



# JANUS HENDERSON INDICES

VelocityShares LIBOR Indices Methodology  
January 2019

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## Introduction

This document describes in detail VelocityShares LIBOR Index Family Methodology. The Family consists of three Indices:

- VelocityShares LIBOR 1Y Index
- VelocityShares Long LIBOR Index
- VelocityShares Short LIBOR Index

VelocityShares LIBOR 1Y Index reflects a weighted average of the first eight<sup>1</sup> quarterly reference Eurodollar Futures implied yields, where each implied yield is tied to the London Interbank Offered Rate (LIBOR).

VelocityShares Long LIBOR Index is designed to provide a long exposure to a weighted average of the first eight quarterly reference Eurodollar Futures implied yields, where each implied yield is tied to the London Interbank Offered Rate (LIBOR). The Index is replicable; an investor holding the reference futures associated with the index at the same weights adjusted daily should realize returns similar to that of VelocityShares Long LIBOR Index.

VelocityShares Short LIBOR Index is designed to provide an inverse exposure to a weighted average of the first eight<sup>2</sup> quarterly reference Eurodollar Futures implied yields and is replicable as well; an investor holding the reference futures associated with the index at the same weights adjusted daily should realize returns similar to that of VelocityShares Short LIBOR Index.

The indices have been designed to approximate performance of investments in the *yield* itself, as if the yield was an asset.

The reference securities are US listed Eurodollar Futures contracts expiring in March, June, September and December, which trade on the Chicago Mercantile Exchange (CME). The Indices' Inception Date was September 30<sup>th</sup>, 2016. All data prior to this date is a backtest.

## Index Sponsor and Index Calculation Agent

The Index Sponsor is Janus Henderson Indices LLC. As at the date of this Index Methodology, the Index Sponsor has appointed Solactive as Index Calculation Agent to calculate and publish the Indices in accordance with the Index Methodology contained in this document. The Index Sponsor may, in its sole discretion and without notice, appoint an alternative Index Calculation Agent at any time which may be the Index Sponsor or one of its Affiliates.

The Index Sponsor's determinations in respect of the Indices shall be final.

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<sup>1</sup> The first contract rolls off two days prior to expiry, so for a brief period of time the ninth listed quarterly contract is included.

<sup>2</sup> The first contract rolls off two days prior to expiry, so for a brief period of time the ninth listed quarterly contract is included.

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## Index Overview

The Indices are notional rules-based proprietary indices sponsored by Janus Henderson Indices LLC (the “Index Sponsor”). VelocityShares LIBOR Index family consists of three Indices:

- VelocityShares LIBOR 1Y Index
- VelocityShares Long LIBOR Index
- VelocityShares Short LIBOR Index

VelocityShares Long LIBOR and Short LIBOR Indices are excess return indices. The Indices are described as replicating notional positions in Eurodollar Futures because there is no actual portfolio of assets to which any person is entitled or in which any person has any ownership interest. The Indices simply references certain investment positions the performance of which is used as a reference point for the purpose of calculating Index Levels.

The Indices are calculated on Index Business Days. An Index Business Day is a weekday (1) on which the New York Stock Exchange and Chicago Mercantile Exchange are both open for trading for their regular trading sessions.<sup>3</sup>

### Eurodollar Futures Prices

The closing price for each quarterly Eurodollar Futures contract on an Index Business Day is the price of the contract at the regular close of the principal trading session on the Chicago Mercantile Exchange (3:00pm ET) for that Index Business Day.<sup>4</sup> Eurodollar futures prices are expressed at 100 minus (the implied 3-month (USD) LIBOR interest rate x 100).

## Reference Index Calculations

Calculation of the indices begins with the calculation of VelocityShares LIBOR 1Y Index (“the Reference Index.”) The Reference Index Level on each Scheduled Index Business Day  $t$  shall be an amount determined by the Index Calculation Agent in accordance with the formula set out below. The Reference Index Level for each Index Business Day is defined as follows:

$$L_t = \text{Max}[1, 100 \times \sum_{i=1}^{M+1} w_{it} (100 - P_{i,t})]$$

where  $P_{i,t}$  is the settlement price<sup>5</sup> of the  $i^{\text{th}}$  quarterly Eurodollar Futures contract on Index Business Day  $t$ ,  $M=8$ , and  $w_{it}$  is the weight of each contract  $i$  on Index Business Day  $t$ , as defined below, with

$$\sum_{i=1}^{M+1} w_{it} = 1$$

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<sup>3</sup> Prior to June 16<sup>th</sup>, 2017, VelocityShares LIBOR Indices also considered London bank holidays to be index holidays.

<sup>4</sup> Eurodollar Futures are “based on a \$1 million face-value, 3-month maturity Eurodollar Time Deposit. They are settled in cash on the 2<sup>nd</sup> London bank business day prior to the 3<sup>rd</sup> Wednesday of the contract month by reference to the ICE Benchmark Administration Limited (ICE) Interest Settlement Rate for three-month Eurodollar Interbank Time Deposits.” (Source: CME)

<sup>5</sup> For more on Settlement Prices, please see <http://www.cmegroup.com/confluence/display/EPICSANDBOX/Eurodollar>.

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## Calculating the Weights

At any point in time, the Reference Index Level will seek to provide an indicator of 3-month LIBOR interest rate levels through a set of Eurodollar Futures contracts. Let each quarterly Eurodollar Futures contract be denoted by the subscript  $i$ , where

$$i = 1 \dots M + 1$$

and  $M=8$ .

The Reference Index targets constant maturity: its weights are chosen to target a constant average maturity of the contracts. Though the Reference Index effectively considers the first eight contracts, two days prior to a Eurodollar Futures contract expiry, the Reference Index also utilizes what is, at that point, the  $(M+1)^{\text{th}}$  contract. In order to target constant maturity, this requires that the weight in the front contract rolls off into the back of the curve. This is achieved by the use of three successive quarterly contracts whereby:

$F_{-1}$  = the prior (expired) quarterly Eurodollar Futures contract

$F_0$  = the current (expiring) quarterly Eurodollar Futures contract

$F_1$  = the next quarterly Eurodollar Futures contract (immediately successive to  $F_0$ )

The weights are calculated as follows.

- Define  $T$  as the tenor (in days) of  $F_0$ . This is calculated as the number of Scheduled Index Business Days between the  $F_{-1}$  and  $F_0$  contract expiries (including the day of expiry).
- Define  $T_2$  as the tenor (in days) of  $F_1$ . This is calculated as the number of Scheduled Index Business Days between the  $F_0$  and  $F_1$  contract expiries (including the day of expiry).
- Define  $\tau$  as the number of Scheduled Index Business Days remaining in the  $F_0$  contract until (and including) expiry.
- Define  $\tau_2$  number of Scheduled Index Business Days until the next roll date. This is calculated as  $\tau - 2$ . If  $\tau < 2$ ,  $\tau_2 = \tau - 2 + T_2$ .

Scheduled Index Business Days are weekdays for which there are no holidays (as defined below) or no (1) pre-announced closings of the New York Stock Exchange or (2) pre-announced closings of the Chicago Mercantile Exchange.<sup>6</sup>  $T_2$  is determined two Scheduled Index Business Days prior to  $F_0$  expiry and is fixed at that point, regardless of future announcements of closures. Upon the immediate quarterly Eurodollar Futures contract expiry,  $T_2$  becomes  $T$ .

If  $\tau \geq 2$ , the contracts from  $i=2$  to  $M-1$  hold the weight

$$w_{it} = \frac{1}{(M - 1)}$$

The remaining weight of  $w_{it}$  is distributed between the first and  $M^{\text{th}}$  contracts whereby the weight on the front-quarterly contract is

$$w_{1t} = w_{Mt} \frac{\tau_2}{T}$$

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<sup>6</sup> Prior to June 16<sup>th</sup>, 2017, VelocityShares LIBOR Indices also considered London bank holidays to be index holidays.

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Note that this weight will go to zero two days prior to expiry.

The weight on  $M^{\text{th}}$  contract is

$$w_{Mt} = w_{2t} \frac{T - \tau_2}{T}$$

For completeness, note that when  $\tau \geq 2$ ,  $w_{M+1,t} = 0$ .

If  $\tau < 2$ , the weights on contracts  $i=3$  to  $M$  are

$$w_{it} = \frac{1}{(M - 1)}$$

Here the second contract rolls to the 9<sup>th</sup> contract until those contracts roll and become the 1<sup>st</sup> and 8<sup>th</sup> contracts, respectively. The remaining weight of  $w_{it}$  is thus distributed between the second and the  $(M + 1)^{\text{th}}$  contracts.

The weight on the front-quarter contract is zero,

$$w_{1t} = 0$$

the second-quarter contract is

$$w_{2t} = w_{3t} \frac{\tau_2}{T_2}$$

and the  $(M + 1)^{\text{th}}$  weight is

$$w_{M+1,t} = w_{3t} \frac{T_2 - \tau_2}{T_2}$$

## VelocityShares Long LIBOR Index Calculations

VelocityShares LIBOR 1Y Index is not investable, meaning that there is no sustainable strategy to invest in Eurodollar Futures contracts that will replicate the Index. This is because each day contracts are replaced in the front quarter with contracts from the back quarter. VelocityShares Long LIBOR Index addresses this issue, by holding a position in Eurodollar Futures contracts on each Index Business Day and then rolling the contracts the following day to maintain constant maturity.

VelocityShares Long LIBOR Index Level on each Index Business Day  $t$  (following the Index Start Date) shall be an amount determined by the Index Calculation Agent in accordance with the formula set out below.

Let

$$w_t = [w_{1t} \ w_{2t} \ \dots \ w_{Mt} \ w_{M+1,t}]$$

be the weight vector on any Index Business Day  $t$ . These weights are the same weights as those defined above. Define

$$P_{it} = \text{Settlement Price on Day } t \text{ of the } i^{\text{th}} \text{ Quarterly Contract}$$

and the implied yields are defined as follows:

$$Y_{it} = 100 \times (100 - P_{it})$$

Let

$$dY_{it} = Y_{it} - Y_{it-1}$$

and

$$dY_t = [dY_{1t} \ dY_{2t} \ \dots \ dY_{M+1,t}]$$

For clarity, the term subscript reflects the term as of day  $t$ . For example, if  $t-1$  is a Eurodollar futures expiry date, then contract  $i$  on day  $t$  was contract  $i+1$  on day  $t-1$ . In this case,  $Y_{it-1}$  should be read as the yield on today's  $i^{\text{th}}$  contract observed on day  $t-1$ . The Index Level is denoted  $I_t$  and starts at  $I_0$ .<sup>7</sup> Further, we define an additional value,  $I_t^*$ , that reflects the value of the Index prior to transactions.

VelocityShares Long LIBOR Index value is updated as a function of the changes in implied yields and the number of contracts held in each quarterly expiry.

Let  $N_{t-1}$  be the total number of contracts held on day  $t-1$ . Recall that holding long positions in a Eurodollar Futures contract will have negative P&L if the change in implied yield on that contract is positive.

By establishing a short position in Eurodollar futures contracts (i.e.,  $-N_{t-1}$ ), the dollar profit on the day's positions will be:

$$\pi_t = -N_{t-1} \times 25 \times \sum_{i=1}^{M+1} w_{it-1} dY_{it}$$

$$\pi_t = -N_{t-1} \times 25 \times \left[ \sum_{i=1}^{M+1} w_{it} Y_{it} - \sum_{i=1}^{M+1} w_{it-1} Y_{it-1} - \sum_{i=1}^{M+1} dw_{it} Y_{it} \right]$$

<sup>7</sup> The Index starting value is chosen such that the Index Level is 10,000 on December 30<sup>th</sup>, 2016.

<sup>8</sup> Note that a 1 point basis point change in yields is a \$25 change in the value of a contract.

$$\pi_t = -N_{t-1} \times 25 \times [L_t - L_{t-1} - \varepsilon_t]$$

where  $dw_{it} = w_{it} - w_{it-1}$ .<sup>8</sup>

The term  $\varepsilon_t$  represents a roll return. By choosing the right number of contracts, we can approximate the return in VelocityShares LIBOR 1Y Index with the return in VelocityShares Long LIBOR Index, subject to the roll.

We set  $N_{t-1}$  to:

$$N_{t-1} = -\frac{I_{t-1}^*}{25 \times \hat{L}_{t-1}}$$

where

$$\hat{L}_{t-1} = \max(100, L_{t-1})$$

and the adjusted weight vector is

$$\hat{w}_t = -N_t w_t$$
<sup>9</sup>

The Long LIBOR Index is updated according to the following formula:

$$I_t^* = I_{t-1} + 25 \cdot \sum_{i=1}^{M+1} \hat{w}_{i,t-1} dY_{i,t}$$

To account for Eurodollar Futures spreads, this level is adjusted as follows. Define the spread on contract  $i$  on day  $t$  as

$$Spr = .005$$

Then

$$I_t = I_t^* - 2500 \times \sum_{i=1}^{M+1} 0.5 \times |\hat{w}_{i,t} - \hat{w}_{i,t-1}| \times Spr$$

The Index Return is defined as

$$R_t = \frac{I_t}{I_{t-1}} - 1$$

<sup>7</sup> The Index starting value is chosen such that the Index Level is 10,000 on December 30<sup>th</sup>, 2016.

<sup>8</sup> Note that a 1 point basis point change in yields is a \$25 change in the value of a contract.

## VelocityShares Short LIBOR Index Calculations

Let  $I_t^{Sh}$  be the Short LIBOR Index Level on date  $t$ .

Dollar profit on the positions held is as follows:

<sup>9</sup> The return to VelocityShares Long LIBOR Index is approximately

$$\frac{\pi_t}{I_{t-1}^*} = \frac{-N_{t-1} \times 25 \times [L_t - L_{t-1} - \varepsilon_t]}{I_{t-1}^*}$$

Assuming no roll, we have an approximation:

$$\frac{\pi_t}{I_{t-1}^*} \cong \frac{-N_{t-1} \times 25 \times [L_t - L_{t-1}]}{I_{t-1}^*}$$

We wish to find  $N$  so that this return equals the return on spot:

$$\frac{\pi_t}{I_{t-1}^*} \cong \frac{-N_{t-1} \times 25 \times [L_t - L_{t-1}]}{I_{t-1}^*} = \frac{[L_t - L_{t-1}]}{L_{t-1}^*}$$

Therefore:

$$\frac{-N_{t-1} \times 25}{I_{t-1}^*} = \frac{1}{L_{t-1}}$$

And hence:

$$N_{t-1} = -\frac{I_{t-1}^*}{25 \times L_{t-1}}$$

$$\begin{aligned} \pi_t^{Sh} &= -N_{t-1}^{Sh} \times 25 \times \sum_{i=1}^{M+1} w_{it-1} dY_{it} \\ \pi_t^{Sh} &= -N_{t-1}^{Sh} \times 25 \times \left[ \sum_{i=1}^{M+1} w_{it} Y_{it} - \sum_{i=1}^{M+1} w_{it-1} Y_{it-1} - \sum_{i=1}^{M+1} dw_{it} Y_{it} \right] \\ \pi_t^{Sh} &= -N_{t-1}^{Sh} \times 25 \times [L_t - L_{t-1} - \varepsilon_t] \end{aligned}$$

By choosing the right number of contracts, we can approximate the negative of the return in VelocityShares LIBOR 1Y Index with the return in the Short LIBOR Index, subject to the roll.

Using a similar methodology to solve for  $N_{t-1}$ , We set  $N_{t-1}^{Sh}$  to:

$$N_{t-1}^{Sh} = \frac{I_{t-1}^{Sh*}}{25 \times \tilde{L}_{t-1}}$$

where

$$\tilde{L}_{t-1} = \max(250, L_{t-1})$$

and the adjusted weight vector is

$$\hat{w}_t^{Sh} = -N_t^{Sh} w_t$$

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The Inverse Index is updated according to the following formula:

$$I_t^{Sh*} = I_{t-1}^{Sh} + 25 \cdot \sum_{i=1}^{M+1} \widehat{w}_{i,t-1}^{Sh} dY_{i,t}$$

As defined above, the spread on contract i on day t as

$$Spr = .005$$

Then

$$I_t^{Sh} = I_t^{Sh*} - 2500 \times \sum_{i=1}^{M+1} 0.5 \times |\widehat{w}_{i,t}^{Inv} - \widehat{w}_{i,t-1}^{Inv}| \times Spr$$

The Short LIBOR Index Return is defined as

$$R_t^{Sh} = \frac{I_t^{Sh}}{I_{t-1}^{Sh}} - 1$$

Subject to the occurrence or existence of a Disrupted Day (as defined below), the Index Levels are calculated by the Index Calculation Agent at approximately 6:30PM Eastern Time on each Index Business Day. The Index Levels are the closing levels of the Indices for the relevant Index Business Day. The Index Calculation Agent may also, but is not obliged to, calculate the level of the Index at another time on any Index Business Day or any other day with the consent of the Index Sponsor.

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## **Intra-Day Index Calculation**

The value of the indices will be calculated intra-day by applying the then current market prices of the reference securities as if they were the end of day prices and following the end-of-day calculations described above.

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## Index Maintenance

### Base Date

Both VelocityShares Long LIBOR and Short LIBOR Indices have been computed such that the Index Levels of both are 10,000 on December 30<sup>th</sup>, 2016.

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## Index Policy

### Announcements

Announcements regarding changes to the indices will be made publicly available prior to the effective date of the change. All announcements will be published on the index website: [indices.janushenderson.com](http://indices.janushenderson.com)

### Holiday Schedule

VelocityShares LIBOR Indices will not be calculated on days when (a) the New York Stock Exchange is closed<sup>9</sup>, or (b) the Chicago Mercantile Exchange (CME) is closed.<sup>10,11</sup> To avoid all doubt, please see the Appendix for a list of Holidays for upcoming calendar years.

### Force Majeure

Calculation of the indices may not be possible or feasible under certain events or circumstances, including, without limitation, market disruptions, a systems failure, natural or man-made disaster, act of God, armed conflict, act of terrorism, riot or labor disruption or any similar intervening circumstance, that is beyond the reasonable control of the Index Sponsor and that the Index Sponsor determines affects the Indices or underlying markets. Upon the occurrence of any such force majeure event, the Index Sponsor may, in its discretion, elect one (or more) of the following options:

- Make such determinations and/or adjustments to the terms of the Indices as it considers appropriate to determine any closing level on any such appropriate Index Business Day; and/or
- Defer publication of the information relating to the Indices until the next Index Business Day on which it determines that no force majeure event exists; and/or
- Permanently cancel the publication of the information relating to the Indices. The Index Sponsor employs the methodology described above and its application of the methodology shall be conclusive and binding.

### Market Disruption

“Disrupted Day” shall mean any Scheduled Index Business Day on which any of the events set out below occurs:

- The Chicago Mercantile Exchange or the New York Stock Exchange fails to open for trading; or
- A suspension of or limitation imposed (whether by reason of movements in price exceeding permitted limits or otherwise) on the trading on the Chicago Mercantile Exchange of Eurodollar Futures at any time during the one hour period which ends at 3pm NY Time (“the Valuation Time”); or
- An event which disrupts or impairs the ability of market participants in general to effect transactions in or to obtain market values for Eurodollar Futures contracts at any time during the one hour period which ends at the relevant Valuation Time; or
- The closure of the Chicago Mercantile Exchange in respect of Eurodollar Futures contracts prior to its Scheduled Closing Time (3:00pm NY time, unless such earlier closing time is announced by the Chicago Mercantile Exchange at least one hour prior to the earlier of (i) the actual closing time for the regular trading session; and (ii) the deadline for the submission of orders to be entered into the Chicago Mercantile Exchange system for execution at the Valuation Time).

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<sup>10</sup> <https://www.nyse.com/markets/hours-calendars>

<sup>11</sup> <http://www.cmegroup.com/tools-information/holiday-calendar.html>

<sup>12</sup> Prior to June 16<sup>th</sup>, 2017, VelocityShares LIBOR Indices also considered London bank holidays to be index holidays.

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In the event of a Disrupted Day, the roll for that day is carried out on the next Scheduled Index Business Day. The rest of the scheduled roll proceeds accordingly after the completion of the next (non-disrupted) Index Business Day.

Note that all historical levels for VelocityShares LIBOR 1Y, Long LIBOR, and Short LIBOR Indices prior to the inception date were calculated by treating prior market disruptions as scheduled holidays.

### **Delisting of Futures Contracts**

If one or more futures contracts included in one of the indices is no longer listed, the Index Sponsor may choose to suspend publication of any affected indices at that time.

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## Index Committee

The Index Committee, composed of senior Janus Henderson personnel and an external representative, is responsible for reviewing the design, composition, and calculation of VelocityShares LIBOR Indices, the development of new indices, and to determine changes, if any, to the index methodology.

Decisions made by the Index Committee include all matters related to index policy and maintenance. The Index Committee meets periodically to review market conditions and index performance, or on an as-needed basis to address major market developments.

The Index Committee reserves the right to exercise its discretion in making decisions with respect to any index policy or action. Index Committee internal procedures and discussions are considered to be potentially market moving and are therefore kept confidential.

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## Index Dissemination

### Index Tickers

The indices are calculated in real-time and disseminated by the Consolidated Tape Association (CTA) every 15 seconds during the U.S. trading day. Official closing index levels are published on each index business day at approximately 6:30 PM Eastern Time and are made available on [www.janusindices.com](http://www.janusindices.com).

### FTP

Daily index level information is available via FTP. Please contact the Index Sponsor for subscription information.

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## Contact Information

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## Appendix I: Holiday Schedule

2019	2020	2021
January 1	January 1	January 1
January 21	January 20	January 18
February 18	February 17	February 15
April 19	April 10	April 2
May 27	May 25	May 31
July 4	July 3	July 5
September 2	September 7	September 6
November 28	November 26	November 25
December 25	December 25	December 24

Note: The Chicago Mercantile Exchange (CME) lists Columbus Day and Veterans' Day as holidays on their group holiday calendar website, however, for 2017 the CME publicly declared that these two days would be normal schedule (i.e. not treated as holidays). As a result, we have removed these days from the holiday schedule above. As for future years, CME may repeat the same procedure; if they do, we would not treat Columbus Day and Veterans' Day as holidays.