

# PRICE DEVELOPMENT PROCESS FOR CRYPTOCURRENCY BASED CFD INSTRUMENTS

## PROCESS OF DOWNLOADING PRICES FROM REFERENCE INSTITUTIONS

Prices published by XTB are developed based on market prices provided by reference institutions. They are publicly available on particular exchanges' websites. Based on the above prices, XTB creates the order book consisting of 5 order lines<sup>1</sup> for each of the instruments of each of the virtual currency exchanges.

Depth of each of the order lines downloaded by XTB is defined by the parameter dependent on available depths offered by reference institutions, namely cryptocurrency exchanges being the price sources. The parameter defines how high the order volume must be for the given line in order to conclude that it involves sufficient liquidity. If a single line does not reach the value defined by the parameter, volumes of subsequent lines are added to its volume until the total value of the volumes exceeds the parameter. The price for such a line is calculated based on prices of the lines whose volumes were aggregated. Calculation involves summing up of prices weighted with the volumes assigned to them.

In the case of cryptocurrencies whose ratio of market price to quoted currency market price is low, i.e. the market price expressed in cryptocurrencies (e.g. in bitcoin or ethereum units) is a thousandth, a ten thousandth part or takes an even lower value, XTB employs the multiplier parameter, which is expected to make the prices reach a certain higher level while maintaining real depths offered by the reference institutions. The process involves multiplying the price of the given cryptocurrency by a multiple of 10 and dividing the volumes by the same value. For example: quoting of the EOS/BTC instrument where the exemplary price is 0.00083059 while the volume is 1689, will be modified into 0.83059, while the volume will be modified to 1.689 (that is, the price was multiplied by 1000, and the volume was divided by 1000, respectively).

## PROCESS OF OBTAINING THE FINAL XTB'S PRICE FOR CRYPTOCURRENCIES

Prices and volumes obtained from particular exchanges (in the process discussed above), making up the quoting step (tick), are subsequently verified in terms of depth, i.e. the available volume of respective purchase and sale orders. If the tick does not have a minimum of 5 order lines composed of the BID price, volume for the respective BID price, ASK price and volume for the respective ASK price, it is not taken into consideration during the process aimed at determination of XTB's final price.

In order to optimise the trading system's speed, XTB subsequently limits the number of ticks for the given instrument and for the given exchange to no more than 1 at the intervals of 100 milliseconds, provided however that the period of 100 milliseconds is calculated from occurrence of the previous tick for the given instrument, for the given exchange. No limitations apply to quotations received less frequently than every 100 milliseconds.

Further on, with each subsequent tick which passes the previous limitations, the weighing process aimed at determination of final prices and volumes for the instrument begins. The process results from

---

<sup>1</sup> Order lines contain information on the price and volume available for the given price. Altogether, they make up the order book.

significant differences in price levels for particular instruments at different exchanges, as well as from absence of a final reference market where verification of market character of particular quotations could be performed. XTB reserves the possibility to quote prices on the given instrument based on quotations from one exchange only. This, however, is an exceptional situation which may be caused – for example – by a technological breakdown of the exchanges named as the reference institutions, followed by absence, delay or quotations grossly deviating from other market quotations.

The weighing process is divided into a number of consecutive actions. Importantly enough, each of these actions uses data known at the very beginning of the process only. Thus, newly flowing in quotations cannot distort the process. One should also emphasise that the process of price calculation – for instance, for the BITCOIN instrument – employs quotations for the instrument obtained from different exchanges. Particular stages of the process are as follows:

1. First of all, calculation of the Total Book Price (TBP)<sup>2</sup> for the tick from each exchange – this involves calculation of the sum of ten BID and ASK price multiples and corresponding volumes (BID\_VOL and ASK\_VOL). That is, TBP for the given tick from the given exchange equals:

TBP=(BID1 \* BID VOL1) + (BID2 \* BID VOL2) + (BID3 \* BID VOL3) + (BID4 \* BID VOL4) + (BID5 \* BID VOL5) + (ASK1 \* ASK VOL1) + (ASK2 \* ASK VOL2) + (ASK3 \* ASK VOL3) + (ASK4 \* ASK VOL4) + (ASK5 \* ASK VOL5)

$$TBP = \sum_{i=1}^5 BID_i * BID\_VOL_i + \sum_{i=1}^5 ASK_i * ASK\_VOL_i$$

2. Summing up of the Total Book Price from different exchanges, followed by calculation of the percentage share of particular exchanges in that total sum (Weight1) – TBPs for ticks from different exchanges are added to one another. TBPs from particular exchanges are compared against the value obtained as above, and the ratio of the two values is recalculated into percentage. For example:

Exchange 1 TBP = 100

Exchange 2 TBP = 200

Exchange 3 TBP = 700

Total TBP = 1000

Percentage share of particular exchanges (hereinafter referred to as Weight1) in total TBP is: Exchange 1 – 10%, Exchange 2 – 20%, Exchange 3 – 70%.

3. Limitation of individual exchanges' domination – if any of the exchanges reaches an excessively high TBP share as compared with the total TBP of all exchanges (Weight1), its value may be limited. The limitation process is described by the following formula:

$$W2 = E + \sqrt[3]{(W1 - E)^2}$$

W2 – Weight2

W1 – Weight1

---

<sup>2</sup> Auxiliary value used to calculate the final transaction price.

E – domination parameter value determined per instrument. The assumption is that it should not be lower than 51%.

This results in determination of the Weight2 value for the exchange whose impact is limited. Subsequently, excess share taken away from that exchange is distributed among the remaining exchanges pursuant to the principle that exchanges with a higher Weight1 value obtain a proportionally greater part of the share than exchanges with a lower Weight1 value. Weight2 for those exchanges, therefore, equals the Weight1 factor plus share obtained from the dominant exchange.

If Weight1 is not greater than the above domination parameter value (E) specified above for any of the exchanges, Weight2 = Weight1.

Limitation of individual exchanges' domination is aimed at reducing impact of one exchange's quotations onto the final price of XTB for the specific instrument. In case of a breakdown at an exchange with a very high share in the whole weighing process, XTB's price of the instrument could change abruptly even if a similar situation did not occur on cryptocurrency exchanges.

4. Limitation of the impact of old quotations onto XTB's final price and calculation of the Weight3 factor – to limit the impact of old ticks from virtual currency exchanges onto XTB's final price, the mechanism involving gradual reduction of Weights of exchanges whose most recent tick allowed in the weighing process is older than time defined by the parameter G has been implemented. The so-called TimeoutFactor (TF) of the exchange is calculated as the difference of time between the time of current weighing and the time of the most recent tick from the given exchange. As a rule, TF grows when the difference is greater than the parameter G and falls if lower than G. Moreover, parameter TF change is scaled by the parameter D which identifies how significant the difference between the times of weighing and tick, and the parameter G must be.

Example:

Difference between the time of weighing and the tick for the given exchange is 150 seconds (parameter X)

Parameter G is 100 seconds

Parameter D is 5 seconds

TF change =  $(X-G)/D$

TF change =  $(150 - 100)/5=10$

Both parameters – D and G – are configurable per instrument and may change depending on the market situation.

If TF for the given exchange is lower than or equal to 0 for the given exchange, then Weight3 = Weight2. Otherwise, Weight3 is calculated as follows:

Weight3 = Weight2 \* TP<sup>TF</sup>

Where TP denotes the parameter TimeoutPenalty and identifies the basis of penalty for each TF for the specific exchange. The parameter is configurable (determined by a value from 0 to 1) and may change depending on the market situation.

5. Calculation of the final weight – the next step is calculation of the final weight (Weight4), which is calculated according to the following formula:

$$W_{4_t} = \frac{W_{4_{t-1}} * (N - 1) + W_3}{N}$$

Where:

$W_{4_t}$  – denotes current Weight4

$W_{4_{t-1}}$  – denotes previous Weight4 used for calculations

N – value of the parameter smoothening the values of particular weights

$W_3$  – denotes current Weight3

In exceptional situations (such as absence of prices from individual exchanges or rounding of calculation results), towards the end of the process, the sum of weights for the given instrument for all exchanges participating in weighing may not be equal to 100%. In that case, Weights are increased or reduced by respective values, proportional to their share in the total sum, in order to reach a sum equal to 100% after that modification.

6. Calculation of XTB's final price and tick volumes based on reference institutions' ticks and Weights4 assigned to them – this step involves calculation of 5 levels of BID and ASK prices including volumes assigned to them, making up XTB's tick. Calculation is described by the following formula:

$$BID1_{XTB} = BID1_{Exchange1} * Weight4_{Exchange1} + BID1_{Exchange2} * Weight4_{Exchange2} + BID1_{Exchange3} * Weight4_{Exchange3}$$

$$BID VOL1_{XTB} = BID VOL1_{Exchange1} * Weight4_{Exchange1} + BID VOL1_{Exchange2} * Weight4_{Exchange2} + BID VOL1_{Exchange3} * Weight4_{Exchange3}$$

$$XTB_{BID1} = \sum_{i=1}^n BID1_{EXCHANGEi} * WEIGHT4_{EXCHANGEi}$$

$$XTB_{BIDVOL1} = \sum_{i=1}^n BIDVOL1_{EXCHANGEi} * WEIGHT4_{EXCHANGEi}$$

The process is repeated, respectively, for all 5 BIDs and ASKs, and their volumes. The formula is subject to modification depending on the number of exchanges admitted to weighing in the current situation.

Upon the client's request, XTB provides prices and weights making up the given price presented on XTB's platform.