

# **MSCI Fixed Income Index Calculation Methodology**

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## 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](http://www.msci.com).

## 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 will not change on days that are declared SIFMA US Holidays as per the schedule found at -

<https://www.sifma.org/resources/general/holiday-schedule/>.

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

- When an index constituent is in default or misses an interest payment, the last price reported by the pricing source is used.
- 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.

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 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 price<sup>1</sup> movements, exchange rate fluctuations, coupon income earned as well as P&L generated from redemption of principal.

## 1.1 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 interest<sup>2</sup>. Therefore, market value of the security accounts for daily changes in price and interest accrued from the fixed income security.

$$DP_{t,j} = P_{t,j} + A_{t,j}$$

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

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<sup>3</sup>

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

$N_{t,j}$  - Amount Outstanding of the security j at the close of day t

$MV_{t,j}$  – 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

<sup>1</sup> 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.

<sup>2</sup> Please refer to MSCI Fixed Income Glossary for definition of the technical terms used in the document.

<sup>3</sup> Please refer to Appendix – Section 4.3 of the document for details in adjustment to accrued interest in the ex-coupon period

## 1.2 Market value with cash

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.

$$MVC_{t,j} = MV_{t,j} + CCB_{t,j}$$

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).

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

$$CCP_{t,j} = CCP_{t-1,j} + \text{Cash from Coupon}_{t,j}$$

$$CCR_{t,j} = CCR_{t-1,j} + \text{Cash from Redemption}_{t,j}$$

Where:

$CCP_{t,j}$  - Cumulative cash from coupon payments of the security j, accrued since last rebalancing at the close of t

$CCR_{t,j}$  - Cumulative cash from principal redemption of the security j, accrued since last rebalancing at the close of t

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

In case of corporate bonds, cash from coupon and cash from redemption are calculated using the formulae defined below.

$$\text{Cash from Coupon}_{t,j} = \frac{\text{Coupon}_j/100}{\text{Coupon Frequency}_j} * N_{t-1,j} * K_{t,j}^4$$

Where:

$\text{Coupon}_j$  – Annual coupon rate of the bond j

$\text{Coupon Frequency}_j$  – Coupon payment frequency of bond j. For instance, it is common for corporate bonds to pay coupon semi-annually which implies a coupon frequency of 2.

$$\text{Cash from Redemption}_{t,j} = \left( \frac{RP_{t,j} + A_{t,j}}{100} \right) * (N_{t-1,j} - N_{t,j}) * K_{t,j}$$

Where:

$RP_{t,j}$  - Redemption Price of security j at the event effective day t. It is the price at which the security is redeemed by the issuer. This price may vary from the current market price of the security. If the data for redemption price is unavailable, then it is assumed to be the clean bid price of the security j at the close of t.

### 1.3 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

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<sup>4</sup> Please refer to Appendix – Section 4.3 for details on calculation of cash from coupon for bonds with a provision for ex-coupon period.

Daily security level total return between t-1 and t is calculated using the following formula. Note that Adjusted MVC is treated appropriately to account for corporate events. Please refer to Section 2 for details.

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

$$Initial\ MVC_{t,j} = MVC_{t-1,j} * FX_{t-1,j}$$

$$Adjusted\ MVC_{t,j} = MVC_{t,j} * FX_{t,j}$$

Where:

$FX_{t,j}$  – Foreign Exchange Rate applicable for security j in Foreign Currency/USD convention 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, principal on day t

Note that  $Adjusted\ MVC_{t,j}$  calculation shown above pertains to return calculation in USD. In case of return calculation in “local” currency, MSCI uses  $FX_{t-1,j}$  in the formula. Similar adjustments are made in calculation of  $Price\ Income_{t,j}$ ,  $Coupon\ Income_{t,j}$  and  $Redemption\ Income_{t,j}$  to capture the return attribution accurately in local currency. Currency Return is always zero for the local currency variant.

$$Adjusted\ MVC_{t,j}^{local} = MVC_{t,j} * FX_{t-1,j}$$

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

### 1.3.1 Security Level Price Return

Price return of the security is calculated using the following formula –



$$SLPR_{t-1,t,j} = \frac{Price\ Income_{t,j}}{Initial\ MVC_{t,j}}$$

$$Price\ Income_{t,j} = \left( \frac{P_{t,j} - P_{t-1,j}}{100} \right) * N_{t-1,j} * FX_{t,j} * K_{t,j}$$

Where:

$SLPR_{t-1,t,j}$  – Security Level Price Return of the security j between t-1 and t

$Price\ Income_{t,j}$  – P&L generated between t-1 and t for security j from market movements of clean bid price

### 1.3.2 Security Level Income Return

Income Return of the security represents part of total return that is earned via regular interest payments as well as interest accrued over time in between interest payment dates. Income return also accounts for P&L generated when principal is paid out at a premium or a discount as compared to closing clean bid price of the security on the effective date of the corporate event.

$$SLIR_{t-1,t,j} = \frac{Coupon\ Income_{t,j} + Redemption\ Income_{t,j}}{Initial\ MVC_{t,j}}$$

$$Coupon\ Income_{t,j} = \left( \left( \frac{A_{t,j} - A_{t-1,j}}{100} \right) * N_{t-1,j} + Cash\ from\ Coupon_{t,j} \right) * FX_{t,j} * K_{t,j}$$

$$Redemption\ Income_{t,j} = \left( \frac{RP_{t,j} - P_{t,j}}{100} \right) * (N_{t-1,j} - N_{t,j}) * FX_{t,j} * K_{t,j}$$

Where:

$SLIR_{t-1,t,j}$  - Security Level Income Return of the security j between t-1 and t

$Redemption\ Income_{t,j}$  – P&L generated due to difference in market price and redemption price of the security j at the close of day t

*Coupon Income<sub>t,j</sub>* – Interest earned from coupon payments and accruals between t-1 and t for security j

### 1.3.3 Currency Return

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.

$$FXR_{t-1,t,j} = \frac{FX_{t,j}}{FX_{t-1,j}} - 1$$

Where:

*FXR<sub>t-1,t,j</sub>* - Currency Return of the security j between t-1 and t

Therefore, for a given security j, total return between t-1 and t can also be calculated using the attribution return components.

$$SLTR_{t-1,t,j} = SLPR_{t-1,t,j} + SLIR_{t-1,t,j} + FXR_{t-1,t,j}$$

## 1.4 Index Level Total Return Calculation

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

$$Index\ TR_{t-1,t} = \sum_{j=1}^n SLTR_{t,j} * opening\ wt_{t,j}^{MVC\ 5}$$

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<sup>5</sup> 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 4.1.

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

Where:

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

$Index TR_{t-1,t}$  – Index level total return between t-1 and t

### 1.4.1 Index Total Return Attribution

Daily Index level total return is attributed into the following three parts, like security level total return

- Daily Index level Price Return (Index PR)
- Daily Index level Income Return (Index IR)
- Daily Index level Currency Return (Index XR)

As shown in the formulae below, they are calculated using the weighted average of security level price and income returns.

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

$$Index IR_{t-1,t} = \sum_{j=1}^n SLIR_{t,j} * \text{opening } wt_{t,j}^{MVC}$$

$$Index XR_{t-1,t} = \sum_{j=1}^n FXR_{t,j} * \text{opening } wt_{t,j}^{MVC}$$

### 1.4.2 Calculation of Index Levels

MSCI will create 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 between period t-s and t to calculate index levels.

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

Where:

$TRI_t$  – Total Index Level at the close of day t

MSCI also calculates Index levels for Price return (PRI) and Income return (IRI) using similar formulae.

## 2 Corporate Events Treatment

This section of the methodology book provides a description of the rules and guidelines followed by MSCI for the treatment of corporate events within the MSCI Fixed Income Indexes.

Any exceptions to these rules are reviewed and approved by the MSCI Fixed Income Index Committee (FIIC) and are publicly announced in advance of the implementation. This methodology book focuses on the implementation of corporate events affecting securities across all the MSCI Fixed Income Indexes and products.

MSCI endeavors to develop and maintain a set of corporate event implementation rules that are as generic as possible and that can apply to any fixed income security included in the MSCI Fixed Income universe.

Unless otherwise stated, the policies and guidelines apply therefore to all securities in the MSCI Fixed Income universe.

For certain corporate events, MSCI applies a market value adjustment at the security level to neutralize (at least partially) the price movement due to the event and keep only the price performance in the index due to real market movement.

The policies and guidelines set forth apply in most corporate events cases. For corporate events not described in this Methodology Book or combinations of different types of corporate events and other exceptional cases, MSCI reserves the right to determine the most appropriate implementation method and announces it prior to the changes becoming effective in the MSCI Fixed Income Indexes.

MSCI has identified three broad categories of corporate events based on their impact on outstanding amount of the security.

- 1) Outstanding amount decreases
- 2) Outstanding amount increases
- 3) Outstanding amount decreases, and new security is issued in exchange

### 2.1 Outstanding Amount Decreases

MSCI treats decrease in amount outstanding of the security as redemption, thus the security level cash balance is increased when the outstanding amount decreases. Formulaically, security level return and market value calculation as described in section 1.2 and 1.3 handle such corporate events implicitly.

## 2.2 Outstanding Amount Increases

Certain corporate events may result in an increase in the notional amount outstanding of the fixed income security. MSCI handles these events by increasing the weight of the security in the opening portfolio of the next business day. On the day of the event for the purposes of return calculation, adjusted market value with cash of the security is calculated in the following manner.

$$Adjusted\ MVC_{t,j} = MVC_{t,j} * FX_{t,j} * \left( 1 + \frac{(P_{t,j} + A_{t,j}) * (N_{t-1,j} - N_{t,j}) * K_{t,j}}{100 * MVC_{t,j}} \right)$$

Note that in this event notional amount outstanding increases and no redemption income is generated.

## 2.3 Outstanding Amount Decreases, and a New security is Issued in Exchange

Securities in an index may be exchanged or restructured by the issuer where a security is issued in exchange for another. In such cases, MSCI applies market neutral treatment and includes the security / securities issued in exchange in the opening index portfolio of the next business day, provided it is eligible for index inclusion.

If the security issued in exchange is not eligible, then the corporate event is treated as a redemption event and the treatment is based on principles outlined in Section 2.1.

Security eligibility criteria is same as that defined in the relevant MSCI Corporate Bond Index methodology.

In this case no cash is received from principal redemption, therefore Cash from Redemption and Redemption Income as defined in Section 1.2 and Section 1.3.2 are set to zero. However, cash is assumed to be paid out in case there is difference in the accrued interest between exchanged security and “issued in exchange” security.

On the event effective day (t) for the purposes of return calculation, adjusted market value with cash and cumulative cash balance of the security is calculated using the following formulae.

$$CCB_{t,j} = CCP_{t,j} + CCR_{t-1,j} + \left( \frac{A_{t,j} - A_{t,j}^{new}}{100} \right) * (N_{t-1,j} - N_{t,j}) * K_{t,j}$$

$$Adjusted\ MVC_{t,j} = MVC_{t,j} * FX_{t,j} + \frac{(P_{t,j}^{new} + A_{t,j}^{new}) * (N_{t-1,j} - N_{t,j}) * FX_{t,j} * K_{t,j}}{100}$$

Where:

$P_{t,j}^{new}$  – Clean bid price of the security issued in exchange of security j at the close of day t

$A_{t,j}^{new}$  – Accrued Interest of the security issued in exchange of security j at the close of day t

Note that to be included in the index, the securities issued in exchange must have price coverage at the close of event effective date (t).

Income return component of security level total return accounts for P&L generated if the clean price of security issued in exchange differs from clean price of exchanged security.

$$SLIR_{t-1,t,j} = \frac{Coupon\ Income_{t,j} + ((P_{t,j}^{new} - P_{t,j})/100) * (N_{t-1,j} - N_{t,j}) * FX_{t,j} * K_{t,j}}{Initial\ MVC_{t,j}}$$

### 3 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.

#### 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

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

#### Index Average Clean Price

$$AP_t = \sum_{j=1}^n P_{t,j} * w_{t,j}^N$$

#### Index Average Dirty Price

$$ADP_t = \sum_{j=1}^n DP_{t,j} * w_{t,j}^N$$



**Index Average Coupon**

$$AC_t = \sum_{j=1}^n Coupon_j * w_{t,j}^N$$

**Index Average Notional**

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

**Index Average Time to Maturity**

$$TM_t = \sum_{j=1}^n TM_{t,j} * w_{t,j}^N$$

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

**Index Average Modified Duration**

$$AD_t^{MOD} = \sum_{j=1}^n D_{t,j}^{MOD} * w_{t,j}^{MVC}$$

**Index Average Effective duration**

$$AD_t^{EFF} = \sum_{j=1}^n D_{t,j}^{EFF} * w_{t,j}^{MVC}$$

**Index Average Convexity**

$$AX_t = \sum_{j=1}^n X_t * w_{t,j}^{MVC}$$

**Index Average Effective Convexity**

$$AEX_t = \sum_{j=1}^n EX_{t,j} * w_{t,j}^{MVC}$$

**Index Average Yield to Maturity**

$$AY_t = \sum_{j=1}^n Y_{t,j} * w_{t,j}^{MVC}$$

**Index Average Yield to Worst**

$$AYW_t = \sum_{j=1}^n YW_{t,j} * w_{t,j}^{MVC}$$

**Index Average OAS**

$$OAS_t = \sum_{j=1}^n OAS_{t,j} * w_{t,j}^{DMV}$$

**Index Average Credit Rating**

$$ART_t = \sum_{j=1}^n RT_{t,j} * w_{t,j}^{MVC}$$

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 Appendix Section 4.2. Using the numerical scores, final credit rating score of the security is calculated as shown below.

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

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 Appendix - Section 4.2.

## 4 Appendix

### 4.1 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.

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

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

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

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

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

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

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.

Index Total Return calculated for MSCI Fixed Income Indexes can be attributed to price, income, currency and transaction cost components as shown below. On the effective date of rebalancing (t = s), total return calculation will have a finite transaction cost adjustment, whereas on non-rebalancing days transaction cost component will be zero.

$$Index TR_{t-1,t} = Index PR_{t-1,t} + Index IR_{t-1,t} + Index XR_{t-1,t} - Cost_{t-1,t}$$

## 4.2 Credit Rating Scale

Moody's	S&P	Score	MSCI
Aaa	AAA	0	AAA
Aa1	AA+	1	AA1
Aa2	AA	2	AA2
Aa3	AA-	3	AA3
A1	A+	4	A1
A2	A	5	A2
A3	A-	6	A3
Baa1	BBB+	7	BBB1
Baa2	BBB	8	BBB2
Baa3	BBB-	9	BBB3

Ba1	BB+	10	BB1
Ba2	BB	11	BB2
Ba3	BB-	12	BB3
B1	B+	13	B1
B2	B	14	B2
B3	B-	15	B3
Caa1	CCC+	16	CCC1
Caa2	CCC	17	CCC2
Caa3	CCC-	18	CCC3
Ca	CC	19	CC
C	C	20	C

### 4.3 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 into the ex-coupon period, then accrued interest for the security is adjusted for calculation purposes as shown below.

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

## Contact us

clientservice@msci.com

### AMERICAS

Americas	1 888 588 4567 *
Atlanta	+ 1 404 551 3212
Boston	+ 1 617 532 0920
Chicago	+ 1 312 675 0545
Monterrey	+ 52 81 1253 4020
New York	+ 1 212 804 3901
San Francisco	+ 1 415 836 8800
São Paulo	+ 55 11 3706 1360
Toronto	+ 1 416 628 1007

### EUROPE, MIDDLE EAST & AFRICA

Cape Town	+ 27 21 673 0100
Frankfurt	+ 49 69 133 859 00
Geneva	+ 41 22 817 9777
London	+ 44 20 7618 2222
Milan	+ 39 02 5849 0415
Paris	0800 91 59 17 *

### ASIA PACIFIC

China North	10800 852 1032 *
China South	10800 152 1032 *
Hong Kong	+ 852 2844 9333
Mumbai	+ 91 22 6784 9160
Seoul	00798 8521 3392 *
Singapore	800 852 3749 *
Sydney	+ 61 2 9033 9333
Taipei	008 0112 7513 *
Thailand	0018 0015 6207 7181 *
Tokyo	+ 81 3 5290 1555

\* = toll free

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