Janus Henderson
INVESTORS

JANUS HENDERSON INDICES

Janus Henderson Adaptive Market Leaders Index Methodology

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Introduction

This document describes the Janus Henderson Adaptive Market Leaders Index ("Adaptive") Methodology. The Adaptive Index family includes a variety of indices that all follow the Index Methodology with varying parameters. We describe each member of the family below. The indices are designed to replicate portfolios consisting of a set of Exchange-Traded Funds (ETFs) or component indices comprising futures. The percentage weight of each ETF or component index within each of the Adaptive Indices is determined in accordance with the Adaptive Index methodology described below.

Each Index is rebalanced monthly. On each monthly Calculation Day, the percentage weight of each ETF or component index to be included in each Index is determined in accordance with the Adaptive Index methodology. New weights for the ETFs and component indices are given effect as of the related Rebalancing Day.

The Indices are designed to be investible – an investor holding the reference ETFs and the futures underlying the component indices associated with the Index at the same weights adjusted daily should realize returns similar to that of each Index. All the reference ETFs are listed on US exchanges and all the component indices comprise futures listed on the Chicago Mercantile Exchange. The Index inception date for all the Indices is Feb 5th, 2020. All data prior to this date is pre-inception index performance (PIP).

Index Sponsor and Index Calculation Agent

The index sponsor is Janus Henderson Indices LLC (the "Index Sponsor"). The Index Sponsor's determinations in respect of each Index shall be final.

Index Overview

The Adaptive Market Leaders Indices are a family of notional, rules-based proprietary indices sponsored by the Index Sponsor. Each index is designed with three choices in mind: geography (US versus Global), return type (Total Return versus Excess Return) and volatility target (No VT, or "Core," versus 5% VT). Volatility target is only applicable to Excess Return indices. As a result, the family consists of:

- The Janus Henderson Adaptive Market Leaders Core US Total Return Index
- The Janus Henderson Adaptive Market Leaders Core Global Total Return Index
- The Janus Henderson Adaptive Market Leaders Core US Excess Return Index
- The Janus Henderson Adaptive Market Leaders Core Global Excess Return Index
- The Janus Henderson Adaptive Market Leaders 5% VT US Excess Return Index
- The Janus Henderson Adaptive Market Leaders 5% VT Global Excess Return Index

Index Base Dates

Index Base Dates for the Core Indices are March 31st, 2006. Index Base Dates for the 5% VT Indices are June 15th, 2006.

Signal ETFs

The Adaptive Market Leaders Indices use signals from publicly traded options on ETFs as inputs to the model. The Global and US models use different sets of signal ETFs as described in the below table:

Sector	*Signal ETF*	*Model*
US Large Cap	**SPY** (SPDR S&P 500 ETF Trust)	Global, US
Developed	**EFA** (iShares MSCI EAFE ETF)	Global
Emerging	**EEM** (iShares MSCI Emerging Markets ETF)	Global
US Technology	**QQQ** (Invesco Nasdaq 100 ETF)	Global, US
US Small Cap	**IWM** (iShares Russell 2000 ETF)	Global, US
Fixed Income	**TLT** (iShares 20+ Year Treasury Bond ETF)	Global, US

Reference Securities (Investment Set)

There are 9 Reference "Securities", 9 for the global model and 7 for the US model. Securities are either Exchange-Traded Funds (ETFs) or investable "component" indices comprising futures, as shown in the table below. For US Large Cap, Developed and Emerging market, each asset category comprises two ETFs but only one ETF will be held at any one time, which is solely dependent on time periods. For the Government category, all of the indices may be included in the Indices at any point in time.

Asset	*Reference ETF*	*Model*
US Large Cap	**SPY** (SPDR S&P 500 ETF Trust) – Prior to 9/10/10	Global ,US
	VOO (Vanguard S&P 500 ETF) – 9/10/10 to Present	
Developed	**EFA** (iShares MSCI EAFE ETF) – Prior to 10/23/2012	Global
	IEFA (iShares Core MSCI EAFE ETF) – 10/23/2012 to Present	
Emerging	**EEM** (iShares MSCI Emerging Markets ETF) – Prior to 10/23/2012	Global
	IEMG (iShares Core MSCI Emerging Markets ETF) – 10/23/2012 to Present	
US Technology	**QQQ** (Invesco Nasdaq 100 ETF)	Global, US
US Small Cap	**IWM** (iShares Russell 2000 ETF)	Global ,US
Corporate	**LQD** (iShares iBoxx Investment Grade Corporate Bond ETF)	Global ,US
Government	**SGIXBFV Index** (SGI US 5Y Bond Future Index) **SGIXBTY Index** (SGI US 10Y Bond Future Index) **SGIXBUS Index** (SGI US 20Y Bond Future Index)	Global ,US

Scheduled Index Business Days
Weekdays in which the New York Stock Exchange is open for settlement.

Index Business Days
Weekdays in which the New York Stock Exchange is open for settlement on which no Index Disruption Event exists.

Index Calculation Days
The last Index Business Day of each month starting with the last Index Business Day of March, 2006.

Rebalance Days
The close of the Index Business Day after an Index Calculation Day; provided, however, that if such date is an Index Disruption Day, the rebalancing scheduled for such date will be postponed until the first Calculation Day which is not an Index Disruption Day.

Constituent Prices
The closing price for each Constituent on an Index Business Day is the price of the security, expressed in US dollars, at the regular close of the principal trading session on the primary exchange on which the security is listed as published by the Consolidated Tape for that Index Business Day.

Core Index Calculations

The following calculations refer to the Global Core Indices only. Each Index Level on the Index Base Date shall be 1,000. A Constituent shall be an ETF, a component index as described above or cash. Cash will have a negative weight when the index is leveraged.

Define the Total Return Index Level on each Index Business Day t as:

$$I_t = \sum_{i \in K} S_{i,t-1} P_{i,t}$$

Where:

$S_{i,t}$ = Index Share Count of Constituent i at the close of Index Business Day t and is adjusted for corporate actions where necessary,

$P_{i,t}$ = Closing Price of Constituent i on Index Business Day t. These are total return price series. For ETFs, this price is adjusted for dividends, stock splits and etc. For futures indices, this price is adjusted to include Libor 3M. Closing price of cash is 1 but also adjusted to include Libor 3M return. See Appendix for details.

and $i \in K$ where

$$K = [US\ Large\ Cap, Dev, EM, US\ Technology, US\ Small\ Cap, Corp, Gov't\ 5yr, Gov't\ 10yr, Gov't\ 20yr, cash]$$

Let

$$K^{EQ} = [US\ Large\ Cap, Dev, EM, US\ Technology, US\ Small\ Cap]$$

be the set of Equity Reference categories.

Let

$$K^{FI} = [Corp, Gov't\ 5yr, Gov't\ 10yr, Gov't\ 20yr]$$

be the set of Fixed Income Reference categories.

The total number of Reference Securities held by an Index at any point in time is at most 9.

The Index Share Count is calculated as follows:

$$S_{i,t} = \frac{w_{i,t} I_t}{P_{i,t}}$$

Where

$w_{i,t}$ = Desired weight of Constituent i on Index Business Day t.

Index Share Counts are subject to change as a result of Additional Rebalancing Event, Dividend Adjustment Event, Stock Split Adjustment Event or other Adjustment Events, as described in later sections.

Subject to the occurrence or existence of a Disrupted Day, the Index Level is calculated by the Index Calculation Agent at 6:30PM Eastern Time (the "Index Valuation Time") on each Index Business Day. The Index Level is the closing level of the Index for the relevant Index Business Day. The Index Calculation Agent may also, but is not obliged to, calculate the level of the Index in respect of any other valuation time on any Index Business Day or any other day with the consent of the Index Sponsor.

Selection and Weighting Methodology

Each Constituent in the index will receive a weight, $w_{i,t}$ $(i \in K)$ on each Index Calculation Day. How those weights are determined is described below.

Step 1: Calculating Equity Weights

The first step is to determine the allocation of equity components within the equity basket.

On each Index Business Day t, two-month (2M) 25-delta call and put implied volatilities (IVs) are calculated ($IV_{C,it}$, $IV_{P,it}$) as well as ATM (50-delta) IV, $IV_{ATM,it}$, for all $i \in K^{EQ}$, i.e. for all Equity Reference categories. All IV data refers to the Signal ETFs associated with the particular Equity Reference Category, i.e. all IV data refers to SPY, EFA, EEM, QQQ and IWM.

Define the Raw Expected Tail Ratio for each Equity Reference category i $(i \in K^{EQ})$ on day t as

$$ETR_{it} = \frac{IV_{C,it}}{IV_{P,it}}$$

and the Mean ETR on day t, $\overline{ETR}_{it}$, as the average of ETR_{it} of the prior 756-day period.

Calculate the Adjusted Call IV, $\widetilde{IV}_{C,it}$, as follows:

$$\widetilde{IV}_{C,it} = \frac{IV_{C,it}}{\overline{ETR}_{it}}$$

This normalizes the smile (i.e. the ratio between put and call implied volatilities) for each Equity Reference category to be about 1.0.

Calculate smoothed implied volatilities to be an exponential-weighted moving average of the unsmoothed implied volatilities for all $i \in K^{EQ}$ using a weight parameter of 0.75:

$$\widetilde{IV}^{S}_{C,it} = 0.75 \times \widetilde{IV}_{C,it} + 0.25 \times \widetilde{IV}^{S}_{C,it-1}$$
$$IV^{S}_{P,it} = 0.75 \times IV_{P,it} + 0.25 \times IV^{S}_{P,it-1}$$
$$IV^{S}_{ATM,it} = 0.75 \times IV_{ATM,it} + 0.25 \times IV^{S}_{ATM,it-1}$$

Benchmark Portfolio Calculation

Define the benchmark portfolio as the inverse volatility-weighted portfolio of the constituent ETFs: SPY, EFA, EEM, QQQ, and IWM. Formally, for each benchmark constituent on day t, define the weight of each constituent in the benchmark based on the inverse of its 63-day volatility relative to the sum of the inverse of 63-day volatility for each of the constituent ETFs:

$$w^{B}_{j,t} = \frac{1/Vol_{j,t}}{\sum_{j \in J} 1/Vol_{j,t}}$$

Where

$Vol_{j,t} =$
$63\ day\ volatility\ of\ constituent\ j, calculated\ from\ j's\ daily\ Total\ Returns\ for\ the\ previous\ 63\ Index\ Business\ Days$

$J = [SPY, EFA, EEM, QQQ, IWM]$.

Define the covariance matrix of the Equity Categories as Σ_t, a 5x5 matrix where

$$\Sigma_{ij,t} = \begin{cases} IV^S_{ATM,it} \times IV^S_{ATM,jt} \; if \; i = j \\ IV^S_{ATM,it} \times IV^S_{ATM,jt} \times 0.5 \; if \; i \neq j \end{cases}$$

Define the volatility of the benchmark on day t as

$$\sigma^B_t = \sqrt{w^{B\prime}_t \, \Sigma_t w^B_t}$$

and tracking error of the equity portfolio to the benchmark portfolio as a function of the equity weight vector, w^E_t,

$$w^E_t = \begin{pmatrix} w_{US\,Large\,Cap,t} \\ w_{Dev,t} \\ w_{EM,t} \\ w_{US\,Technology,t} \\ w_{US\,Small\,Cap,t} \end{pmatrix},$$

the benchmark weight vector, w^B_t, and the covariance of the Equity Categories:

$$TE_t = \sqrt{(w^{E\prime}_t - w^{B\prime}_t) \, \Sigma_t (w^E_t - w^B_t)}.$$

Define the skew in category i on day t as

$$Skew_{i,t} = \frac{\widetilde{IV}^S_{C,it}}{IV^S_{ATM,it}} \; for \; i \in K^{EQ}$$

We solve the following optimization on each Calculation Date to set the weights on that date:

$$\max_{w^E_t} w^{E\prime}_t Skew_t - 1.5 \frac{TE^2_t}{\sigma^B_t}$$

subject to

$$\sum_i w^E_{it} = 1 \;\; and \; w^E_{it} \geq 0 \; \forall i \; \in \; K^{EQ}$$

The optimization seeks the highest weighted skew subject to a "cost" of tracking error relative to the benchmark, where the tracking error is normalized relative to volatility. Final Equity Weights, $\widehat{w}^E_{it}$, are then set to a weighted average of the new optimized weights and the current holding weights:

$$\widehat{w}^E_{it} = 0.75 \times w^E_{it} + 0.25 \times \dot{w}^E_{i,t}$$

where

$$\dot{w}^E_{i,t} = \frac{S_{i,t-1} P_{i,t}}{\sum_{i \in K^{EQ}} S_{i,t-1} P_{i,t}} \; \forall \; i \in K^{EQ}$$

represents the weight held in Equity Category i on day t, which incorporates market movements from the time the positions were initially placed.

Step 2: Calculating Allocation to Equities

Now, given the equity weights within the equity portfolio $\widehat{w}_{it}^{E}$, the next step is to determine how much to allocate to the equity portfolio.

Calculate benchmark IV 25-delta call, 25-delta put and ATM (50-delta) as follows:

$$IV_{C,t}^{A} = \sum_{i \in K^{EQ}} w_{i,t}^{B} IV_{C,it}$$
$$IV_{P,t}^{A} = \sum_{i \in K^{EQ}} w_{i,t}^{B} IV_{P,it}$$

$$IV_{ATM,t}^{A} = \sum_{i \in K^{EQ}} w_{i,t}^{B} IV_{ATM,it}$$

Smooth the IV's as follows:

$$IV_{C,t}^{SA} = 0.75 \times IV_{C,t}^{A} + 0.25 \times IV_{C,t-1}^{SA}$$
$$IV_{P,t}^{SA} = 0.75 \times IV_{P,t}^{A} + 0.25 \times IV_{P,t-1}^{SA}$$
$$IV_{ATM,t}^{SA} = 0.75 \times IV_{ATM,t}^{A} + 0.25 \times IV_{ATM,t-1}^{SA}$$

Define the Smooth Expected Tail Ratio for the benchmark as

$$ETR_{t}^{A} = \frac{IV_{C,t}^{SA}}{IV_{P,t}^{SA}}$$

with

$$\overline{ETR}_{t}^{A}$$

and

$$\sigma_{ETR,t}^{A}$$

as the 756-day mean and standard deviation of the Smoothed ETR, respectively. Define

$$\overline{IV}_{P,t}^{SA}$$

and

$$\sigma_{IV,P,t}^{A}$$

as the 756-day mean and standard deviation of the Smoothed Put IV.

Define the Z-Scores for Smoothed ETR and Smoothed Put IV, respectively, as:

$$Z_{ETR,t}^{SA} = \frac{ETR_{t}^{A} - \overline{ETR}_{t}^{A}}{\sigma_{ETR,t}^{A}}$$

$$Z_{P,t}^{SA} = \frac{IV_{P,t}^{SA} - \overline{\overline{IV}^{SA}_{P,t}}}{\sigma_{IV,P,t}^{A}}$$

Define 12M Drawdown on day t, $D_{12,t}$, as the maximum drawdown (negative) over the last 252 days based on the total return of the index.

$$DD_{12,t} = \frac{I_t}{\max\limits_{i\in[t-251,t]} I_t} - 1$$

Define 11M Drawdown on day t, $D_{11,t}$, as the maximum drawdown (negative) over the last 231 days based on the total return of the index.

$$DD_{11,t} = \frac{I_t}{\max\limits_{i\in[t-230,t]} I_t} - 1$$

Define Final Drawdown as a weighted average of the 11M Drawdown and 12M Drawdown as follows:

$$DD_t = \frac{\min(DD_{11,t} - DD_{12,t}, 2\%)}{2\%} DD_{11,t} + \left(1 - \frac{\min(DD_{11,t} - DD_{12,t}, 2\%)}{2\%}\right) DD_{12,t}$$

Define a Risk Aversion parameter:

$$R = 90\%$$

Define the portfolio Sharpe ratio, vol and mean, respectively, as follows:

$$\lambda_t = 0.36275 \times \left[1 + 0.25 \times Max\left\{-1, Min\left(1, \frac{Z^{SA}_{ETR,t}}{2}\right)\right\}\right]$$

$$\sigma_t = 0.15 + 0.05 \times Max\{-2, \mathrm{Min}(2, Z^{SA}_{P,t})\}$$

$$\mu_t = \lambda_t \sigma_t + \frac{\sigma_t^2}{2}$$

$$\tilde{\gamma}_t = \frac{\mu_t}{\sigma_t^2} \times \frac{1}{[(2-R)R]} \times (1 - \frac{R}{1+DD_t})$$

$$\tilde{\gamma}_t = Max(0, Min(1, \tilde{\gamma}_t))$$

Define γ_t as the allocation to the equity portfolio on Index Business Day t:

$$\gamma_t = 0.90 \times \gamma_{t-1} + 0.10 \times \tilde{\gamma}_t$$

Then the allocation to each Equity Reference ETF is:

$$w_{i,t} = \gamma_t * \widehat{w}^E_{it}$$

Where $i \in K^{EQ}$.

The fixed income basket is allowed to have an exposure of 100% to 200%, resulting in an overall leveraged portfolio. The above calculated weights are the final weights of equity components in the overall leveraged portfolio.

Step 3: Calculating the Fixed Income Allocation

In this step, we'll first determine the exposure of the fixed income portfolio, and then the allocation to each fixed income component within the fixed income portfolio.

Fixed Income Exposure

On each Index Business Day t, two-month (2M) 25-delta call and put implied volatilities (IVs) are calculated ($IV_{C,TLT,t}$, $IV_{P,TLT,t}$) as well as ATM (50-delta) IV, $IV_{ATM,TLT,t}$, for TLT.

Define the Raw Expected Tail Ratio for TLT on day t as

$$ETR_{TLT,t} = \frac{IV_{C,TLT,t}}{IV_{P,TLT,t}}$$

and the Mean ETR on day t, $\overline{ETR}_{TLT,t}$, as the average of $ETR_{TLT,t}$ of the prior 756-day period.

Calculate the Adjusted Call IV, $\widetilde{IV}_{C,TLT,t}$, as follows:

$$\widetilde{IV}_{C,TLT,t} = \frac{IV_{C,TLT,t}}{\overline{ETR}_{TLT,t}}$$

Calculate smoothed implied volatilities to be an exponential-weighted moving average of the unsmoothed implied volatilities for TLT using a weight parameter of 0.75:

$$\widetilde{IV}^{S}_{C,TLT,t} = 0.75 \times \widetilde{IV}_{C,TLT,t} + 0.25 \times \widetilde{IV}^{S}_{C,TLT,t-1}$$
$$IV^{S}_{P,TLT,t} = 0.75 \times IV_{P,TLT,t} + 0.25 \times IV^{S}_{P,TLT,t-1}$$
$$IV^{S}_{ATM,TLT,t} = 0.75 \times IV_{ATM,TLT,t} + 0.25 \times IV^{S}_{ATM,TLT,t-1}$$

Define the skew in TLT on day t as

$$Skew_{TLT,t} = \frac{\widetilde{IV}^{S}_{C,TLT,t}}{IV^{S}_{ATM,TLT,t}}$$

Define the minimum and maximum observed skew in TLT as $minSkew$ and $maxSkew$. They are the minimum and maximum observation during the observation period from 1/10/2005 to 1/10/2019.

$$minSkew = 0.94$$
$$maxSkew = 1.37$$

Define the Fixed Income exposure, L_t, as a linear transformation of $Skew_{TLT,t}$:

$$L_t = L^{min} + \frac{\max(\min(Skew_{TLT,t},\ maxSkew) - minSkew, 0)}{maxSkew - minSkew}(L^{max} - L^{min})$$

where $L^{min} = 1$ and $L^{max} = 2$.

Fixed Income Weights

On Calculation Days, the Fixed Income weights are computed by solving the following risk parity optimization:

$$\widehat{w}_t^{FI*} = \arg\min f(\widehat{w}_t^{FI})$$

$$f(\widehat{w}_t^{FI}) = \sum_{i=1}^{M}\sum_{j=i+1}^{M}\left[\widehat{w}_{it}^{FI}\sum_{m=1}^{M}\widehat{w}_{mt}^{FI}\sigma_{i,m,t} - \widehat{w}_{jt}^{FI}\sum_{m=1}^{M}\widehat{w}_{mt}^{FI}\sigma_{j,m,t}\right]^2$$

subject to

$$\sum_{i=1}^{M}\widehat{w}_{it}^{FI} = 1$$

$$0 \leq \widehat{w}_{it}^{FI} \leq 1; i = 1 \dots M$$

where the instruments are the M Fixed Income assets: LQD and the Government exposures and $\sigma_{\cdot,\cdot,t}$ represents an element of the daily covariance matrix constructed from the total returns for the previous 63 days in the Fixed Income assets/indices.

These weights sum to one and reflect the Fixed Income Allocation,$1-\gamma_t$.

The allocation to each Fixed Income Reference ETF is then adjusted by the Fixed Income Allocation and the Exposure:

$$w_{i,t} = L_t * (1-\gamma_t) * \widehat{w}_{it}^{FI}$$

for each of Fixed Income securities, i.e. $i \in K^{FI}$.

When the Fixed Income Exposure is more than 100%, the fixed income portfolio will borrow cash to invest in the Fixed Income Reference ETFs. Then the weight in cash is negative and is calculated as follows:

$$w_{cash,t} = -(L_t - 1) * (1-\gamma_t)$$

When the Fixed Income Exposure is 100%, the cash weight is 0.

On any Index Rebalance Day, $\widehat{w}_{it}^{E}$ and w_{it}^{FI} are determined according to the above steps on the corresponding Index Calculation Day. On any other Index Business Day,

$$\widehat{w}_{it}^{E} = \frac{S_{i,t-1} * P_{i,t}}{\sum_{i \in K^{EQ}} S_{i,t-1} P_{i,t}} \; for \; i \in K^{EQ}$$

$$\widehat{w}_{it}^{FI} = \frac{S_{i,t-1} * P_{i,t}}{\sum_{i \in K^{FI}} S_{i,t-1} P_{i,t} + S_{cash,t-1} * P_{cash,t-1}} \; for \; i \in K^{FI}$$

$$w_{cash,t} = \frac{S_{cash,t-1} * P_{cash,t}}{\sum_{i \in K^{FI}} S_{i,t-1} P_{i,t} + S_{cash,t-1} * P_{cash,t}}$$

i.e. the relative weights within the equity basket and within the fixed income basket grow by the instrument total returns respectively.

US Core Index Calculation

For the US Indices, the calculations are performed the same way but with different equity components, i.e.:

$$K^{EQ} = [US\ Large\ Cap, US\ Technology, US\ Small\ Cap]$$
$$J = [SPY, QQQ, IWM].$$

Excess Return Index Calculations

Each Excess Return Index is derived from the related Total Return Index with 3 components subtracted: index fee, transaction cost and 3M LIBOR.

Define the pre-transaction holding dollar amount in each constituent as:

$$H_{i,t}^{-} = I_{t-1}^{ER} * w_{i,t-1} * \frac{P_{i,t}}{P_{i,t-1}}$$

Where I_t^{ER} is the Excess Return Index level on Index Business Day t,

$I_0^{ER} = 1000$, i.e. Index starts at 1000 on Index Base Date,

$i \in K$ and,

$K = [US\ Large\ Cap, Dev, EM, US\ Technology, US\ Small\ Cap, Corp, Gov't\ 5yr, Gov't\ 10yr, Gov't\ 20yr, cash]$

Then the daily return on the excess return index is:

$$r_t^{ER} = \frac{\sum_{i \in K^{all}} H_{i,t}^{-} - TC_{t-1}}{I_{t-1}^{ER}} - (LBR_{t-1} + MF) * \frac{N}{360} - 1$$

Where

LBR_t = 3M LIBOR on Index Business Day t,

MF = index fee, currently set at 50 bps per annum,

N = number of calendar days between Index Business Day t and t-1.

$TC_t =$ transaction cost and is calculated as follows:

$$TC_t = \sum_i | I_t^{ER} * w_{i,t-1} - H_{i,t}^{-} | * tCost$$

Where $tCost = 0.0006$ (6 bps),

$TC_0 = 0$,

$i \in [US\ Large\ Cap, Dev, EM, US\ Technology, US\ Small\ Cap, Corp, Gov't\ 5yr, Gov't\ 10yr, Gov't\ 20yr]$, note there is no transaction cost charged on the cash component.

A 6bps charge is applied to changes in the weights to account for transaction costs. To be clear, if the weight on one security declines by 2% in order for another weight to increase by 2%, the total charge off the index is 4% × 6bps.

Then the Excess Return Index is:

$$I_t^{ER} = I_{t-1}^{ER} * (1 + r_t^{ER})$$

For the US Indices, the calculations are performed the same way but with different equity components, i.e.:

$K = [US\ Large\ Cap, US\ Technology, US\ Small\ Cap, Corp, Gov't\ 5yr, Gov't\ 10yr, Gov't\ 20yr, cash]$

Volatility Targeted Index Calculations

Let $UER_{i,t}$ be the excess return for Constituent i on Index Business Day t:

$$UER_{i,t} = \frac{P_{i,t}}{P_{i,t-1}} - 1 - LBR_{t-1} * \frac{N}{360}$$

Recall,

$P_{i,t}$ = Adjusted Closing Level of Constituent i on Index Business Day t,

LBR_t = 3M LIBOR on Index Business Day t,

N = number of calendar days between Index Business Day t and t-1,

$UER_{cash,t} = 0$.

Given the Weights $w_{i,t}$, from above, we can define an Excess Return Index evolution as follows:

$$ERL_t = ERL_{t-1} * \left[1 + \sum_{i=1}^{N} w_{i,t-1} * UER_{i,t}\right]$$

The Vol Targeted version of each Index, I_t^{VT}, evolves as follows, where I_0^{VT} = 1000.

$$I_t^{VT} = I_{t-1}^{VT} * \left[1 + E_{t-1}\left(\frac{ERL_t}{ERL_{t-1}} - 1\right) - MF * \frac{Act_{t-1,t}}{360}\right] - TC_{t-1}$$

Transaction Cost TC_t is,

$$TC_t = tCost * \sum_i |I_t^{VT} * E_t * w_{i,t} - I_{t-1}^{VT} * E_{t-1} * w_{i,t-1} * (UER_{i,t} + 1)|$$

where $tCost = 0.0006$ (6 bps) and $TC_0 = 0$.

$i \in [US\ Large\ Cap, Dev, EM, US\ Technology, US\ Small\ Cap, Corp, Gov't\ 5yr, Gov't\ 10yr, Gov't\ 20yr]$, again there is no transaction cost charge on the cash component.

MF = 50 bps is the index fee, $Act_{t-1,t}$ is the actual number of calendar days between t (included) and $t-1$ (excluded) and E_t is the exposure to the Excess Return Index (ERL_t). Exposure at any point in time is a function of the Target Exposure (TE):

$$E_t = E_{t-1} + Min[10\%, Max(-10\%, TE_t - E_{t-1})]$$

where TE is defined as:

$$TE_t = Min\left(175\%, \frac{TV}{HV_{t-2}} * VAF_t\right)$$

where

TV is the Target Volatility for the Index, currently set at 5%.
HV is an historical measure of volatility defined below, and

VAF is a Volatility Adjustment Factor, defined below.

We construct a metric of likely expected volatility using current weights. Define HV as

$$HV_t = \sqrt{\frac{1}{49}\sum_{q=0}^{49}\left[\frac{365}{Act_{t-q-3,t-q}} * ln\left(\frac{CWI_{t,t-q}}{CWI_{t,t-q-3}}\right)^2\right]}$$

CWI is a hypothetical "constant weight" index that supposes a certain set of weights is present for each daily observation. That is, for any $q > 0$,

$$CWI_{t,t-q} = CWI_{t,t-q-1} * \left[1 + \sum_{i \in K}\left(w_{i,t+2} * \ UER_{i,t-q}\right)\right]$$

with $CWI_{t,t} = 1{,}000$. HV_t then reflects a measure of volatility as if the current weights were consistent over a historical period.

The Volatility Adjustment Factor (VAF) is defined as follows:

$$VAF_t = Min\left\{150\%, Max\left[50\%, \sqrt{Max\left(0{,}2 - \left[\frac{IHV_t}{TV}\right]^2\right)}\right]\right\}$$

Where IHV is a measure of Index Historical Volatility:

$$IHV_t = \sqrt{\frac{1}{37}\sum_{q=0}^{37}\left[\frac{365}{Act_{t-q-3,t-q}} * ln\left(\frac{I^{VT}_{t-q}}{I^{VT}_{t-q-3}}\right)^2\right]}$$

and $VAF_t = 1$ for all $t \leq 42$.

Index Maintenance

Index Base Date Level

Each Index has a level of 1000 on the Index Base Date, and on each Index Business Day thereafter the Index Level is equal to the Index Level at the beginning of the period times one plus the Index Return (R) for the period.

Delisting of Reference ETFs

Whenever a Constituent (ETF) is delisted, the "Removed Constituent" will be removed from the Index. The Index Committee may designate a Replacement ETF to which the weight of the Removed Constituent would be transferred on the date of delisting. If, however, no Replacement ETF is designated, the Removed Constituent weight will be transferred to a cash holding until the next Rebalance Date. The associated Calculation Date will perform the weight calculation without this ETF as a possible holding.

If, due to any applicable law or regulation or policy, the Index Sponsor or the Index Calculation Agent is not permitted (or there is a reasonable likelihood that, within the next 30 Index Business Days, it will not be permitted) to continue to sponsor or calculate, as applicable, an index that includes a Constituent ETF, then the Constituent will be removed from the Index on a designated day by the Index Calculation Agent or the Index Sponsor (in which case the Index Sponsor will notify the relevant date to the Index Calculation Agent). The Index Committee may designate a Replacement ETF to which the weight of the Removed Constituent would be transferred on the date of delisting. If, however, no Replacement ETF is designated, the Removed Constituent weight will be transferred to a cash holding until the next Rebalance Date. The associated Calculation Date will perform the weight calculation without this ETF as a possible holding.

Corporate Actions

The Index Committee, as described further below, will be solely responsible for the determination and calculation of any adjustments to the price of any instrument underlying an Index and of any related determinations and calculations with respect to any corporate action and its determinations and calculations will be conclusive absent manifest error.

Complex corporate actions: should any corporate action exist which the Index Committee deems requires a price adjustment, it will be solely responsible for determining the method and timing for any necessary price adjustments. In the case of simultaneous corporate actions, the Index Committee will determine the application of the above price adjustments which is the most accurate reflection of the impact of the corporate actions.

For most routine corporate actions the Index Committee delegates the implementation of standard corporate action procedures as outlined in this document to the Index Calculation Agent.

Index Policy

Announcements
Announcements regarding changes to any of the Indices will be made publicly available prior to the effective date of the change. All announcements will be published on the Index website: https://indices.janushenderson.com/indices.

Holiday Schedule
Each Index will be calculated on days when (a) the New York Stock Exchange is open for settlement and (b) the primary exchange for the reference securities is open for settlement. (Please see the Appendix.)

Force Majeure
Calculation of an Index 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 Calculation Agent and/or the Index Sponsor determines affects an Index 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 an Index 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 an Index 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 an Index.

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, in respect of a Share, any Scheduled Trading Day for such Share on which any of the events set out below occurs:

(a) any relevant Exchange or any relevant Related Exchange fails to open for trading during its regular trading session; or

(b) the occurrence or existence at any time during the one hour period which ends at the relevant Valuation Time of any suspension of or limitation imposed (whether by reason of movements in price exceeding permitted limits or otherwise) on the trading on (i) any relevant Exchange of such Share; or (ii) any relevant Related Exchange of futures contracts or options contracts relating to such Share; or

(c) the occurrence or existence at any time during the one hour period which ends at the relevant Valuation Time of any other event (other than an event described in Sub-paragraph (d) or Sub-paragraph (e) of this definition) which disrupts or impairs the ability of market participants in general (i) (on any relevant Exchange) to effect transactions in or to obtain market values for such Share; or (ii) (on any relevant Related Exchange) to effect transactions in or to obtain market values for any futures contracts or options contracts relating to such Share; or

(d) the closure on any Exchange Business Day of any relevant Exchange prior to its Scheduled Closing Time (unless such earlier closing time is announced by such Exchange at least one hour prior to the earlier of (i) the actual closing time for the regular trading session on such Related Exchange on such Exchange Business Day; and (ii) the deadline for the submission of orders to be entered into such Exchange system for execution at the relevant Valuation Time on such Exchange Business Day); or

(e) the closure on any Exchange Business Day of any relevant Related Exchange in respect of futures contracts or options contracts relating to such Share prior to its Scheduled Closing Time (unless such earlier closing time is announced by such Related Exchange at least one hour prior to the earlier of (i) the actual closing time for the regular trading session on such Related Exchange on such Exchange Business Day; and (ii) the deadline for the submission of orders to be entered into such Related Exchange system for execution at the Valuation Time on such Exchange Business Day).

Index Committee

The Index Committee is responsible for reviewing the design, composition, and calculation of the Indices, the development of new indices, and to determine changes, if any, to the Index Methodology (including rules for selecting companies, share counts or other matters), and the treatment of corporate actions.

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 confidential.

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 p.m. Eastern Time and are made available on https://indices.janushenderson.com/indices.

FTP

Daily Index Level information is available via FTP. Please contact indexgroup@janushenderson.com for subscription information.

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Appendix I: Price Adjustment

ETF

Upon the occurrence of a Dividend Adjustment Event or a Stock Split Adjustment Event (each as defined below), the Index Calculation Agent will make the appropriate adjustments to the closing price of the component ETF.

Dividend Adjustments

Following the declaration by the issuer of any Constituent ETF of a Dividend (as defined below) (a "Dividend Adjustment Event"), the Index Calculation Agent shall adjust the price of such Constituent on the Ex-Dividend Date (as defined below) in accordance with the formula set out below. . If such Ex-Date is not an Index Business Day, the adjustment shall be made on the next following Index Business Day.

$$P_{i,ex} = P_{i,ex-1} * \left(\frac{S_{i,ex}}{S_{i,ex-1} - D_i} \right)$$

Where
$S_{i,ex}$ = Closing price of Component i on Ex-Dividend Date as observed on the relevant Exchange

$S_{i,ex-1}$ = Closing price of Component i on the Index Business Day immediately preceding Ex-Dividend Date as observed on the relevant Exchange

D_i = The total applicable Dividend Amount (as defined below)

"Dividend" means, in respect of a Constituent ETF, any dividend (in the form of a cash dividend, a scrip (stock) dividend, or any dividend which is described as "special," "extra," "irregular" or a "return of capital") declared by the issuer of such Constituent for which the Ex-Dividend Date falls on any day after the Index Base Date.

"Dividend Amount" means, in respect of a Dividend:

(i) if such Dividend is a cash dividend, 100% of the gross cash dividend per one stock as declared by the issuer of the relevant Constituent, before the withholding or deduction of taxes at source by or on behalf of any applicable authority having power to tax in respect of such a dividend (an "Applicable Authority"), and shall exclude (a) any imputation or other credits, refunds or deductions granted by an Applicable Authority (together, the "Credits"), and (b) any taxes, credits, refunds or benefits imposed, withheld, assessed or levied on the Credits referred to in (a) above (converted, if necessary, at the applicable FX Rate for the conversion of the currency in which the relevant Dividend Amount is denominated into the currency in which the Constituent Closing Level of the relevant Constituent is published).

(ii) if such Dividend is a non-cash dividend, an amount per one stock equal to the cash value declared by the issuer of the relevant Constituent (whether or not such non-cash dividend includes stock that are the Constituent) or, if no cash value is declared by the issuer of the relevant Constituent, the cash value of such non-cash dividend as determined by the Index Sponsor, calculated by reference, where available, to the closing price of the Constituent Closing Level (as the case may be) comprising such non-cash dividend on the last trading day immediately preceding the relevant Ex-Dividend Date, taking into account (where such non-cash dividend consists of the stock of the Constituent) any diluting effect on the theoretical value of the Constituent stock resulting from such non-cash dividend. The cash

value of a non-cash dividend shall be converted, if necessary, at the applicable FX Rate for the conversion of the currency in which the relevant Dividend Amount is denominated into the currency in which the Constituent Closing Level of the relevant Constituent is published.

"Ex-Dividend Date" means, in respect of a Component ETF and a dividend payment which has been announced by the issuer of such ETF, the first day on which a purchaser of such ETF will not be entitled to receive the relevant dividend payment, as fixed by the issuer of such ETF and/or the primary exchange on which such ETF is traded.

"FX Rate" means, in respect of the notional exchange of one currency to another currency, the applicable WM/Reuters "Closing Spot Rate" as published by The World Markets Company plc in conjunction Reuters at approximately 4.00 p.m. (London Time) on the Ex-Dividend Date or, if such rate is discontinued or unavailable on the relevant day for any reason, such other exchange rate for the relevant currency conversion as the Index Sponsor shall determine appropriate by reference to an alternative foreign exchange rate service.

Stock Split Adjustments

Following the declaration by the issuer of a Constituent ETF of a Stock Split (as defined below) (a "Stock Split Adjustment Event"), the Index Calculation Agent shall adjust the Closing Price of such Constituent on the Ex-Date (as defined below) in relation to such Stock Split in accordance with the formula set out below. If such Ex-Date is not an Index Business Day, the adjustment shall be made on the next following Index Business Day.

$$P_{i,ex} = P_{i,ex-1} * \frac{S_{i,ex}}{S_{i,ex-1}/SR_{ex}}$$

where:
$S_{i,ex}$ = Closing price of Component i on Ex-Dividend Date as observed on the relevant Exchange

$S_{i,ex-1}$ = Closing price of Component i on the Index Business Day immediately preceding Ex-Dividend Date as observed on the relevant Exchange

SR_{ex} = Split Ratio of the Stock Split, i.e. SR = 2 (Stock Split 2 for 1) and SR = 0.5 (Stock Split 1 for 2).

"Ex-Date" means, in respect of a Stock Split in respect of a Constituent, the effective date of such Stock Split, as fixed by the issuer of such Constituent and/or the primary exchange on which such Constituent is traded.

"Stock Split" means, in respect of a Constituent, a stock split, subdivision, reverse stock split, consolidation or similar reclassification of the stock of such Constituent, for which the Ex-Date falls on any day after the Index Base Date.

Treasuries Futures Index

The closing price of each Reference Treasuries Futures Index is adjusted to include the 3M Libor Return:

$$P_{i,t} = P_{i,t-1} * (\frac{S_{i,t}}{S_{i,t-1}} + LBR_{t-1} * \frac{N}{360})$$

Where

$S_{i,t}$ = Closing price of the Treasuries Futures Index i on Index Business Day t as observed on the relevant Exchange

LBR_t = 3M LIBOR on Index Business Day t,

N = number of calendar days between Index Business Day t and t-1,

The "price" of cash on each Index Business Day t is:

$$P_{cash,t} = P_{cash,t-1} * (LBR_{t-1} * \frac{N}{360})$$

Appendix II: Reference ETFs and Primary Exchanges

Reference ETF	Primary Exchange
SPY	NYSE
VOO	NYSE
EFA	NYSE
IEFA	CBOE
EEM	NYSE
IEMG	NYSE
IWM	NYSE
QQQ	NASDAQ
LQD	NYSE
TLT	NASDAQ

Appendix III: Holiday Schedule

NYSE 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