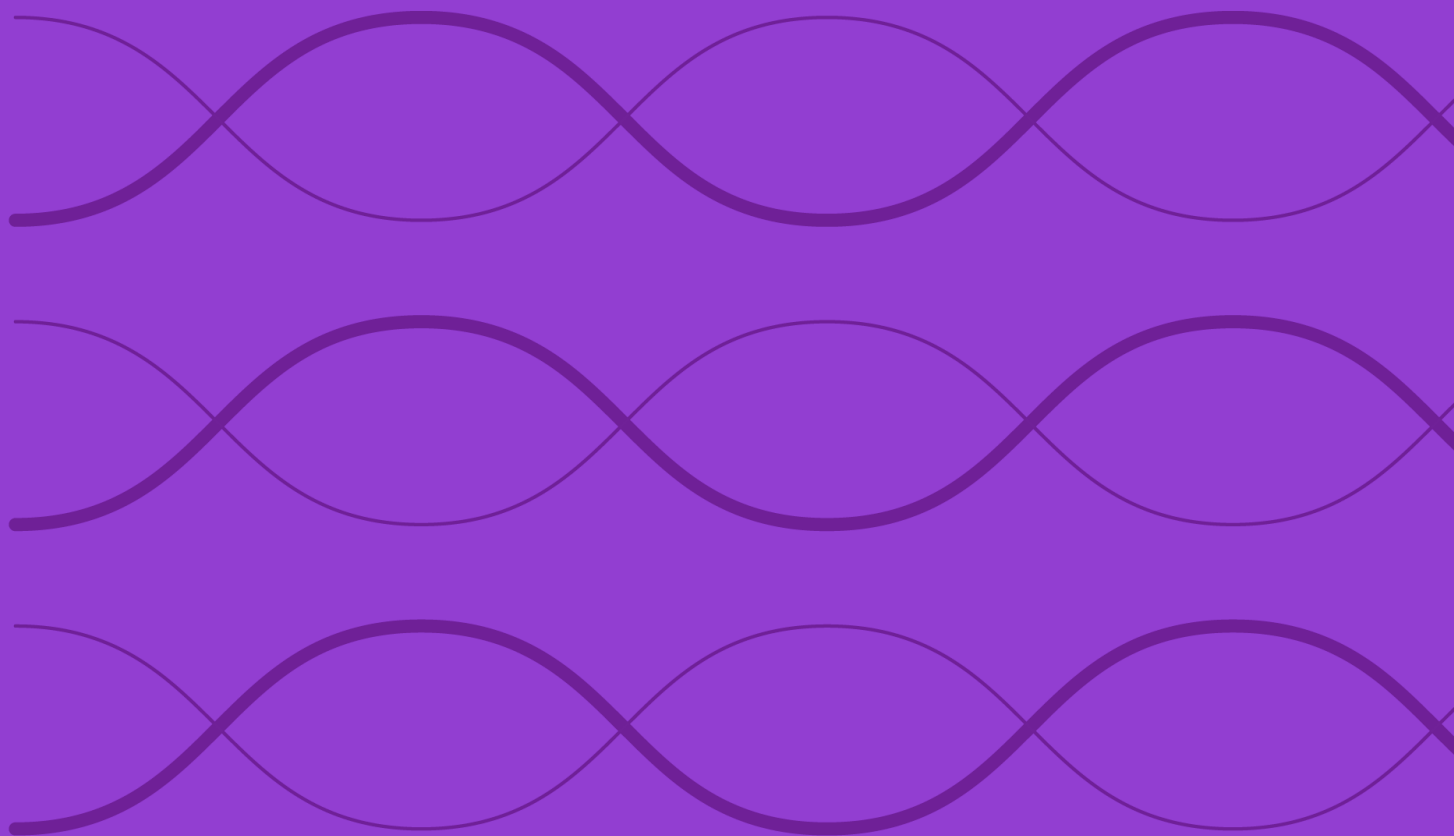


Morningstar[®] Target Volatility Methodology Paper



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Overview

The Objective of the Morningstar® Target Volatility methodology is to provide variable exposure to a given Base Index so as to maintain a certain volatility target. The balance of exposure to the Base Index compared to a cash investment is adjusted as the volatility of the Base Index changes according to the rules outlined in the rest of the document. The methodology may be applied to any Base Index, and the various parameters such as the volatility target, maximum exposure and volatility tolerance can all be customized.

Two scenarios may occur in attempting to maintain the given volatility target. An unleveraged position arises when the measured volatility of the Base Index is higher than the volatility target. In this case, the volatility control mechanism reduces the percentage of the Base Index held in the Target Volatility Index and increases the percentage of cash. Conversely, a leveraged position arises when the measured volatility of the Base Index is lower than the volatility target. When this occurs, the volatility control mechanism decreases or removes altogether the amount of cash held in the Target Volatility Index. At the same time, the Target Volatility Index will increase its exposure to the Base Index up to the maximum exposure limit, usually 150%. All constituents are levered proportionally in the Base Index.

Index Inception Date

The inception date of the Target Volatility Index is 60 business days after the inception date of the Base Index. Daily index levels are available from this date forward. The index level at inception is 1,000.

Calculation and Dissemination of Index Values

Index values for the Target Volatility Index are currently calculated and disseminated daily at close of trade.

Index Calculation

Overview

The Target Volatility Index holds variable exposure to the Base Index. When the exposure is less than 100% of the Target Volatility Index, the remaining percentage up to 100% is comprised of a cash investment. When the exposure is greater than 100%, the Target Volatility Index is in a leveraged position in regards to the Base Index. In this situation, there is no cash investment.

Total Return Calculation

The total return of the Target Volatility Index is comprised of two sources of return – the return on the Base Index, and the return on the cash investment. To calculate the return on the Base Index, we compare today's closing value to the previous day's close. To calculate the return on the cash investment, Morningstar uses the daily Fed Funds effective rate as an approximation of the interest gain on the cash investment.

When the Target Volatility Index is in a leveraged position, there will be no cash investment. However, because the exposure to the Base Index is over 100%, it is essentially borrowing money to invest in the Base Index. Morningstar uses the SOFR in USD to calculate the borrowing cost associated with the leveraged position.

The total return index calculation equation is shown below.

If $w_{t-1} \leq 100$ then

$$TR_t = TR_{t-1} \times \left[w_{t-1} \cdot \left(\frac{B_t}{B_{t-1}} \right) + (1 - w_{t-1}) \cdot \left(\frac{FFE_t}{FFE_{t-1}} \right) \right]$$

Else:

$$TR_t = TR_{t-1} \times \left[w_{t-1} \cdot \left(\frac{B_t}{B_{t-1}} \right) + (1 - w_{t-1}) \cdot \left(\frac{SOFR_t}{SOFR_{t-1}} \right) \right]$$

where:

TR_t	=	Total Return Index Level on date t, rounded to two decimal places
w_{t-1}	=	Realized exposure of the index on date t-1
B_t	=	Base index level on date t
FFE_t	=	Index capitalizing at the federal-funds effective rate on date t with a base value of 1 on the inception date of the base index, calculated daily using value from date t-1, on an (actual/360) day count basis. The underlying fed-funds rates follow the U.S. Fed calendar
$SOFR_t$	=	Index capitalizing at the SOFR rate on date t with a base value of 1 on the inception date of the base index, calculated daily using value from date t-1, on an (actual/360) day count basis. The underlying SOFR rates follow the U.S. Fed calendar

Excess Return Calculation

The excess return of the Target Volatility Index is equal to the total return minus the cash borrowing cost associated with holding the Base Index. The simplest way to explain this is to view it as an opportunity cost of investing in the Base Index instead of a cash investment. Thus, the total return of the Target Volatility Index is “dragged” by the cash borrowing rate to arrive at the return in excess of the expected return of a pure cash investment. Morningstar uses the SOFR in USD as the cash borrowing rate.

The excess return index calculation equation is shown below.

If $w_{t-1} \leq 100$ then

$$ER_t = ER_{t-1} \times \left[2 - \left(\frac{SOFR_t}{SOFR_{t-1}} \right) \right] \times \left[w_{t-1} \cdot \left(\frac{B_t}{B_{t-1}} \right) + (1 - w_{t-1}) \cdot \left(\frac{FFE_t}{FFE_{t-1}} \right) \right]$$

Else:

$$ER_t = ER_{t-1} \times \left[2 - \left(\frac{SOFR_t}{SOFR_{t-1}} \right) \right] \times \left[w_{t-1} \cdot \left(\frac{B_t}{B_{t-1}} \right) + (1 - w_{t-1}) \cdot \left(\frac{SOFR_t}{SOFR_{t-1}} \right) \right]$$

where:

I_t	=	Index level on date t
W_{t-1}	=	Realized exposure of the index on date t-1
B_t	=	Base index level on date t
FFE_t	=	Index capitalizing at the federal-funds effective rate on date t with a base value of 1 on the inception date of the base index, calculated daily using value from date t-1, on an (actual/360) day count basis. The underlying fed-funds rates follow the U.S. Fed calendar
$SOFR_t$	=	Index capitalizing at the SOFR rate on date t with a base value of 1 on the inception date of the base index, calculated daily using value from date t-1, on an (actual/360) day count basis. The underlying SOFR rates follow the U.S. Fed calendar

Measuring Volatility

The measured volatility of the base index is taken as either the trailing 20-business-day historic volatility or the trailing 60-business-day historic volatility, whichever is greater.

$$measured_volatility = \max(Vol20_t, Vol60_t)$$

Where:

$$Vol20_t = \sqrt{252 \times \frac{20}{19} \times \left[\frac{1}{20} \sum_{k=1}^{20} \ln^2 \left(\frac{B_{t-k}}{B_{t-k-1}} \right) - \left(\frac{1}{20} \sum_{k=1}^{20} \ln \left(\frac{B_{t-k}}{B_{t-k-1}} \right) \right)^2 \right]}$$

And:

$$Vol60_t = \sqrt{252 \times \frac{60}{59} \times \left[\frac{1}{60} \sum_{k=1}^{60} \ln^2 \left(\frac{B_{t-k}}{B_{t-k-1}} \right) - \left(\frac{1}{60} \sum_{k=1}^{60} \ln \left(\frac{B_{t-k}}{B_{t-k-1}} \right) \right)^2 \right]}$$

Determining the Target Exposure

The target exposure of the Morningstar Ultimate Stock-Pickers Target Volatility Index to the base index is determined by the formula below, with the aim of maintaining a target volatility. It is based on the ratio between the target volatility and the measured historic volatility of the base index, and will vary between zero and the maximum allowable exposure.

$$w_{Target(t)} = \min \left(\max_exposure, \frac{target_volatility}{measured_volatility} \right)$$

Where:

max exposure = 150%

target volatility = Target volatility chosen for the index

To discourage daily rebalancing of Target Volatility Indexes, the target exposure is updated only when there is a change that is greater than the exposure tolerance percentage. The current exposure of the index on the inception date shall be equal to the target exposure on the inception date.

$$w_0 = w_{Target(0)}$$

On any subsequent date t, the current exposure shall be determined as follows:

$$w_t = \begin{cases} w_{Target(t)} & \text{if } w_{t-1} > (1 + tolerance) \cdot w_{Target(t)} \\ w_{Target(t)} & \text{if } w_{t-1} < (1 - tolerance) \cdot w_{Target(t)} \\ w_{t-1} & \text{otherwise} \end{cases}$$

Where tolerance = 10%

w_t = Realized exposure of the index on date t

$w_{Target(t)}$ = Target exposure of the index on date t

Trading Cost Adjustment Factor, or TCAF

To account for higher transaction and portfolio management costs associated with the target volatility strategy, a flat adjustment factor is applied to the calculated index level to arrive at the final, published index level for volatility indexes.

On any index business day, the final adjusted index level I_t , shall be calculated as follows:

$$I_t = I_{t-1} \times \left(\frac{ER_t}{ER_{t-1}} \right) \times \left[1 - TCAF \times \left(\frac{n}{360} \right) \right]$$

Where:

ER_t = Unadjusted index level on day t

n = Number of days between t and (t-1)

Index Maintenance

The Target Volatility Index contains variable exposure to the Base Index. This exposure is assessed daily, and therefore theoretically, the Index may be rebalanced daily as well.

Refer to Appendix 1 for details on reconstitution and rebalancing.

However, daily rebalancing is rare, and will only occur during the most turbulent markets. On average, we expect the Index to be rebalanced every one to two weeks.

Data Correction and Precision

Intraday Index Data Corrections

Commercially reasonable efforts are made to ensure the accuracy of data used in real-time index calculations. If incorrect price or corporate action data affects index daily highs or lows, it is corrected retroactively as soon as is feasible.

Index-Related Data and Divisor Corrections

Incorrect pricing and corporate action data for individual issues in the database will generally be corrected upon detection. In addition, an incorrect divisor of an index, if discovered within two days of its occurrence, will be fixed retroactively on the day it is discovered to prevent an error from being carried forward. Commercially reasonable efforts are made to correct an older error subject to its significance and feasibility.

For more details, refer to the [Recalculation Guidelines](#).

Computational and Reporting Precision

For reporting purposes, index values are rounded to two decimal places and divisors are rounded to appropriate decimal places.

Exceptions

While Morningstar will seek to apply the method described above, the market environment, supervisory, legal, financial, or tax reasons may require an alternative approach to be adopted. A decision to take an alternative approach will be made by the relevant Morningstar Indexes Methodology Committee, and in all instances, the application of a nonstandard process will be reported to the Morningstar Indexes Oversight Committee.

About Morningstar Indexes

Morningstar Indexes was built to keep up with the evolving needs of investors — and to be a leading-edge advocate for them. Our rich heritage as a transparent, investor-focused leader in data and research uniquely equips us to support individuals, institutions, wealth managers, and advisors in navigating investment opportunities across major asset classes, styles, and strategies. From traditional benchmarks and unique IP-driven indexes to index design, calculation, and distribution services, our solutions span an investment landscape as diverse as investors themselves.

Morningstar Indexes Methodology Committee

The Morningstar Indexes Methodology Committee oversees all new index development, index methodology changes, and cessation of indexes for any indexes where Morningstar owns the intellectual property. This committee is also charged with ensuring that indexes align with Morningstar Research principles and values. The group comprises members of the index team with index research, product development, product management, client service, index implementation, and operation expertise who provide the first layer of governance over index design and methodology.

Morningstar Indexes Operations Committee

The Morningstar Indexes Operations Committee governs the processes, systems, and exception handling of the day-to-day management of all live indexes, including index rebalancing and reconstitution, restatements, market classification, and contingency management. The committee oversees the annual review of index methodology (as required by U.K. and EU benchmark regulations, or BMR), ensuring that methodologies remain fit for purpose and continue to achieve their stated investment objectives. The group comprises members of the index team with data, operations, corporate actions, product development, index launch, client service, and index management experience who provide the first layer of governance over index operations.

Morningstar Indexes Oversight Committee

The Morningstar Indexes Oversight Committee is responsible for the index oversight function as per the requirements of the U.K. and European BMR, providing independent oversight of all aspects of the governance of benchmark administration as required by the relevant BMR. Its remit extends to all calculation and administration-related business activities of Morningstar Indexes, including administration of Morningstar-owned benchmarks as well as client-owned benchmarks and index calculation. The oversight function is part of the organizational structure of Morningstar but is separate and independent from the index business, index management, and the other index committees.

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