

Tradeweb iNAV Overview and Methodology

As of April 2023

Overview

The Tradeweb iNAV is a calculation that reflects the indicative net asset value of an ETF based on the fair value of its basket of constituent instruments at a point in time. Currently the Tradeweb iNAV is calculated in real-time during European market hours, for European listed ETFs.

The calculation of the iNAV is intended to mirror, as closely as possible, the same method used by the fund administrator in calculating the ETF's official Net Asset Value each day. Tradeweb references the issuer's Portfolio Composition File (PCF) in order to capture the fund's latest constituents, weightings, cash, accruals, and other features, where relevant.

Tradeweb takes a bottom up approach to iNAVs, pricing each constituent according to the applicable pricing waterfall, applying weightings and other features, and returning a single 'per share' indicative net asset value for the fund.

Tradeweb's iNAVs are disseminated in all relevant listing currencies for an ETF, and by default EUR, GBP, CHF, USD, JPY as well.

iNAV data is produced and disseminated for the ETFs of issuers subscribed to Tradeweb's iNAV calculation service.

iNAV Data

The iNAV data created pursuant to the below methodologies may be produced in multiple formats for separate uses, as follows:

1. "**Standard iNAV Data**" means a publicly available single-sided iNAV value, with a frequency of 15 seconds throughout the trading day, of either Bid iNAV or Mid iNAV depending on the ETF's NAV valuation methodology
 - The Standard iNAV Data is available to the public, free of charge
 - Standard iNAV Data may be found available on information vendors such as Bloomberg, Refinitiv, SIX and more, or directly from Tradeweb
2. "**Enhanced iNAV Data**" means enhanced iNAV data, with a frequency of 2 to 15 seconds throughout the trading day, and including Bid iNAV, Mid iNAV, and Ask iNAV values
 - The Enhanced iNAV Data is a licensable market data offering from Tradeweb

Publication

The Tradeweb iNAVs for European listed ETFs are published every day during European market hours of 7:50 local London time, to 16:35 local London time, except for Christmas Eve, Christmas Day, New Year's Eve, and New Year's Day. On Christmas Eve and New Year's Eve, the Standard iNAV Data will only be calculated from 7:50 local London time to 13:30 local London time.

Disclaimer

Tradeweb Europe Limited exercises the greatest of care when sourcing data input and calculating the indicative net asset values (iNAV) in accordance with the methodologies disclosed in this document. However, Tradeweb Europe Limited cannot and does not guarantee or represent that the iNAVs are always calculated free of errors or will be accurate. Tradeweb Europe Limited accepts no liability for any direct or indirect losses suffered, incurred or arising from any incorrect calculation of the iNAVs or from the use of the iNAVs by any person. The iNAVs are indicative values and should not be relied upon or used by any person for anything other than as a simple indication of the possible value of a

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Note regarding iNAV calculation methodologies: The methodologies described in this document are representative of the standard approach taken by Tradeweb in performing the iNAV calculations. As these methodologies look to mirror the approach used by the issuer fund administrator, these calculations may be modified to accommodate unique elements of issuer fund composition, treatment of specific fund constituents in the calculation of NAV, or other nuance across different fund issuers or share classes.

Calculation Methodology

1. Fixed Income

(a) Pricing Sources

As input to the iNAV, different pricing sources are used at a point in time constituent level in order to calculate the iNAV. As the calculated iNAV is updated at least every 15 seconds, the pricing source and waterfall is re-assessed with each update. These include, but are not limited to, the following data sources:

- *Tradeweb Institutional Trading Platform Streams*
This consists of dealer price stream contributions to the Tradeweb institutional trading platform and is combined with outlier detection for contributions that fall away from group consensus thus providing a robust pricing source. Prices across qualifying contribution are averaged into a single value.
- *Tradeweb AiPrice*
Pricing using advanced statistical techniques and both internal and external data sources to create an intelligent pricing engine.
- *Interpolation Methodology*
For securities where live prices are unavailable, an interpolation methodology is used. This methodology adjusts the last closing price for an instrument based on its benchmark real-time price movements.
- *Static Prices*
Where there is no sufficient price available further up in the waterfall, the iNAV calculation reverts to the last closing price available for the security and uses this to calculate the iNAV.
- *Tradeweb iNAV Values (Fund of Fund ETFs)*
In the case of a Fund of Fund ETF or otherwise where an ETF is itself a constituent of another ETF, the TW iNAV values will be used to price that Fund constituent

(b) Pricing Waterfall

In order to calculate the real-time iNAV, a waterfall logic is imposed on the pricing sources. The waterfall for each constituent is determined at every calculation update. The waterfall is as follows (as may be adjusted to reflect changes to pricing sources from time to time):

1. Tradeweb Institutional Trading Platform Streams
 - a. If there are fewer than the minimum required number of dealers contributing to streams and the confidence in AiPrice is above the set threshold of moderate liquidity then prioritize AiPrice
2. Tradeweb AiPrice (the confidence level must be higher than the minimum threshold)
3. Static price with interpolation based on movements made by a benchmark for the constituent
4. Static price alone

(c) Accrued Interest

Each constituent is run through Tradeweb's Calculation Engine to determine the accrued interest to be applied to the price at each calculation step in real-time. In the event that Tradeweb doesn't have the reference data available for the bond, the accrued interest from the fund issuer's PCF is taken and applied to the calculation.

(d) FX Conversions

Constituent bonds may not be denominated in the same currency as the fund itself, if this is the case then the real-time prices quoted for the bonds will be in a different currency. Real-time exchange rates are used to convert these bonds to the same currency as the ETF.

(e) Calculation

Real-Time Fixed Income iNAV Formula:

$$iNAV_{k,t} = \frac{e_{k,T} + r_{k,T} \sum_{j=1}^{N_k} (p_{j,t} + i_{j,T+n}) q_{j,T}}{S_{k,T}}$$

$iNAV_{k,t}$: the iNAV of fund k , at time t

k : the fund for which the iNAV is being calculated

t : iNAV real-time calculation timestamp

$e_{k,T}$: estimated cash component of fund k at time T

T : official NAV calculation date

$r_{k,T}$: share class ratio of fund k , at time T , if none then equal to 1

N_k : total number of constituents in fund k

j : constituent

$p_{j,t}$: price of constituent j at time t

$i_{j,T+n}$: accrued interest of constituent j at settlement $T+n$

$q_{j,T}$: par-adjusted quantity of constituent j at time T

$S_{k,T}$: shares in issue of fund k at time T

- $iNAV_{k,t}$ is in the ETF currency, this is then converted to specified base currencies.

2. Equity / Non-Fixed Income

(a) Pricing Sources

As input to the iNAV, different pricing sources are used at a point in time constituent level in order to calculate the iNAV. As the calculated iNAV is updated at least every 15 seconds, the pricing source and waterfall is re-assessed with each update. These include, but are not limited to, the following data sources:

- *Exchange Bid-Offer*
This captures the real-time best bid and best offer prices for constituent instruments from exchanges.
- *Proxy Interpolation Methodology*
 - When a constituent is outside of its trading hours, a fair value model is used to interpolate the price. Here, a beta is estimated that encompasses future and constituent level daily movements based on the close of the constituent
 - Tradeweb may apply a waterfall of futures when selecting a relevant available future to use in the Proxy Interpolation
- *Static Prices*
Where there is no sufficient exchange pricing, and no ability to calculate interpolation, the iNAV calculation reverts to the last closing price available for the security and uses this to calculate the iNAV
- *TW iNAV Values (Fund of Fund ETFs)*
In the case of a Fund of Fund ETF or otherwise where an ETF is itself a constituent of another ETF, the TW iNAV values will be used to price that fund constituent

(b) Pricing Waterfall

In order to calculate the real-time iNAV, a waterfall logic is imposed on the pricing sources. The waterfall for each constituent is determined at every calculation update. The waterfall is as follows (as may be adjusted to reflect changes to pricing sources from time to time):

1. Real-time trading exchange bid-offer
2. Proxy Interpolation – if there is no available live bid/offer from an exchange source, then a proxy interpolation calculated price is applied based on last close price
3. Static price alone

(c) FX Conversions

Constituent securities may not be denominated in the same currency as the fund itself, if this is the case then the real-time prices quoted for the securities will be in a different currency. Real-time exchange rates are used to convert these securities to the same currency as the ETF

(d) Calculation

Real-Time Equity iNAV Formula:

$$iNAV_{k,t} = \frac{(\sum_{i=0}^{N_k} BV_{i,t}) + C_t}{S_t}$$

$iNAV_{f,t}$: the iNAV of fund k , at time t

N_k : total number of constituents in fund k

i : constituent

$BV_{i,t}$: the basket value for constituent i at time t

C_t : the cash component at time t

S_t : the shares in issue at time t

For each constituent, if the time of iNAV calculation is **within the trading window** for the equity, we calculate the basket value of the constituent as:

$$BV_{i,t} = P_{i,t} \cdot Q_{i,t} \cdot FX_{i,t}$$

$P_{i,t}$: the price of constituent i at time t

$Q_{i,t}$: the quantity of constituent i at time t

$FX_{i,t}$: the exchange rate for constituent i to the fund currency at time t

For each constituent within the fund, if the time of iNAV calculation is **not within the trading window** for the equity, we calculate the basket value of the constituent as:

Proxy Interpolation Model (using futures contract return as an estimation for the constituent-level return):

$$BV_{i,t} = (1 + \hat{\beta}_{i,t'} r_{fut,(t-1,t)}) \cdot FX_{i,t} \cdot \sum_{i=0}^i (P_{i,close} \cdot Q_{i,t})$$

$\hat{\beta}_{i,t'}$: the estimation of beta for constituent i at t' where $t' < t$

$r_{fut,(t-1,t)}$: the futures contract return between $t-1$ (last) and t

$\hat{\beta}_{i,t'} r_{fut,(t-1,t)}$: an OLS regression estimation for the constituent return, r_i , defined as:

$$r_i = \alpha + \beta r_{fut} + \varepsilon$$

r_i : the percentage change of the price for constituent i

r_{fut} : the percentage change of the best fit futures contract for constituent i

α : the intercept of the regression model

ε : is the idiosyncratic error of the regression model

$P_{i,close}$: the close price of constituent i

Static Price Model (using a static close price, where no beta has been calculated):

$$BV_{i,t} = P_{i,close} \cdot Q_{i,t} \cdot FX_{i,t}$$

3. Backup Calculation Methodology

For all ETFs, if Tradeweb is unable for any reason to calculate the iNAV in accordance with the applicable methodology above, Tradeweb shall, to the extent possible, instead calculate the iNAV leveraging a methodology derived from the relevant ETF's exchange listing mid-price, and the official NAV of the ETF.

Contact us for more information

For inquiries about the Tradeweb iNAV calculation service, iNAV public or licensed data, please contact:

Tradeweb Market Data – iNAV:

Email: TWMarketData.iNAV@tradeweb.com

Tradeweb iNAV Price Challenge or Report an Issue:

<https://tradeweb.service-now.com/x/twus/help/home>