Guide to the capital market indices calculation

Version 1.0

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I. Formulas of indices values calculation

1. Current index value

$$Index(b) = \frac{\sum_{i \in Index} b_i p_i}{M * K} * B$$, where:

b_i – current price of i-th instrument in the index portfolio (if for i-th instrument there was no transaction on session the reference price is a substitute);
p_i - current number of shares of i-th instrument in the index portfolio;
M – base market capitalization value of the index portfolio on the base date;
K – adjustment coefficient, used to preserve the continuity of the index during the ordinary adjustment/revision or extraordinary adjustment;
B – base value of the index – first index value on the base date.

2. Index closing value

$$Index(z) = \frac{\sum_{i \in Index} z_i p_i}{M * K} * B$$, where:

z_i - closing price of i-th instrument in the index portfolio (if for i-th instrument there was no transaction on session the reference price is a substitute, non-transaction prices are not included in the WSE indices calculation);
p_i - current number of shares of i-th instrument in the index portfolio;
M – base market capitalization value of the index portfolio on the base date;
K – adjustment coefficient, used to preserve the continuity of the index during the ordinary adjustment/revision or extraordinary adjustment;
B – base value of the index – first index value on the base date.

3. Current percentage index change

$$Change(b)\% = \left(\left(\frac{Index(b)}{Index(d)}\right) - 1\right) * 100\%$$, where:

Index(b) – last index value on the session;
Index(d) – closing value of the index on the previous session (reference value of the index).

4. Daily percentage index change

$$Change(z)\% = \left(\left(\frac{Index(z)}{Index(d)}\right) - 1\right) * 100\%$$, where:

Index(z) – index closing value on the session;
Index(d) – closing value of the index on the previous session (reference value of the index).

5. Index percentage YTD

$$Change(YTD)\% = \left(\left(\frac{Index(z)}{Index(r)} \right) - 1 \right) * 100\%$$, where:

Index(z) – index closing value on the session;
Index(r) - index closing value on the last session in the previous year.

6. Current index change in points

$$Change(b) = Index(b) - Index(d)$$, where:

Index(b) – last index value on the session;
Index(d) – closing value of the index on the previous session (reference value of the index).

7. Daily index change in points

$$Change(z) = Index(z) - Index(d)$$, where:

Index(z) – index closing value on the session;
Index(d) – closing value of the index on the previous session (reference value of the index).

8. Index YTD in points

$$Change(YTD) = Index(z) - Index(r)$$, where:

Index(z) – index closing value on the session;
Index(r) - index closing value on the last session in the previous year.

9. Current index market value

$$M(b) = \sum_{i \in Index} b_i p_i$$, where:

b_i – current price of i-th instrument in the index portfolio (if for i-th instrument there was no transaction on session the reference price is a substitute);
p_i - current number of shares of i-th instrument in the index portfolio.

10. Closing index market value

$$M(z) = \sum_{i \in Index} z_i p_i$$, where:

z_i - closing price of i-th instrument in the index portfolio (if for i-th instrument there was no transaction on session the reference price is a substitute, non-transaction prices are not included in the WSE indices calculation);
p_i - current number of shares of i-th instrument in the index portfolio.

11. Indicator of the index opening portfolio

$$W(b) = \frac{\sum_{i \in O} b_i p_i}{\sum_{i \in Z} b_i p_i} * 100\%$$, where:

b_i – current price of i-th instrument in the index portfolio (if for i-th instrument there was no transaction on session the reference price is a substitute);
p_i - current number of shares of i-th instrument in the index portfolio;
O – a subset of instruments in the index portfolio, for which there was at least one transaction on the session;
Z – a set of all instruments in the index portfolio.

12. LEVERAGE index calculation formula

$$INDEXlev_t = \underbrace{INDEXlev_T \cdot \left(2 \cdot \frac{Base\_index_t}{Base\_index_T} - 1\right)}_{\text{leverage term}} \underbrace{- INDEXlev_T \cdot \left(\frac{R}{360}\right) \cdot d}_{\text{cost term}}$$, where:

$INDEXlev_t$ – current value of LEVERAGE index;
$INDEXlev_T$ – last closing value of the LEVERAGE index;
$Base\_index_t$ – current value of the underlying index;
$Base\_index_T$ – last closing value of the underlying index;
R – percentage rate (WIBOR ON or WIRON);
d – number of calendar days between day t and day T.
'Levarage term' is a part of algorithm, which describes the impact of the underlying index on the LEVERAGE index.
'Cost term' is a part of algorithm, which represents the cost, which arises from raising capital and reinvestment in the underlying index portfolio.

13. SHORT index calculation formula

$$INDEXshort_t = \underbrace{INDEXshort_T \cdot \left(-1 \cdot \frac{Base\_index_t}{Base\_index_T} + 2\right)}_{\text{leverage term}} \underbrace{+ 2 \cdot INDEXshort_T \cdot \left(\frac{R}{360}\right) \cdot d}_{\text{profit term}}$$, where

$INDEXshort_t$ – current value of SHORT index;
$INDEXshort_T$ – last closing value of the SHORT index;
$Base\_index_t$ – current value of the underlying index;
$Base\_index_T$ – last closing value of the underlying index;
R – percentage rate (WIBOR ON or WIRON);
d – number of calendar days between day t and day T.
'Levarage term' is a part of algorithm, which describes the inverse impact of the undelying index on the SHORT index.

'Profit term' is a part of algorithm, which reveals the additional profit, which results from short selling of the underlying index 'portfolio', followed by a risk free investment of capital received from short sale.

14. Bond indices calculation formula

$$Index(b) = \frac{\sum_{i \in Index} b_i p_i}{M * K} * B$$

b_i – current price (including nominal value and accrued interest) of i-th bond in the index current "dirty" price (reference price of treasury bonds determined on the Treasury BondSpot Poland market, taking into account the nominal price of the bond plus the value of interest on the transaction settlement date) of the i-th bond from the index portfolio;
p_i - current number of bonds of i-th instrument in the index portfolio;
M – base market capitalization value of the index portfolio on the base date;
K – adjustment coefficient, used to preserve the continuity of the index during the ordinary adjustment/revision or extraordinary adjustment;
B – base value of the index – first index value on the base date.

II. Adjustment coefficients calculation formulas regarding extraordinary adjustments

1. Addition of the instrument

$$K_{t+1} = \frac{M_{t+1}}{M_t} * K_t \quad \text{and} \quad M_{t+1} = M_t + z_i p_i \quad \text{, where:}$$

K_t – adjustment coefficient before addition of i-th instrument to the index portfolio;
K_{t+1} - adjustment coefficient after addition of i-th instrument to the index portfolio;
M_t – market capitalization before addition of i-th instrument to the index;
M_{t+1} - market capitalization after addition of i-th instrument to the index;
z_i - closing price of i-th instrument added to the index portfolio;
p_i - number of shares of i-th instrument added to the index portfolio.

2. Deletion of the instrument

$$K_{t+1} = \frac{M_{t+1}}{M_t} * K_t \quad \text{and} \quad M_{t+1} = M_t - z_i p_i \quad \text{, where:}$$

K_t – adjustment coefficient before deletion of i-th instrument from the index portfolio;
K_{t+1} - adjustment coefficient after deletion of i-th instrument from the index portfolio;
M_t – market capitalization before deletion of i-th instrument from the index;
M_{t+1} - market capitalization after deletion of i-th instrument from the index;
z_i - closing price of i-th instrument deleted from the index portfolio;
p_i - number of shares of i-th instrument deleted from the index portfolio.

3. Change of the number of shares (weighting factor)

$$K_{t+1} = \frac{M_{t+1}}{M_t} * K_t \quad \text{and} \quad M_{t+1} = M_t + z_i(p_i \pm s_i) \quad \text{, where:}$$

K_t – adjustment coefficient before change of the number of shares of i-th instrument from the index portfolio;
K_{t+1} - adjustment coefficient after change of the number of shares of i-th instrument from the index portfolio;
M_t – market capitalization before change of the number of shares of i-th instrument from the index;
M_{t+1} - market capitalization after change of the number of shares of i-th instrument from the index;
z_i - closing price of i-th instrument from the index portfolio;
p_i - previous number of shares of i-th instrument from the index portfolio;
s_i - changed part of the number of shares of i-th instrument from the index.

III. Adjustment coefficients calculation formulas regarding corporate actions

1. Right to dividends (only total return indices)

$$K_{t+1} = \frac{M_{t+1}}{M_t} * K_t \quad \text{and} \quad M_{t+1} = M_t - D_i p_i \quad \text{, where:}$$

K_t – adjustment coefficient before excluding income from the dividend of i-th instrument from the index portfolio;
K_{t+1} - adjustment coefficient after excluding income from the dividend of i-th instrument from the index portfolio;
M_t – market capitalization before excluding income from the dividend of i-th instrument from the index;
M_{t+1} - market capitalization after excluding income from the dividend of i-th instrument from the index;
Di – value of the dividend from the shares or theoretical value of the dividend from the shares (calculated by the Exchange pursuant to the Detailed Exchange Trading Rules) first listed 'without dividend' at day t+1; where the dividend is set in a foreign currency, the dividend is translated into PLN;
p_i - number of shares of i-th instrument from the index portfolio.

2. Pre-emptive rights (for total return indices)

$$K_{t+1} = \frac{M_{t+1}}{M_t} * K_t \quad \text{and} \quad M_{t+1} = M_t - V_i \quad \text{and} \quad V_i = \frac{z_i - e_i}{N_i + 1} * p_i \text{,} \quad \text{where:}$$

K_t – adjustment coefficient before including the pre-emptive right of i-th instrument from the index portfolio;
K_{t+1} - adjustment coefficient after including the pre-emptive right of i-th instrument from the index portfolio;
M_t – market capitalization before including the pre-emptive right of i-th instrument from the index;
M_{t+1} - market capitalization after including the pre-emptive right of i-th instrument from the index;
V_i – theoretical value of the pre-emptive rights from of the i-th instrument first time listed 'without pre-emptive rights' at day t+1; where the issue price (e_i) is higher than the share price (z_i), the theoretical value V_i is not calculated;
z_i - closing price of i-th instrument from the index portfolio;
e_i – issue price of the new issue of i-th instrument from the index portfolio;
N_i - number of rights necessary to acquire 1 share of the new issue of i-th instrument;
p_i - number of shares of i-th instrument from the index portfolio.

3. Pre-emptive rights (for total return indices)

For price indices pre-emptive rights involve the deletion of a certain company from the index during the first 'without pre-emptive right' trading session, if the price of 'without pre-emptive right' shares quoted for the first time is lower than the last closing price. Then, the formula describing removal of the instrument from the index portfolio is used:

$$K_{t+1} = \frac{M_{t+1}}{M_t} * K_t \quad \text{and} \quad M_{t+1} = M_t - z_i p_i \quad \text{, where:}$$

K_t – adjustment coefficient before deletion of i-th instrument from the index portfolio;
K_{t+1} - adjustment coefficient after deletion of i-th instrument from the index portfolio;
M_t – market capitalization before deletion of i-th instrument from the index;
M_{t+1} - market capitalization after deletion of i-th instrument from the index;
z_i - closing price of i-th instrument deleted from the index portfolio;
p_i - number of shares of i-th instrument deleted from the index portfolio.

After the session at which a certain company was listed for the first time 'without pre-emptive' it is back added to the index portfolio. Then, the formula describing addition of the instrument to the index portfolio is used:

$$K_{t+1} = \frac{M_{t+1}}{M_t} * K_t \quad \text{and} \quad M_{t+1} = M_t + z_i p_i \quad \text{, where:}$$

K_t – adjustment coefficient before addition of i-th instrument to the index portfolio;
K_{t+1} - adjustment coefficient after addition of i-th instrument to the index portfolio;
M_t – market capitalization before addition of i-th instrument to the index;
M_{t+1} - market capitalization after addition of i-th instrument to the index;
z_i - closing price of i-th instrument added to the index portfolio;
p_i - number of shares of i-th instrument added to the index portfolio.

4. Split

$$K_{t+1} = \frac{M_{t+1}}{M_t} * K_t \quad \text{and} \quad M_{t+1} = M_t - z_i p_{i_t} + z_i p_{i_{t+1}} \quad \text{and} \quad p_{i_{t+1}} = p_{i_t} * S \quad \text{, where:}$$

K_t – adjustment coefficient before split of i-th instrument to the index portfolio;
K_{t+1} - adjustment coefficient after split of i-th instrument to the index portfolio;
M_t – market capitalization before split of i-th instrument to the index;
M_{t+1} - market capitalization after split of i-th instrument to the index;
z_i - closing price of i-th instrument from the index portfolio;
$p_{i_{t+1}}$ - new number of shares of i-th instrument from the index portfolio on day t+1;
p_{i_t} - previous number of shares of i-th instrument from the index portfolio on day t;
S – split ratio.

5. Reverse split

$$K_{t+1} = \frac{M_{t+1}}{M_t} * K_t \quad \text{and} \quad M_{t+1} = M_t - z_i p_{i_t} + z_i p_{i_{t+1}} \quad \text{and} \quad p_{i_{t+1}} = p_{i_t} * S \quad \text{, where:}$$

K_t – adjustment coefficient before reverse split of i-th instrument to the index portfolio;
K_{t+1} - adjustment coefficient after reverse split of i-th instrument to the index portfolio;
M_t – market capitalization before reverse split of i-th instrument to the index;
M_{t+1} - market capitalization after reverse split of i-th instrument to the index;
z_i - closing price of i-th instrument from the index portfolio;
$p_{i_{t+1}}$ - new number of shares of i-th instrument from the index portfolio on day t+1;
p_{i_t} - previous number of shares of i-th instrument from the index portfolio on day t;
S – reverse split ratio.

6. Spin-off

$$K_{t+1} = \frac{M_{t+1}}{M_t} * K_t \quad \text{and} \quad M_{t+1} = M_t - (z_i - W_i)p_i \quad \text{, where:}$$

K_t - adjustment coefficient before spin-off of i-th instrument to the index portfolio;
K_{t+1} - adjustment coefficient after spin-off of i-th instrument to the index portfolio;
M_t - market capitalization before spin-off of i-th instrument to the index;
M_{t+1} - market capitalization after spin-off of i-th instrument to the index;
z_i - closing price of i-th instrument from the index portfolio;
W_i – spin-off coefficient (percentage or value);
p_i - number of shares of i-th instrument from the index portfolio.

7. Bonus issue

$$K_{t+1} = \frac{M_{t+1}}{M_t} * K_t \quad \text{and} \quad M_{t+1} = M_t - z_i p_i + \{\frac{z_i n}{n+m}\}p_i \quad \text{, where:}$$

K_t - adjustment coefficient before bonus issue of i-th instrument to the index portfolio;
K_{t+1} - adjustment coefficient after bonus issue of i-th instrument to the index portfolio;
M_t - market capitalization before bonus issue of i-th instrument to the index;
M_{t+1} - market capitalization after bonus issue of i-th instrument to the index;
z_i - closing price of i-th instrument from the index portfolio;
p_i - number of shares of i-th instrument from the index portfolio;
n – number of shares with the right to bonus issue;
m – number of bonus issue attributable to shareholders entitled to shares "with the right to bonus issue".

IV. Other index formulas

1. Index participant weighting

$$weighting(i) = \left(\frac{z_i p_i}{\sum_{i \in Index} z_i p_i} \right) * 100\%$$, where

z_i - closing price of i-th instrument in the index portfolio;
p_i - number of shares of i-th instrument added to the index portfolio

2. Index PE ratio

$$PE(I) = \frac{\sum_{i \in Index} z_i e_i}{\sum_{i \in Index} w_i}$$, where

z_i - closing price of i-th instrument in the index portfolio;
e_i – number of outstanding shares of an Issuer of shares of i-th instrument in the index portfolio;
w_i – net profit for the 4 quarters of an Issuer of shares of i-th instrument in the index portfolio.

3. Index PBV ratio

$$PBV(I) = \frac{\sum_{i \in Index} z_i e_i}{\sum_{i \in Index} k_i}$$, where

z_i - closing price of i-th instrument in the index portfolio;
e_i – number of outstanding shares of an Issuer of shares of i-th instrument in the index portfolio;
k_i – book value of an Issuer of shares of i-th instrument in the index portfolio.

4. Index dividend yield

$$DYW(I) = \frac{\sum_{i \in Index} D_i}{\sum_{i \in Index} z_i e_i} * 100\%$$, where

D_i – total value of dividend paid in a given year by an Issuer of shares of i-th instrument in the index portfolio;
z_i - closing price of i-th instrument in the index portfolio;
e_i – number of outstanding shares of an Issuer of shares of i-th instrument in the index portfolio.