

MSCI FIXED INCOME INDEX CALCULATION METHODOLOGY

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1 Introduction

This methodology book describes MSCI's general Index calculation methodology for the MSCI Fixed Income Indexes.

These policies and guidelines affect all securities across the MSCI Fixed Income Indexes and products. Unless otherwise stated the policies and guidelines apply therefore to all securities in the MSCI Fixed Income universe.

Please note that the index construction methodology, input data specification and other guiding principles for MSCI Fixed Income Indexes can be found at www.msci.com.

2 MSCI Fixed Income Indexes

MSCI Fixed Income Indexes measure the performance of a set of fixed income securities over time. They are calculated using the Laspeyres' concept of a weighted arithmetic average together with the concept of chain-linking.

MSCI calculates its fixed income indexes in "local" currency as well as in USD. Index levels are also available in several other currencies such as EUR, GBP etc. While the local currency series of indexes cannot be replicated in the real world, it represents the theoretical performance of an index without any impact from foreign exchange fluctuations i.e., a continuously hedged portfolio.

MSCI Fixed Income Indexes are calculated 5 days a week, from Monday to Friday. However, the index levels may not change on days that are noted as holidays as per the MSCI Fixed Income Data methodology¹

MSCI also reviews its fixed income indexes on an ongoing basis to account for the following:

- If an index constituent is no longer priced (intra-rebalancing) by the pricing source or the price is unavailable, the last available price is used.
- MSCI, at times, may use a price different from the last available price provided, including 0.00 in the case of as default or missed interest payment. MSCI will employ procedures as noted in the MSCI Fixed Income Data Methodology document relevant to pricing.

Please see Appendix 5.4 for detailed policy around handling of missing data and use of alternate data sources.

Announcements with relevant information pertaining to MSCI Fixed Income Indexes will be made at 6 p.m. EST and calculated Index levels will be distributed at end of each business day at 7 p.m. EST.

¹ MSCI Fixed Income Data Methodology on <https://www.msci.com/index-methodology>

3 MSCI Fixed Income Index Return Calculation Methodology

The total return index measures the change in market value of a Fixed Income portfolio over a given period relative to a starting base date value. This includes, return from fixed income security price² movements, exchange rate fluctuations, coupon income earned as well as P&L generated from redemption of principal.

Market value of a Fixed Income Security

Market Value of a security is defined as the product of its notional amount outstanding and dirty price. Dirty price of the security is calculated by adding its clean bid price and accrued interest³. Therefore, market value of the security accounts for daily changes in price and interest accrued from the fixed income security.

$$DP_{t,j} = P_{t,j} + A_{t,j} \text{ --- (1)}$$

$$MV_{t,j} = \frac{DP_{t,j} * N_{s,j} * K_{t,j}}{100} \text{ --- (2)}$$

Where:

$P_{t,j}$ – Clean Bid Price of the security j at the close of day t

$A_{t,j}$ - Accrued Interest of the security j at the close of day t ⁴

$DP_{t,j}$ - Dirty Price of the security j at the close of day t

$N_{s,j}$ - Amount Outstanding of the security j at the close of the previous index rebalancing day s

$MV_{t,j}$ – Market Value of the security j at the close of day t

$K_{t,j}$ – Security Inclusion Factor of the security j at the close of day t

² In the document term price refers to price of the fixed income security, unless explicitly stated otherwise. Please refer to MSCI Fixed Income Data Methodology for detailed specification on input data points.

³ Please refer to MSCI Fixed Income Glossary for definition of the technical terms used in the document.

⁴ Please refer to Appendix – Section 5.3 of the document for details in adjustment to accrued interest in the ex-coupon period.

Market value and Cash calculations

In the MSCI Fixed Income Indexes, constituent securities accrue cash balance from regular interest payments and principal redemptions in between two index reviews. The accrued cash is reinvested across the index on the Rebalancing date.

Therefore, we define market value with cash as follows.

$$MVC_{t,j} = MV_{t,j} + CCB_{t,j} \text{ --- (3)}$$

Where:

$MVC_{t,j}$ - Market Value with Cash of the security j at the close of day t

$CCB_{t,j}$ - Total cumulative cash balance of the security j at the close of day t

Total cumulative cash balance of the security is a summation of cash flow accrued from interest payments and principal redemptions between last Rebalancing date and the return calculation date (t).

$$CCB_{t,j} = CCB_{t-1,j} + \text{Cash from Coupon}_{t,j} \text{ --- (4)}$$

Where:

$CCB_{t,j}$ - Total cumulative cash balance of the security j accrued since last rebalancing at the close of t

In case of a redemption or coupon payment event for a bond, cash from coupon and cash from redemption are calculated using the formulae defined below.

$$\text{Cash from Coupon}_{t,j} = \frac{\text{CouponPaid}_{j,t}}{100} * N_{s,j} * K_{t,j}^5 \text{ --- (5)}$$

Where:

CouponPaid_j - Coupon payment of the bond j at the close of day t

⁵ Please refer to Appendix – Section 5.3 for details on calculation of cash from coupon for bonds with a provision for ex-coupon period.

Security Level Total Return Calculation

MSCI calculates daily security level total return to account for changes in-

- Market Price
- Accrued Interest
- Cash generated from interest payments.
- Cash generated from redemption or prepayment of the outstanding principal.
- Exchange Rate
- Corporate Events

Daily security level total return between t-1 and t is calculated using the following formula.

$$SLTR_{t-1,t,j}^{USD} = \left(\frac{Adjusted\ MVC_{t,j}}{Initial\ MVC_{t,j}} - 1 \right) \dots (6)$$

$$Initial\ MVC_{t,j} = MVC_{t-1,j} * FX_{t-1,j} \dots (7)$$

$$Adjusted\ MVC_{t,j} = MVC_{t,j} * FX_{t,j} \dots (8)$$

Where:

$FX_{t,j}$ – Foreign exchange rate applicable for security j at the close of day t

$Initial\ MVC_{t,j}$ – Market value inclusive of cash with which security j is included in the opening index portfolio for return calculation on day t

$Adjusted\ MVC_{t,j}$ – Market value inclusive of cash for security j adjusted for changes in price, interest and / or principal on day t

Note that $Adjusted\ MVC_{t,j}$ calculation shown above pertains to return calculation in base currency which is USD. In case of return calculation in “local” currency, the following formula is employed.

$$SLTR_{t-1,t,j}^{local} = \left(\frac{MVC_{t,j}}{MVC_{t-1,j}} - 1 \right) \dots (9)$$

MSCI decomposes security level total return calculation into the following components for attribution purposes.

Security Level Price Return

Price return of the security in local currency is calculated using the following formula–

$$SLPR_{t-1,t,j}^{local} = \frac{P_{t,j}}{P_{t-1,j}} - 1 \quad \text{--- (10)}$$

Where:

$P_{t,j}$ – Clean Bid Price of the security j at the close of day t

Security Level Income Return

Income Return of the security in local currency represents part of total return that is earned via regular interest payments as well as interest accrued over time in between interest payment dates.

$$SLIR_{t-1,t,j}^{local} = \frac{1 + SLTR_{t-1,t,j}^{local}}{1 + SLPR_{t-1,t,j}^{local}} - 1 \quad \text{--- (11)}$$

Currency

Fixed Income securities denominated in foreign currency will be impacted by the movement of exchange rate between foreign and local currency. MSCI captures return from exchange rate movements using the following formula.

$$FXR_{t-1,t,j} = \frac{FX_{t,j}}{FX_{t-1,j}} - 1 \quad \text{--- (12)}$$

Accounting for FX movements, local total and price returns can be converted into total and price returns of various currencies (e.g., USD, EUR, GBP etc.) using the following formulae –

$$SLTR_{t-1,t,j}^{USD} = (1 + SLTR_{t-1,t,j}^{local}) * (1 + FXR_{t-1,t,j}) - 1 \quad \text{--- (13)}$$

$$SLPR_{t-1,t,j}^{USD} = (1 + SLPR_{t-1,t,j}^{local}) * (1 + FXR_{t-1,t,j}) - 1 \quad \text{--- (14)}$$

Index Level Total Return Calculation

Index level total return can be calculated using the below formula -

$$Index TR_{t-1,t}^{USD} = \sum_{j=1}^n SLTR_{t-1,t,j}^{USD} * opening wt_{t,j}^{MVC} \text{ --- (15)}$$

$$Index TR_{t-1,t}^{local} = \sum_{j=1}^n SLTR_{t-1,t,j}^{local} * opening wt_{t,j}^{MVC} \text{ --- (16)}$$

Where:

opening $wt_{t,j}^{MVC}$ – Opening weight of security j in the index including market value and cash on day t

$$opening wt_{t,j}^{MVC} = \frac{Initial MVC_{t,j}}{\sum_{j=1}^n Initial MVC_{t,j}}$$

Index Level Total Return Attribution

Security level attribution outlined earlier in Section 2.3 is extended to the index level by aggregating security level price and income returns using the weighted average method. Daily Index level total return is attributed into the following two parts –

- Daily Index Level Price Return (Index PR)
- Daily Index Level Income Return (Index IR)

They are calculated as shown in the formulae below –

$$Index PR_{t-1,t}^{USD} = \sum_{j=1}^n SLPR_{t-1,t,j}^{USD} * opening wt_{t,j}^{MVC} \text{ --- (17)}$$

$$Index PR_{t-1,t}^{local} = \sum_{j=1}^n SLPR_{t-1,t,j}^{local} * opening wt_{t,j}^{MVC} \text{ --- (18)}$$

$$Index IR_{t-1,t}^{USD} = \frac{1 + Index TR_{t-1,t}^{USD}}{1 + Index PR_{t-1,t}^{USD}} - 1 \text{ --- (19)}$$

$$Index IR_{t-1,t}^{local} = \frac{1 + Index TR_{t-1,t}^{local}}{1 + Index PR_{t-1,t}^{local}} - 1 \text{ --- (20)}$$

⁶ Note that on the effective date of index rebalancing, certain variants of the index total return are adjusted to account for transaction costs. Details on transaction cost adjustment to the total return variant is outlined in the Appendix – Section 5.1.

Calculation of Index Levels

Generally, MSCI will calculate and publish three variants of the index levels. They will start with the base value (example: 1000) and will be calculated by chain-linking of appropriate daily index returns. Formulae shown below are example of chain-linking daily index returns in USD between period t-s and t to calculate index levels in USD. A similar approach is used on daily index returns in local currency to calculate index levels in local currency.

$$TRI_t^{USD} = TRI_{t-s}^{USD} * \left[\prod_{t-s < u \leq t} [1 + Index\ TR_{u-1,u}^{USD}] \right] \text{--- (21)}$$

$$PRI_t^{USD} = PRI_{t-s}^{USD} * \left[\prod_{t-s < u \leq t} [1 + Index\ PR_{u-1,u}^{USD}] \right] \text{--- (22)}$$

$$IRI_t^{USD} = IRI_{t-s}^{USD} * \left[\prod_{t-s < u \leq t} [1 + Index\ IR_{u-1,u}^{USD}] \right] \text{--- (23)}$$

Where:

TRI_t^{USD} – Total Return Index Level in USD at the close of day t

PRI_t^{USD} – Price Return Index Level in USD at the close of day t

IRI_t^{USD} – Income Return Index Level in USD at the close of day t

4 MSCI Index Level Datapoints

MSCI calculates aggregated index level data points for MSCI Fixed Income Indexes using weighted average methodology, as shown in the formulae enlisted below.

Index Average Clean Price

$$AP_t = \sum_{j=1}^n P_{t,j} * w_{t,j}^N \text{ --- (24)}$$

Index Average Dirty Price

$$ADP_t = \sum_{j=1}^n DP_{t,j} * w_{t,j}^N \text{ --- (25)}$$

Index Average Coupon

$$AC_t = \sum_{j=1}^n Coupon_j * w_{t,j}^N \text{ --- (26)}$$

Index Average Notional

$$AN_t = \frac{\sum_{j=1}^n N_{t,j} * K_{t,j}}{n} \text{ --- (27)}$$

Index Average Time to Maturity

$$TM_t = \sum_{j=1}^n TM_{t,j} * w_{t,j}^N \text{ --- (28)}$$

$$\text{Where, } TM_{t,j} = \frac{\text{Number of days between Maturity Date and } t}{365}$$

Index Average Modified Duration

$$AD_t^{\text{MOD}} = \sum_{j=1}^n D_{t,j}^{\text{MOD}} * w_{t,j}^{\text{MVC}} \text{ --- (29)}$$

Index Average Effective duration

$$AD_t^{EFF} = \sum_{j=1}^n D_{t,j}^{EFF} * w_{t,j}^{MVC} \text{ --- (30)}$$

Index Average Convexity

$$AX_t = \sum_{j=1}^n X_t * w_{t,j}^{MVC} \text{ --- (31)}$$

Index Average Effective Convexity

$$AEX_t = \sum_{j=1}^n EX_t * w_{t,j}^{MVC} \text{ --- (32)}$$

Index Average Yield to Maturity

$$AY_t = \sum_{j=1}^n Y_{t,j} * w_{t,j}^{MVC} \text{ --- (33)}$$

Index Average Yield to Worst

$$AYW_t = \sum_{j=1}^n YW_{t,j} * w_{t,j}^{MVC} \text{ --- (34)}$$

Index Average OAS

$$OAS_t = \sum_{j=1}^n OAS_{t,j} * w_{t,j}^{DMV} \text{ --- (35)}$$

Index Average Credit Rating

$$ART_t = \sum_{j=1}^n RT_{t,j} * w_{t,j}^{MVC} \text{ --- (36)}$$

MSCI converts credit rating in letter from Moody's and S&P by assigning each security with a credit score using the table presented in the Appendix. Using the numerical scores, final credit rating score of the security is calculated as shown below.

$$\text{Where, } RT_{t,j} = \max (RT_{t,j}^{Moody's}, RT_{t,j}^{S\&P})$$

Index level aggregated numerical credit rating score is rounded to the nearest integer and converted back to a MSCI credit rating as presented in the table in the Appendix.

Weight calculation formulae, employed in evaluation of these index level metrics are enlisted below -

Market Value Weight with Cash

$$w_{t,j}^{MVC} = \frac{MV_{t,j} * FX_{t,j}}{\sum_{j=1}^n (MV_{t,j} + CCB_{t,j}) * FX_{t,j}}$$

Nominal Weight

$$w_{t,j}^N = \frac{N_{t,j} * K_{t,j}}{\sum_{j=1}^n N_{t,j} * K_{t,j}}$$

Effective Duration Adjusted Weight

$$w_{t,j}^{DMV} = \frac{MV_{t,j} * FX_{t,j} * D_{t,j}^{EFF}}{\sum_{j=1}^n D_{t,j}^{EFF} * (MV_{t,j} + CCB_{t,j}) * FX_{t,j}}$$

5 Appendix

Transaction cost adjustment on Index Returns

On the effective date of index rebalancing ($t = s$), certain variants of the total index return are adjusted to account for transaction costs. The return adjustment for transaction costs reflects the fact that in replicating portfolio rebalancing, new index additions and securities where weight has increased are traded at the ask price, whereas index deletions and securities where weight has decreased are traded at the bid price. The formulae mentioned below calculates the impact of the bid-ask spread on the index total return.

$$Cost_{t=s} = \sum_{\substack{j = \text{all bonds with increase in} \\ \text{wt including} \\ \text{new index additions}}} \frac{P_{ask,t-1,j} - P_{bid,t-1,j}}{P_{bid,t-1,j} + A_{t-1,j}} * (opening\ wt_{j,t}^{mv} - closing\ wt_{j,t-1}^{mv}) - - - (37)$$

Where:

$P_{t-1,j}^{ask}$ – Closing ask price of security j on one business day before the effective day of rebalancing

$P_{t-1,j}^{bid}$ – Closing bid price of security j on one business day before the effective day of rebalancing

$$opening\ wt_{j,t}^{mv} = \frac{Initial\ MV_{t,j}}{\sum_{j=1}^n Initial\ MV_{t,j}}$$

$$closing\ wt_{j,t-1}^{mv} = \frac{Adjusted\ MV_{t-1,j}}{\sum_{j=1}^n Adjusted\ MV_{t-1,j}}$$

$$Initial\ MV_{t,j} = \frac{DP_{t-1,j} * N_{t-1,j} * FX_{t-1,j} * K_{t,j}}{100}$$

$$Adjusted\ MV_{t,j} = \frac{DP_{t,j} * N_{t,j} * FX_{t,j} * K_{t,j}}{100}$$

Therefore, index total return (Index TR) on the effective date of rebalancing is adjusted as follows.

$$Index\ TR_{t=s}^{TC} = Index\ TR_{t=s} - Cost_{t=s}$$

Where:

$Index\ TR_s^{TC}$ - Index total return adjusted for transaction cost on the effective date of rebalancing.

Credit Rating Scale

Moody's	S&P	Fitch	Score	MSCI
Aaa	AAA	AAA	0	AAA
Aa1	AA+	AA+	1	AA+
Aa2	AA	AA	2	AA
Aa3	AA-	AA-	3	AA-
A1	A+	A+	4	A+
A2	A	A	5	A
A3	A-	A-	6	A-
Baa1	BBB+	BBB+	7	BBB+
Baa2	BBB	BBB	8	BBB
Baa3	BBB-	BBB-	9	BBB-
Ba1	BB+	BB+	10	BB+
Ba2	BB	BB	11	BB
Ba3	BB-	BB-	12	BB-
B1	B+	B+	13	B+
B2	B	B	14	B
B3	B-	B-	15	B-
Caa1	CCC+	CCC+	16	CCC+
Caa2	CCC	CCC	17	CCC
Caa3	CCC-	CCC-	18	CCC-
Ca1	CC+	CC+	19	CC+
Ca2	CC	CC	20	CC
Ca3	CC-	CC-	21	CC-
C1	C+	C+	22	C+
C2	C	C	23	C
C3	C-	C-	24	C-
D ⁷	D	D	25	D

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

Treatment for Negative Accrued Interest

Accrued Interest is almost always expected to be positive, but bonds with a provision for ex-coupon period can have negative accrued interest.

If a bond is purchased in the ex-coupon period, the buyer is not entitled to the upcoming coupon payment. The buyer of such a bond thus incurs a loss of interest income for remainder of the ex-coupon period. This aspect is reflected accurately by negative accrued interest during that period.

Total return calculation framework for the MSCI Fixed Income Indexes accounts for this by adjusting security calculation in the ex-coupon period based on when it was added to the index.

If a security was added to the index in the ex-coupon period, then it does not receive coupon payment on the next coupon date (i.e., Cash from Coupon = 0). On the other hand, if a security is already a part of the index portfolio when it enters the ex-coupon period, then accrued interest for the security is adjusted for calculation purposes as shown below.

$$A_{t,j}^{ex-coupon} = A_{t,j} + \frac{Coupon_j/100}{Coupon\ Frequency_j}$$

Treatment of Missing Data and Usage of Alternate Sources

For index maintenance purposes, MSCI often uses data received from multiple sources. Such data may need to be taken on specific and defined dates ('Data Date') as is relevant to a specific index methodology. In certain instances, due to an extraordinary event or exceptional technical issue, data needed as of a Data Date may not be available as expected. In such cases, unless otherwise specified in the relevant index methodology, MSCI will use the most recent data available prior to the Data Date. MSCI will release a public announcement to inform clients about the occurrence of any event where this methodological directive is enacted.

Additionally, MSCI independently monitors the quality of data from its data sources on an ongoing basis. MSCI may under exceptional circumstances elect to use data from alternative sources if MSCI determines that the primary source data is not reflective of market conditions. In such circumstances, and if deemed material, MSCI will release a public announcement to inform clients about the change. All such determinations are made by the MSCI Fixed Income Index Committee (FIIC). If appropriate, MSCI may conduct a consultation with the investment community to gather feedback on the most relevant alternate source.

Glossary of Terms

Glossary of Terms in the order of their appearance

P – Clean Bid Price of a security

A - Accrued Interest of a security

DP - Dirty Price of a security

N - Amount Outstanding of a security

K – Security Inclusion Factor of a security

MV – Market Value of a security

MVC – Market Value with Cash of a security

CCB - Total cumulative cash balance of a security

CCP - Cumulative cash from coupon payments of a security accrued since last rebalancing

CouponPaid – Actual coupon paid for a security on the coupon payment date

FX – Foreign exchange rate

Initial MVC – Market value inclusive of cash a security in the opening index portfolio

Adjusted MVC - Market value inclusive of cash for a security adjusted for changes in price, interest and / or principal

SLTR – Security level Total Return

SLPR – Security level Price Return

SLIR – Security level Income Return

FXR – FX Return

Index TR – Index Total Return

Index PR – Index Price Return

Index IR – *Index Income Return*

TRI – Total Return Index Level

PRI – Price Return Index Level

IRI – Income Return Index Level

The following sections have been modified since August 2020:

Section MSCI Fixed Income Indexes: Referenced the MSCI Fixed Income Data methodology for details on holiday treatment.

The following sections have been modified since April 2022:

Section 1.3.1 – Security Level Price Return

Section 1.3.2 – Security Level Income Return

Section 1.4.1 – Index Level Total Return Attribution

Added Section 4.5 – Glossary of Terms

The following sections have been modified since December 2023:

Section 6.2 – Credit rating scale expanded to include all credit ratings till Default.

The following sections have been modified since July 2024:

Section 3 – Modified to reflect fixing of amount outstanding as per last rebalance date of the index.

Section 4 – Removed

The following sections have been modified since December 2024:

Appendix – Added a column for Fitch Credit Ratings

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