be redeemed when it is most advantageous to the holder of the option to do so. In other words, it is the minimum yield for callable bonds and the maximum yield for puttable bonds across all the possible redemption payment dates.

#### 5.2.2.1 Yield-to-Call

Yield-to-call is defined as the internal rate of return on any callable investment that will make the present value of the cash flows equal to the price assuming the bond is called on the next call/put date.

In order to calculate yield-to-call the bond is assumed to be held until its first viable call date, $T_c$. The first viable call date is the first call date that is later than the settlement date $d_s$. The bond is redeemed at $T_c$ for the corresponding strike price, $K$ (Note that K is a dirty price and includes accrued interest up to $T_c$). In this case the yield is calibrated using:

$$P = \sum_{i=1}^{n_c} D(y, t_i) c_i + D(y, T_c) K \tag{3}$$

where the sum covers the $n_c$ cashflows before or on $T_c$, and we have explicitly separated the contribution from the bond redemption at $T_c$.

#### 5.2.2.2 Yield-to-Put

In order to calculate yield-to-put the bond is assumed to be held until its first viable put date, $T_p$. The first viable put date is the first put date that is later than the settlement date $d_s$. The bond is redeemed at $T_p$ for the corresponding strike price, $K$ (Note that K is a dirty price and includes accrued interest up to $T_p$). In this case the yield is calibrated using:

$$P = \sum_{i=1}^{n_p} D(y, t_i)c_i + D\big(y, T_p\big)K \tag{4}$$

where the sum covers the $n_p$ cashflows before or on $T_p$, and we have explicitly separated the contribution from the bond redemption at $T_p$.

## 5.3 Duration

Duration is a linear approximation of the price sensitivity of a bond to changes in interest rates.

### 5.3.1 Macaulay Duration

Macaulay duration $(MD_m)$ represents the time-weighted present value of cash flows of a bond divided by the bond's price. Macaulay duration implicitly assumes that a bond's cash flows do not change when interest rates change. Therefore, Macaulay duration is not an appropriate measure of duration for bonds with embedded options.

Macaulay Duration is defined as:

$$MD_m = \frac{1}{|P|}\sum_{i=1}^{N} t_i D(y, t_i)c_i \tag{5}$$

Where:

$c_i = \text{cashflow at time } t_i$

$D = \text{discount factor for discout rate } y_k \text{ at time } t_i$

$P = \text{clean price}$

$t_i = \text{time to coupon / principal payment}$

$y = \text{yield-to-maturity}$

### 5.3.2 Modified Duration

Modified duration is a measure of price sensitivity of a bond with respect to the yield-to-maturity. It assumes that the expected cash flows for a bond remain constant for a given change in yield. This assumption holds for bonds without embedded options, however, given this assumption modified duration is not an appropriate measure of duration for bonds with embedded options.

Modified Duration is defined as:

$$MD = -\frac{1}{|P|}\frac{\partial P}{\partial y} = \frac{MD_m}{(1 + y/k)} \tag{6}$$

Where:

$k =$ annual compounding frequency

$MD_m =$ Macaulay Duration

$MD =$ Modified Duration

$P =$ clean price

$y =$ yield-to-maturity

### 5.3.3 Effective Duration

Effective duration directly measures the price sensitivity of a bond with respect to changes in the par yield curve and is an appropriate measure of price sensitivity for bonds with embedded options.

Effective duration is defined as:

$$D_{effective} = -\frac{1}{|P|}\frac{P_{+\Delta x} - P_{-\Delta x}}{2\Delta x} * 10000 \tag{7}$$

Where:

$\Delta x =$ parallel shift in basis points applied to the par yield curve (equal to 5 bps)

$D_{effective} =$ Effective Duration

$P =$ clean price

### 5.3.4 Duration-to-Worst

Duration to worst is modified duration calculated with respect to yield-to-worst. See section 5.2.2 Yield-to-Worst.

### 5.3.5 Effective Spread Duration

Effective spread duration measures the price sensitivity of a bond with respect to changes in the credit spread. See 5.5.1 Option-Adjusted Spread.

Effective Spread Duration is defined as:

$$SD_{zc} = -\frac{1}{|P|}\frac{P_{+\Delta s} - P_{-\Delta s}}{2\Delta s} * 10000 \tag{8}$$

Where:

$\Delta s =$ shift in basis points applied to the OAS (equal to 10 bps)

$SD_{zc} =$ Effective Spread Duration

$P =$ clean price

### 5.3.6 Key Rate Duration

Key rate duration (KRD) is a component of Effective duration, where the parallel shift in the par yield curve is replaced with a “tent-shaped” shift centered at a given key-rate node.

Key Rates are defined as 1M, 6M, 1Y, 2Y, 5Y, 7Y, 10Y, 20Y, 30Y, 50Y.

### 5.3.7 Dollar Value of a Basis Point

The Dollar Value of a Basis Point (DV01) is the change in the price of a bond for a parallel, positive 1 basis point shift in the par-yield curve.

$$DV01 = -\frac{\Delta P}{\Delta y} \tag{9}$$

Where:

$\Delta P =$ change in price

$\Delta y = +1$ basis point shit in the par-yield curve

## 5.4 Convexity

Convexity is the second derivative of the price-yield function and measures the second-order sensitivity of the price of a bond with respect to yield changes.

### 5.4.1 Effective Convexity

Effective convexity is the second order sensitivity of the price of a bond with respect to changes in the par-yield curve.

Effective convexity is defined as:

$$Convexity_{py} = -\frac{1}{100|P|}\frac{P_{+\Delta x} + P_{-\Delta x} - 2P}{\Delta x^2} * 10000 \quad (10)$$

Where:

$\Delta x =$ parallel shift in basis points applied to the par yield curve (equal to 10 bps)

$Convexity_{py} =$ Effective Convexity

$P =$ clean price

### 5.4.2 Modified Convexity

Modified convexity is the second-order sensitivity of the price with respect to yield-to-worst. See 5.2.1Yield-to-Maturity5.2.2 Yield-to-Worst

$$MC = -\frac{1}{|P|}\frac{\partial^2 P}{\partial y^2} \quad (11)$$

Where:

$MC =$ Modified Convexity

$P =$ clean price

$y =$ yield-to-$worst$

### 5.4.3 Spread Convexity

Spread convexity is the second order sensitivity of the price with respect to credit spread. See 5.5.1 Option-Adjusted Spread.

$$Convxty_{spread} = -\frac{1}{|P|}\frac{\partial^2 P}{\partial s^2} = -\frac{1}{P}\frac{P_{\Delta s} + P_{-\Delta s} - 2P}{\Delta s^2} \quad (12)$$

Where:

$\Delta s =$ shift in basis points applied to the OAS (equal to 10 bps)

$Convexity_{py} =$ Effective Convexity

$P =$ clean price

$s =$ credit spread

## 5.5 Spread

### 5.5.1 Option-Adjusted Spread

Option Adjusted Spread (OAS) is a constant spread ($s$) above the zero-coupon risk-free (government) rate ($r$) that makes a bond's model price ($P_{model}$) equal to its market price ($P_{market}$):

$$P_{market} = P_{model}(r, s) \tag{13}$$

Where:

$P_{market}$ = market price

$P_{model}$ = model price

$r$ = zero-coupon risk-free (government) $rate$

$s$ = OAS

## 5.6 Accrued Interest

Accrued Interest is the calculated amount of interest on a fixed income security which has been earned but not yet paid between the last coupon date and the analysis date. Accrued interest is calculated as-of the pricing date and not the settlement date.

### 5.6.1 Coupon Payments

The generic form for calculation of a coupon payment is given by:

$$\sum_{k=1}^{n} \hat{P}_k * c_k * \tau_k \tag{14}$$

Where:

$c_k$ = the coupon rate for period $(t_k, t_{k+1})$

$\hat{P}_k$ = the modified outstanding principal at $\tau_k$

$\tau_k$ = the time between $t_k$ and $t_{k+1}$, computed according to the bond's day count convention

### 5.6.2 Fixed-Coupons

The method for calculating accrued interest for a fixed-rate bond with a single fixed-coupon rate and regular coupon periods is detailed below.

Coupon payments are computed using Eq. (14):

ACT_ACT, 30_ACT, and 30E_ACT define $\tau_k$ as the fraction of coupon periods between $\tau_k$ and $t_{k+1}$ divided by the coupon frequency in 1/years

$$t_k = \frac{\tau(t_k, t_{k+1})}{\tau(T^{start}, T^{end})} / couponFrequency \tag{15}$$

Where:

- ACT_ACT is the actual/actual ICMA day-count convention
- 30_ACT is the SIA 30/actual day-count convention
- 30E_ACT is the E 30 (ICMA)/actual ICMA day-count convention

### 5.6.3 Ex-Dividend Bonds

Bonds that trade ex-dividend do not include the interest or coupon payment when purchased or sold. The last date a bond trade settles on a cum-dividend basis is the ex-dividend date. Trades settling after the ex-dividend date and inclusive of the next coupon date trade on an ex-dividend basis. RiskServer defines the ex-dividend date as the date corresponding to the number of specified ex-dividend days before the next scheduled coupon date.

The impact of ex-dividend treatment on accrued interest is when a bond settles on an ex-dividend basis the accrued interest is negative. If $ACI_{cum}(t)$ represents the accrued interest at time $t$ assuming the bond does not trade ex-dividend and instead settles cum-dividend accrued interest at time $t$ can be expressed as:

$$ACI(t) = ACI_{cum}(t) \tag{16}$$

When a bond settles on an ex-dividend basis the discounted value of the next coupon is subtracted from the accrued interest cum-dividend and accrued interest is negative.

$$ACI(t) = ACI_{cum}(t) - C_n e^{-(r_n + s_d)t_n} \tag{17}$$

Regardless if a bond trades cum-dividend or ex-dividend, the clean and dirty price at time $t$ are bound by Eq. (18).

$$P_{clean}(t) = P_{dirty}(t) - ACI(t) \tag{18}$$

Where:

$P_{clean}(t) = \text{clean present value}$

$P_{dirty}(t) = \text{present value}$

$ACI = \text{Accrued Interest}$

*Note that the PV statistics report the present value of a bond on analysis date, regardless of settlement period.

# 6 Corporate Events Handling

Corporate events consist of all events resulting in a change to the asset level outstanding amount or asset characteristics that can impact eligibility throughout the lifespan of a bond included in the Index Universe. The redemption price is attached to each event given the vendor's best knowledge and availability of information from the market. The new effective bonds due to exchange or funge events will be linked to the existing bonds, to better reflect the replacement relationship. Events that do not impact the asset level amount outstanding but impact the qualitative status of an asset like defaults or recovery from defaults will also be recorded as corporate events.

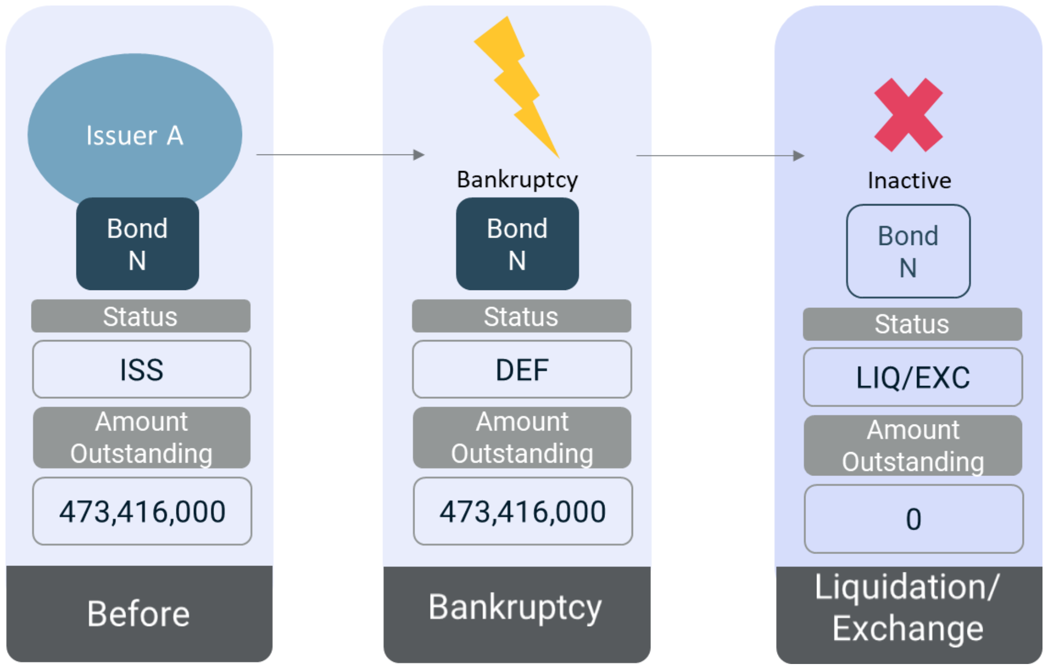
Corporate events data not only reflects changes in the historical asset level outstanding amount but can also have forward-looking functionality, foreshowing announced events in the future.

Assets that originally qualified to be added to the Index Universe will remain in the Index Universe after a corporate event even if the assets do not meet eligibility criteria post-event.

## 6.1 Issuers Corporate Event Handling

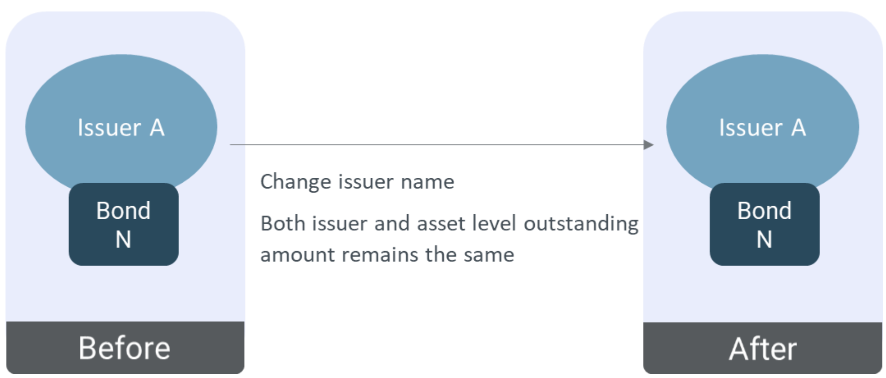
### 6.1.1 Issuer Bankruptcy

Once an issuer files for bankruptcy, and the event becomes effective, the assets attached to the issuer will be classified as "In default". If the issuer emerges from bankruptcy and has a reorganization plan, the assets will be updated as "liquidated" or "exchanged" as applicable.



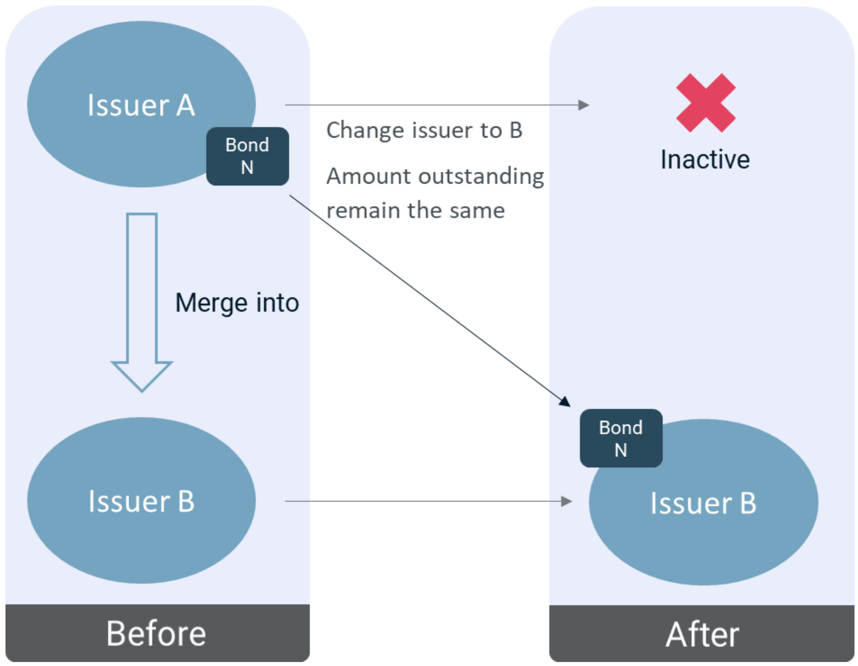

### 6.1.2 Issuer Name Change

Issuer's name changes are reflected at the time they occur. Such events do not impact the attributes of the issuer/bond in the universe.



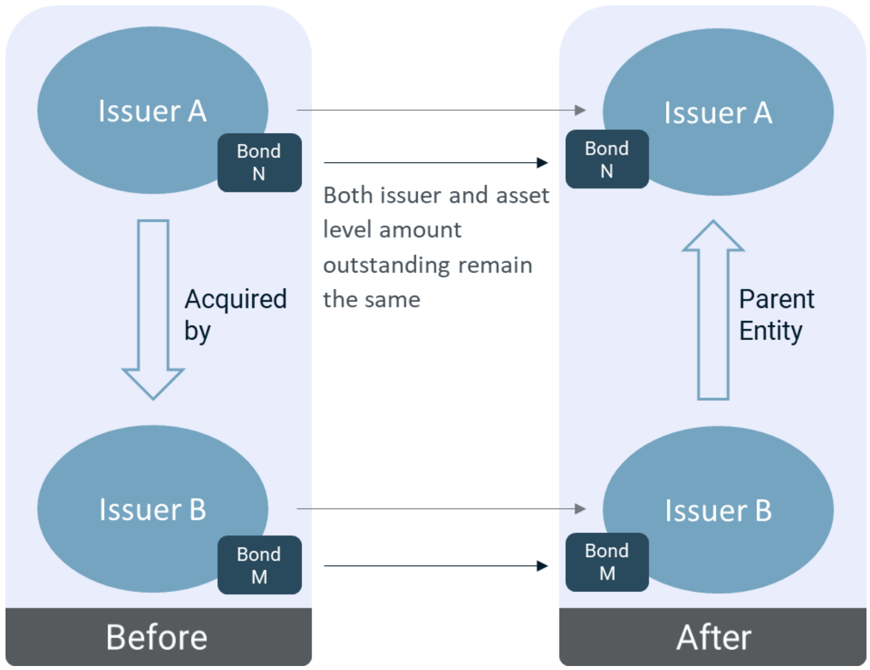

### 6.1.3 Issuer Merger

In the event Issuer A merges with, and into, Issuer B, all of instruments associated with Issuer A will be moved to Issuer B. The issuer amount outstanding of Issuer B will increase by an amount equivalent to the issuer amount outstanding of Issuer A after the completion of the merger. There is no impact to the asset level outstanding amount due to such events.



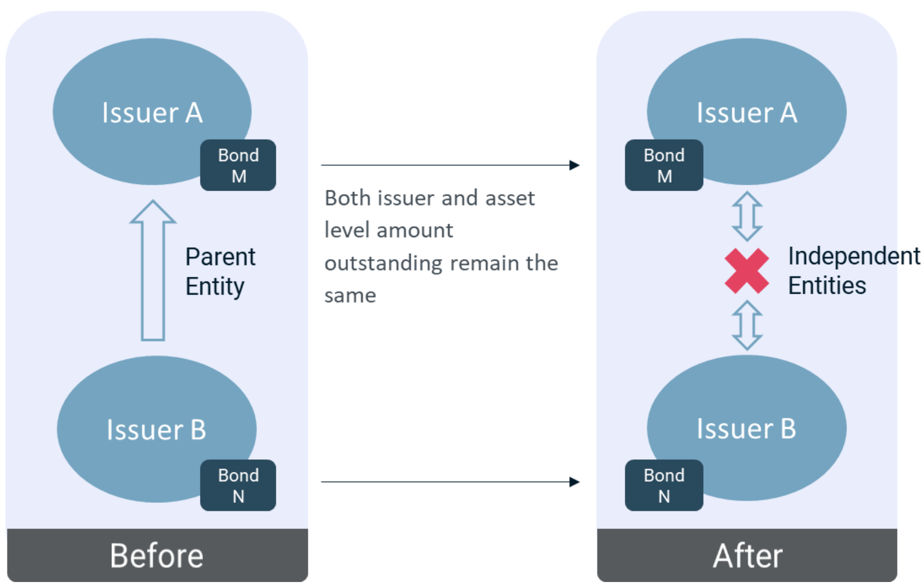

### 6.1.4 Issuer Acquisition

In the event Issuer A is acquired by Issuer B, both issuers are still treated as active and there is no impact to the issuer to issue mapping. Issuer B will be marked as new parent entity of Issuer A. There is no impact to the asset level outstanding amount due to such events.




### 6.1.5 Issuer Spin-off

A spun-off entity will remain as "active" as it is either a creation of an independent company or distribution of new shares of an existing business or division of a parent company. There is no impact to the asset level outstanding amount due to such events.



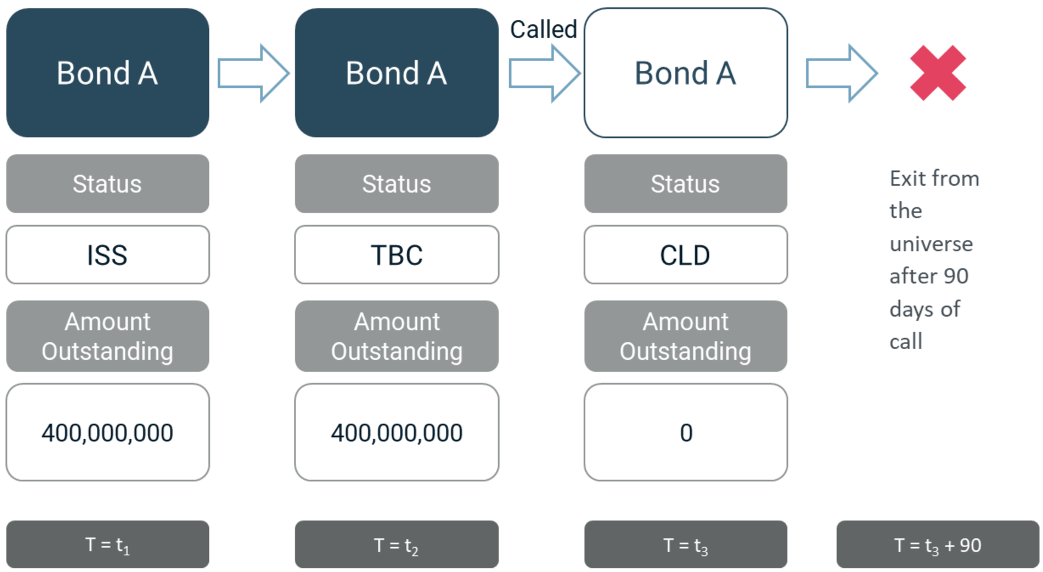

 

## 6.2 Issue Level Corporate Event Handling

The following charts represent the logic of some common corporate events on an issue level. Please refer to 12.5 Corporate Event Terminology for the exhaustive list of issue level corporate events.

### 6.2.1 Asset Called

An asset is called when there is a cancellation of debt issued by the issuer. There is no change in the asset identifier nor a transfer of amount to any existing or new security. The debt will be terminated and its amount outstanding decreased to zero. 90 days after the call date, the asset will exit from the universe.

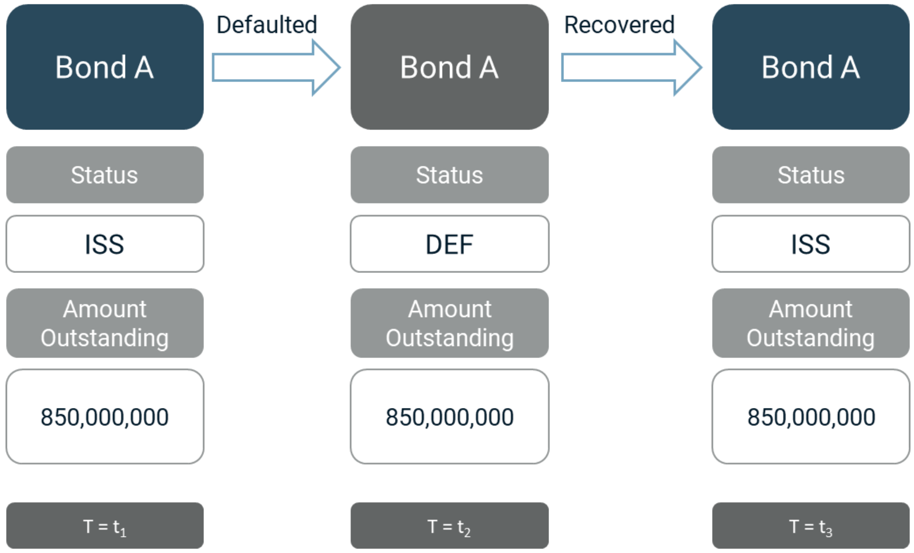



### 6.2.2 Asset-in-Default

When the reference data vendor confirms a bond issuer is under financial difficulty and fails to make an interest or principal payment within the specified period for payment, the bond will be classified as "in default". There is no change in asset identifier nor a transfer of amount to any existing or new security.

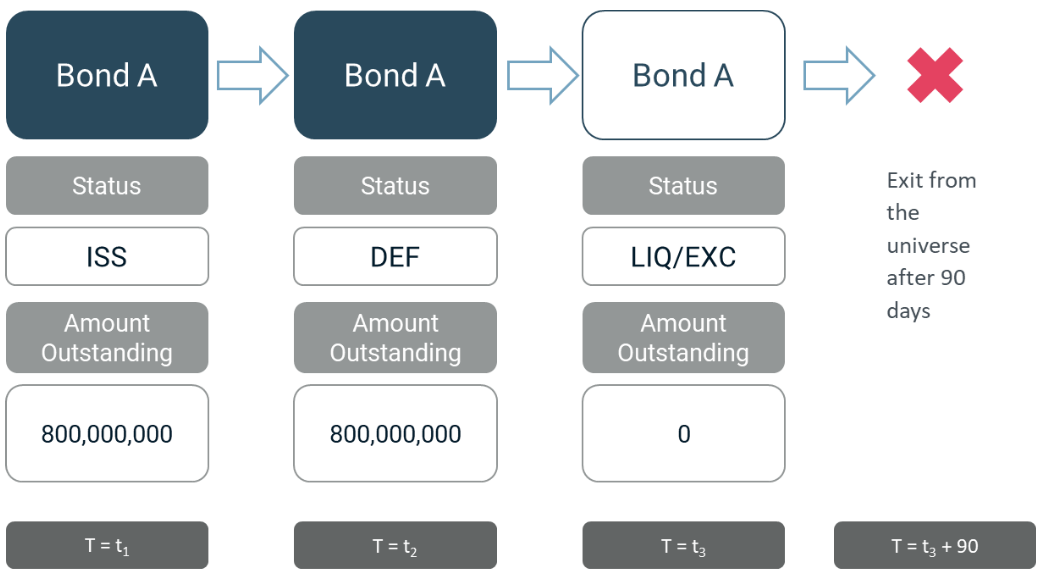
#### 6.2.2.1 Asset Recovered from Default

If the liquidity of the issuer of a defaulted bond improves and the issuer is able to repay the missing interest or principal payments, the bond will recover from default and change back to "Issuance" status.




### 6.2.2.2 Asset Liquidated/Exchanged after Default

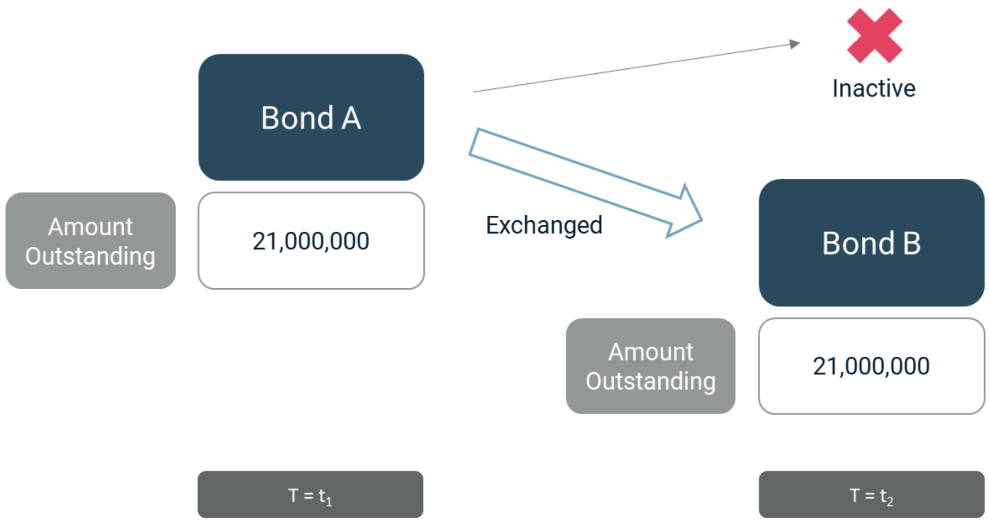
If the financial difficulty of the issuer persists and leads to bankruptcy of the issuer, the bond will be liquidated or exchanged into other instruments as part of the reorganization plan. In either case, the bond will become inactive after the liquidation/exchange.



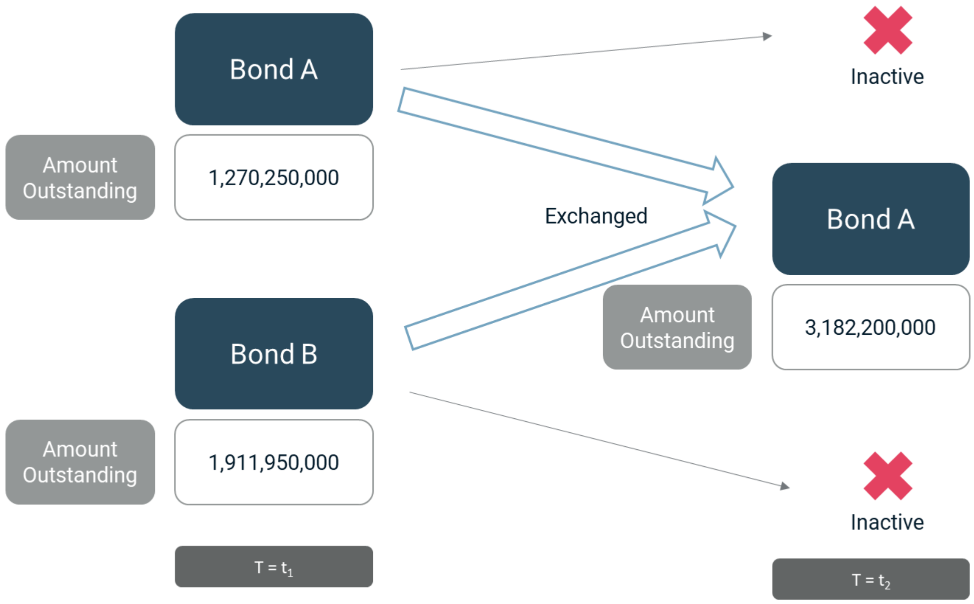

### 6.2.3 Asset Exchanged

When an existing security is fully exchanged to a new security the asset status is updated to “Exchanged/Converted”. A new asset identifier will be generated, and the exchanged amount of the old security will be transferred to the new security.

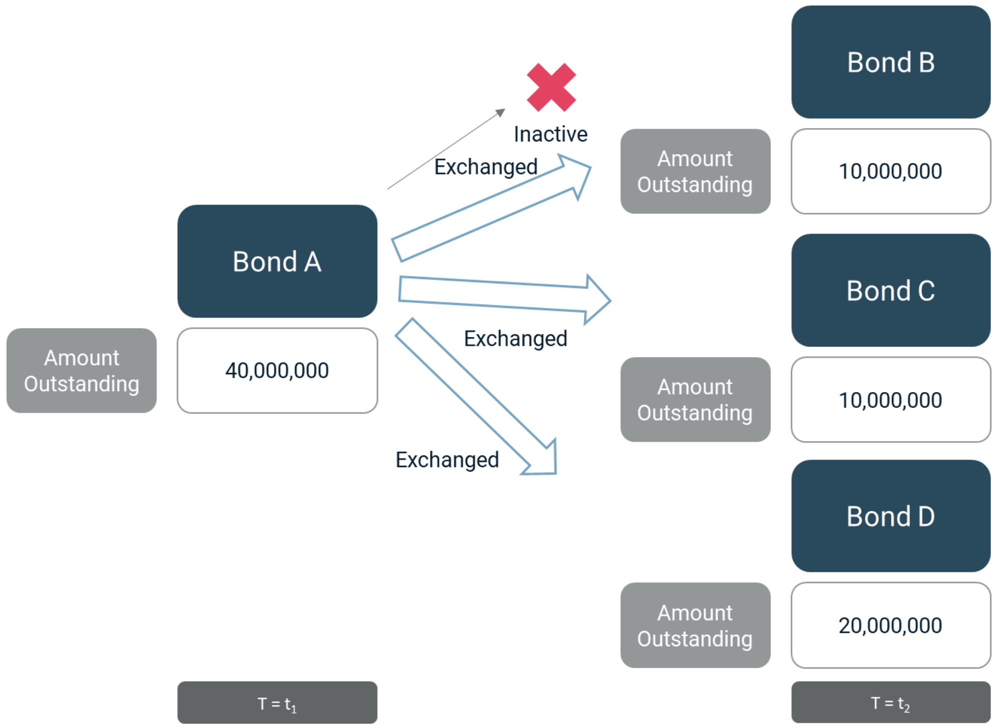
#### 6.2.3.1 One-to-One Exchange




#### 6.2.3.2 Multiple-to-One Exchange

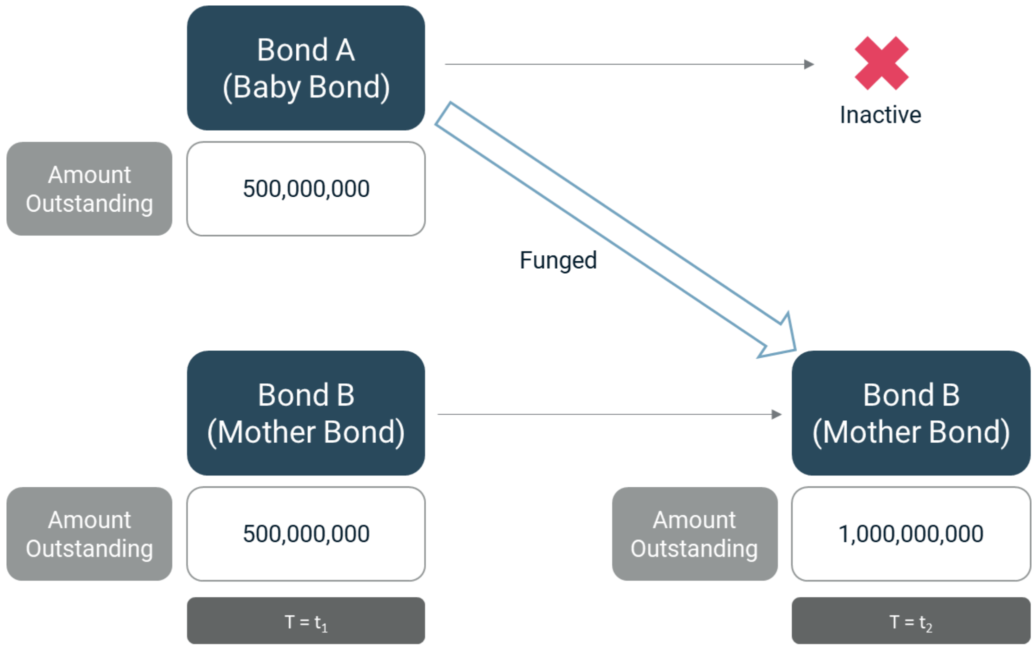



#### 6.2.3.3 One-to-Multiple Exchange




### 6.2.4 Asset Funged

Funging is the process of retiring the temporary identifiers for a temporary security (baby bond) and merging the temporary security with the permanent security (mother bond). There will be a temporary security with a unique identifier which trades separately for a certain number of days (generally 40 days) and is then funged. The asset status of the temporary security is updated to “FNG” (inactive) and the amount outstanding will be added to the current amount outstanding of the mother bond. Consequently, the amount outstanding for the temporary security/identifier becomes zero.



Bond A
(Baby Bond)
Inactive
Amount Outstanding
500,000,000
Funged
Bond B
(Mother Bond)
Bond B
(Mother Bond)
Amount Outstanding
500,000,000
Amount Outstanding
1,000,000,000
T = t1
T = t2

# 7 Forward Looking Information

Forward looking information covers prospective corporate events for all active issues received from vendor in the Index Universe.[6] Such information is used to calculate forward looking issuer amount outstanding covering T+1 to T+10 as well as issue amount outstanding using the same methodology as described in section 2.6

# 8 Additional Published Reference Data

## 8.1 Government Amount Outstanding Allocation

Government amount outstanding allocation or government holdings refers to the amount held by the issuing government as a percentage of the current amount outstanding. The percentage of amount held by government only applies to US, UK, and CA sovereign bonds only.

Central banks conduct open market operations as part of their monetary measures by holding government bonds issues. Therefore, there is usually a difference between total amount outstanding of sovereign bonds and the actual amount available in the marketplace, the difference being the amount held by the government.

The percentage of government holding is calculated by the sum of the amount outstanding held by the government and the amount outstanding held by central banks divided by the total amount outstanding. The amount held by central banks is only applicable to GB gilts, representing the portion of the current amount outstanding held by Debt Management Office.

The bellow is an example of the percentage of government holding for a U.S. Treasury bond with ISIN US912828K585.

| Effective Date | End Date | Amount Held by Government | Amount Held by Central Banks | Total Amount Outstanding | Amount Held by Government% |
|---|---|---|---|---|---|
| 1/1/2020 | 3/19/2020 | 303031700 | 0 | 35127646800 | 0.86 |
| 3/20/2020 | 3/22/2020 | 403031700 | 0 | 35127646800 | 1.15 |
| 3/23/2020 | 4/29/2020 | 523031700 | 0 | 35127646800 | 1.49 |
| 4/30/2020 | null | 0 | 0 | 0 | 0 |

[6] The information, while prospective, is based on announced publicly available information.

# 9 Market Conventions

## 9.1 Market Calendars and Settlement Conventions

Calendar conventions vary across markets and currencies. The calendar convention for a given currency/market determines the holiday schedule for that market and if pricing and SSAs data will be published on designated holidays.

Please refer to 12.2 Market Calendars and Settlement Conventions for market calendars detailed by market.

Standard index settlement convention will be same day (e.g., T+0) unless otherwise specified. The market settlement convention varies across markets and currencies.

## 9.2 Timing of Prices and Reference Data

### 9.2.1 Bond Pricing

The timing of the bond pricing data collection used for the instruments included in the Index Universe is presented in the table below.

| Currency / Market | Bond Pricing Timing |
|---|---|
| USD | 3pm EST (15.00 local New York) |
| CAD | 3pm EST (15.00 local New York) |
| EUR | 4pm GMT (16.15 local London) |
| GBP | 4pm GMT (16.15 local London) |

### 9.2.2 Bond Terms and Conditions

Sovereign, supranational, and corporate bond reference data with terms and conditions for bonds included in the Index Universe, including rating, is collected throughout the day to ensure timely maintenance as well as appropriate quality assurance.

The final timing of terms of reference data is synchronized with the bond pricing data collection used for any currency covered in the Index Universe.

### 9.2.3 Swap Data Timing

The timing of the swap pricing data collection is coordinated with the respective bond pricing data collection specified for that currency.

| Currency / Market | Par Swap Pricing Timing | Reference Rates |
|---|---|---|
| USD | 3PM ET (15.00 local New York) | ICE Libor Rates 11.55GMT (11:55: local London) |
| USD Secured Overnight Financing Rate | 3PM ET (15.00 local New York) | SOFR<br>08:00 ET (08:00 local New York) |
| CAD | 3PM ET (15.00 local New York) | CDOR<br>10.15ET (10.15 local Toronto) |
| EUR | 4.15PM GMT (16.15 local London) | EURIBOR®<br>11.00CET (11.00 local Brussels) |
| EUR Euro short-term rate | 4.30PM GMT (16.30 local London) | €STR<br>09.00CET (09:00 local Brussels) |
| GBP | 4.15PM GMT (16.15 local London) | ICE Libor Rates 11.55 GMT (11:55: local London) |
| GBP Sterling Overnight Interbank Average rate | 4.30PM GMT (16.30 local London) | SONIA<br>09.00GMT (09:00 local London) |

### 9.2.4 Swaption Data Timing

The timing of the ATM Swaption volatilities data collection is coordinated with the respective bond pricing data collection specified for that currency.

| Currency / Market | ATM Swaption Timing |
|---|---|
| USD | 3PM ET pricing (15.00 local New York) |
| CAD | 3PM ET pricing (15.00 local New York) |
| EUR | 4.15PM GMT pricing (16.15 local London) |
| GBP | 4.15PM GMT pricing (16.15 local London) |

# 10 Data Sources and Quality Assurance

MSCI uses a well-established global provider of reference and terms & conditions (T&C) data as a consistent source across all markets and segments as well as multiple sources for bonds pricing from readily available data providers whenever relevant and or available.

## 10.1 Reference Data and Terms and Conditions Quality Assurance

Throughout the day, MSCI applies stringent QA processes to the T&C data to ensure data integrity and the timeliness of changes provided by our vendor. MSCI escalates to the T&C data provider for scenarios such as:

- Daily changes in any critical data fields including maturity date, coupon, call schedule entries, etc.
- Nullified T&C data
- Logical inconsistencies or mismatches between related T&C data fields.

## 10.2 Pricing Data Quality Assurance

The instruments included in the Index Universe use pricing data from readily available asset pricing products from multiple global price vendors, when available and relevant.

MSCI performs stringent pricing QA to ensure adequate coverage and validity of the pricing data through:

- Asset universe pricing coverage by market
- Static asset price review and vendor confirmation
- Multiple pricing source comparison (when available and relevant)
- Extreme or suspicious price and return review and vendor confirmation

### 10.2.1 Handling of Missing Prices

In the case of a missing price from vendors, MSCI systematically escalates to vendors to challenges missing prices. In the absence of vendor's response or until vendor responds, for any instrument already eligible for inclusion in the Index Universe with a price missing from vendors, MSCI applies a price filling rule for up to 10 consecutive business days after which the asset is dropped from the Index Universe.

MSCI's price filling rules are defined based on the instrument level rating. However, for government bonds issued by sovereign entities in local currency, issuer level ratings are considered in-lieu if instrument level ratings are not available:

- For Investment Grade bonds, MSCI applies a flat-spread price filling method. This method assumes that Investment Grade bond prices are predominantly driven by changes in the interest rate term structure. In this case, a new price is derived daily by applying the spread as of the date of last available vendor price on top of the relevant daily risk-free curve.

- For High-Yield bonds, MSCI applies a flat price filling method. This method assumes that High-Yield bond prices are predominantly driven by credit specific characteristics and are not very sensitive to the interest rate term structure. In this case, the latest available vendor price is carried forward.

### 10.2.2 Handling of Outlier Prices

In the case of severe outlying prices MSCI rejects the received price, generates an escalation to the vendor, and applies price filling as described in section 10.2.1. Severe outlying prices are defined as any price received which is negative (<0) or greater than a specified threshold that is determined on a market-by-market basis.

### 10.2.3 Handling of Abnormal Returns

In the case of receipt of a price which implies a severe outlying return, MSCI rejects the received price, generates an escalation to the vendor and applies price filling as described in section 10.2.1. for up to 2 consecutive business days. If the vendor does not confirm that the price implying an abnormal return is incorrect within 2 consecutive business days, the price is deemed valid and no longer rejected.

Severe outlying returns are dynamically defined relative to returns for similar bonds as well as across pricing sources (when available and relevant).

Comparative analysis across multiple pricing sources is leveraged (when available and relevant) to inform severe outlying price and return validation.

# 11 Data Governance

The Fixed Income Data Committee (FIDC) presides over the development, review and calibration of the fixed income data methodology and provides its recommendations to other product or research level bodies, such as the FIIC (Fixed Income Index Committee).

# 12 Appendices

## 12.1 MSCI Rating Methodology

### 12.1.1 MSCI Average Rating Methodology

To be eligible in the Index Universe, each instrument must be rated by at least one nationally recognized statistical rating organization (NRSRO). For government bonds issued by sovereign entities in local currency, issuer level ratings are provided if the instrument is not rated. MSCI sources ratings from Standard and Poor's Rating Services (S&P) or Moody's Investor Service (Moody's). The MSCI Average Rating is the average rating of S&P and Moody's, rounded up to the nearest integer, if a half value occurs.

The MSCI average rating is based on the mappings and scores below:

| Moody's | S&P | Score | MSCI |
|---|---|---|---|
| Aaa | AAA | 0 | AAA |
| Aa1 | AA+ | 1 | AA+ |
| Aa2 | AA | 2 | AA |
| Aa3 | AA- | 3 | AA- |
| A1 | A+ | 4 | A+ |
| A2 | A | 5 | A |
| A3 | A- | 6 | A- |
| Baa1 | BBB+ | 7 | BBB+ |
| Baa2 | BBB | 8 | BBB |
| Baa3 | BBB- | 9 | BBB- |
| Ba1 | BB+ | 10 | BB+ |
| Ba2 | BB | 11 | BB |
| Ba3 | BB- | 12 | BB- |
| B1 | B+ | 13 | B+ |
| B2 | B | 14 | B |
| B3 | B- | 15 | B- |
| Caa1 | CCC+ | 16 | CCC+ |
| Caa2 | CCC | 17 | CCC |

| | | | |
|---|---|---|---|
| Caa3 | CCC- | 18 | CCC- |
| Ca1 | CC+ | 19 | CC+ |
| Ca2 | CC | 20 | CC |
| Ca3 | CC- | 21 | CC- |
| C1 | C+ | 22 | C+ |
| C2 | C | 23 | C |
| C3 | C- | 24 | C- |
| D[7] | D | 25 | D |

### 12.1.2 MSCI Issuer Rating Methodology

MSCI currently provides issuer level ratings for government bonds issued by sovereign entities in local currency only. Such bonds will be considered eligible if issuer level ratings are available, regardless of availability of bond level rating. Currently, MSCI supports below sovereign government issuers and corresponding local currencies:

| Sovereign Government | Local Currency |
|---|---|
| United States | USD |
| Canada | CAD |
| Austria | EUR |
| Belgium | EUR |
| Cyprus | EUR |
| Estonia | EUR |
| Finland | EUR |
| France | EUR |
| Germany | EUR |
| Greece | EUR |
| Ireland | EUR |
| Italy | EUR |

[7] Average ratings methodology applies to defaulted assets too, and default events are reported individually in corporate action

| | |
|---|---|
| Latvia | EUR |
| Lithuania | EUR |
| Luxembourg | EUR |
| Malta | EUR |
| Netherlands | EUR |
| Portugal | EUR |
| Slovakia | EUR |
| Slovenia | EUR |
| Spain | EUR |
| United Kingdom | GBP |

## 12.2 Market Calendars and Settlement Conventions

### 12.2.1 Settlement Conventions

For the US and Canada bond settlement shifted to T+2 business days as-of September 2nd, 2017. For all days prior to this date, corporate settlement conventions are T+3 business days to settle.

For EURO and GBP, the specific settlement conventions are determined by various clearing systems and are a function of, instrument type, issuer country of domicile, and type of issuer. With settlement days ranging from T+1 to T+3, 90% of bonds in the Index Universe have a settlement between T+2 and T+3 business days based on our analysis[8].

### 12.2.2 USD Market Calendar

The US holiday calendar is derived from the SIFMA US holiday guidelines and populated from year 1996 up to 2099. The assumptions of each holiday and its observed rule are outlined below.

| Holiday Name | Rule | Observed Rule (if applicable) |
|---|---|---|
| New Year's Day | First day of each year | Take the next day as observed holiday if holiday falls on Sunday, |

[8] Analysis conducted as of April 12, 2021.

| Holiday Name | Rule | Observed Rule (if applicable) |
|---|---|---|
| | | no observed holiday if falls on Saturday. |
| Martin Luther King Day | 3rd Monday of January | N/A |
| Presidents' Day | 3rd Monday of February | N/A |
| Good Friday | The Friday before the first Sunday after the first ecclesiastical full moon that occurs on or after March 21 | N/A |
| Memorial Day | Last Monday of May | N/A |
| Independence Day | 4th of July | Take the next day as observed holiday if falls on Sunday. Take the preceding day if falls on Saturday. |
| Labor Day | First Monday of September | N/A |
| Columbus Day | Second Monday of October | N/A |
| Veterans Day | 11th of November | Take the next day as observed holiday if holiday falls on Sunday, no observed holiday if falls on Saturday. |
| Thanksgiving Day | 4th Thursday of November | N/A |
| Christmas Day | 25th of December | Take the next day as observed holiday if falls on Sunday. Take the preceding day if falls on Saturday. |

In addition, the market will close early on 2PM Eastern Time (14.00 local New York) on the weekday preceding or succeeding the following six holidays:

| Early Close Date | Observed Rule (if applicable) |
|---|---|
| Day before New Year's Day | Take the previous Friday if the observed holiday falls on Monday. |
| Thursday before Good Friday | N/A |

| Early Close Date | Observed Rule (if applicable) |
|---|---|
| Friday before Memorial Day | Take the previous Friday. |
| Day before Independence Day | Take the previous Friday if the observed holiday falls on Monday. |
| Friday after Thanksgiving Day | N/A |
| Day before Christmas Day | Take the previous Friday if the observed holiday falls on Monday. |

### 12.2.3 CAD Market Calendar

The CAD holiday calendar is derived from the Toronto Stock Exchange's published settlement holidays and populated from year 1974 up to 2068. The assumptions of each holiday and its observed rule are outlined below.

| Holiday Name | Rule | Observed Rule (if applicable) |
|---|---|---|
| New Year's Day | First day of each year | Take the next Monday day as observed holiday if holiday falls on Saturday or Sunday. |
| Family day | 3rd Monday of February | N/A |
| Good Friday | The Friday before the first Sunday after the first ecclesiastical full moon that occurs on or after March 21 | N/A |
| Victoria Day | Penultimate Monday of May | N/A |
| Canada Day | 1st of July | Take the next day as observed holiday if falls on Sunday, no observed holiday if falls on Saturday. |
| Civic Holiday | First Monday of August | N/A |
| Labour Day | First Monday of September | N/A |
| National Day for Truth and Reconciliation | 30th of September | Take the next Monday day as observed holiday if holiday falls on Saturday or Sunday. |

| | | |
|---|---|---|
| Thanksgiving Day | 4th Thursday of November | N/A |
| Remembrance Day | 11th of November | Take the next Monday day as observed holiday if holiday falls on Saturday or Sunday. |
| Christmas Day | 25th of December | Take the next Monday as observed holiday if falls on Sunday or Saturday. |
| Boxing Day | 26th of December | Take the next Tuesday as observed holiday if falls on Sunday or Monday. Take the next Monday as observed holiday if falls on Saturday. |

### 12.2.4 EURO Market Calendar

The EURO holiday calendar is derived from Trans-European Automated Real-time Gross Settlement Express Transfer (TARGET) settlement holidays and is populated from year 1950 up to 2100. The assumptions of each holiday and its observed rule are outlined below.

| Holiday Name | Rule | Observed Rule (if applicable) |
|---|---|---|
| New Year's Day | First day of each year | No observed holiday if falls on Saturday or Sunday. |
| Good Friday | The Friday before the first Sunday after the first ecclesiastical full moon that occurs on or after March 21 | N/A |
| Easter Monday | First Monday after Good Friday | N/A |
| Labour Day | 1st of May | No observed holiday if falls on Saturday or Sunday. |
| Christmas Day | 25th of December | No observed holiday if falls on Saturday or Sunday. |
| Christmas Holiday | 26th of December | No observed holiday if falls on Saturday or Sunday. |

### 12.2.5 GBP Market Calendar

The GBP holiday calendar is derived from London Stock Exchange's settlement holidays and is populated from year 1960 up to 2069. The assumptions of each holiday and its observed rule are outlined below.

| Holiday Name | Rule | Observed Rule (if applicable) |
|---|---|---|
| New Year's Day | First day of each year | Take the next Monday day as observed holiday if holiday falls on Saturday or Sunday. |
| Good Friday | The Friday before the first Sunday after the first ecclesiastical full moon that occurs on or after March 21 | N/A |
| Easter Monday | First Monday after Good Friday | N/A |
| Early May Bank Holiday[9] | First Monday in May | N/A |
| Late May Bank Holiday | Last Monday in May | N/A |
| Summer Bank Holiday | First Monday in August | N/A |
| Christmas Day | 25th of December | Take the next Monday as observed holiday if falls on Sunday or Saturday. |
| Boxing Day | 26th of December | Take the next Tuesday as observed holiday if falls on Sunday or Monday. Take the next Monday as observed holiday if falls on Saturday. |

[9] In 2020, this holiday was moved to May 8 (Friday) to coincide with Victory in Europe Day.

## 12.3 Currency Specific Model Definitions & Reference Curves

### 12.3.1 Zero-Coupon Government Curves

Zero-coupon government curves are derived using the most relevant methodology for each currency / market. The constituent basket used in estimation is defined as any Government issued fixed coupon bond with the following properties:

- Not inflation linked
- Not callable
- Not the on-the-run bond for its associated benchmark tenor

The table below provides more details about the curve methodology and the constituent basket by currency / market.

| Currency / Market | Constituent Baskets |
|---|---|
| USD | 1M, 3M, 6M, 1Y Benchmark T-Bills, and off-the-run T-notes and T-bonds >1Y to Maturity |
| CAD | T-Bills between 1M and 6M and off-the-run T-bonds >1Y to Maturity |
| EURO | Bubills between 3M and 6M and off-the-run Schaetze, Bobls, and Bunds >1Y to Maturity |
| GBP | T-Bills between 1M and 6M and off-the-run Gilts >1Y to Maturity |

### 12.3.2 Zero-Coupon Swap Curve

Zero-coupon swap curves are used to create a forward-looking expectation for the reference rates which are used in the pricing of fixed-to-float bonds. Additionally, swap curves are used to calibrate the short-rate volatility and the mean reversion speed parameters of the option pricing model for optionable bonds when at-the-money swaption surface is not available.

#### 12.3.2.1 Zero-Coupon Swap Curve

| Currency / Market | Constituent Baskets |
|---|---|
| USD | ICE Libor: Overnight, 1-Week, 2-Week, 1-Month, 2-Month, 3-Month<br>Par-Swap: USD Semi-Annual Par Swap Rates on 3-Month ICE Libor, snap at 15:00 local New York from 1 to 10Y, plus 12Y, 15Y, 20Y and 30Y. |
| CAD | CDOR: 3-Month |

| | |
|---|---|
| | Par-Swap: CAD Semi-Annual Par Swap Rates on 3-Month CDOR, snap at 15:00 local New York from 2Y to 10Y, plus 12Y, 15Y, 20Y, 25Y, and 30Y. |
| EURO | EURIBOR®: 6-Month, published at 11.00 Brussels<br>Par-Swap: EUR Annual Par Swap Rates on 6-Month EURIBOR®, snap at 16.15 local London from 1Y to 15Y, plus 20Y, 25Y, 30Y, 40Y, and 50Y. |
| GBP | ICE Libor: 6-Month<br>Par-Swap: GBP Semi-Annual Par-Swap Rates on 6-Month Libor, snap 16:15 local London from 1Y to 10Y, plus 12Y, 15Y, 20Y, 25Y, 30Y, 40Y, and 50Y. |

#### 12.3.2.2 Zero-Coupon Overnight Indexed Swap Curve

| Currency / Market | Constituent Baskets |
|---|---|
| USD | SOFR: Overnight<br>Par-Swap: USD SOFR At-maturity and Annual Par Swap Rates on Overnight SOFR, snap at 15:00 local New York from 1 to 3W, monthly from 1M to 12M; 15M, 18M; yearly from 2Y to 10Y; 12Y; each 5 years from 20Y to 50Y. |
| EURO | €STR: Overnight<br>Par-Swap: EUR €STR At-maturity and Annual Par Swap Rates on Overnight €STR, snap at 16:30 local London from 1 to 6W, monthly from 1M to 12M; quarterly from 15M to 33M; yearly from 3Y to 30Y; each 10 years from 40Y to 60Y. |
| GBP | SONIA: Overnight<br>Par-Swap: GBP SONIA At-maturity and Annual Par Swap Rates on Overnight SONIA, snap at 16:30 local London from 1 to 3W, monthly from 1M to 12M; quarterly from 15M to 21M; yearly from 2Y to 15Y; each 10 years from 30Y to 70Y. |

On December 13th, 2021, the swap curves for USD, EURO and GBP transitioned to Overnight Index Swaps used in the pricing of fixed-to-float bonds which are indexed to their corresponding alternative reference rate. This is to address the continuity of Swap curves after LIBOR Cessation. In the case of EURO, a multi-rate approach is taken with both EURIBOR® and €STR swap curves to co-exist.

### 12.3.3 ATM Swaption Implied Volatility Surface

The ATM swaption volatilities are used to calibrate the short rate volatility and the mean reversion speed parameters of the option pricing model. They are passed to the option pricing model as-is, no transformation of the swaption surface is applied.

The table below provides more details about the instruments used in the construction of the At-the-Money Swaption Surface by currency / market.

| Currency / Market | Swap Terms | Option Terms | Reference Rates |
|---|---|---|---|
| USD | 2-Year Swap, 10-Year Swap | 1M, 3M, 6M, 1Y, 2Y, 3Y, 4Y, 5Y, 7Y, 10Y, 15Y, 20Y, 25Y, and 30Y. | ICE Libor |
| CAD | 2-Year Swap, 10-Year Swap | 1M, 3M, 6M, 1Y, 2Y, 3Y, 4Y, 5Y, 7Y, and 10Y. | CDOR |
| EURO | 2-Year Swap, 10-Year Swap | 1M, 3M, 6M, 1Y, 2Y, 3Y, 4Y, 5Y, 7Y, 10Y, 15Y, 20Y, 25Y, and 30Y. | ICE Libor |
| GBP | 2-Year Swap, 10-Year Swap | 1M, 3M, 6M, 1Y, 2Y, 3Y, 4Y, 5Y, 7Y, 10Y, 15Y, 20Y, 25Y, and 30Y. | ICE Libor |
| GBP | 2-Year Swap, 10-Year Swap | 1M, 3M, 6M, 9M,1Y,18M, 2Y, 3Y, 4Y, 5Y, 6Y, 7Y,8Y,9Y,10Y, 12Y,15Y, 20Y, 25Y, and 30Y. | SONIA |

On December 13$^{th}$ 2021, the volatilities for GBP (Pound Sterling) ATM Swaption used in the option pricing model transitioned to volatilities which are indexed and discounted to Sterling Overnight Interbank Average rate (SONIA). This is to address the continuity of ATM Swaptions after LIBOR Cessation.

## 12.4 Data for Back-Calculated History

This section lists the variations / assumptions used for deriving the data supporting the back-calculated history of the Index Universe.

Unless it is stated otherwise, the data quality assurance for reference data and term and conditions as well as pricing detailed in section 10 Data Sources and Quality Assurance is also applied for history.

### 12.4.1 For USD Index Universe

#### 12.4.1.1 Bond Pricing for Treasury and Corporate Bonds

Historical pricing information for the period ranging from Feb 17, 2005 to Sep 13, 2018 has been sourced from end-of-day (EOD) pricing sources reflecting 8PM Eastern Time (20.00 local New York) fixed income asset prices.

#### 12.4.1.2 Par-Swap Pricing

Historical swap pricing for the period ranging from Jan 1, 2005 to Jun 27, 2018 has been sourced from end-of-day (EOD) swap pricing sources reflecting prices as-of 5PM Eastern Time (17.00 local New York).

#### 12.4.1.3 ATM Swaption Implied Volatility

Swaption collection as of 3PM Eastern Time (15.00 local New York) is only available beginning Aug 1, 2018, all historical prices prior to this date represent “market close” values. Swaption market close timing varies by market, for the US market, the effective close price represents data as-of 4PM Eastern Time (16.00 local New York).

Prior to the beginning of the ATM swaption surface time series (Aug 22, 2012), the swap curve is used for pricing the call option associated with puttable and callable bonds.

### 12.4.2 For CAD Index Universe

#### 12.4.2.1 Bond Pricing for Treasury and Corporate Bonds

Historical pricing information for the period ranging from Feb 17, 2005 to Sep 13, 2018 has been sourced from end-of-day (EOD) pricing sources reflecting 8PM Eastern Time (20.00 local New York) fixed income asset prices.

#### 12.4.2.2 Par-Swap Pricing

Historical swap pricing for the period ranging from Jan 1, 2005 to Sep 10, 2019 has been sourced from end-of-day (EOD) swap pricing sources reflecting prices as-of 5PM Eastern Time (17.00 local New York).

#### 12.4.2.3 ATM Swaption Implied Volatility

Swaption collection as of 3PM Eastern Time (15.00 local New York) is only available beginning Nov 26, 2019, all historical prices prior to this date represent “market close” values. Swaption market close timing varies by market, for the US market, the effective close price represents data as-of 4PM Eastern Time (16.00 local New York).

### 12.4.3 For EURO Index Universe

#### 12.4.3.1 Bond Pricing for Treasury and Corporate Bonds

Historical pricing information for the period ranging from Apr 8, 2005 to Oct 8, 2019 has been sourced from end-of-day (EOD) pricing sources reflecting 23.00 GMT fixed income asset prices.

#### 12.4.3.2 Par-Swap Pricing

Historical swap pricing for the period ranging from Jan 1, 2005 to Dec 13, 2019 has been sourced from end-of-day (EOD) swap pricing sources reflecting prices as-of 21.15 GMT.

#### 12.4.3.3 ATM Swaption Implied Volatility

Prior to the beginning of the ATM swaption surface time series (Feb 7, 2013), the swap curve is used for pricing the call option associated with puttable and callable bonds.

### 12.4.4 For GBP Index Universe

#### 12.4.4.1 Bond Pricing for Treasury and Corporate Bonds

Historical pricing information for the period ranging from Apr 8, 2005 to Oct 8, 2019 has been sourced from end-of-day (EOD) pricing sources reflecting 23.00 GMT fixed income asset prices.

#### 12.4.4.2 Par-Swap Pricing

Historical swap pricing for the period ranging from Jan 1, 2005 to Dec 3, 2019 has been sourced from end-of-day (EOD) swap pricing sources reflecting prices as-of 21.15 GMT.

#### 12.4.4.3 ATM Swaption Implied Volatility

Prior to the beginning of the ATM swaption surface time series (Feb 7, 2013), the swap curve is used for pricing the call option associated with puttable and callable bonds.

## 12.5 Corporate Event Terminology

**Event Type** - Represents the reason for a change in the value of the amount outstanding on the instrument level.

**Event Effective Date** - Represents a schedule of the history and proforma of all obtainable dates of changed amounts outstanding.

**Redemption Price** - In case of an issuance, this is the price at which the public may purchase the individual tranche of the offered security, from the underwriter(s). In case of a redemption event, it represents price at which the issuer redeemed the individual tranche of the security.

**Effective Instrument ID** - Represents the exchanged/funged instrument from the existing instrument.

The below is a summary of supported event types and their definitions.

| Event | Description | Details |
|---|---|---|
| CAN | Cancelled | Cancelation of debt issued by the issuer due to any event or any other cause. No change in identifier or transfer of amount to any existing or new security. The debt is terminated. |
| CAP | Capitalization of Interest | Increase in the principal amount outstanding of a security if the issuer has an option to add unpaid interest to the amount outstanding |
| CLD | Called | Debt issued by the issuer is called. No change in identifier or transfer of amount to any existing or new security. The debt is terminated. |
| CPT | Call – Pro Rata | Debt issued by the issuer is partially called. No change in identifier or transfer of amount to any existing or new security. The debt is still alive. |
| CUR | Currency Redenomination | Used when a country has a currency redenomination. |
| DEF | In Default | When the bond issuer fails to make an interest or principal payment within the specific period. No change in identifier or transfer of amount to any existing or new security. |
| EXC | Exchange/Converted | Existing security is fully exchanged to new security then the asset status is updated to Exchanged/Converted. The new identifier will be generated, and the exchanged amount of the old security will be transferred to new security. |
| FDD | Repaid via Final Default Distribution | Generally, NOT CLEAR constitutes as a part of bankruptcy proceedings and creditors' claims are settled. No change in identifier or transfer of amount to any existing or new security. |
| FNG | Funged | Funging is a process of retiring the temporary identifiers and merging the temporary security (baby bond) with the permanent security (mother bond). There will be a temporary identifier/ identifier (Baby bond) which trades separately for certain days (generally 40 days) and then 'funged' with the original security post then the asset status for the baby bond is updated as FNG (inactive) and the amounts will be |

| | | |
|---|---|---|
| | | added to the current amount outstanding of mother bond thereby resulting amount outstanding as 0 for the temporary identifier (baby bond). |
| IEX | Issued in Exchange | Issuance of a new instrument due to conversion or exchange from an old instrument. The amount outstanding is transferred from the old instrument. |
| INF | Increase due to Funding | Increase in amount outstanding of a mother bond due to funging of a baby bond. |
| ISA | Issuance due to a Switch Auction | Increase in amount outstanding due to switch auction. |
| ISS | Issued | When an instrument past its first settlement date and is available in the market. External identifiers will be made available. Amount outstanding may change if "ISS" status in use. |
| LIQ | Liquidated | Generally, the debt is liquidated as part of bankruptcy proceeding and creditors' claims are settled. No change in identifier or transfer of amount to any existing or new security |
| MAT | Expired/Matured | When the debt is fully repaid by issuer on the scheduled maturity date and no other action occurred that resulted in a full repayment before the maturity date. |
| MLT | Multiple Actions | When the reduction in the amount outstanding of the debt is due to multiple corporate action events. |
| NAC | Not Active | When vendor has confirmed information that the asset is inactive, but the reason is unknown. For example, if we receive a Null/Void or worthless status from clearing house, the issuer was in default for many years and no bankruptcy proceedings is ongoing in any court of law then we will update the asset as NAC. |
| OVA | Overallotment | Increase in outstanding amount due to overallotment from the issuer. |
| PPT | Prepayment | Decrease in outstanding amount due to Prepayment made by the issuer. |
| PRE | Preliminary | Instruments that are added based on initial data for Norwegian bonds, without Final Terms and Conditions. |
| PRT | Prepayment – Pro Rata | When each bondholder is paid out as part of repurchase. |
| PUT | Put | When a security is fully repaid via the exercise of a put option then we update asset status as 'Put'. |

| | | |
|---|---|---|
| RBM | Repaid before Maturity | When the debt is fully repaid by the issuer before maturity and the repayment was not a result of a call or a put. |
| RDM | Euro Redenominated | Security redenominated in EUR when the country responsible for the currency of denomination joins the European Monetary Union. |
| REF | Refinancing Transaction | When the issuer redeems a portion of the debt by replacing it with a new debt obligation. |
| REM | Remarketing | When the security is remarketed by the remarketing agent with few changes in terms and conditions. |
| REO | Reorganization | Represents the principal reduction in a security due to restructuring of the security to equity/other issuances. |
| REP | Repurchased/Bought back | The outstanding debt is fully bought back by repurchase option by the issuer and not the call option. The amount of the security repurchased is not transfer to any existing or new security. The security is turned to inactive. |
| RES | Restructured | The existing debt of the issuing entity is restructured into new debt, equity, preferred stock, etc. as part of bankruptcy proceedings. The restructured debt may convert into new securities (debt, equity, preferred stock, etc.) as per the plan of reorganization approved by the bankruptcy court or via voluntary restructuring. |
| REV | Reverse Auction | When there is a decrease in amount when the seller of the security (the holder) places bids to retire the debt. |
| RMK | Remarketed | When the security is remarketed by the remarketing agent with few changes in terms and conditions then we update the status of bond to remarketed (active status). Remarketed means investor will have the option to sell their bonds to the market. The re-marketing agent will handle the resale process. The remarketing agent receives notices from investors who want to sell their bonds. The remarketing agent then surveys the market to determine a rate at which all the bonds being put up for sale can be sold to other investors. Sometimes new identifier is generated. |
| RPN | Reopened | Re-opening is an option of the issuer to issue additional Notes under the original indenture without any new identifiers. The 'Reopened' securities will have identical terms and conditions same as the notes originally issued save for the amount, issue price and settlement |

| | | |
|---|---|---|
| | | date. These reopening securities will be immediately consolidated and form a single series with the already issued and outstanding securities. There will be an increase in amount outstanding. There will not be a new identifier issued/assigned. |
| RTA | Retained Amount | When issuers market their bonds and retain a small portion of the issue amount and sell it later when they need funds, which are represented as retained amount. |
| RTP | Reinstatement – Pro Rata | Issuers can reinstate the amount written down. This event is related to Contingent Convertible bonds only. |
| TEN | Tendered | The security is fully bought back as part of a tender offer by the issuer. No change in identifier or transfer of amount to any existing or new security. The security is either fully or partially repaid by the issuer which leads to a reduction in amount outstanding. (In case of a partial tender we will not update the asset status). |
| UNK | Unknown | Represents all remaining uncategorized events not listed herein due to no details received from vendor, in terms of the event nature. The outstanding amount change is published, without further specifying the details. |
| WDP | Write Down – Pro Rata | Issuers can write down their Contingent Convertible bonds on a pro rata basis. |
| WRT | Write Down | Contingent Convertible bonds that absorb losses when the capital of the issuing bank falls below a certain level. |
| CAN | Cancelled | Cancelation of debt issued by the issuer due to any event or any other cause. No change in identifier or transfer of amount to any existing or new security. The debt is terminated. |

### 12.5.1 Issuer Corporate Actions Examples

#### 12.5.1.1 Issuer Bankruptcy

In May 2012, issuer RESIDENTIAL CAPITAL LLC filed for chapter 11 bankruptcy protection and bond US76113BAR06 under this issuer changed status to “DEF” (in default). The issuer was liquidated in December 2013 and the asset status was changed to “LIQ” (liquidation).

**T&C Received from Vendor**

| ISIN | EFF_DATE | END_DATE | ASSET_STATUS_CD | ISSUER_LONG_NAME | AMT_OUTSD |
|---|---|---|---|---|---|
| **US76113BAR06** | 4/17/2012 | 5/13/2012 | ISS | RESIDENTIAL CAPITAL LLC | 473416000 |
| **US76113BAR06** | 5/14/2012 | 12/16/2013 | DEF | RESIDENTIAL CAPITAL LLC | 473416000 |
| **US76113BAR06** | 12/17/2013 | 12/31/3999 | LIQ | RESIDENTIAL CAPITAL LLC | 0 |
| **Index Universe** | | | | | |
| **ISIN** | EFF_DATE | END_DATE | MARKET_STATUS | ISSUER_NAME | OUTSTD |
| **US76113BAR06** | 4/18/2012 | 5/13/2012 | ISS | RESIDENTIAL CAPITAL LLC | 473416000 |
| **US76113BAR06** | 5/14/2012 | 12/16/2013 | DEF | RESIDENTIAL CAPITAL LLC | 473416000 |
| **US76113BAR06** | 12/17/2013 | 12/31/3999 | LIQ | RESIDENTIAL CAPITAL LLC | 0 |
| **Issuer Amount Outstanding** | | | | | |
| **DATE** | ISSUER | | | AMT_OUTSTD | |
| **7/30/2013** | RESIDENTIAL CAPITAL LLC | | | 1770388641 | |
| **12/17/2013** | RESIDENTIAL CAPITAL LLC | | | 0 | |

### 12.5.1.2 Issuer Name Change

In December 2018, issuer WESTROCK RKT CO changed its name to WESTROCK RKT LLC. This event does not affect its outstanding amount nor the relationship between the parent and child entity. It is treated in the following manner:

| T&C Received from Vendor | | | | | |
|---|---|---|---|---|---|
| **ISIN** | EFF_DATE | END_DATE | ASSET_STATUS_CD | ISSUER_LONG_NAME | AMT_OUTSD |
| **US772739AL23** | 11/2/2018 | 12/27/2018 | ISS | WESTROCK RKT CO | 399000000 |
| **US772739AL23** | 12/28/2018 | 5/8/2019 | ISS | WESTROCK RKT LLC | 399000000 |

| Index Universe | | | | | |
|---|---|---|---|---|---|
| **ISIN** | EFF_DATE | END_DATE | MARKET_STATUS | ISSUER_NAME | OUTSTD |
| **US772739AL23** | 11/2/2018 | 12/27/2018 | ISS | WESTROCK RKT CO | 399000000 |
| **US772739AL23** | 12/28/2018 | 5/8/2019 | ISS | WESTROCK RKT LLC | 399000000 |

| Issuer Amount Outstanding | | |
|---|---|---|
| **DATE** | ISSUER | AMT_OUTSTD |
| **12/27/2018** | WESTROCK RKT CO | 1450000000 |
| **12/28/2018** | WESTROCK RKT LLC | 1450000000 |

### 12.5.1.3 Issuer Merger

In May 2019, COOPER INDUSTRIES merged into EATON CORPORATION, and the assets under issuer COOPER US INC (subsidiary of Cooper Industries) changed issuer to EATON ELECTRIC HOLDINGS LLC with outstanding amount transferred to EATON ELECTRIC HOLDINGS LLC. This event is treated as follows:

| T&C Received from Vendor | | | | | |
|---|---|---|---|---|---|
| **ISIN** | EFF_DATE | END_DATE | ISSUER_LONG_NAME | PARENT_ISSUER_LONG_NAME | AMT_OUTSD |
| **US216871AE36** | 5/28/2019 | 5/28/2019 | COOPER US INC | COOPER INDUSTRIES | 238967000 |
| **US216871AE36** | 5/29/2019 | 12/31/3999 | EATON ELECTRIC HOLDINGS LLC | EATON CORPORATION PLC | 238967000 |

| Index Universe | | | | | |
|---|---|---|---|---|---|
| **ISIN** | EFF_DATE | END_DATE | ISSUER_NAME | P_ISSUER_NAME | OUTSTD |
| **US216871AE36** | 5/28/2019 | 5/28/2019 | COOPER US INC | COOPER INDUSTRIES | 238967000 |
| **US216871AE36** | 5/29/2019 | 12/31/3999 | EATON ELECTRIC HOLDINGS LLC | EATON CORPORATION PLC | 238967000 |

| Issuer Amount Outstanding | | |
|---|---|---|
| **DATE** | ISSUER | AMT_OUTSTD |
| **5/28/2019** | COOPER US INC | 238967000 |
| **5/28/2019** | EATON ELECTRIC HOLDINGS LLC | N/A |
| **5/29/2019** | COOPER US INC | 0 |
| **5/29/2019** | EATON ELECTRIC HOLDINGS LLC | 238967000 |

#### 12.5.1.4 Issuer Acquisition

BECTON DICKINSON acquired BARD (C.R.) by the end of 2017, and the assets under issuer C R BARD INC did not change issuer but added BECTON DICKINSON AND CO as its parent entity. The outstanding amount of the asset remained the same. This event is treated as following:

| T&C Received from Vendor | | | | | |
|---|---|---|---|---|---|
| **ISIN** | EFF_DATE | END_DATE | ISSUER_LONG_NAME | PARENT_ISSUER_LONG_NAME | AMT_OUTSD |
| **US067383AC36** | 12/29/2017 | 12/31/2017 | C R BARD INC | | 67782000 |
| **US067383AC36** | 1/1/2018 | 1/2/2018 | C R BARD INC | BECTON DICKINSON AND CO | 67782000 |
| **Index Universe** | | | | | |
| **ISIN** | EFF_DATE | END_DATE | ISSUER_NAME | P_ISSUER_NAME | OUTSTD |
| **US067383AC36** | 12/29/2017 | 1/1/2018 | C R BARD INC | | 67782000 |
| **US067383AC36** | 1/2/2018 | 1/10/2018 | C R BARD INC | BECTON DICKINSON AND CO | 67782000 |

| Issuer Amount Outstanding | | |
|---|---|---|
| **DATE** | ISSUER | AMT_OUTSTD |
| **12/29/2017** | C R BARD INC | 610658000 |

| | | |
|---|---|---|
| **1/1/2018** | C R BARD INC | 610658000 |

### 12.5.1.5 Issuer Spin-Off

In June 2018, WYNDHAM HOTELS & RESORTS INC was spun off from its parent entity WYNDHAM DESTINATIONS INC. Post the event, WYNDHAM HOTELS & RESORTS INC is a standalone entity and the bonds under this issuer remained under the same entity except that the new independent entity does not have a parent issuer anymore. Assets under the original parent entity remained the same.

| T&C Received from Vendor (parent entity) | | | | | |
|---|---|---|---|---|---|
| **ISIN** | EFF_ DATE | END_ DATE | ISSUER_LONG_NAME | PARENT_ISSUER_ LONG_NAME | AMT_ OUTS D |
| **US0673 83AC36** | 6/1/2 018 | 6/3/2 018 | WYNDHAM DESTINATIONS INC | | 40000 0000 |
| **US0673 83AC36** | 6/4/2 018 | 9/27/ 2018 | WYNDHAM DESTINATIONS INC | | 40000 0000 |
| **Index Universe (parent entity)** | | | | | |
| **ISIN** | EFF_ DATE | END_ DATE | ISSUER_NAME | P_ISSUER_NAME | OUTST D |
| **USU983 23AA39** | 6/1/2 018 | 6/3/2 018 | WYNDHAM DESTINATIONS INC | | 40000 0000 |
| **USU983 23AA39** | 6/4/2 018 | 9/27/ 2018 | WYNDHAM DESTINATIONS INC | | 40000 0000 |
| **T&C Received from Vendor (subsidiary)** | | | | | |
| **ISIN** | EFF_ DATE | END_ DATE | ISSUER_NAME | P_ISSUER_NAME | OUTST D |
| **USU983 23AA39** | 6/1/2 018 | 6/18/ 2018 | WYNDHAM HOTELS & RESORTS INC | WYNDHAM DESTINATIONS INC | 50000 0000 |
| **USU983 23AA39** | 6/19/ 2018 | 8/7/2 018 | WYNDHAM HOTELS & RESORTS INC | | 50000 0000 |
| **Index Universe (subsidiary)** | | | | | |
| **ISIN** | EFF_ DATE | END_ DATE | ISSUER_NAME | P_ISSUER_NAME | OUTST D |

| | | | | | |
|---|---|---|---|---|---|
| **USU98323AA39** | 6/1/2018 | 6/18/2018 | WYNDHAM HOTELS & RESORTS INC | WYNDHAM DESTINATIONS INC | 500000000 |
| **USU98323AA39** | 6/19/2018 | 8/7/2018 | WYNDHAM HOTELS & RESORTS INC | | 500000000 |

| Issuer Amount Outstanding | | |
|---|---|---|
| **DATE** | ISSUER | AMT_OUTSTD |
| **6/18/2018** | WYNDHAM DESTINATIONS INC | 2390067000 |
| **6/19/2018** | WYNDHAM DESTINATIONS INC | 2390067000 |

### 12.5.2 Asset Level Corporate Event Examples

#### 12.5.2.1 Asset Called

For instance, Bond US854502AF89 changed status from “ISS” (issuance) to “TBC” (to-be-called) on Jan 25, 2019 and were called on Feb 25, 2019. Its outstanding amount changed to 0 when its status changed to “CLD”.

| T&C Received from Vendor | | | |
|---|---|---|---|
| **ISIN** | ASSET_STATUS_CD | STATUS_EFF_DT | AMT_OUTSD |
| **US854502AF89** | ISS | 12/3/2013 | 400000000 |
| **US854502AF89** | TBC | 1/25/2019 | 400000000 |
| **US854502AF89** | CLD | 2/25/2019 | 0 |
| **Index Universe** | | | |
| **ISIN** | EVENT_TYPE | EVENT_EFF_DATE | OUTSTANDING_AMT |
| **US854502AF89** | ISS | 12/3/2013 | 400000000 |
| **US854502AF89** | CLD | 2/25/2019 | 0 |

#### 12.5.2.2 Asset Recovered from Default

In July 2003, MIRANT AMERICAS GENERATION LLC, issuer of bond US60467PAH73, filed for bankruptcy. In January 2006, the issuer fully recovered from bankruptcy and made all missing interest payments. Outstanding amount of 850,000,000 remained unchanged.

| T&C Received from Vendor |
|---|

| ISIN | ASSET_STATUS_CD | STATUS_EFF_DT | AMT_OUTSD |
|---|---|---|---|
| **US60467PAH73** | ISS | 9/19/2001 | 850000000 |
| **US60467PAH73** | DEF | 7/14/2003 | 850000000 |
| **US60467PAH73** | ISS | 1/3/2006 | 850000000 |
| **Index Universe** | | | |
| **ISIN** | EVENT_TYPE | EVENT_EFF_DATE | OUTSTANDING_AMT |
| **US60467PAH73** | ISS | 9/19/2001 | 850000000 |
| **US60467PAH73** | DEF | 7/14/2003 | 850000000 |
| **US60467PAH73** | ISS | 1/3/2006 | 850000000 |

### 12.5.2.3 Asset Liquidated after Default

Bond US281023AX91 defaulted in December 2012 when its issuer EDISON MISSION ENERGY filed for bankruptcy. The bond was further liquidated as part of the issuer's plan of reorganization in March 2014.

| T&C Received from Vendor | | | |
|---|---|---|---|
| **ISIN** | ASSET_STATUS_CD | STATUS_EFF_DT | AMT_OUTSD |
| **US281023AX91** | ISS | 11/20/2007 | 800000000 |
| **US281023AX91** | DEF | 12/17/2012 | 800000000 |
| **US281023AX91** | LIQ | 3/11/2014 | 0 |
| **Index Universe** | | | |
| **ISIN** | EVENT_TYPE | EVENT_EFF_DATE | OUTSTANDING_AMT |
| **US281023AX91** | ISS | 11/20/2007 | 800000000 |
| **US281023AX91** | DEF | 12/17/2012 | 800000000 |
| **US281023AX91** | LIQ | 3/11/2014 | 0 |

#### 12.5.2.4 Asset Exchanged (One-to-One)

Bond US96647KAF93 was exchanged into a new bond US713448EA28 on Nov 9, 2018. Outstanding amount of 88,230,000 was transferred to the new bond.

| T&C Received from Vendor | | | |
|---|---|---|---|
| **ISIN** | ASSET_STATUS_CD | STATUS_EFF_DT | AMT_OUTSD |
| **US96647KAG76** | ISS | 9/23/1996 | 21000000 |
| **US96647KAG76** | EXC | 11/9/2018 | 0 |
| **US713448EB01** | IEX | 11/9/2018 | 21000000 |
| **Index Universe** | | | |
| **ISIN** | EVENT_TYPE | EVENT_EFF_DATE | OUTSTANDING_AMT |
| **US96647KAG76** | ISS | 9/23/1996 | 21000000 |
| **US96647KAG76** | EXC | 11/9/2018 | 21000000 |

#### 12.5.2.5 Asset Exchanged (Multiple-to-One)

Bonds US611688AA01 and US61166WAC55 were exchanged into a new bond US07274NBA00 on Jul 12, 2018. Total outstanding amount of 318,220,000 was transferred to the new bond.

| T&C Received from Vendor | | | |
|---|---|---|---|
| **ISIN** | AMT_OUTSD_CHG_CD | AMT_OUT_DT | AMT_OUTSD |
| **US611688AA01** | ISS | 7/15/2005 | 150000000 |
| **US611688AA01** | EXC | 7/12/2018 | 22975000 |
| **US61166WAC55** | ISS | 7/15/2005 | 250000000 |
| **US61166WAC55** | EXC | 7/12/2018 | 58805000 |
| **US07274NBA00** | IEX | 7/12/2018 | 3182200000 |
| **Index Universe** | | | |

| ISIN | EVENT_TYPE | EVENT_EFF_DATE | OUTSTANDING_AMT | EFEFCTIVE_INSTRUMENT_ID |
|---|---|---|---|---|
| **US611688AA01** | ISS | 7/15/2005 | 150000000 | |
| **US611688AA01** | EXC | 7/12/2018 | 22975000 | US07274NBA00 |
| **US61166WAC55** | ISS | 7/15/2005 | 250000000 | |
| **US61166WAC55** | EXC | 7/12/2018 | 58805000 | US07274NBA00 |

### 12.5.2.6 Asset Funged

Baby bond USA8372TAH17 was funged on Dec 19, 2018. The bond issue amount outstanding was decreased to 0 and was added to the issue amount outstanding of the mother bond USA8372TAC20:

| T&C Received from Vendor | | | | |
|---|---|---|---|---|
| **ISIN** | AMT_OUTSD_CHG_CD | STATUS_EFF_DT | AMT_OUTSD | |
| **USA8372TAH17** | ISS | 11/6/2018 | 500000000 | |
| **USA8372TAH17** | FNG | 12/19/2018 | 0 | |
| **USA8372TAC20** | RPN | 10/22/2017 | 500000000 | |
| **USA8372TAC20** | RPN | 12/19/2018 | 1000000000 | |
| **Index Universe** | | | | |
| **ISIN** | EVENT_TYPE | EVENT_EFF_DATE | OUTSTANDING_AMT | EFEFCTIVE_INSTRUMENT_ID |
| **USA8372TAH17** | ISS | 11/6/2018 | 500000000 | |
| **USA8372TAH17** | FNG | 12/19/2018 | 0 | USA8372TAC20 |

## 12.6 Glossary

### 12.6.1 Bond Terminology

- **Accrued Interest** - The amount of interest as a percentage of par that accrues between the last coupon date and the bond settlement date owed to a buyer of the bond.
- **Amount outstanding** – The amount outstanding or par value of a bond determines not only the notional balance on which an issuer pays interest, but the amount of principal to be repaid by an issuer at the end of a bond's term. Par amount outstanding is seen as a measure of relative liquidity and as a proxy of the float available for investors to purchase, with larger bonds viewed as more accessible than smaller ones.
- **Bullet Bond** – A bond whose entire principal value is paid all at once on the maturity date, as opposed to amortizing the bond over its lifetime. Bullet bonds cannot be redeemed early by an issuer, which means they are non-callable.
- **Callable Bond** – A bond that can be redeemed or "called" by the issuer on or after a specific date. Interest payments on these bonds are generally higher to compensate buyers for reinvestment risk as issuers will tend to redeem them when prevailing interest rates fall as they can reissue/refinance at a lower rate.
- **Convertible Bond** – A convertible bond is a fixed-income debt security that pays interest payments but can be converted into a predetermined number of common stock or equity shares. The conversion from the bond to stock can be done at certain times during the bond's life and is usually at the discretion of the bondholder.
- **Coupon** – The effective interest rate for the instrument.
- **Coupon Payment Frequency** – Represents the frequency of scheduled accrued interest payments per year.
- **Credit** – Quality of a bond as measured by the ratings agencies, Moody's, Standard and Poor's, and Fitch. This is important for index users with investment guidelines that make a clear distinction between investment grade (rated BBB-/Baa3 and above) and high yield (rated BB+/Ba1 thru C-/C3) securities.
- **Currency** –Denomination of a bond's principal and interest payments
- **Day Count Convention** – Represents the number of days in a month and the number of days assumed in a year. The day count convention is used to calculate the accrued interest on the offered instrument.
- **Defaulted Bond** – A bond is defaulted when it fails to repay its interest or principal. A default can occur when a borrower is unable to make timely payments, misses payments, or avoids or stops making payments.

- **Dual Currency Bond** – A debt instrument in which the coupon and principal payments are made in two different currencies. The currency in which the bond is issued, which is called the base currency, will be the currency in which interest payments are made.
- **Equity Clawbacks** – Equity Clawbacks allow the issuer to refinance a certain amount of the outstanding bonds with proceeds from an equity offering.
- **Exchange-Traded Notes** – A type of bond that does not pay interests and pays the return of the index it tracks at maturity. Prices of exchange-traded notes fluctuate like stocks.
- **Fixed-Rate Coupon** – Coupon or interest payment on a bond that remains fixed at a given rate throughout the term of the bond.
- **Floating-Rate Coupon** – Coupon or interest payment on a bond is tied to a benchmark rate such as a U.S. Treasury note rate, the Federal Reserve funds rate, the London Inter-bank Offered Rate (LIBOR), or the prime rate throughout the term of the bond. The coupon rate is calculated based on the aggregation of underlying index level and a predetermined margin spread.
- **Hybrid securities** – Bonds that have the qualities of both an interest-bearing debt and equity. These allow borrowers to defer interest payments without defaulting. Deferred interest can be cumulative or non-cumulative. Interest payments are made from pre-taxed income.
- **Inflation linked bonds** – Bonds where the principal to be repaid at maturity is indexed to inflation or deflation daily over the life of the bond.
- **Issue Amount** – Represents the amount issued at initial issuance.
- **Issue Date** – The settlement date for the first placement that resulted in an issuance of securities.
- **Issuer** – Company, government, government-sponsored entity, or any other entity accessing capital markets and that sells newly created bonds to raise money for funding operations.
- **Make Whole Call** – A type of call provision on a bond allowing the issuer to pay off remaining debt early. The issuer typically has to make a lump sum payment to the investor derived from a formula based on the net present value (NPV) of future coupon payments that will not be paid incrementally because of the call combined with the principal payment the investor would have received at maturity.
- **Maturity** – Redemption date of the security from the auction.
- **NVCC** - Non-viability Contingent Convertibles are subordinated debt or preferred shares that are issued by banks in Canada and can be converted into common stocks if a trigger event occurs. This conversion has two potential trigger events:

1) when a bank is facing financial difficulties so severe that it is deemed "non-viable" by the Office of the Superintendent of Financial Institutions (OSFI); or 2) if a government injection of capital or similar support has been provided or agreed to, without which the bank would be non-viable.

- **Par Value** – The face value of a security, typically in $100 or $1000.
- **Parent issuer** – A parent issuer is a company that owns or controls the issuer through the ownership of greater than 50% of the voting stock.
- **Payment-in-Kind Bond** – A bond that pays interest in additional bonds rather than cash. These are considered a type of deferred coupon bond and usually issued by firms in financial distress. Sometimes referred to as PIK bonds.
- **Perpetual** –Perpetual bond is a type of bond with no maturity date assigned. Issuers will make nonstop periodic coupon payments on perpetual bonds, and the issuer doesn't have the obligation to redeem the principal as no maturity is defined.
- **Preferred Security** – A preferred security is a form of instrument with properties of both equity and a debt instrument and is generally considered a hybrid instrument. Preferred shareholders have priority over common stockholders when it comes to dividends, which generally yield more than common stock and can be paid monthly or quarterly.
- **Private Placement** – A bond or other security that is sold to a small number of usually large, qualified investors (Qualified Institutional Buyers ("QIBs") for example) without being registered with the SEC.
- **Puttable Bond** – A bond where the holder can demand the issuer redeem on or after specific dates before maturity. The interest payments will be lower than prevailing interest rates as the option to force redemption has value to the holder.
- **Reg-S Bonds** – Bonds offered and sold outside the U.S. and thus not subject to SEC registration requirements. As such, offering participants (the issuer, banks involved in offer or their affiliates) cannot engage in direct selling efforts nor can offers and sales be made to U.S. persons, including U.S. persons physically located outside the U.S.
- **Sector** –Classification of the bond issuer, recognizing the wide range of issuer types in the fixed income market including corporate, government and securitized borrowers.
- **Secured Debt** - Any type of debt or general obligation that is protected by a guarantor or collateralized by a lien on specific assets of the borrower in the case of a bankruptcy or liquidation or failure to meet the terms for repayment.

- **Senior Debt** – Senior unsecured debt of an issuer's outstanding bonds, is considered lower risk than subordinated debt. Although senior debt holders must be repaid before other unsecured creditors in a bankruptcy event, the securities are backed only by the credit of the issuer and its ability to service the debt.
- **Sinking Bonds** – These are bonds backed by funds set aside to ensure principal and interest payments are made as promised and often accompanied by call schedules covering the life of the bond. They are often referred to as Sinkable Bonds or Sinking Fund Bonds.
- **Step-down Coupon** – Coupon or interest payment on a bond that can decrease by a given increment at some point or points over the life of the bond.
- **Step-up Coupon** – Coupon or interest payment on a bond that can increase by a given increment at some point or points over the life of the bond.
- **Strippable** – It is the process of separating a bond into its principal component and interest components. These components are then sold separately into interest only and principal only bonds.
- **Strips** –STRIPS (Separate Trading of Registered Interest and Principal of Securities) are debt securities that are created through the process of coupon stripping. The bond's principal and interest have been separated as two separate instruments.
- **Subordinated Issues** – Bonds or notes that rank below other debt in terms of claims on the issuer assets in the event of a bankruptcy or liquidation.
- **Ultimate Parent Issuer** – An ultimate parent issuer is a company that owns or controls the parent issuer through the ownership of greater than 50% of the voting stock.
- **Unsecured Debt** –Any type of debt or general obligation that is not protected by a guarantor or collateralized by a lien on specific assets of the borrower in the case of a bankruptcy or liquidation or failure to meet the terms for repayment.
- **Warrant-linked bond** – Bonds issued with warrants that entitle the bearer to buy shares in the issuing company at a predetermined price, usually following a given period.
- **Zero-Coupon** – Bonds that do not have a coupon or make periodic interest payments. They sell at a discount to par value and pay out par value at maturity. The discount equates to interest paid by the issuer and is amortized over the holding period of the bond.
- **144(a) Bonds** – Privately placed bonds that can trade under SEC rule 144(a). This rule allows privately placed bonds to trade among QIBs without the minimum two-year holding period assuming other provisions are met

### 12.6.2 Single Security Analytics Terminology

- **Convexity** –This is the second derivative of the price-yield function and measures the second-order change in the price of a bond with respect to yield changes. Convexity is positive for conventional bonds. Negative convexity dampens the price appreciation if interest rates fall and aggravates the price decline if interest rates rise.
- **Current Yield** – This is the ratio of the annual income (interest) received by the bond divided by the current price of the security.
- **Duration Times Spread** (DTS) - Duration Times Spread is usually calculated as L-OAS * OASD. This measure is popular for spread/credit risk analysis, as the volatility of the spread return of a security is typically proportional to its DTS. DTS is one input of our Volatility & our Value FI Factor index.
- **Key Rate Duration -** a component of Effective Duration, where the parallel shift in the par yield curve is replaced with a "tent-shaped" shift centered at a given key-rate node.
- **Macaulay Duration** – This is a measure of the weighted average time to maturity (in years) for an investor to receive the present value cash flows from a bond.
- **Maturity** - The time (in years) for which an instrument remains outstanding. The term refers to a finite period at the end of which the instrument will no longer exist and the principal is repaid with
- **Modified Duration** – This is a measure of the effect that a 100bp change in interest rates will have on the price of a bond.
- **Nominal Yield** – This represents the coupon rate on a bond. The nominal yield is the interest rate (to par value) that the bond issuer promises to pay the bond holders.
- **Option-Adjusted Spread (OAS)** – This is the constant spread that when added to all discount rates from the government curve on the binomial interest rate tree model (used by the indices) will make the theoretical value of the future cash flows equal to the market price of the instrument.
- **Yield-to-Maturity** - it represents the rate of return anticipated on a bond if held until its maturity. The YTM calculation takes into account the bond's current market price, par value, coupon interest rate and time to maturity under the assumptions that all cash flows received are reinvested at the same rate as the bond's current yield.
- **Yield-to-Worst-** Represents the lowest potential yield that an investor would receive on a bond if the issuer does not default. The yield to worst is calculated by making worst-case scenario assumptions on the issue by calculating the returns that would be received if provisions, including prepayment, call or sinking

fund, are used by the issuer. The YTW is used to evaluate the worst-case scenario for yield to help investors manage their risk and exposures.

## 12.7 Excluded Security Types

### 12.7.1 Excluded Instrument Types

| Instrument Type Code | Description | Instrument Type Code | Description |
|---|---|---|---|
| ABS | Asset Backed Security | LOB | Lease Obligation Bond |
| ACS | Asset Covered Security (Covered Bond) | LPN | Loan Participation Note |
| C2 | Certificate of Participation | LTRGAGE | Lettre de Gages (Covered Bond) |
| C3 | Certificate of Obligation | MBS | Mortgage Backed Security |
| CAPSEC | Capital Security | PASSTHRU | Pass Through Certificate |
| CAT | Insurance Linked Security | PFDSTK | Preferred Stock |
| CDBCRP | Certificate of Deposit | PFOFFEN | Oeffentlicher Pfandbrief (Covered Bond) |
| CDINST | Certificate of Deposit - Institutional | PNOTE | Equity Participation Note |
| CDO | Collateralized Debt Obligation | SAKOBL | Sakerstallda Obligation (Covered Bond) |
| CDOSYN | Synthetic Collateralized Debt Obligation | STPROD | Structured Product |
| CLN | Credit Linked Note | SUKIJA | Islamic Sukuk (Ijara) |
| COLLTR | Collateral Trust | SUKITH | Islamic Sukuk (Istithmar) |
| CTF | Certificate | SUKMUD | Islamic Sukuk (Mudaraba) |
| CVDBND | Covered Bond (Other) | SUKMUR | Islamic Sukuk (Murabaha) |
| DEPSH | Depositary Share of Preferred Stock | SUKMUS | Islamic Sukuk (Musharaka) |
| EETC | Enhanced Equipment Trust Certificate | SUKUK | Islamic Sukuk (Other) |
| EQUIPTR | Equipment Trust | SUKWAK | Islamic Sukuk (Wakala bil istithmar) |

| | | | |
|---|---|---|---|
| EQUNIT | Equity Unit | SYKHYB | Islamic Sukuk (Hybrid) |
| FAC | Facility Bond | TR | Trust |
| INCBND | Income Bond | TRCTF | Trust Certificate |
| INCNT | Income Note | TRPFDSEC | Preferred Security (Trust, SPV) |
| INT | Strip - Interest only | UNIT | Unit |

### 12.7.2 Excluded Seniority Types

| Seniority Type Code | Description |
|---|---|
| 2NDLIEN | Senior Secured - Second Lien |
| 2NDMTG | Senior Secured - Second Mortgage |
| 3RDMTG | Senior Secured - Third Mortgage |
| MTG | Senior Secured - Mortgage |
| REFMTG | Senior Secured - General & Refunding Mortgage |

## 12.8 MSCI Fixed Income Data Methodology Book Tracked Changes

**First version reviewed and published in December 2019.**

**The following modifications are effective from June 2020.**

- General coverage of additional currencies released to Fixed Income Asset Platform: CAD, GBP, EUR throughout the document
- Section 2 - Opportunity Set and Eligibility Criteria
  - Section 2.5.1 – Eligible Bond Types – addition of asset coverage approved by the Fixed Income Data Committee
  - Section 2.6.3 – Country of Domicile – added detail on the eligibility of emerging markets
- Section 7 – Forward Looking Information
  - Addition of Section 7
- Section 8 – Market Conventions
  - Added currency specific timing
- Section 11 – Appendix
  - Addition of currency specific definitions for market calendars, timing of prices and reference data, reference curves, back-calculated history

**The following modifications are effective from August 2021.**

- Section 2– Opportunity Set and Eligibility Criteria

    - Section 2.2 – Asset Classification – addition of Sub-sovereign bonds and removal of municipal bonds in effort to create alignment with MSCI Entity Classification and Relationship Methodology
    - Section 2.3 – Credit Quality – added detail on exceptions for rating requirements for government issued bonds as long as the issuer is rated.
    - Section 2.5.2 – Non-Eligible Bond Types – Clarification denoting that only STRIPS bonds are ineligible.
    - Section 2.6.1 – Issuer Amount Outstanding – Clarification that STRIPS are excluded in calculation of issuer amount outstanding
- Section 5 – Single Security Analytics
    - Section 5.2.2 – Yield-to-Worst – Improvement to statistic definition
    - Section 5.4.2 – Modified Convexity – Correction to statistic definition b/c it is in relation to YTW as opposed to YTM
- Section 8 – Market Conventions
    - Section 8.1 – Market Calendars and Settlement Conventions – removal of language stating "interest accrued during the month will be reflected within the calendar month" because RiskServer is not currently able to accommodate this desired interest accrual.
- Section 9 – Data Sources and Quality Assurance
    - Section 9.2.1 – Handling of Missing Prices – clarifying language as to how handle missing prices for unrated issuances given that price filling is based on rating.
- Section 11 – Appendix
    - Section 11.1.1 – MSCI Average Rating Methodology – clarifying language detailing that for unrated government bonds issuer level ratings are provided in-lieu
    - Section 11.1.2 – MSCI Issuer Rating Methodology – addition of this section
    - Added Section 11.7 – MSCI Fixed Income Data Methodology Book Tracked Changes

**The following modifications are effective from December 2021.**

- Section 1– Opportunity Set and Eligibility Criteria
    - Added pf Additional Published Reference Data: covers additional reference data points including derived methodology supporting index calculations.

- Section 2– Opportunity Set and Eligibility Criteria
    - Section 2.4 – Seniority – Added exception of seniority types eligible to the Index Universe.
    - Section 2.5.1 – Eligible Bond Types – Introducing hybrid securities with deferrable interest payments that have not been deferred.
    - Section 2.5.2 – Non-Eligible Bond Types – Clarification denoting that hybrid securities whose interest payments have been deferred by the issuer, addition of excluded instrument types and seniority types.
    - Section 2.6.3 – Country of Domicile – Correction to eligible issuer country of domicile.
- Section 4 – Reference Curves and Reference Rates
    - Section 4.2.1 – Reference Rates – Added usage of reference rates and applicable scope.
- Section 8 – Additional Published Reference Data
    - Section 8.1 – Government Amount Outstanding Allocation – Addtion of the section, announcing the support of additional data attributes, including data definition, representation, calculation methodology.
- Section 9 – Market Conventions
    - Section 9.2.3 – Swap Data Timing – Added timing of the swap pricing data for USD Secured Overnight Financing Rate, EUR Euro short-term rate, GBP Sterling Overnight Interbank Average rate
- Section 12 – Appendices
    - Section 12.2.3. – CAD Market Calendar – Inclusion of newly announced federal statutory holiday, National Day for Truth and Reconciliation
    - Section 12.3.2.1. – Zero-Coupon Swap Curve – Clarification denoting ICE as provider under GBP and USD libor.
    - Section 12.3.2.2. – Zero-Coupon Overnight Indexed Swap Curve – Addition of this section
    - Section 12.3.3. – ATM Swaption Implied Volatility Surface – Addition of GBP SONIA to construct ATM swaption surface. Clarification of reference rates used in the market.
    - Section 12.6.1. – Bond Terminology – Added definiton of Hybrid Securities.
    - Section 12.7. – Excluded Security Types – Addition of this section.

# 13 References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