MSCI FX Hedge and MSCI Global Currency Indexes Methodology

August 2020

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1 Introduction

This methodology book covers the following indexes:

- MSCI FX Hedge Indexes, described in section 3, aim to measure the impact on performance of hedging the currency exposure of MSCI Equity Indexes and contain only a currency component.
- MSCI Global Currency Indexes, described in section 4, aim to measure the total return of currencies of an MSCI Equity Index and reflect both currency appreciation / depreciation and interest accruing from holding the currencies.

Section 2 describes the common principles used for the calculation of all of the above-mentioned indexes.

The Appendix describes how the MSCI FX Hedge Indexes can be customized to incorporate a cash component in the index calculation.

MSCI FX Hedge Indexes and MSCI Global Currency Indexes are part of the MSCI Blended Index Family. For further details on the MSCI Blended Index Family, please refer to the MSCI Blended Index Family – Benchmark statement available on www.msci.com.

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2 Common Principles in the Calculation of MSCI FX Hedge and MSCI Global Currency Indexes

2.1 Currency Data

2.1.1 Closing Spot Rates

MSCI uses the WM/Reuters closing Spot rates (the mid-point of closing bid and ask rates to five decimal places), taken at 4 p.m. UK time in the daily index calculation and also in the determination of the notional amount of currencies to be sold forward on the roll date.

The WM/Reuters closing Spot rates are provided by Refinitiv. MSCI may elect to use alternative sources of exchange rates if the WM/Reuters rates are not available, or if MSCI determines that the WM/Reuters rates may not reflect market conditions.

2.1.2 Closing Forward Rates

MSCI uses the mid values of the 1-month, 1-week and TN (tomorrow next) WM/Reuters closing Forward rates published by Refinitiv at 4 p.m. UK time.

2.1.3 Missing Spot or Forward Rates

In the case Refinitiv does not provide Spot rates for specific markets on a given day (for example, Christmas Day and New Year Day), the Spot rates on the last weekday for which they are available will be used. If a Forward rate is missing, the Forward premium/discount on the last weekday for which it is available is applied to the current day's Spot rate.

2.1.4 Currency Crisis

Disruptions in the currency Spot and/or Forward market, may potentially result in a currency being excluded from the MSCI FX Hedge and/or MSCI Global Currency Indexes even though the currency may be still included in the parent MSCI Equity Indexes. In this case, the resulting currency weights may be different from the currency weights in the parent MSCI Equity Index.

In such circumstances, MSCI would send an announcement to clients with the related information and with sufficient advance notice. All such determinations are made by the MSCI Equity Index Committee (EIC). If appropriate, MSCI may conduct a consultation with the investment community to gather feedback on the treatment of the currency in the MSCI FX Hedge and/or MSCI Global Currency Indexes.

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2.2 Calculation Time and Frequency

The MSCI FX Hedge and MSCI Global Currency Indexes are calculated at the same time as the underlying MSCI Equity Index. In real time, their calculation begins as soon as the parent MSCI Equity Index is open and calculating, and ends as soon as the WM/Reuters rates are available, or when the parent MSCI Equity Index calculation is finished and validated, whichever comes later.

More details about calculation time and frequency of MSCI indexes can be found in the MSCI Index Calculation Methodology available on MSCI's web site at www.msci.com.

Similar to the MSCI Equity Index calculation schedule, the official month-end index level for the MSCI FX Hedge and MSCI Global Currency Indexes is calculated on the last weekday of the month.

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3 MSCI FX Hedge Indexes

3.1 Overview

MSCI FX Hedge Indexes aim to measure the impact on performance of hedging the currency exposure of MSCI Equity Indexes against an investor's home currency using a monthly Forward contract rollover. The index aims to measure the results of an investment process of selling each of the foreign currency exposures in the MSCI Equity Index against the home currency at one-month Forward rate on the last weekday of the month. The amount of Forwards notionally sold for each currency is derived from the free-float adjusted market capitalization weights of the securities quoted in that currency in the corresponding MSCI Equity Index. The currency weights are fixed as of the close of two weekdays before the first calendar day of the following month but taking into account any month end changes in the index constituents due to rebalancing and corporate actions. After one month, a similar process is performed for an amount representing the new market value of the index. No adjustments to the hedges are made during the month to account for changes in the indexes due to price movement of securities, corporate events, additions, deletions or any other changes. In other words, the amount hedged is kept constant over the whole month.

To compute the daily index value, the Forwards are marked-to-market on a daily basis using a linear interpolation methodology based on Spot, 1-week and 1-month FX Forwards premium or discounts.

3.2 Constructing the MSCI FX Hedge Indexes

Constructing the MSCI FX Hedge Indexes involves the following steps:

- Defining the home currency
- Identifying the currencies to be sold in the index
- Identifying the weight for each currency to be sold in the index

3.2.1 Defining the Home Currency

The Home Currency is the home currency of an investor investing in international equity markets. Often, a cross-border investor would measure the performance impact of hedging the currency exposure of his holdings relative to his home currency. For construction of MSCI FX Hedge Indexes the default home currency is the US Dollar (USD). The MSCI FX Hedge Indexes can be constructed against any home currency.

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3.2.2 Identifying the Currencies to be Sold in the Index

MSCI Equity Indexes have security constituents that are quoted in different foreign currencies. Each foreign currency used to denote securities in the underlying MSCI Equity Index is included in the calculation of the MSCI FX Hedge indexes.

3.2.3 Identifying the Weight for Each Currency to be Sold in the Index

In the MSCI FX Hedge Indexes, the weight of each currency corresponds to the relative market cap weight of the securities quoted in that currency in the underlying MSCI Equity Index. More precisely, the weights are derived from the aggregate free-float adjusted market capitalization of the securities quoted in the respective currencies in the underlying MSCI Equity Index as of the close of two weekdays before the first calendar day of following month, but taking into account any month end changes in the index constituents due to rebalancing and corporate actions.

3.3 Maintaining the MSCI FX Hedge Indexes

The MSCI FX Hedge Indexes are maintained with an objective of reflecting the evolution of the underlying currency exposures in the MSCI Equity Indexes on a timely basis. In particular, index maintenance involves:

- Resetting the weights of the currencies to be sold in the index
- Rolling the Forward contracts over to the next month

The MSCI FX Hedge Indexes are rebalanced monthly on the last trading day of the month, when the index will take into account the effect of rolling into new 1-month Forward contracts based on the newly determined weights of currency to be sold for the next month's index calculation. The currency weights are determined as of the close of two weekdays before the first calendar day of following month and remain constant intra month. This means that no changes in the weights are made during the month to account for changes in the indexes due to price movement of securities, corporate events, additions, deletions or any other changes.

3.4 MSCI FX Hedge Index Calculation Formula

The MSCI FX Hedge Index aims to measure the performance impact of currency hedging which is calculated as the difference between the notional cost to hedge on the Forward contract and the notional gain or loss on the Spot exchange rate. The daily index calculation is given by:

$$FHI(t) = FHI(M-1) \times \left[1 + \sum_{i=1}^{n} \left\{ Weight_{i,M-2} \times FXRate_{i,M-2} \times \left(\frac{1}{FFRate_{i,M-1}} - \frac{1}{FFRate_{i,odd-days_t}} \right) \times DF(t) \right\}\right]$$

where:

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t = Index calculation date

M = First calendar day of the month

$FHI(t)$ = FX Hedge index in the home currency at time *t*

$FHI(M-1)$ = FX Hedge index on the last day of the previous calendar month in the home currency

$Weight_{i,M-2}$ = Weight of the currency i in the underlying MSCI Equity Index two weekdays before the start of the current calendar month, but reflecting changes in the composition of the index to be implemented as of the close of the last weekday of the previous month

$FXRate_{i,M-2}$ = Spot rate of the currency i two weekdays before the start of the current calendar month. This term determines the notional amount of the foreign currency to be sold corresponding to its weight in the index

$FFRate_{i,M-1}$ = 1-month Forward for the currency i one weekday before the start of the current calendar month (or last weekday of the previous calendar month)

$FFRate_{i,odd-days_t}$ = Interpolated odd-days Forward rate of the currency i on day t. This term is used to mark to market the currency position intra month and is equal to the Spot rate of currency i on the last day of the month. Its calculation is described in Section 3.6

$DF(t)$ = Discount factor between the calculation date (t) and the last weekday of the current month, used to calculate the value at t of the Forward position and based on the one-month London InterBank Offered Rates (LIBOR) rate in the home currency of the index[1]. The source for LIBOR rates is the British Bankers' Association (BBA). More specifically, the value at time *t* of the Forward position initiated at time M-1 is determined by discounting the gain or loss relative to a new offsetting Forward contract initiated at time *t*, with the same delivery date as the original Forward contract. This discounted gain (loss) would be received (paid) by the investor as the original Forward contract is closed out at time *t*.

=

$$\frac{1}{\left(1+\frac{d}{360}\times LIBOR(1M)_t\right)}$$

[1] The following LIBOR rates are currently available: USD, EUR, GBP, JPY, CHF. For MSCI FX Hedge Indexes using another currency as home currency, MSCI will use a rate of zero (and hence a discount factor of one) in the index calculation.

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d = the number of calendar days remaining until the last weekday in the current month (not including day *t*)

3.5 Calculation of Daily Returns

3.5.1 Marking to Market the Forward Contracts on a Daily Basis

The daily calculation of MSCI FX Hedge Indexes marks to market the one-month Forward contracts on a daily basis by using an equal and offsetting Forward position. For instance, after 8 days, the Forward would be marked to market using a 22-days offsetting Forward in the case of a month when the last weekday of the month is the 30th (i.e. 30 – 8 = 22).

3.5.2 Pricing the Offsetting Forward

Typically, only a limited number of standard duration of Forwards is available in the market. These rates are called "tenors", and represent one day, one week, one month, etc. This means that other durations for Forwards (called odd-days Forwards) are generally not available, but must be calculated. When calculating MSCI FX Hedge Indexes, MSCI uses a linear interpolation based both on the 1-week and 1-month Forwards to estimate the value of odd-days Forwards every day during the whole month. Odd-days Forwards are computed as the Spot (1-Week Forward) rate plus the premium or discount between the Spot (1-Week Forward) and the 1-Week Forward (1-month Forward), pro-rated for the number of days until the last weekday of the month.

3.6 Calculation of Odd-Days Forwards Using a Linear Interpolation

3.6.1 Calculation Formula

- If the number of days until the last weekday of the current month end is greater than 7, the interpolation will use the 1-week Forward rate and the 1-month Forward rate as follows:

$$FFRate_{odd-days_t} = FFRate_{1-week_t} + \left(FFRate_{1-month_t} - FFRate_{1-week_t}\right) \times \frac{Odd - days_t - 7}{TotCalDaysDuringMonth - 7}$$

- If the number of days until the last weekday of the current month end is less than or equal to 7, the interpolation will use the current Spot rate and the 1-week Forward rate as follows:

$$FFRate_{odd-days_t} = FXRate_t + \left(FFRate_{1-week_t} - FXRate_t\right) \times \frac{Odd - days_t}{7}$$

where

$FFRate_{1-week_t}$ = 1-Week Forward rate at time *t*

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$FFRate_{1-month_t}$ = 1-Month Forward rate at time *t*

$FXRate_t$ = Spot rate at time *t*

$Odd - days_t$ = Number of days until the last weekday in the month (not including *t*)

3.6.2 Calculation Example A

To compute a linear interpolation, the following process is used, using as an example data as of January 08, 2009:

a) Check if today is the last weekday of the month, in which case, the Spot rate is used and there is no need to compute a linear interpolation.

b) Obtain the date of the last weekday of the month, in our example January 30, 2009. See if there are more than 7 days left from today January 08, 2009 till the last weekday of the month. If there are equal to or less than 7 days left from today till the last weekday of the month, then the linear interpolation process is explained in example B.

c) Obtain the 1-week Forward and 1-month Forward rate as of today, e.g., on January 08, 2009, 1.18671, and 1.18720 CAD/USD. These Forwards settle in one week and one month from today. The total number of days taken into account is the number of days in the current month, in our example 31, as there are 31 days in January 2009. There are 31-7 = 24 days between the expiry of the 1-month and 1-week Forwards.

d) Compute the price difference between the 1-week Forward and the 1-month Forward, as of today, January 08, 2009. In this example, premium difference is 0.0005.

e) Compute the expiry date of the 1-week Forward which is 8+7=15

f) Using a linear interpolation, compute the value, as of today, January 08, 2009, of a Forward with a duration equal to the number of days until the last weekday of the month. In our example, the last weekday of the month is the January 30th, so the duration of the Forward from the expiry of the 1-week Forward is 30 - 15 = 15 days or 22 days from January 08, 2009.

The value of a 22 day Forward is estimated as the 1-week Forward rate plus the premium difference between 1-week and 1-month Forwards prorated for the period.

Interpolated value of a Forward settling in 22 days from today is:

= 1.18671 + 0.0005*(15/24)

= 1.18671 + 0.0003

= 1.1870

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3.6.3 Calculation Example B

If there are less than or equal to seven days from today till the next roll date to compute a linear interpolation, the following process is used, using as an example data as of January 25, 2009:

a) Check if today is the last weekday of the month, in which case, the Spot exchange rate is used and there is no need to compute a linear interpolation.

b) Obtain the date of the last weekday of the month, in our example January 30, 2009. See if there are less than or equal to 7 days left from today January 25, 2009 till the last weekday of the month. If there are more than 7 days left from today till the last weekday of the month, than linear interpolation process is explained in example A.

c) Obtain the Spot and 1-week Forward rate as of today, e.g., for January 25, 2009, 1.18645, and 1.18671 CAD/USD. The Forward settle in one week. There are fewer than 7 days between today and expiry of 1-week Forward.

d) Compute the price difference between the Spot and 1-week Forward, as of today, January 25, 2009. In this example, premium difference is 0.0003.

e) Using a linear interpolation, compute the value, as of today, January 25, 2009, of a Forward with a duration equal to the number of days until the last weekday of the month. In our example, the last weekday of the month is the January 30th, so the duration of the Forward is 30 - 25 = 5 days.

The interpolated value of a 5 day Forward is estimated as the Spot rate plus the premium prorated for the period.

Interpolated value of a Forward settling in 5 days from today is:

= 1.18645 + 0.0003*(5/7)

= 1.18645 + 0.0002

= 1.1867

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4 MSCI Global Currency Indexes

4.1 Overview

MSCI Global Currency Indexes are designed to measure the total return of currencies of countries in a regional or composite MSCI Equity Index, weighed by their country weights. The total return reflects the currency appreciation/depreciation of the currencies included in the Currency Index relative to the home currency and interest accruing from holding the currencies. For example, the MSCI Emerging Market Currency Index in US Dollar (USD) measures the total return of 27 emerging market currencies relative to the USD where the weight of each currency is equal to its country weight in the MSCI Emerging Markets Index.

The index aims to represent the performance of an investment process that uses a combination of monthly trades of currency Forwards against the home currency and home currency LIBOR deposits to capture the currency and interest rate returns.

4.2 Constructing the MSCI Global Currency Indexes

Constructing the MSCI Global Currency Indexes involves the following steps:

- Defining the home currency.
- Identifying the currencies in the index.
- Identifying the weight for each currency in the index.
- Determining the accrued interest rate for each currency in the index.

Each of these steps is described in detail below.

4.2.1 Defining the Home Currency

Investors investing in foreign exchange would typically measure the performance of his holdings relative to their home currency. For construction of MSCI Global Currency Indexes the default home currency is the US Dollar. The MSCI Global Currency Indexes can be constructed against any home currency.

4.2.2 Identifying the Currencies to be included in the Index

The currency of each country included in the underlying MSCI Equity Index is included in the calculation of the MSCI Global Currency Indexes.

4.2.3 Identifying the Weight of Each Currency in the Index

In the MSCI Global Currency Indexes, the currency weights correspond to the country weights in the underlying MSCI Equity Index. By default, these are determined as of

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the close of two weekdays before the first calendar day of the following month and take into account any changes in the composition of the index implemented as of the close of last weekday of the month.

4.2.4 Determining the Accrued Interest Rate for each Currency in the Index

MSCI Global Currency Indexes reflect the currency appreciation/depreciation of currencies against a home currency as well as the interest earned by holding the currencies. To calculate interest, MSCI uses the accrued foreign interest rates from the Forward-Spot relation in the currency markets.

Please see section 4.4.2 for more details on the calculation of accrued foreign interest rates.

4.3 Maintaining the MSCI Global Currency Indexes

The MSCI Global Currency Indexes are maintained with an objective of reflecting the evolution of the underlying country weights on a timely basis. In particular, index maintenance involves:

- Resetting the accrued foreign currency interest rates.
- Resetting the weights of the currencies included in the index.

The MSCI Global Currency Indexes are rebalanced monthly on the last trading day of the month, when the currency weights and accrued foreign interest rates are reset for the next month's index calculation.

4.3.1 Resetting the Accrued Interest Rate for each Foreign Currency in the Index

The accrued interest for each foreign currency is reset on the last trading day of the month. This new accrued interest rate is accrued in the index until the next rebalancing date, i.e. the last weekday of the following month.

4.3.2 Resetting the Weights of Currencies in the Index

The currency weights are determined two weekdays before the first calendar day of the following month and reset after the close of the last trading day of the month. They remain constant intra month, i.e. no changes in the weights are made during the month to account for changes in the indexes due to price movement of securities, corporate events, additions, deletions or any other changes.

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4.4 MSCI Global Currency Indexes Calculation

4.4.1 Index Calculation Formula

There are two components to the Currency Index returns:

1. The performance (appreciation/depreciation) of the constituent currencies relative to the home currency.
2. The foreign currency deposit interest earned on the constituent currencies.

The Currency Index calculation formula is defined as follows

$$CI(t) = CI(M-1) \times \sum_i \left\{ Weight_{i,M-1} \times \frac{S_{i,t}}{S_{i,M-1}} \times \left(1 + R_{i,fgn,M-1} \times \frac{t}{360}\right)\right\}$$

where

t = Index calculation date expressed as the number of days elapsed since the last rebalancing date (including weekends and non-trading days)

M = First weekday of the current month

$CI(t)$ = Currency Index at time *t*

$CI(M-1)$ = Currency Index one weekday before the first day of current month

$Weight_{i,M-1}$ = Weight of currency i at time M-1

$S_{i,t}$ = Spot rate of currency i at time t

$S_{i,M-1}$ = Spot rate of currency i at time M-1

$R_{i,fgn,M-1}$ = Interest rate for currency i determined at time M-1 and defined below

4.4.2 Accrued Foreign Interest Rate Calculation Formula

The accrued foreign interest rate is calculated using the Forward-Spot relationship at the time of rebalancing.

$$R_{fgn,M-1} = \left\{\frac{S_{M-1}}{F_{M-1}}\left(1 + LIBOR(1M)_{M-1} \times \frac{D}{360}\right) - 1\right\} \times \frac{360}{D}$$

where

S_{M-1} = Spot rate at time M-1

F_{M-1} = 1-Month Forward rate at time M-1

$LIBOR(1M)_{M-1}$ = 1-Month home currency LIBOR rate (reset monthly).

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D = number of days between rebalancings, i.e., the difference in days between the last weekday of the month and the previous month's last weekday

4.4.3 Handling Non-trading Days at Month End for Index and Accrued Interest Rates Calculation

The official index level for each month is calculated on the last weekday of the month. The last weekday of the month may coincide with an official holiday of a constituent currency. But since currency markets will be open in other countries, the Currency Index will be calculated for that day.

- Example A: If the last day of the following month is not a trading day

To price a one month Forward on October 31, when the last trading day in November is the 29th, the days to maturity for Forwards will be 29 days. This will be used as number of the days in the accrued interest rate formula.

The Currency Index will accrue interest in November for 29 days and the official index level for November will be calculated on the same date.

- Example B: If the last day of the current month is not a trading day

To price a one month Forward on November 29, which happens to be last trading day in November, the days to maturity for Forwards settling on December 31 will be 32 days. This will be used as number of the days in the accrued interest rate formula. The Currency Index will accrue interest in December for 32 days. The first accrual will happen at the opening of index on December 1.

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Appendix: Custom Indexes With Cash Adjustment

Description

The MSCI FX Hedge Indexes, described in section 3, can be customized to incorporate a cash component in the index calculation.

The cash amount is determined as of the close of the weekday prior to the last weekday of the month and is reflected in the index as of the close of the last weekday of the month. The cash amount is determined as a percentage of the value of the MSCI FX Hedge Index as of the close of the weekday prior to the last weekday of the month. The cash amount acts as a cash drag to the index performance.

The cash amount remains unchanged intra-month (no adjustments would be made to account for changes in the indexes due to price movement of securities or changes resulting from corporate events).

The custom indexes with cash adjustment can also incorporate a return on cash, calculated using one month London InterBank Offered Rates (LIBOR) rates.

Calculation Formula – MSCI FX Hedge Indexes

The daily index level calculation for the MSCI FX Hedge Indexes with cash adjustment is as follows:

$$FHI(t) = FHI(M-1) \times \left[1 + \left[(1 - \%Cash(t)) \times \sum_{i=1}^{n} \left\{ Weight_{i,M-2} \times FXRate_{i,M-2} \times \left(\frac{1}{FFRate_{i,M-1}} - \frac{1}{FFRate_{i,odd-days_t}} \right) \times DF(t) \right\} \right] + \left(\%Cash(t) \times CashRet(t)\right)\right]$$

where

t	= Index calculation date
$\%Cash(t)$	= Percentage of cash at time t. The percentage of cash is unchanged intra-month
M	see section 3.4
$FHI(t)$	see section 3.4
$FHI(M-1)$	see section 3.4
$Weight_{i,M-2}$	see section 3.4
$FXRate_{i,M-2}$	see section 3.4
$FFRate_{i,M-1}$	see section 3.4
$FFRate_{i,odd-days_t}$	see sections 3.4 and 3.6

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$DF(t)$ see section 3.4

$CashRet(t)$ = Return on cash between the beginning of the month and the calculation date (t)

=

$$\left(\frac{days}{360} \times LIBOR(1M)_{M-1}\right)$$

$days$ = the number of calendar days since the beginning of the month (including day t)

$LIBOR(1M)_{M-1}$ = one month London InterBank Offered Rates (LIBOR) rate one weekday before the start of the current calendar month. The source for LIBOR rates is the British Bankers' Association (BBA). The following LIBOR rates are currently available: USD, EUR, GBP, JPY, CHF

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Methodology Book Tracked Changes

The following sections have been modified as of October 2017:

Added an appendix on custom indexes with cash adjustment

The following sections have been modified as of October 2018:

Section 2.1.3

- Updated the treatment of missing forward rates

The following sections have been modified as of November 2018:

Replaced “business day” with “weekday” for clarity in all relevant sections

The following sections have been modified as of August 2019:

Section 4.1

- Updated the example in the section

The following sections have been modified as of August 2020:

Section 3.4

- Added footnote on available LIBOR rates.

The introduction has been updated to reflect that the index is a part of the MSCI Blended Index Family.

Replaced “Thomson Reuters” with “Refinitiv” in relevant sections.

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