

# PX Index Manual

## I. Introduction

The PX index is the official index of the Prague Stock Exchange (hereinafter referred to as the "Stock Exchange"). The PX index was calculated for the first time on 20 March 2006 when it replaced the PX 50 and PX-D indices. The PX index took over the historical values of the Stock Exchange's oldest index, the PX 50, and continues in its development. The calculation of the PX 50 index complied with the IFC (International Finance Corporation) methodology recommended for the creation of indices in emerging markets. The starting date for the calculation of the index was 5 April 1994 when a base composed of 50 issues was created and the opening value of the index was fixed at 1,000.0 points. From December 2001 on, the number of basic issues has been variable. The PX index is a price index and dividend yields are not considered in its calculation.

## II. Calculation Formulas

The following calculation formula applies to the PX index:

$$PX(t) = K(t) \times \frac{M(t)}{M(0)} \times 1000 \quad (1)$$

where

- $M(0) = \text{CZK } 379,786,853,620.0$  is the market capitalisation of the base on the starting date of 5 April 1994
- $K(t)$  is the chaining factor at time  $t$  (takes into account changes made in the index base), where  $K(0)$  on 5 April 1994 means  $K(0) = 1.00000000$
- $M(t)$  is market capitalisation of the base at time  $t$  defined by the formula

$$M(t) = \sum_{i=1}^{N(t)} q_i(t) \cdot p_i(t)$$

where

$q_i(t)$  denotes the number of securities of the  $i$ -th base issue used for the calculation of the index at time  $t$ ;

$p_i(t)$  denotes the price quotation of the  $i$ -th base issue at time  $t$ ;

$N(t)$  denotes the number of base issues at time  $t$ .

The formula (1) can be rewritten as follows

$$PX(t) = \frac{M(t)}{D(t)} \times 1000 \quad (2)$$

where the denominator

$$D(t) = \frac{M(0)}{K(t)} \text{ denotes the "base value".}$$

If at time t+1 the index base does not correspond to the base at time t, the K(t) and D(t) coefficients will be adjusted as follows.

$$K(t+1) = K(t) \times \frac{M(t)}{M^*(t)}$$

$$D(t+1) = D(t) \times \frac{M^*(t)}{M(t)}$$

where

M(t) denotes the market capitalisation of the base at time t before the adjustments;

M\*(t) denotes the market capitalisation of the new (updated) base at time t.

It is easy to prove that the following recurrent relation for the calculation of the index is equivalent to the formulas (1) and (2).

$$PX(t+1) = PX(t) \times \frac{M(t+1)}{M^*(t)} \quad (3)$$

where both market capitalisations M(t+1) and M\*(t) are calculated from the “new” base and P(0) = 1,000.0 points. The Stock Exchange uses formula (3) to calculate the PX index. The values of the K(t) and D(t) coefficients are available.

### III. Calculation Frequency

The index is calculated during trading hours within price-shaping segments, i.e. from 9:25 a.m. to 4:00 p.m., in 1-minute intervals. The continual calculation of the PX 50 and PX-D indices, PX index predecessors, was launched on 4 January 1999.

### IV. Price Quotations Used in the Calculation

1) In the case of base issues assigned to SPAD the calculation of the index uses:

- a) the midpoints of the valid spread during the period of the SPAD open phase
- b) the auction prices and the prices of the last trades effected under the continual regime during the SPAD closed phase.

2) In the case of base issues not assigned to SPAD the calculation of the index uses the auction prices and the prices of the last trades effected under the continual regime.

## V. Principles of Updating the PX Index Base

The Commission for the Administration of Exchange Indices applies the following rules.

1. Share issues of investment funds and issues of mutual funds units (Sector No. 18), issues of those holding companies which have emerged from transformation of investment funds, share issues from the non-regulated free market and investment certificate issues shall not be included in the base. Foreign issues from the regulated market for which the volume traded at the Prague Stock Exchange does not exceed 10% of the trading volumes on the most liquid market for the issue in question shall not be included in the index base.
2. Security issues of the following companies may not be included in the base:
  - a) the assets of which have been declared to be in bankruptcy or for which settlement (composition) has been allowed;
  - b) for which it has been decided on winding up through liquidation;
  - c) for which securities trading at the Stock Exchange has been suspended on a long-term basis.
3. The updating is carried out quarterly. The updated bases enter into force on the first exchange day after the third Friday of March, June, September and December.
4. Share issues complying with conditions 1 and 2 may be included in the PX index base, provided that these meet the following requirements:
  - a) The market capitalisation of the issue, as at the decisive (record) date, is higher than p1 billion CZK. The value of the parameter p1 is fixed by the Commission upon the recommendation of the Exchange Committee on Exchange Trades. The decisive dates for calculation of the market capitalisation are the last exchange days in February, May, August and November.
  - b) The average daily trading volume of the issue without block deals in the decisive period is higher than p2 million CZK. To calculate the average volume, only the exchange days of the decisive period when the issue was registered for trading on the Stock Exchange are taken into account. The value of the parameter p2 is fixed by the Commission upon the recommendation of the Exchange Committee on Exchange Trades. The decisive period shall be defined as six months prior to the decisive date.
  - c) The issue had been traded in at least 90% of the exchange days that took place during the decisive period when it was registered for trading on the Stock Exchange.
  - d) The issue had been traded in at least 10 sessions until the decisive date; this includes conditional trading.
5. Under serious circumstances, an issue can be excluded from the base without compensation and this can be done at dates other than those fixed for the periodic updating.
6. The total share of base issues owned by one issuer in the total market capitalisation of the base may not exceed 25%
  - a) on the decisive dates;
  - b) on the days when the decision was made, according to point 5 of these Principles, about the extraordinary exclusion of the issue from the index base;

c) in the case of the stock event of securities merger, where base issue is involved. If the set limit is exceeded, a reduction in the number of securities follows. If the set limit is exceeded by an issuer with more than one base issue, the process of reduction in the number of securities begins with the issue of this issuer with the smallest market capitalisation.

## VI. Procedure for Reducing the Number of Securities in Base Issues

### Designation:

M denotes the number of base issues

v = 0,25 represents weight limit for the base issue

$N_i$  for  $i=1, \dots, M$  denotes the actual number of securities in base issues

$n_i$  for  $i=1, \dots, M$  denotes the numbers of securities after reduction

$p_i$  for  $i=1, \dots, M$  denotes price quotation rates of base issues

### a) One issue present in the base from one issuer

Let us assume that the issues are organized according to market capitalisation in descending order and let us use "K" to mark the number of issues where the weight limit "v" has been exceeded. If  $K=0$ , there will be no reduction. In case  $K>0$ , the following applies:

$$\frac{n_i \cdot p_i}{\sum_{j=1}^K n_j \cdot p_j + \sum_{j=K+1}^M N_j \cdot p_j} = v$$

for all  $i=1, \dots, K$ .

The listed relation shows that in all issues in which the allowed share in market capitalisation of the base was exceeded, the number of securities will decrease so that the share precisely equals the set limit. The relation shows:

$$n_1 \cdot p_1 = n_2 \cdot p_2 = \dots = n_K \cdot p_K$$

If we calculate  $n_1$ , we can easily identify the other reduced calculations using the equality.

If we identify

$$B = \sum_{j=K+1}^M N_j \cdot p_j$$

we can, of course write:

$$\frac{n_1 \cdot p_1}{K \cdot n_1 \cdot p_1 + B} = v$$

thus

$$n_1 = \frac{n \cdot B}{(1 - n \cdot K) \cdot p_1}$$

As it was already mentioned, the remaining reduced numbers will be easily identified, while the resulting values are rounded down.

A situation can occur, where an issue, the share of which in market capitalisation of the base prior to the reduction was lower than the allowed limit, exceeds such limit after the reduction. In that case, the process of reduction needs to be repeated with the difference being that such issue shall be considered an issue exceeding the permitted limit. Therefore, value K will increase and value B needs to be recalculated (a sum of market capitalisations of issues where the weights are not reduced). The process will end at the time when none of the issues exceeds the permitted limit.

#### **b) Two issues in the base from one issuer**

First of all, a calculation is carried out as described in a), while affiliation of the issues to the issuers is not taken into account. We differentiate between two scenarios:

1) The sum of shares of market capitalisations of base issues of any issuer in the market capitalisation of the base does not exceed 25%. In that case, the process of reducing the number of securities used in the index calculations ends.

2) For some issuers, the sum of the share of market capitalisations of base issues in the market capitalisation of the base exceeds 25%. Decrease of numbers of securities in the less capitalized issue of such issuer shall be used to correct the weight of the issuers. In order to identify the number of securities used in the index calculation, a procedure analogous to the one described in part a) is used.

### **VII. Influence of stock events with securities**

Carrying out stock events shall be governed by Stock Exchange Rules, part XIII. - "Stock events with securities".

#### **VII – 1 Payments of Dividends**

The PX index is a price index; payments of dividends do not influence the index calculation.

#### **VII – 2 Splitting of Securities**

The event does not change the market capitalisation of the issue. As at the date of the splitting, the number of securities used in the index calculation is multiplied by the price quotation ration, i.e. the number of new shares replacing one original share. Securities originated by splitting are listed for trading

with a midpoint of the valid spread which is calculated as a ratio of the last final rate prior to the splitting and the quotation ration. A result calculated to two decimal places shall be rounded up to the quotation step.

### **VII – 3 Free Division of Shares**

The event does not change the market capitalisation of the issue. As at the day of the operation, the number of securities used in the index calculation is multiplied by the value of  $1 + \alpha$ , where

$$\alpha = \frac{\text{number of newly issued securities}}{\text{number of the original securities}},$$

while the product is rounded down.

As at the date of the operation, the trading starts with midpoint of the valid spread (SPR), which is identified according to the following relation:

$$\text{SPR} = \frac{\text{last price quotation}}{1 + \alpha}$$

with rounding up to the quotation step.

### **VII – 4 Securities Merger**

As at the date of merger of the securities, the issue originated by the merger is listed for trading with a midpoint of the valid spread, which is calculated as a weighted average of the last final quotations of the merging issues. The weights are numbers of securities in the merging issues.

We differentiate among the following three scenarios:

a) The acquiring issue is included into the base; the acquisition is not included into the base

The acquiring issue will remain in the base. In compliance with point 6 c) of the Principles of updating the index PX base (hereinafter “Principles”) the numbers of securities used in the index calculations will be modified so that the share of the base issues in the market capitalisation does not exceed 25%.

b) Both merging issues are included into the base

The acquiring issue will remain in the base; the acquisition will be excluded from the base. In compliance with point 6 c) of the “Principles” the numbers of securities used in the index calculations will be modified so that the share of the base issues in the market capitalisation does not exceed 25%.

a) The acquiring issue is not included into the base; the acquisition is included into the base

The acquisition will be excluded from the base. In compliance with point 6 c) of the “Principles” the numbers of securities used in the index calculations will be modified so that the share of the base issues in the market capitalisation does not exceed 25%.

With the exception of an operation of securities merger the increase in the number of securities in the base issue is not applied until the next update.