Ground Rules

Guide to Calculation Methods for the FTSE UK Index Series
v5.7

Contents

Section 1

Purpose of the Guide

1.0 Purpose of the Guide

1.1 The aims of the guide are:

    A.   to describe how the indices are calculated;

    B.   to make it easier for users to replicate the indices in order to support their investment and trading activities; and

    C.   to assist users in understanding the component factors which influence the performance of the indices.

1.2 FTSE Russell

1.2.1 FTSE Russell is a trading name of FTSE International Limited, Frank Russell Company, FTSE Global Debt Capital Markets Limited (and its subsidiaries FTSE Global Debt Capital Markets Inc. and FTSE Fixed Income Europe Limited), FTSE Fixed Income LLC, The Yield Book Inc and Beyond Ratings.

Section 2

Price Indices

2.0 Price Indices

2.1 The FTSE UK Index Series is an arithmetic weighted Series where the weights are the market capitalisation of each company. The price index is the summation of the free float adjusted market values (or capitalisations) of all companies within the index divided by the divisor (see 2.2). The price movement of a larger company (say, representing five per cent of the value of the index) will, therefore, have a larger effect on the index than a smaller company (say, representing one per cent of the value of the index).

2.2 The formula used for calculating the indices is straightforward. However, determining the capitalisation of each constituent company and calculating the capitalisation adjustments to the index are more complex. At the starting date for calculating an index an arbitrary value (e.g.1000) is chosen as the initial value. On that date a divisor is calculated as the sum of the market capitalisations of the index constituents divided by the initial index value. The divisor is subsequently adjusted for any capital changes in the index constituents. In order to prevent discontinuities in the index in the event of a corporate action or change in constituents it is necessary to make an adjustment to the prices used to calculate the index to ensure that the change in index between two consecutive dates reflects only market movements rather than including change due to the impact of corporate actions or constituent changes. This ensures that the index values remain comparable over time and that changes in the index level properly reflect the change in value of a portfolio of index constituents with weights the same as in the index.

The adjustment used by FTSE Russell is based on the Paasche formula (see 2.3 below) (also known as the current-weighted formula) which adjusts the divisor for the index for the day before a corporate action and calculates the change from that adjusted index to the index for the following day in which the corporate action occurs. The implication of this adjustment for a portfolio manager wishing to track the index is that the manager needs to either invest or realise cash at the opening of the market on the day of the corporate action depending on whether the constituent is realising or raising capital. In practice the portfolio manager will sell/invest at the previous close.

2.3   Paasche Formula

$$I_t^{Paas} = \frac{\sum_{i=1}^n P_{i,t}\, Q_{i,t}}{\sum_{i=1}^n P_{i,0}\, Q_{i,t}}$$

Where:

I_t^{Paas} =   Paasche Index

$P_{i,t}$ =   price at start of day t for constituent i after adjustments for corporate action or event.

$P_{i,0}$ =   price of constituent i on the starting day of calculating the index.

$Q_{i,t}$ =   number of shares included in the index for constituent i at the start of day t.

Chained Paasche index

$$I_t^{Paas} = I_{t-1}^{Pass}\, \frac{\sum_{i=1}^n P_{i,t}\, Q_{i,t}}{\sum_{i=1}^n P_{i,t-1}\, Q_{i,t}}$$

- Denominator uses today's quantities (post-repayment, ex-price) and yesterday's price (pre-repayment, cum-price)

- To prevent discontinuities, need to adjust **yesterday's** closing price with a price adjustment factor to make it comparable to today's

- Price Adjustment Factor $(PAF_{i,t})$ = ex-price/cum-price = $(P_{t-1}-1)/P_{t-1}$

Example:

Suppose there are 2 constituents A and B and the index starts on day t-1 with a value of 100. the price of A is 10 and the price of B is 5 on day t-1. B then has a 2 for 1 split on day t.

	Price		Number of shares			Market cap	
	t-1	t	t-1	t	PAF	Pt x Qt	Pt-1 x Qt
A	10	11	10	10	1	110	100
B	5	2	5	10	0.5	20	50
					Numerator $\sum$(Pt x Qt)		130
					Denominator $\sum$(PAFi,t x Pt-1 x Qt)		125

$$I_t^{Paas} = I_{t-1}^{Pass}\, \frac{\sum_{i=1}^n P_{i,t}\, Q_{i,t}}{\sum_{i=1}^n P_{i,t-1}\, Q_{i,t}\, PAF_{i,t}} = 100 \times \frac{130}{125} = 104$$

2.3.1   A simple example of the calculation method between two dates when there have been no capital changes is as follows. Please note, these calculations are to be used only as examples and where necessary, numbers have been rounded for simplicity. Actual index calculations are undertaken to sufficient significant figures to eliminate rounding errors. In this example the free float is 100% of shares in issue for each constituent.

Example 1

Step 1	Calculate the capitalisation of constituent companies at starting date.			
Company	Share Price (p)	Shares-in-Issue (m)	Free Float Factor	Market Value (£m)
A	270.0	61,443	1.00	165,896.10
B	605.0	22,579	1.00	136,602.95
C	968.0	9,229	1.00	89,336.72
Total Market Value				391,835.77

Step 2   Set starting value of index (say, 100)

Step 3   Calculate index divisor on the starting date

Index divisor	=	Total Market Value / Index Value
	=	391,835.77 / 100.0
	=	£3918.36

Step 4	Calculate the capitalisation of constituent companies on the end date.			
Company	Share Price (p)	Shares-in-Issue (m)	Free Float Factor	Market Value (£m)
A	283.0	61,443	1.00	173,883.69
B	588.0	22,579	1.00	132,764.52
C	945.0	9,229	1.00	87,214.05
Total Market Value				393,862.26

Step 5   Calculate index value at end date

Index Value	=	Total Market Value / Index Divisor
	=	393,862.26 / 3,918.36
	=	100.5
Index Value		
-Start date	=	100.0
-End date	=	100.5

2.3.2 Example 2: Shares in Issue Increase

When a company increases the number of shares it has in issue, the market capitalisation of that company increases and the total market capitalisation will rise accordingly. The index divisor is adjusted to maintain a constant index value. The change is explained showing the impact of Company A having a 700 million shares in issue increase.

Step 1	Calculate index as at close (immediately before the share increase).			
Company	**Share Price (p)**	**Shares-in-Issue (m)**	**Free Float Factor**	**Market Value (£m)**
A	283.0	61,443	1.00	173,883.69
B	588.0	22,579	1.00	132,764.52
C	945.0	9,229	1.00	87,214.05
Total Market Value				393,862.26

$$\text{Index Value} = \frac{\text{Total Market Value}}{\text{Latest Index Divisor}}$$

$$= \frac{393,862.26}{3,918.36}$$

$$= 100.5$$

Step 2	Adjust company A shares in issue by 700m			
Company	**Share Price (p)**	**Shares-in-Issue (m)**	**Free Float Factor**	**Market Value (£m)**
A	283.0	**62,143**	1.00	**175,864.69**
B	588.0	22,579	1.00	132,764.52
C	945.0	9,229	1.00	87,214.05
				395,843.26

Step 3   Calculate New Divisor

$$\text{New Divisor} = \frac{\text{Total Market Value}}{\text{Constant Index Value}}$$

$$= \frac{395,843.26}{100.5}$$

$$= \mathbf{3,938.74}$$

2.3.3 Example 3: Shares in Issue Decrease (Buy-Back)

When a company decreases the number of shares it has in issue, the market capitalisation of that company decreases and the total market capitalisation will fall accordingly. The index divisor is adjusted to maintain a constant index value. The change is explained showing the impact of Company A having a 700 million shares in issue decrease.

Step 1	Calculate index as at close (immediately before the share decrease).			
Company	**Share Price (p)**	**Shares-in-Issue (m)**	**Free Float Factor**	**Market Value (£m)**
A	283.0	61,443	1.00	173,883.69
B	588.0	22,579	1.00	132,764.52
C	945.0	9,229	1.00	87,214.05
Total Market Value				393,862.26

$$\text{Index Value} = \frac{\text{Total Market Value}}{\text{Latest Index Divisor}}$$

$$= \frac{393,862.26}{3,918.36}$$

$$= 100.5$$

Step 2	Adjust company A shares in issue by 700m			
Company	**Share Price (p)**	**Shares-in-Issue (m)**	**Free Float Factor**	**Market Value (£m)**
A	283.0	**60,743**	1.00	**171,902.69**
B	588.0	22,579	1.00	132,764.52
C	945.0	9,229	1.00	87,214.05
				391,881.26

Step 3   Calculate New Divisor

$$\text{New Divisor} = \frac{\text{Total Market Value}}{\text{Constant Index Value}}$$

$$= \frac{391,881.26}{100.5}$$

$$= \textbf{3,899.32}$$

2.3.4 Example 4: Company Additions and Deletions

When a company is added to or deleted from the index, the market capitalisation of that company is added to or deleted from the index and the total market capitalisation will rise or fall accordingly. The index divisor is adjusted to maintain a constant index value. The change can be explained using the previous example.

Step 1	Calculate index as at close on day before constituent change.			
Company	**Share Price (p)**	**Shares-in-Issue (m)**	**Free Float Factor**	**Market Value (£m)**
A	283.0	61,443	1.00	173,883.69
B	588.0	22,579	1.00	132,764.52
C	945.0	9,229	1.00	87,214.05
Total Market Value				393,862.26

$$\text{Index Value} = \frac{\text{Total Market Value}}{\text{Latest Index Divisor}}$$

$$= \frac{393,862.26}{3,918.36}$$

$$= 100.5$$

Step 2	Remove C and insert D.			
Company	**Share Price (p)**	**Shares-in-Issue (m)**	**Free Float Factor**	**Market Value (£m)**
A	283.0	61,443	1.00	173,883.69
B	588.0	22,579	1.00	132,764.52
C	2,026.0	3,649	1.00	73,928.74
				380,576.95

Step 3 Calculate New Divisor

$$\text{New Divisor} = \frac{\text{Total Market Value}}{\text{Index Value}}$$

$$= \frac{380,576.95}{100.5}$$

$$= \mathbf{3,786.84}$$

Section 3

Index Points

3.0 Index Points

3.1 Index Points. It is useful to define the concept of index points, which puts a value on the index. The index level at any time can be equated to the market capitalisation of the constituents at that time, so that one index point has a value of the market capitalisation divided by the index level (which is equal to the index divisor). The divisor can therefore be used to quickly calculate the impact of an event on an index. The effect of a change in the price of a constituent company expressed in index points is calculated as follows:

The impact of a change in price for a constituent is derived from the following formula:

$$\left\{ \left[\frac{\text{Constituent shares in issue}}{\text{Index Divisor}} \right] * \text{Change in share price} * \text{Free float factor} \right\} / 100$$

Note: change in share price expressed in the same units as the divisor

Using the previous example:

Company	Shares-in-Issue (m)	Price Change (p)	Free Float Factor	Effect in Index Points
A	61,443	13.0	1.00	2.04
B	22,579	-17.0	1.00	-0.98
C	9,229	-23.0	1.00	-0.54
Total Change in Index Points				0.52

3.2 Similarly, the market value of a rise or fall in an index can be calculated using the index divisor as follows:

Change in Index Points x Index Divisor

Using the same example again, the market value of the gain in the index is:

= 0.52 x 391,836p

= 203,755p

Section 4

Dividends and Earnings Statistics

4.0 Dividends and Earnings Statistics

4.1 Dividend yield

4.1.1 Dividend yield is a widely used measure of the income return on a stock or index. In calculating index dividend yields, FTSE Russell applies a free float adjustment to the number of shares in issue for each constituent. The dividend used to calculate the yield is the dividend declared by the companies.

4.1.2 Dividends for the previous 12 months are included in the dividend yield calculation from the XD date. If the dividend is declared in a currency other than sterling, the 4pm WM/Reuters Closing Spot Rate on the day before the dividend is XD is used to convert the dividend into sterling unless the company announces a sterling equivalent which is used instead.

4.1.3 The formula for the dividend yield in percent is:

$$\sum_{i=1}^{n} \frac{g_i \times s_i \times f_i}{c} \times 100$$

Where:

g_i = dividends declared in the previous 12 months of the ith component security

s_i = the weighting of the ith component security (equal to the number of ordinary shares issued by the company)

c = total market capitalisation of the index constituents, adjusted for free float

f_i = free float factor for the ith component security

Dividends declared that are denominated in a currency other than sterling will be converted using WM/Reuters Closing Spot Rates, one day prior to the ex-dividend date.

4.2 Earnings calculations

4.2.1 Earnings are an important element in valuing a company. The treatment of earnings in the calculation of statistics on the FTSE UK Index Series is based on the companies' own published data. The Headline Earnings formula issued by the CFA Society of the UK (previously named the Institute of Investment Management & Research (IIMR)) in response to FRS3 is used in the calculation of the earnings statistics in order to reflect the trading performance of companies on a standardised basis.

4.2.2 A tax adjusted earnings number is derived from a company's most recent audited report and accounts by taking tax liabilities expected to be paid and tax credits expected to be received for the current year fully into account for the purpose of calculating corporate earnings for that year.

Definition of Headline Earnings from CFA

https://secure.cfauk.org/assets/2074/Headline_earnings_Combined.pdf

4.2.3 The earnings statistics for the FTSE UK Index Series are calculated on an 'as reported' basis (i.e. they reflect the last reported year's earnings and interims when published) and represent the sum of the latest two half years' earnings (or the sum of quarterly earnings for those companies which report quarterly). It should also be noted that losses are included in the earnings calculations on the FTSE UK Index Series.

4.2.4 Where a company discloses the tax consequences of individual items in the report and accounts, these will form the basis of any tax adjustments made. Where a company makes no specific disclosure, but where an adjustment is required, the guiding principle will be to apply the average rate of tax on the FRS3 profits to any adjustment made.

4.3 Dividend Cover

4.3.1 The dividend cover shows the ability of the company to meet dividend payments from its current earnings. The conventional method for calculating dividend cover is:

$$\frac{\text{Earnings adjusted for free float}}{\text{Dividends adjusted for free float}}$$

Dividends declared that are denominated in a currency other than sterling will be converted using WM/Reuters Closing Spot Rates, one day prior to the ex-dividend date.

4.4 P/E Ratio

4.4.1 The price-earnings (P/E) ratio is a measure of value for a stock or an index. The ratio is calculated using net earnings, as defined under the CFA Society of the UK (previously the UK Society of Investment Professionals) Headline Earnings formula, and is the total market value adjusted by free float factors of all index constituents divided by the sum of the net earnings, calculated similarly, as shown below for an index.

$$\frac{\sum_{i=1}^{N} p_i \times s_i \times f_i}{\sum_{i=1}^{N} e_i \times f_i}$$

Where:

N = The number of securities in the Index

s_i = the number of shares in issue used by FTSE for the security, as defined in the Ground Rules.

p_i = price of the ith component security

e_i = aggregate earnings of the ith component security

f_i = free float factor for the ith component security

Section 5

Total Returns

5.0 Total Returns

Using both the price and total return indices, investors have a reliable guide to both the capital performance and reinvested income returns.

5.1 Ex-Dividend Adjustment

5.1.1 The ex-dividend (xd) adjustment represents the value of dividends declared by constituent companies on the xd date expressed in index points (see formula below). Xd adjustments are based on declared dividends.

The algorithm used by FTSE Russell for this adjustment assumes that on the Ex-Dividend date, the index is adjusted at the start of the day to allow for the amount of dividends due on that date and that the full amount of the dividend is reinvested at the adjusted price level. Consequently, when the total return index is calculated at the end of that day's trading, it assumes that both the price index and the dividend are adjusted by the change in the price level from the previous day's close to the current day's close.

The value of one index point can be expressed as market value of constituents/Index. Also, since Index = market value of constituents/divisor, one index point is equal to the divisor. The value of dividends can therefore be converted to index points by the formula:

$$\sum_{i=1}^{N} \frac{g_i \times s_i \times f_i \times wme_{i-1}}{d}/100$$

Where:

N   =   number of securities in the Index

g_i =   dividend per share of the ith component security

si =   the weighting of ith the component security

        (equal to the number of ordinary shares issued by the company)

d =   divisor

f_i =   free float factor for the ith component security

wme_{i-1} =   WM exchange rate as of 4pm London time of the index at i-1

        (applies only to dividends paid in a different currency to the index).

5.1.2   If a company declares a dividend in a currency other than Sterling, the published Sterling equivalent will be used, if available. If there is no Sterling equivalent, the dividend will be converted to Sterling using the 4pm WM/Reuters Closing Spot Rate the day before the stock goes xd.

5.1.3   For example, the following table shows the calculation that would be performed if A and B each declared a dividend payment with an xd date of today in order to determine the xd-adjustment for the index.

Company	Dividend	Shares	Value of Dividends	Free Float Factor	xd adjustment (Index points)
	(p)	(m)	(£m)		
A	12.56	61,443	7,717.2	1.00	1.97
B	14.00	22,579	3,161.0	1.00	0.81
Total xd adjustment for Index					2.78
Index divisor			=	3,918.36 (£m)	

5.1.4   The method for calculating the xd adjustment uses the divisor as at the close of business on the preceding day after implementing any capitalisation changes. Where a company has more than one line of shares included in the indices, the xd adjustment is calculated separately for each line.

5.2   Calculation of the Total Returns Indices (TRIs)

5.2.1   The Total Returns Indices (TRIs) measure the total return on the underlying indices, combining both capital performance and reinvested income. The TRIs are calculated using declared dividends. Although in reality there is a timing delay between the xd date and the receipt of dividends (payment date), it is considered preferable to assume all income is reinvested on the xd date rather than incur the complications of allowing a time lag before reinvestment of the declared dividends. The formula for calculation of the current day's TRI based on the previous day's TRI and the xd adjustment is shown below:

$$R_t = \left\{ R_y \times I_y / \left(I_y - XD \right) \right\} \times I_t / I_y$$

$$= R_y \times I_t / \left(I_y - XD \right)$$

Where:

R_y =   Total Returns Index (TRI) value yesterday

R_t =   TRI value today

I_y =   Underlying capital index yesterday

I_t =   Underlying capital index today

XD =   xd adjustment to underlying capital index

5.2.2   The TRIs are calculated daily and some are also calculated in real time. The calculation method will vary according to whether any dividends are declared xd on a given day. The following table and examples explain how the calculation is performed.

	Capital Index (CI)	**xd Adjust (XD)**	**TRI**
Day 1	3190	-	1000.00 *
Day 2	3200	-	1003.13
Day 3	3220	5	1010.98

* starting value

Where no xd adjustment occurs:

$$TRI = \text{Previous TRI} \times \frac{\text{Today's CI}}{\text{Previous CI}}$$

$$\text{Day 2} \quad TRI = 1000.00 \times \frac{3200}{3190}$$

$$= 1003.13$$

Where an xd adjustment occurs:

$$TRI = \text{Previous TRI} \times \frac{\text{Today's CI}}{(\text{Previous CI - XD})}$$

$$\text{Day 3} \quad TRI = 1003.13 \times \frac{3220}{(3200 - 5)}$$

$$= 1010.98$$

Section 6

Further Information

6.0 Further Information

A Glossary of Terms used in FTSE Russell's Ground Rule documents can be found using the following link:

Glossary.pdf

Further information on the FTSE UK Index Series is available from FTSE Russell.

For contact details please visit the FTSE Russell website or contact FTSE Russell client services at info@ftserussell.com.

Website: www.ftserussell.com