

**Ground Rules for the  
Management of the  
FTSE Actuaries UK Gilts Index Series**



## TABLE OF CONTENTS

### SECTIONS

- 1 Introduction**
  - 1.0 Introduction
- 2 Management Responsibilities**
  - 2.1 FTSE Policy Group
  - 2.2 FTSE Bond Indices Committee
  - 2.3 Committee membership
  - 2.4 Secretary to the FTSE Policy Group and FTSE Bond Indices Committee
  - 2.5 FTSE
- 3 Amendments and exceptions to the Ground Rules**
  - 3.0 Amendments and exceptions to the Ground Rules
- 4 Conventional Gilts**
  - 4.1 Gilts
  - 4.2 Sectors
  - 4.3 Price Indices
  - 4.4 Yield Indices
- 5 Index-linked Gilts**
  - 5.1 Gilts
  - 5.2 Sectors
  - 5.3 Price Indices
  - 5.4 Yield Indices
- 6 Prices**
  - 6.0 Prices
- 7 Addition, Removal and Alterations to Constituents**
  - 7.1 Addition of constituents
  - 7.2 Removal of constituents
  - 7.3 Alterations to constituents
- 8 Formulae and Calculation Methods applying to both Conventional and Index-linked gilts**
  - 8.1 Notation
  - 8.2 Accrued Interest for each Gilt
  - 8.3 Calculation of Index Value for a Sector
  - 8.4 Days change %
  - 8.5 Accrued Interest for a Sector
  - 8.6 XD adjustment
  - 8.7 Total Return Index for a Sector
  - 8.8 Weight % of a Sector
- 9 Formulae and Calculation Methods: Conventional Gilts only**
  - 9.1 Redemption Yield for a Gilt
  - 9.2 Equilibrium Price
  - 9.3 Redemption Yield for a Sector

## **TABLE OF CONTENTS (continued)**

### **SECTIONS**

- 9.4 Duration for a Gilt
- 9.5 Duration for a Sector
- 9.6 Convexity for a Gilt
- 9.7 Convexity for a Sector
- 9.8 Fitted Yields for Conventional gilts
- 9.9 Technical note on Duration, Modified Duration and Convexity

### **10 Formulae and Calculation Methods: Index-linked Gilts only**

- 10.1 "Real" Redemption Yield for a Gilt
- 10.2 "Real" Redemption Yield for a Sector
- 10.3 Duration for a Gilt
- 10.4 Duration for a Sector
- 10.5 Convexity for a Gilt
- 10.6 Convexity for a Sector

### **11 Formulae and Calculation Methods: Capital Changes**

- 11.1 Changes to constituents
- 11.2 Adjustments to base values
- 11.3 Normal calculations
- 11.4 Capital changes  
Table 11

### **APPENDICES**

- 1 Gilts excluded from the calculation of Fitted Yields**
- 2 Daily layout in the *Financial Times***

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## SECTION 1

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### 1.0 INTRODUCTION

- 1.1 This paper sets out the Ground Rules for the management of the FTSE Actuaries UK Gilts Index Series, as adopted by the FTSE Policy Group. Copies of the Ground Rules are available from FTSE. For further information on the indices, visit the FTSE internet site at <http://www.ftse.com>.
- 1.2 The FTSE Actuaries UK Gilts Index Series include the following:

#### **Conventional Gilts**

##### **Price indices and other information for the following sectors:**

All stocks – Gilts with all outstanding terms  
Gilts with an assumed outstanding term of up to 5 years  
Gilts with an assumed outstanding term of over 5 years  
Gilts with an assumed outstanding term of 5 -10 years  
Gilts with an assumed outstanding term of 10 -15 years  
Gilts with an assumed outstanding term of 5 -15 years  
Gilts with an assumed outstanding term of up to 15 years  
Gilts with an assumed outstanding term of over 15 years  
Gilts with an assumed outstanding term of up to 20 years  
Gilts with an assumed outstanding term of 15 -25 years  
Gilts with an assumed outstanding term of over 25 years  
Irredeemables – undated Gilts

##### **Fitted Yields for the following terms to maturity:**

5, 10, 15, 20, 25, 30, 35, 40, 45, 50 years and irredeemables (undated Gilts)

#### **Index-linked Gilts**

##### **Price indices and yields for the following sectors:**

All stocks – Gilts with all outstanding terms  
Gilts with an outstanding term of up to 5 years  
Gilts with an outstanding term of 5 -15 years  
Gilts with an outstanding term of up to 15 years  
Gilts with an outstanding term of 5 -25 years  
Gilts with an outstanding term of over 5 years

The yields are calculated assuming future inflation rates of 0%, 3%, 5% and 10%

Please see Rules 4.2.2 and 4.2.3 for the detailed treatment of indices incorporating gilts within a fixed range of outstanding terms or with terms greater than a specified minimum period or up to a specified maximum period.

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## SECTION 1

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- 1.3 The indices are currently calculated at the end of each business day, and are published in the *Financial Times* on the following day (see Appendix 2). The day on which they are calculated is referred to as the "calculation date". Some calculations make use of the "settlement date", which is normally the next following working day, e.g. normally Tuesday after a Monday, etc., and Monday after a Friday, but with exceptions at public holidays.

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## **SECTION 2**

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### **2.0 MANAGEMENT RESPONSIBILITIES**

#### **2.1 FTSE Policy Group**

2.1.1 The FTSE Policy Group advises on the creation of new indices and reviews the ongoing management of the FTSE family of indices. The FTSE Policy Group ensures compliance with the high standards which apply to all FTSE's Indices and assists in determining development priorities. It approves major policy matters and monitors the activities of the other Committees. Significant exceptions and/or changes to the Ground Rules may be made only as permitted by Section 3

#### **2.2 FTSE Bond Indices Committee**

2.2.1 The FTSE Bond Indices Committee is established jointly by FTSE and the Faculty and Institute of Actuaries. The Committee may approve changes to the Ground Rules as permitted by Section 3.

#### **2.3 Committee membership**

2.3.1 FTSE appoints the Chairman and Deputy Chairman of the FTSE Policy Group. The Chairman of the FTSE Bond Indices Committee must be selected from the membership of the FTSE Policy Group. The Chairman of the FTSE Bond Indices Committee shall be appointed or removed by FTSE in consultation with the Faculty and Institute of Actuaries. The members of the FTSE Bond Indices Committee are appointed by the Chairman in consultation with FTSE. The Deputy Chairman is selected by the Committee from its members. The Chairman, or in his/her absence the Deputy Chairman, chairs meetings of the Committee and represents that committee outside meetings. Subcommittees are appointed from the Committee when additional viewpoints are required by the Chairman and Deputy Chairman.

2.3.2 The Chairman and Deputy Chairman of the FTSE Bond Indices Committee are collectively responsible for approving any exceptional changes to the FTSE Actuaries Gilts Index Series between meetings of the Committee on advice from the Secretary to the Committee and as permitted and as specified by these Ground Rules. Other Committee members can deputise for the Chairman and Deputy Chairman in their absence.

#### **2.4 Secretary to the FTSE Policy Group and FTSE Bond Indices Committee**

2.4.1 A Secretary to the FTSE Policy Group and FTSE Bond Indices Committee is appointed by FTSE to support the work of the FTSE Policy Group and the FTSE Bond Indices Committee. The Secretary maintains a record of constituent changes to the FTSE Actuaries Gilts Index Series and is responsible for the timely publication of all constituent changes.

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## **SECTION 2**

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### **2.5 FTSE**

- 2.5.1 FTSE is responsible for the operation of the FTSE Actuaries UK Gilts Index Series, including the daily calculation of all the index values in accordance with the Ground Rules. FTSE maintains records of all the constituents and is responsible for the addition and deletion of gilts and changes of nominal amounts, in accordance with the Ground Rules.
- 2.5.2 FTSE informs the Secretary to the FTSE Bond Indices Committee of all changes to constituents as soon as possible after they have occurred.

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## SECTION 3

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### **3.0 AMENDMENTS AND EXCEPTIONS TO THE GROUND RULES**

- 3.1 In the event that the FTSE Bond Indices Committee or any of those responsible for the operation and administration of the FTSE Actuaries UK Gilts Index Series consider that a change of principle or exception should be made to any of the Ground Rules, the issue must be brought to the attention of the Chairman or Deputy Chairman (or their deputies) of the FTSE Bond Indices Committee, who will normally put the matter to the full FTSE Bond Indices Committee for a decision.
- 3.2 If, however, the matter is urgent, the Chairman and Deputy Chairman (or their deputies) are collectively empowered to authorise an exception on behalf of the FTSE Bond Indices Committee but must immediately notify, and subsequently refer the matter to a meeting of the FTSE Bond Indices Committee. Where an exception is granted to the Ground Rules under Rule 3.1, it shall not be deemed to create a precedent for future decisions of the FTSE Bond Indices Committee. Significant changes or exceptions to these Ground Rules can be authorised only by the FTSE Policy Group.

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## SECTION 4

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### 4.0 CONVENTIONAL GILTS

#### 4.1 Gilts

- 4.1.1 All Conventional Gilts quoted on the Stock Exchange, other than index-linked gilts (see Rule 5), are considered for inclusion in the price indices.
- 4.1.2 Gilts which are regarded by the Debt Management Office as "rump stocks" (i.e. too small an amount is in issue for an effective market) and are listed as such by the Debt Management Office are excluded from the indices.
- 4.1.3
- 4.1.4 Partly-paid gilts are excluded from the indices until they become fully paid.
- 4.1.5 The total market issuance of strippable gilts is included in the indices as if the gilts had not been stripped.
- 4.1.6 Gilts issued by the Debt Management Office under their "special repo" or "standing repo" arrangements are not included in the indices.

#### 4.2 Sectors

- 4.2.1 For the price indices there are 12 sectors: see Rule 1.2 for a full list of sectors. The sector in which each\_gilt is placed depends on the term from the date of calculation to the date of redemption of the gilt.
- 4.2.2 "Shorteners": For an index defined as incorporating gilts within a fixed range of outstanding terms or with terms greater than a specified minimum period or up to a specified maximum period, a gilt is added to an index, at its closing price, after the close of business on the day when its redemption date is exactly equal to the maximum outstanding term and removed from an index, at its closing price, after the close of business on the day when its redemption date is exactly equal to the minimum outstanding term. Thus, stocks will be included in an index defined as incorporating stocks above a minimum outstanding term on the day of the appropriate anniversary and included in an index defined as incorporating stocks below a minimum outstanding term on the day after the anniversary. For more details, please see the Guide to Calculation Methods; Section 3.4.2.
- 4.2.3 If a gilt is due to be included in or excluded from an index defined under Rule 4.2.2 on a day when the market is closed, the stock will be included or excluded after the close on the last trading day before the appropriate anniversary so that it will be included in an index from the beginning of the first trading day for which it becomes eligible and excluded from an index from the beginning of the first trading day for which it becomes ineligible
- 4.2.4 "Sliders": a gilt that has a spread of redemption dates is treated as if it were to be redeemed on the earliest possible or latest possible date, depending on which date gives the lower redemption yield. This is equivalent to using the earliest date if the

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## SECTION 4

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(dirty) price is above the "equilibrium price" (see Rule 9.2), and the latest date if the price is below the equilibrium price. As its price moves above or below the equilibrium price, so that the applicable redemption date changes, a gilt may move from one sector to another (either shorter or longer). "Sliders" are moved from one sector to another after the close of business on the day their sector changes, and are moved at the equilibrium price, but in a calculation that allows for intermediate prices at the same time for other gilts (see Rule 11.4.10).

### 4.3 Price Indices

- 4.3.1 Each of the Price Indices is an arithmetically weighted index based on the gross or dirty price (see Rule 8.2), and weighted by the nominal amount outstanding (see Rule 8.3).
- 4.3.2 In addition to the Price Index for each sector other values are calculated and published in the *Financial Times* (see Appendix 2)
- 4.3.3 The gilts that are used for the calculation of the number of gilts and the weight of the sector on any day include those gilts that have been in the sector during the course of that day, and exclude those gilts that are entering the sector after close of business on that day (see Rule 11.2.3).

The gilts that are used for the calculation of gross redemption yield, duration, convexity and modified duration include those gilts with a maturity over one year that have been in the sector during the course of that day. It excludes those gilts that are entering the sector after the close of business on that day (see Rule 11.2.3) or gilts with a maturity of one year or less

### 4.4 Fitted Conventional Yields

- 4.4.1 All gilts in the Price Indices are considered for inclusion in the yield curve from which the fitted yields for specific terms to maturity are derived.
- 4.4.2 Convertibles with outstanding conversion options, gilts with substantial sinking funds, gilts with special tax status (as defined by the FTSE Bond Indices Committee – see Appendix 1), and gilts with less than one year to redemption (for double dated gilts the assumed redemption date) are excluded from the yield indices.
- 4.4.3 The gilts that are used for the calculation of the yield curve on any day include those gilts that have been in the Indices during the course of that day, and exclude those gilts that are entering the Indices after the close of business on that day (see Rule 11.2.3).
- 4.4.4 Yields are calculated by fitting a curve to the redemption yields for all eligible gilts, including the irredeemable gilts (see Rule 9.8).

- 4.4.5 The redemption yield for each gilt is calculated using the gross price (see Rule 9.1). The redemption yields are gross yields, calculated taking account of the coupon frequency (currently always half-yearly) and then quoted convertible half-yearly.
- 4.4.6 The yield for irredeemables is the average of the yields for the irredeemable gilts in the yield indices, weighted by market capitalisation, and convertible half-yearly.
- 4.4.7 Yields for terms of 5, 10, 15, and 20 years and for irredeemables are published in the *Financial Times* (see Appendix 2). Yields for other terms including 25 years are calculated but not published in the *Financial Times*.

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## SECTION 5

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### 5.0 INDEX-LINKED GILTS

#### 5.1 Gilts

- 5.1.1 All Index-linked Gilts quoted on the Stock Exchange are considered for inclusion in the price indices. This comprises index-linked gilts with either an 8-month or 3-month indexation lag to the Retail Price Index (RPI).
- 5.1.2 Gilts which are regarded by the Debt Management Office as "rump stocks" (i.e. too small an amount is in issue for an effective market) and are listed as such by the Debt Management Office are excluded from the indices.
- 5.1.3 Convertible index-linked gilts with outstanding conversion options are excluded from the indices.
- 5.1.4 If any other index-linked gilts were to be issued with conditions which were significantly different from those of the existing index-linked gilts (e.g. linked to an Earnings Index or to a Limited Price Indexation index), they would be excluded from the indices.
- 5.1.5 Gilts issued by the Debt Management Office under their "special repo" or "standing repo" arrangements are not included in the indices.

#### 5.2 Sectors

- 5.2.1 There are eight sectors: see section 1.2 for a full list of sectors. The sectors in which each gilt is placed depends on the term from the date of calculation to the date of redemption of the gilt.
- 5.2.2 "Shorteners": a gilt is moved, at its closing price, from one sector to a shorter sector after the close of business on the day when its redemption date is exactly 5, 10 or 15 years from the calculation date (when it is described as a "timeous shortener"). If this falls on a bank holiday or a weekend it will be on the first calculation date thereafter (when it is described as a "late shortener").

Please see Rules 4.2.2 and 4.2.3 for the treatment of "Shorteners".

#### 5.3 Price Indices

- 5.3.1 Each of the Price Indices is an arithmetically weighted index based on the gross or dirty price (see Rule 8.2), and weighted by the nominal amount outstanding (see Rule 8.3).
- 5.3.2 In addition to the Price Index for each sector other values are calculated and published in the *Financial Times* (see Appendix 2)

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**SECTION 5**

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5.3.3 The gilts that are used for the calculation of the number of gilts and the weight of the sector on any day include those gilts that have been in the sector during the course of that day, and exclude those gilts that are entering the sector after the close of business on that day (see Rule 11.2.3)

**5.4 Yields**

5.4.1 All gilts in the Price Indices are included in the yield calculations, except gilts with one year or less to redemption.

5.4.2 "Real yields" are calculated for each sector (see Rule 10.2). Since the real yield on index-linked gilts depends on the future rate of inflation assumed, four yields are calculated for each sector, assuming future annual inflation rates of 0%, 3%, 5% and 10% uniformly from the date of the last published value of the Retail Prices Index, but only those for 0% and 5% are published in the *Financial Times* (see Appendix 2).

5.4.3 In addition the duration, and modified duration (see Rule 10.4) and convexity (see Rule 10.6) for each sector on each inflation assumption are calculated but are not published in the *Financial Times*.

5.4.4 The gilts that are used for the calculation of the number of gilts and the weight of the sector on any day include those gilts that have been in the sector during the course of that day, and exclude those gilts that are entering the sector after close of business on that day (see Rule 11.2.3).

The gilts that are used for the calculation of gross redemption yield, duration, convexity and modified duration include those gilts with a maturity over one year that have been in the sector during the course of that day. It excludes those gilts that are entering the sector after the close of business on that day (see Rule 11.2.3) or gilts with a maturity of one year or less.

5.4.5 No yield curve is calculated for the index-linked indices.

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## **SECTION 6**

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### **6.0 PRICES**

- 6.0.1 The prices used for the calculation of the indices are the GEMMA prices compiled and distributed by the Debt Management Office each day on behalf of GEMMA.
- 6.0.2 The indices are calculated using gross or “dirty” prices, i.e. these prices include accrued interest for all gilts (see Rule 8.2).

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**SECTION 7**

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**7.0 ADDITION, REMOVAL AND ALTERATIONS TO CONSTITUENTS**

7.0.1 The following Rules apply to both conventional gilt gilts and index-linked gilts as appropriate except where noted.

**7.1 Addition of constituents**

7.1.1 New issues that are issued fully paid by auction are included in full in the indices at the close of the day when the auction takes place. New issues that are issued partly paid are included at the market price at the close of the day when they become fully paid, at the closing market price.

7.1.2 New issues that are issued by syndicated offering are included in the indices at the close of business on the day of pricing (i.e. with effect from start of trading on the following business day), at the closing market price.

7.1.3 Conversion and switch auction gilts are added at their market price at the close of business on the day on which the operation takes place (see Rules 7.2.3 and 7.3.2).

7.1.4 New issues not issued through an auction process or additional issues of an existing gilt, "taps", are added to the indices at the closing price at the close of business on the day the tap issue takes place.

**7.2 Removal of constituents**

7.2.1 Gilts are removed from the indices on their redemption dates at the closing price on the previous day. If a gilt with a spread of redemption dates is redeemed early it too is removed from the indices on the announced redemption date at the closing price on the previous day; the two redemption dates for such a gilt are both altered to the announced redemption date when such an announcement is made.

7.2.2 Gilts are removed from the indices at the close of business on the day they join the Debt Management Office's list of rump gilts.

7.2.3 Gilts which convert wholly into another gilt are removed from the indices on the conversion date at the closing price on the previous day (see Rules 7.1.2 and 7.3.2).

**7.3 Alterations to constituents**

7.3.1 Alterations to nominal amounts outstanding are adjusted at the close of business on the day the Debt Management Office announces the change in nominal, or the day that FTSE becomes aware of the change.

7.3.2 Changes in the nominal to both gilts (i.e. both positive and negative) following a conversion option are made at the closing prices of the relevant gilts and are not based on the conversion ratio (see Rules 7.1.2 and 7.2.3).

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## SECTION 8

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### 8.0 FORMULAE AND CALCULATION METHODS APPLYING TO BOTH CONVENTIONAL AND INDEX-LINKED GILTS

8.0.1 The Rules in this Section and in Section 9 (Conventional) and 10 (Index-linked) show the normal formulae, when there are no complications. Section 11 gives details of what happens when there are capital changes, "sliders", etc.

#### 8.1 Notation

8.1.1 Data relating to individual Gilts are subscripted by the letter  $i$ ; data relating to Sectors are subscripted by the letter  $s$ ; data relating to a particular Day are subscripted by the letter  $t$ . Thus  $P_{i,t}$  represents the (Dirty) Price of Gilt  $i$  on Day  $t$ . If a formula relates for example only to one Gilt on one Day, or one Sector on one Day relevant subscripts may be omitted.

8.1.2 The previous Calculation Day is denoted by  $y$  ("yesterday"), where  $t$  may be read as "today".  $Y$  is often equal to  $t - 1$  day, but may be as much as five days beforehand, if a holiday and a weekend intervene.

8.1.3  $\Sigma_i$  indicates the summation of the succeeding items for each Gilt  $i$  in the relevant Sector.

8.1.4  $\Sigma_{days}$  indicates the summation of the succeeding items for each *day* in the current calendar year up to day  $t$ .

#### 8.2 Accrued Interest for each Gilt

8.2.1 The "Clean" Price (i.e. excluding Accrued Interest) is collected for each Gilt  $i$  for each Day  $t$  (see Section 6). Accrued Interest per cent nominal for each Gilt  $i$  for each Day  $t$ ,  $AI_{i,t}$ , is calculated in accordance with current market conventions, which are denoted "actual/actual", or more precisely, in the normal case, as:

If the gilt is not 'xd':

$$AI_{i,t} = \text{Coupon} / \text{frequency} \times (S - L) / (N - L)$$

and if the gilt is 'xd':

$$AI_{i,t} = - \text{Coupon} / \text{frequency} \times (N - S) / (N - L)$$

where

$\text{frequency} = 2$  (since interest is payable half-yearly)

$S$  = the settlement date

$L$  = the last coupon date

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**SECTION 8**


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$N$  = the next coupon date

and all differences are measured in days (as applies throughout).

- 8.2.2 Accrued Interest is added to the "Clean" Price to give the "Dirty" Price,  $P_{i,t}$ , which is used hereafter.
- 8.2.3 Special calculations apply during the initial irregular interest period of a Gilt, as follows.

If the gilt has a short first interest period (less than half a year):

If the gilt is not 'xd':

$$AI_{i,t} = \text{Coupon/frequency} \times (S - I) / (N - L)$$

and if the gilt is 'xd':

$$AI_{i,t} = - \text{Coupon/frequency} \times (N - S) / (N - L)$$

where

$S$  = the settlement date

$I$  = the issue date

$N$  = the next (i.e. first) interest date

$L$  = the interest date prior to the issue date (on which no interest was paid)

Note that the actual first interest payable is calculated by the Debt Management Office as:

$$\text{Actual first interest} = \text{Coupon/frequency} \times (N - I) / (N - L)$$

rounded in accordance with current conventions

If the gilt has a long first interest period (more than half a year):

In the period up to the quasi-interest date, i.e. the interest date during the long first period on which interest is not paid, and during which the gilt cannot be xd:

$$AI_{i,t} = \text{Coupon/frequency} \times (S - I) / (Q - L)$$

where

$S$  = the settlement date

$I$  = the issue date

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**SECTION 8**


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$Q$  = the quasi-interest date

$L$  = the interest date prior to the issue date (on which no interest was paid)

In the period after the quasi-interest date:

If the gilt is not 'xd':

$$AI_{i,t} = \text{Coupon/frequency} \times \{(Q - I)/(Q - L) + (S - Q)/(N - Q)\}$$

and if the gilt is 'xd':

$$AI_{i,t} = - \text{Coupon/frequency} \times (N - S)/(N - Q)$$

where

$Q$  = the quasi-interest date

$I$  = the issue date

$L$  = the interest date prior to the issue date (on which no interest was paid)

$S$  = the settlement date

$N$  = the next (first) interest date

Note that the actual first interest payable is calculated as:

$$\text{Actual first interest} = \text{Coupon/frequency} \times \{(Q - I)/(Q - L) + 1\}$$

rounded in accordance with current conventions

### 8.3 Index Value for a Sector

8.3.1 The Index Value for Sector  $s$  for day  $t$ ,  $I_{s,t}$ , is calculated as

$$I_{s,t} = (\sum_i N_{i,t} \times P_{i,t}) / \text{divisor}_{s,t}$$

where

$N_{i,t}$  = the Nominal Amount issued of Gilt  $i$  on day  $t$ , divided by 100 (to give the number of nominal 100s, since prices per cent are used)

$P_{i,t}$  = the "Dirty" Price per cent nominal of Gilt  $i$  at the close of day  $t$ .

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**SECTION 8**


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$divisor_{s,t}$  (also called the "base value") = a figure which was originally set equal to the total market value of Sector  $s$  at the base date divided by the starting Index Value at that date (often 100.00), but which has subsequently been adjusted to allow for changes in the constituents of the Sector and the nominal amounts of the constituent Gilts, so as keep the Index Value "chain-linked" (see Rule 11).

The numerator of the expression for the Index Value is equal to the market value of the Gilts in Sector  $s$  on Day  $t$ .

**8.4 Days change %**

8.4.1 The "Day's change %" is calculated as:

$$100 \times (I_{s,t} / I_{s,y} - 1)$$

**8.5 Accrued Interest for a Sector**

8.5.1 The Accrued Interest for Sector  $s$  for Day  $t$ ,  $AI_{s,t}$ , is calculated as

$$AI_{s,t} = (\sum_i N_i \times AI_i) / divisor_{s,t}$$

where

$AI_i$  = Accrued Interest for Gilt  $i$  calculated as in Rule 8.2.

**8.6 XD Adjustment**

8.6.1 The XD Adjustment for Sector  $s$  for Day  $t$ ,  $XD_{s,t}$ , is calculated as

$$XD_{s,t} = (\sum_i N_i \times XD_i) / divisor_{s,y}$$

where

$XD_i$  = quantum of interest per cent nominal for Gilt  $i$  that has gone "ex div" between the last day on which the indices were calculated,  $y$ , and the opening of the day of calculation,  $t$ , (thus including all "ex div" dates over weekends and holidays).

Note that the divisor for the previous day of calculation,  $divisor_{s,y}$ , is used.

The published figure for Sector  $s$  for Day  $t$  is the XD Adjustment for the year to date,  $XD ytd_{s,t}$ , which is calculated as:

$XD ytd_{s,t} = \sum_{days} XD_{s,day}$ , where the summation is over days of calculation from 1 January of the current year up to Day  $t$ .

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**SECTION 8**


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**8.7 Total Return Index for a Sector**

- 8.7.1 The Total Return Index for Sector  $s$  for Day  $t$ ,  $R_{s,t}$ , is calculated from the Sector Index Value and the XD Adjustment:

$$R_{s,t} = R_{s,y} \times I_{s,t} / (I_{s,y} - XD_{s,t})$$

Note: if a Total Return Index for a Gilt were required, it would be calculated in a similar way, with  $I$  for the Sector replaced by  $P$  for the Gilt.

**8.8 Weight % of a Sector**

- 8.8.1 The Weight % for Sector  $s$  for Day  $t$ ,  $W_{s,t}$ , is calculated from the Total Market Value for the Gilts in the Sector,  $M_{s,t}$ , and the Total Market Value for the Gilts in the All Gilts Sector,  $M_{A,t}$ , where:

$$M_{s,t} = \sum_i N_i \times P_i, \text{ summed over the Gilts in Sector } s$$

$$M_{A,t} = \sum_i N_i \times P_i, \text{ summed over the Gilts in the All Gilts Sector}$$

$$\text{Then } W_{s,t} = 100 \times M_{s,t} / M_{A,t}$$

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**SECTION 9**


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**9.0 FORMULAE AND CALCULATION METHODS: CONVENTIONAL GILT GILTS****9.1 Redemption Yield**

9.1.1 The Redemption Yield for Gilt  $i$  for Day  $t$ ,  $y_{i,t}$ , is calculated by solving an equation of value. The "root",  $v_i$ , of the equation is the value of  $v$  which makes the present value of future payments of interest and capital for the Gilt, denoted  $V_i(v)$ , and calculated using a uniform discount factor,  $v$ , equal to the Price of the Gilt,  $P_i$ , i.e. the value that solves:

$$F_i(v) = V_i(v) - P_i = 0$$

where (except as noted in 9.2.6)::

$$V_i(v) = v^f \times \{C_0 + C \times (v + v^2 + \dots + v^n) + R \times v^n\}$$

time is measured in *periods* between interest dates, so a period is a half year for Gilts with interest payable half-yearly, as all gilts in the Indices currently are

$f$  is the fraction of a period until the next interest date, calculated normally as  $g/h$

$g$  is the number of days from the settlement date ( $S$ ) to the next interest date ( $N$ )

$h$  is the number of days from the last interest date ( $L$ ) to the next interest date ( $N$ ); for half-yearly gilts this is always between 181 and 184 inclusive

$$\text{thus } f = (N - S)/(N - L)$$

$C_0$  is the coupon per cent payable at the next interest date, which is zero if the Gilt is already "ex div"

$C$  is the normal coupon per cent payable at each future due date, which equals the annual coupon rate divided by the *frequency*

*frequency* = 2 for half-yearly

$n$  is the number of complete periods until the redemption date of the Gilt

$R$  is the amount per cent payable on redemption (100 for all British Government Gilts)

$v$  is a discounting factor per period.

9.1.2 Special calculations for the fraction  $f$  apply during the initial irregular interest period of a Gilt, as follows.

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**SECTION 9**


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If the gilt has a short first interest period (less than half a year):

$$f = (N - S) / (N - L)$$

where

$N$  = the next (first) interest date

$S$  = the settlement date

$L$  = the interest date prior to the issue date (on which no interest was paid)

(This the same as the normal calculation, with an appropriate definition of  $L$ .)

If the gilt has a long first interest period (more than half a year):

In the period up to the quasi-interest date, i.e. the interest date during the long first period on which interest is not paid:

$$f = (Q - S) / (Q - L) + 1$$

where

$Q$  = the quasi-interest date

$S$  = the settlement date

$L$  = the interest date prior to the issue date (on which no interest was paid)

In the period after the quasi-interest date:

$$f = (N - S) / (N - Q)$$

where

$N$  = the next (first) interest date

$S$  = the settlement date

$Q$  = the quasi-interest date

(This is the same as the normal calculation, with  $Q$  substituted for  $L$ .)

9.1.3 The expression in parentheses in the middle of the function in 9.1.1 can be simplified:

$$v + v^2 + \dots + v^n = v \times (1 - v^n) / (1 - v)$$

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**SECTION 9**


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- 9.1.4 Then the Redemption Yield per cent convertible half-yearly for Gilt  $i$  for Day  $t$ ,  $y_{i,t}$ , is calculated as:

$$y_{i,t} = 200 \times (1/v_i - 1) \text{ since interest on the Gilt is payable half-yearly.}$$

## 9.2 Equilibrium Price

- 9.2.1 Certain gilts, including the "irredeemables", have a spread of optional redemption dates. They are treated as redeemable either at the earliest possible date or at the latest possible date. For gilts where the earliest possible redemption date has already passed or is approaching but no announcement about the actual redemption date has been made, the presumed earliest redemption date is taken as 95 days after the calculation date. (If the DMO has announced a redemption date for such a gilt, that date is used as the sole redemption date, and the gilt ceases to "double dated", but the calculations described in 9.2.6 may apply.) Whether they are taken at the earliest or the latest date depends on the price. If the price is sufficiently low, the latest date is used, and if the price is sufficiently high the earliest date is used. The redemption date used defines the term to redemption, which determines the sectors into which the gilt falls for the purposes of the price indices, and the term and yield to redemption for the calculation of the yield indices.

- 9.2.2 The critical price is approximately equal to the redemption price, which for conventional gilt gilts is always 100, but it is not exactly so. It is better to call the price the "equilibrium price". The equilibrium price is the price at which the redemption yield to the earliest redemption date (say  $n_1$  integral periods away) is the same as the yield to the latest redemption date (say  $n_2$  integral periods away). Let  $V_1(v)$  be the function denoted  $V_i(v)$  given in Rule 9.1, with  $n = n_1$ , and let  $V_2(v)$  be the same function with  $n = n_2$ . If the redemption yields to both redemption dates are equal, then the discounting factors,  $v$ , are equal, and this gives

$$V_1(v) = V_2(v).$$

- 9.2.3 If both redemption dates are normal coupon dates, it can be shown from these equations that  $v = R / (R + C)$  and the equilibrium price is given by

$$\text{Equilibrium price} = E = \{R / (R + C)\}^f \times (R + C_0)$$

with the same definitions as in Rule 9.1

- 9.2.4 This formula gives the gross equilibrium price. The corresponding net equilibrium price is obtained by deducting the appropriate accrued interest (adding if the gilt is ex-dividend). For the "normal" case, where there are no calls, any irregular first coupon is passed, so that  $C_1 = C$ , and the gilt is not ex-dividend, the net equilibrium price is given by

$$\text{Net equilibrium price} = NE = R\{1 + C/R\}^{1-f} - (1-f)C$$

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**SECTION 9**


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- 9.2.5 The net equilibrium price,  $NE$ , differs from the redemption amount,  $R$ , only because of the difference between compounding at the coupon rate, and the calculation of

accrued interest on a simple interest basis. Where the settlement date is on the interest payment date the gross price and the net price are always equal, and the gross equilibrium price and net equilibrium price both equal the redemption price.

- 9.2.6 If the possible redemption date or the announced actual redemption date is not a normal coupon date, then it is necessary to use a different formula for  $V_i(v)$  from that shown in 9.1.1, viz:

$$V_i(v) = v^f \times \{C_0 + C \times (v + v^2 + \dots + v^n) + (C_L + R) \times v^p\}$$

where:

$C_L$  is the actual or calculated last coupon payment per cent, due on the redemption date, and is calculated taking account of the number of days from the last full interest payment date to the redemption date. It is assumed that the last fractional period is always less than one half year.

$n$  is the number of full interest payments after the next interest payment (which is  $C_0$ ). In practice  $n$  is normally zero.

$p$  is the fraction of a period from the last full interest date until the redemption date, calculated as  $q/r$

$q$  is the number of days from the last full interest date to the redemption date

$r$  is the number of days from the last full interest date to the next pseudo-interest date (which is after the redemption date).

Normally in practice in such a calculation there are only one or two interest payments still due to be paid,  $C_L$ , and perhaps  $C_0$ . When the settlement date is before the last normal coupon date, the formula simplifies to:

$$V_i(v) = v^f \times \{C_0 + (C_L + R) \times v^p\}$$

where  $C_0$  may be zero if the settlement date is after the  $x$ d div date for the last normal coupon.

When the settlement date is on or after the last normal coupon date,  $f$  is zero, and  $p$  is redefined, giving:

$$V_i(v) = v^p \times (C_L + R)$$

where now:

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**SECTION 9**

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$p$  is the fraction of a period from the settlement date until the redemption date, calculated as  $q/r$

$q$  is the number of days from the settlement date to the redemption date

$r$  is the number of days from the last full interest date (which has already passed or is due in the next few days, if the gilt is ex div) to the next pseudo-interest date.

The equilibrium discount factor,  $v_E$ , is then calculated, as in 9.2.2, as that value of  $v$  that makes

$$V_1(v) = V_2(v)$$

The gross equilibrium price can then be calculated as  $V_i(v_E)$  and the calculations proceed as before.

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**SECTION 9**


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**9.3 Redemption Yield for a Sector**

- 9.3.1 The Redemption Yield for Sector  $s$  for Day  $t$ ,  $y_{s,t}$ , is calculated from the root,  $v_s$ , of the corresponding equation:

$$F_s(v) = \sum_i N_i \times F_i(v) = 0$$

where

$F_i(v)$  for Gilt  $i$  is as defined in Rule 9.1, but calculated at the same discount factor for all Gilts in Sector  $s$ .

- 9.3.2 Then the Redemption Yield per cent, convertible half-yearly, for Sector  $s$  for Day  $t$ ,  $y_{s,t}$ , is calculated as:

$$y_{s,t} = 200 \times (1/v_s - 1)$$

**9.4 Duration for a Gilt**

- 9.4.1 The (Macaulay) Duration for Gilt  $i$  for Day  $t$ ,  $D_{i,t}$ , is calculated as:

$$D_{i,t} = A_i(v_i) / V_i(v_i)$$

where:

$$A_i(v) = [v^f \times \{C_0 \times f + C \times \{(f+1) \times v + (f+2) \times v^2 + \dots + (f+n) \times v^n\} + R \times (f+n) \times v^n\}] / \text{frequency}_i$$

$V_i(v)$  is as defined in Rule 9.1.

$v_i$  is the root of the equation  $F_i(v) = 0$  for Gilt  $i$  found previously.

- 9.4.2 The formula for  $A_i(v)$  simplifies to:

$$A_i(v) = [f \times V_i(v) + v^f \times \{C_0 + C \times (v + 2v^2 + \dots + n \times v^n) + R \times n \times v^n\}] / \text{frequency}_i$$

- 9.4.3 The expression in parentheses in the middle of the above formula can be simplified:

$$v + 2v^2 + \dots + n \times v^n = \{v(1 - v^n)/(1 - v) - nv^{n+1}\} / (1 - v)$$

- 9.4.4 The Modified Duration for Gilt  $i$  for Day  $t$ ,  $ModD_{i,t}$ , is calculated as:

$$ModD_{i,t} = D_{i,t} \times v_i$$

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**SECTION 9**


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**9.5 Duration for a Sector**

9.5.1 The Duration for Sector  $s$  for Day  $t$ ,  $D_{s,t}$ , is calculated as:

$$D_{s,t} = A_s(v_s) / V_s(v_s)$$

where

$$A_s(v) = \sum_i N_i \times A_i(v)$$

$$V_s(v) = \sum_i N_i \times V_i(v)$$

$A_i(v)$  and  $V_i(v)$  for Gilt  $i$  are calculated using the discount factor,  $v_s$ , for Sector  $s$ .

$v_s$  for Sector  $s$  is the root of the equation  $F_s(v) = 0$  found previously in the calculation of the Redemption Yield for Sector  $s$ .

9.5.2 The Modified Duration for Sector  $s$  for Day  $t$ ,  $ModD_{s,t}$ , is calculated as:

$$ModD_{s,t} = D_{s,t} \times v_s$$

**9.6 Convexity for a Gilt**

9.6.1 The Convexity for Gilt  $i$  for Day  $t$ ,  $C_{i,t}$ , is calculated as:

$$C_{i,t} = B_i(v_i) / V_i(v_i)$$

where

$$B_i(v) = [v^f \times \{C_0 \times f^2 + C \times \{(f+1)^2 \times v + (f+2)^2 \times v^2 + \dots + (f+n)^2 \times v^n\} + R \times (f+n)^2 \times v^n\}] / frequency_i^2$$

$V_i(v)$  is as defined in Rule 9.1

$v_i$  is the root of the equation  $F_i(v) = 0$  for Gilt  $i$  found previously.

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**SECTION 9**


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**9.7 Convexity for a Sector**

9.7.1 The Convexity for Sector  $s$  for Day  $t$ ,  $C_{s,t}$ , is calculated as:

$$C_{s,t} = B_s(v_s) / V_s(v_s)$$

where

$$B_s(v) = \sum_i N_i \times B_i(v)$$

$V_s(v)$  is as defined in Rule 9.2

$B_i(v)$  and  $V_i(v)$  for Gilt  $i$  are calculated using the discount factor,  $v_s$ , for Sector  $s$

$v_s$  for Sector  $s$  is the root of the equation  $F_s(v) = 0$  found previously in the calculation of the Redemption Yield for Sector  $s$ .

**9.8 Fitted Yields for Conventional gilt Gilts**

9.8.1 Fitted yields for conventional gilt gilts with specific terms to maturity are calculated as follows:

First, the redemption yield for each eligible Gilt  $i$  for Day  $t$ ,  $y_{i,t}$ , is calculated as described in Rule 9.1.

Then a "yield curve" for gilts of term  $m$  to maturity is defined:

$$y(m) = A + B \times \exp(-Cm) + D \times \exp(-Em)$$

Then the parameters of this yield curve,  $A$ ,  $B$ ,  $C$ ,  $D$ ,  $E$ , are found by minimising the sum of squares function:

$$S(A, B, C, D, E) = \sum_i N_i \times P_i \times (y(m_i) - y_i)^2$$

that is, the sum of the squares of the differences between the actual redemption yield for each gilt minus the yield according to the formula, weighted by the market value of the gilt.

Then Fitted Yields, using the formula for  $y(m)$ , for terms  $m = 5, 10, 15, 20$  are published.

For Irredeemables the Fitted Yield,  $y(\infty)$ , is also published and calculated as:

$$y(\infty) = (\sum_i N_i \times P_i \times y_i) / (\sum_i N_i \times P_i)$$

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**SECTION 9**


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where only the irredeemable Gilts are included in the summation. This gives the average Yield for the irredeemable Gilts, weighted by market value.

**9.9 Technical note on Duration, Modified Duration and Convexity**

9.9.1 Duration and modified duration can be defined in terms of differential calculus. Consider a zero-coupon gilt of unit face value of term  $n$  years. Its present value, discounted at the continuously compounded rate (or "force") of interest  $r$  is:

$$V(r) = \exp(-nr).$$

The derivative of  $V$  with respect to  $r$  is:

$$dV/dr = -n(\exp(-nr)).$$

The proportionate sensitivity, or "volatility", of  $V$  to changes in  $r$  is:

$$-1/V \times dV/dr = -(-n(\exp(-nr)))/\exp(-nr) = n.$$

This is also the Macaulay Duration (or just Duration) of the gilt, first defined by F. R. Macaulay in *Some theoretical problems suggested by the movements of interest rates, bond yields and gilt prices in the United States since 1856*, published by the New York National Bureau of Economic Research, 1938 and reprinted by UMI Books on Demand, Ann Arbor, Michigan, 2000. The sensitivity with respect to the continuously compounded rate  $r$  is seen to equal the term of the zero-coupon gilt.

9.9.2 If the gilt is discounted at a rate of interest convertible half-yearly,  $i$ , then its present value is

$$V(i) = (1 + i/2)^{-2n}.$$

The derivative of  $V$  with respect to  $i$  is:

$$dV/di = -2n(1 + i/2)^{-2n-1}/2 = -n(1 + i/2)^{-2n-1}$$

The proportionate sensitivity of  $V$  to changes in  $i$  is:

$$-1/V \times dV/di = -(-n(1 + i/2)^{-2n-1})/(1 + i/2)^{-2n} = n(1 + i/2)^{-1} = n/(1 + i/2)$$

This is the Modified Duration of the zero-coupon gilt, which is the sensitivity with respect to changes in the rate compounded half-yearly,  $i$ .

Putting  $\nu$ , the half-yearly discount factor,  $= 1/(1 + i/2)$ , we see that

$$\text{Modified Duration} = n/(1 + i/2) = n\nu = \text{Duration} \times \nu.$$

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**SECTION 9**


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- 9.9.3 For a coupon gilt, all the calculations are similar, with the numerators and denominators containing sums of the zero-coupon gilts that are the equivalent of the coupon gilts. Suppose that the coupon gilt is equivalent to a series of  $N$  zero-coupon gilts, with amounts  $A_j$  due at terms  $n_j$ , for  $j=1$  to  $N$ . Then the present value of the gilt is, discounted at the continuously compounded rate of interest  $r$  is:

$$V(r) = \sum_j A_j \exp(-n_j r).$$

The derivative of  $V$  with respect to  $r$  is:

$$dV/dr = -\sum_j A_j n_j \exp(-n_j r).$$

The proportionate sensitivity, or "volatility", of  $V$  to changes in  $r$  is:

$$-1/V \times dV/dr = (\sum_j A_j n_j \exp(-n_j r)) / \sum_j A_j \exp(-n_j r).$$

This is the (Macaulay) Duration of the coupon gilt. The sensitivity of the coupon gilt is seen to be the average value of the terms of the constituent zero-coupon gilts, weighted by the discounted present values of the constituent parts. It is therefore also known as the "discounted mean term" (see Redington, F. M. "Review of the principles of life office valuations", *Journal of the Institute of Actuaries*, **78**, 286, 1952). The duration of a coupon gilt varies with the discount rate  $r$ , whereas the duration of a zero-coupon gilt of term  $n$  is always equal to  $n$ . However, the Modified Duration of a zero-coupon gilt varies with  $r$ .

- 9.9.4 As for the zero-coupon gilt, for the coupon gilt we have:

$$\text{Modified Duration} = \text{Duration} \times \nu.$$

- 9.9.6 Convexity is equal to the first term in the last expression in 9.9.4, viz:

$$\text{Convexity} = (\sum_j A_j n_j^2 \exp(-n_j r)) / V = 1/V \times d^2V/dr^2$$

Convexity is therefore equivalent to the second moment of the terms about zero.

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**SECTION 10**


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**10.0 FORMULAE AND CALCULATION METHODS: INDEX-LINKED GILTS**
**10.1 "Real" Redemption Yield for an Index-linked Gilt**

10.1.1 The Real Redemption Yield for Index-linked Gilt  $i$  for Day  $t$ ,  $ry_{i,t}$ , is found as follows:

First, the rate of inflation assumed is denoted  $i$ , e.g.  $i = 0.05$  for 5% inflation.

Then we put  $r = (1 + i)^{1/12}$ , the monthly ratio for inflation.

Then values of the Retail Prices Index for each past month  $m$  are denoted  $Q(m)$ , and the most recent month for which the value of the Retail Prices Index is available is denoted  $M$ .

Then projected values of the Retail Prices Index, using the rate of inflation assumed, for month  $m$  from month  $M + 1$  onwards, are calculated as  $Q^I(m) = Q(M) \times r^{(m-M)}$ .

Then the projected nominal amount of each future payment of interest and redemption amount, indexed according to the rules for the Gilt, is calculated, using the past values of the RPI,  $Q(m)$ , up to month  $M$  and the future projected values,  $Q^I(m)$ , from month  $M+1$  onwards. The indexed interest payments are denoted  $C_0^I$ ,  $C_1^I$ ,  $C_2^I$ , ... and the indexed redemption amount is denoted  $R^I$ . In each case the projected amount, say  $I^I$ , payable in month  $m$  is calculated by multiplying the corresponding nominal amount  $X$  by  $Q(m-8)$  or  $Q^I(m-8)$ , as appropriate, and dividing by  $Q(B-8)$  (assuming an 8-month lag, and a base month  $B$ ).

Then the root  $v_i$  is found of the equation

$$F_i(v) = V_i(v) - P_i = 0$$

where

$$V_i(v) = v^f \times \{C_0^I + C_1^I \times v + C_2^I \times v^2 + \dots + C_n^I \times v^n + R^I \times v^m\}$$

and other terms are as defined in Rule 9.1 for UK gilts.

Then the Real Redemption Yield  $ry_{i,t}$  is calculated as:

$ry_{i,t} = 200 \{1 / (v_i \times r^6) - 1\}$  (for half-yearly Gilts as all Index-linked Gilts are).

**10.2 "Real" Redemption Yield for an Index-linked Sector**

10.2.1 The Real Redemption Yield for Index-linked Sector  $s$  for Day  $t$ ,  $ry_{s,t}$ , is calculated using the methodology for Gilts described in Rule 10.1 and the methodology for Sectors described in Rule 9.3.

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**SECTION 10**


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Thus for Sector  $s$  the Real Redemption Yield is calculated from the root,  $v_s$ , of the equation:

$$F_s(v) = \sum_i N_i \times F_i(v) = 0$$

where

$F_i(v)$  for Gilt  $i$  is as defined in Rule 10.1, but calculated at the same discount factor for all Gilts in Sector  $s$ .

and the Real Redemption Yield is calculated as:

$$ry_{s,t} = 200 \{1 / (v_s \times r^6) - 1\} \text{ (all Index-linked Gilts being payable half-yearly).}$$

**10.3 Duration for an Index-linked Gilt**

10.3.1 The Duration for Index-linked Gilt  $i$  for Day  $t$ ,  $D_{i,t}$ , is calculated as:

$$D_{i,t} = A_i(v_i) / V_i(v_i)$$

where

$$A_i(v) = [v^f \times \{C_0^1 \times f + C_1^1 \times (f+1) \times v + C_2^1 \times (f+2) \times v^2 + \dots + C_n^1 \times (f+n) \times v^n + R^1 \times (f+n) \times v^n\}] / \text{frequency}_i$$

$V_i(v)$  is as defined in Rule 10.1.

$v_i$  is the root of the equation  $F_i(v) = 0$  for Gilt  $i$  found previously.

10.3.2 The Modified Duration for Gilt  $i$  for Day  $t$ ,  $ModD_{i,t}$ , is calculated as:

$$ModD_{i,t} = D_{i,t} \times v_i$$

**10.4 Duration for an Index-linked Sector**

10.4.1 The Duration for Index-linked Sector  $s$  for Day  $t$ ,  $D_{s,t}$ , is calculated as:

$$D_{s,t} = A_s(v_s) / V_s(v_s)$$

where

$$A_s(v) = \sum_i N_i \times A_i(v)$$

$$V_s(v) = \sum_i N_i \times V_i(v)$$

$A_i(v)$  and  $V_i(v)$  for Gilt  $i$  are calculated using the discount factor  $v_s$  for Sector  $s$

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**SECTION 10**


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$v_s$  for Sector  $s$  is the root of the equation  $F_s(v) = 0$  found previously in the calculation of the Real Redemption Yield for Index-linked Sector  $s$ .

10.4.2 The Modified Duration for Sector  $s$  for Day  $t$ ,  $ModD_{s,t}$ , is calculated as:

$$ModD_{s,t} = D_{s,t} \times v_s$$

**10.5 Convexity for an Index-linked Gilt**

10.5.1 The Convexity for Index-linked Gilt  $i$  for Day  $t$ ,  $C_{i,t}$ , is calculated as:

$$C_{i,t} = B_i(v_i) / V_i(v_i)$$

where

$$B_i(v) = [v^f \times \{C_0^1 \times f^2 + C_1^1 \times (f+1)^2 \times v + C_2^1 \times (f+2)^2 \times v^2 + \dots + C_n^1 \times (f+n)^2 \times v^n + R^1 \times (f+n)^2 \times v^n\} / frequency_i^2]$$

$V_i(v)$  is as defined in Rule 10.1

$v_i$  is the root of the equation  $F_i(v) = 0$  for Gilt  $i$  found previously.

**10.6 Convexity for an Index-linked Sector**

10.6.1 The Convexity for Index-linked Sector  $s$  for Day  $t$ ,  $C_{s,t}$ , is calculated as:

$$C_{s,t} = B_s(v_s) / V_s(v_s) \times frequency^2$$

where

$$B_s(v) = \sum_i N_i \times B_i(v)$$

$V_s(v)$  is as defined in Rule 10.4

$B_i(v)$  and  $V_i(v)$  for Gilt  $i$  are calculated using the discount factor  $v_s$  for Sector  $s$

$v_s$  for Sector  $s$  is the root of the equation  $F_s(v) = 0$  found previously in the calculation of the Real Redemption Yield for Index-linked Sector  $s$ .

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**SECTION 11**

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**11.0 FORMULAE AND CALCULATION METHODS: CAPITAL CHANGES****11.1 Changes to constituents**

11.1.1 There are changes in the constituents of the indices from time to time and for each Sector the *divisor* in the expression in Rule 8.3 (the "base value") must be adjusted so as to "chain-link" the indices appropriately. The possible types of change that are considered for the price indices are:

- (a) New issues, brought in on the day of issue at the closing price on the day of issue.
- (b) Late entrants, such as partly-paid new issues, which are brought in at the closing price when fully paid, and conversion gilts, brought in at or near an appropriate conversion date at the closing price.
- (c) Amalgamations of further tranches of an existing gilt (A or B gilts), which take place normally on the first ex-dividend date of the A or B gilt, after which the gilts are identical.
- (d) Alterations of nominal amount outstanding, such as: for gilts with a sinking fund, brought in from time to time as the information is available; for taps (small additional issues of an existing gilt, brought in at the close of business on the day the tap issue takes place at the closing price); for reductions of the amount outstanding for convertible gilts and increases of the amount outstanding for conversion gilts, where the nominal amounts are altered in accordance with the conversion terms, but the prices are the closing prices on the day the alteration is made (and not based on the conversion ratio).
- (e) Redemptions, taken out on the redemption date at the closing price on the previous day, which always in practice equals the redemption amount.
- (f) Early leavers, such as various gilts which have been almost wholly repurchased by the Government in exchange for a different gilt from time to time, and were deleted from the indices; and convertible gilts, once it is estimated that almost all the outstanding issue has been converted; also any gilts whose outstanding amount becomes so small that it gets onto the Debt Management Office's list of rump gilts.

11.1.2 The above changes can apply to any gilts in any of the price indices. In addition a gilt may be transferred from one of the sectors to another depending on the time from the date of calculation to the date of redemption of this gilt. The possible further changes are:

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**SECTION 11**


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- (g) "Shorteners": For an index defined as incorporating gilts within a fixed range of outstanding terms or with terms greater than a specified minimum period or up to a specified maximum period, a gilt is added to an index, at its closing price, after the close of business on the day when its redemption date is exactly equal to the maximum outstanding term and removed from an index, at its closing price, after the close of business on the day when its redemption date is exactly equal to the minimum outstanding term. Thus, stocks will be included in an index defined as incorporating stocks above a minimum outstanding term on the day of the appropriate anniversary and included in an index defined as incorporating stocks below a minimum outstanding term on the day after the anniversary. For more details, please see the Guide to Calculation Methods; Section 3.4.2.
- (h) If a gilt is due to be included in or excluded from an index defined under Rule 4.2.2 on a day when the market is closed, the stock will be included or excluded after the close on the last trading day before the appropriate anniversary so that it will be included in an index from the beginning of the first trading day for which it becomes eligible and excluded from an index from the beginning of the first trading day for which it becomes ineligible
- (i) "Sliders", whereby a gilt that has a spread of redemption dates moves from one sector to another (either shorter or longer) as its price moves above or below the equilibrium price, thus implying that the earlier or later redemption date is appropriate. How the equilibrium price is determined is discussed in Rule 9.2. Sliders are moved from one sector to another on the day the price moves above or below the equilibrium price, and are moved at the equilibrium price; thus, when the closing price goes up, part of the gain is attributed to the old sector and part to the new, and vice versa when the closing price falls; neither sector gains at the expense of the other.

**11.2 Adjustments to base values**

11.2.1 On any one day there may be up to three adjustments to the "base value", i.e. the denominator of the expression in Rule 8.3:

- (1) Redemptions are taken out at "yesterday's" prices. Thus the base value is multiplied by (total market value yesterday of all gilts except redemptions) and divided by (total market value yesterday of all gilts).
- (2) "Sliders" are transferred at equilibrium prices. The adjusted base value is multiplied by (total market value at mean prices (see below) of yesterday's continuing gilts plus sliders-in at equilibrium price, and excluding sliders-out) and divided by (total market value at mean prices of yesterday's continuing gilts, plus sliders-out at equilibrium price, and excluding sliders-in).

- (3) All remaining changes are allowed for at today's closing prices. Thus the third adjustment factor is (total market value at today's prices of gilts after changes, i.e. including new issues etc) divided by (total market value at today's prices of gilts before changes).
- 11.2.2 In calculation (2) above for sliders, reference is made to "mean prices" for continuing gilts. The mean price is intermediate between yesterday's price and today's price, in the same proportion as the equilibrium price of all sliders in the sector lies between yesterday's price and today's price for those sliders, in both cases adjusted suitably for ex-dividend interest today (see Rule 11.4.10).
- 11.2.3 In all calculations that relate to those gilts in a sector or in the indices as at the close of business on any day, such as calculations of yields, durations, etc, the gilts that are used include those gilts that have been in the sector during the course of that day, including those gilts that are leaving the sector after the close and excluding those gilts that are entering the sector after the close of business on that day. Thus redemptions and "sliders", which have been allowed for in adjustments (1) and (2) above, are assumed to have happened before the relevant calculations, whereas all other changes, those which are allowed for in adjustment (3) above, are assumed to take place after the closing calculations have been done (see Rules 4.3.3, 4.4.3, 5.3.3 and 5.4.4).

### 11.3 Normal calculations

- 11.3.1 The above description in words will now be repeated in a precise mathematical formulation. The same notation as defined in Rule 8.1 is used. The nominal amounts (in suitable units) for Gilt  $i$  in issue on the previous calculation date, denoted "yesterday",  $y$ , and the current calculation date, "today",  $t$ , are denoted by  $N_{i,y}$  and  $N_{i,t}$  respectively. Usually these are the same. "Capital changes" occur when these are different for any gilt.
- 11.3.2 On a day when there are no capital changes,  $N_{i,t} = N_{i,y}$  for all gilts. The market value of all gilts in the sector index yesterday was calculated as  $M_y = \sum_i N_{i,y} \times P_{i,y}$ . The market value of these same gilts today is calculated as  $M_t = \sum_i N_{i,t} \times P_{i,t}$ . The "base value" for the index yesterday is denoted by  $B_y$  and the index yesterday was calculated as  $I_y = M_y / B_y$ .
- 11.3.3 Since it is being assumed that there are no capital changes today, the base value for the index today is unchanged from yesterday, so  $B_t = B_y$ , and the index value today is calculated as  $I_t = M_t / B_t = M_t / B_y$ .
- 11.3.4 But  $B_y = M_y / I_y$ , so  $I_t = I_y M_t / M_y$ , showing that the change in the index from yesterday to today is proportional to the change in the market value of the gilts that are constituents of the index.

### 11.4 Capital changes

- 11.4.1 On a day when there are capital changes the calculations are more complicated. The base value needs to be adjusted, and this is done in three stages. Three ratios are

calculated. These are denoted  $r_1$ ,  $r_2$  and  $r_3$ , and the new base value is calculated from the old as  $B_t = B_y \times r_1 \times r_2 \times r_3$ .

- 11.4.2 Each ratio is the quotient of a numerator and a denominator. Thus  $r_1 = N_1 / D_1$ ,  $r_2 = N_2 / D_2$  and  $r_3 = N_3 / D_3$ .
- 11.4.3 The denominator,  $D_1$ , of the first ratio is the same as  $M_y$ , the market value of all gilts in the index yesterday.

## SECTION 11

- 11.4.4 The numerator,  $N_1$ , of the first ratio is the same as  $D_1$ , but with the exclusion of gilts that have just gone out of the index entirely (redemptions and "early leavers").
- 11.4.5 Thus the ratio  $r_1 = N_1 / D_1$  reflects the first adjustment described in Rule 11.2.1 above, under (1). Adjustments (2) and (3) are dealt with similarly.
- 11.4.6 The contributions made to the numerators and denominators for different types of change are shown in Table 11. The numerators and denominators used in the calculation of the ratios are the totals for all relevant gilts of the appropriate contributions. The subscript  $i$  denoting the Gilt is omitted.
- 11.4.7 In Table 11 "Replacements" refer to cases where the recorded gilt details are to be changed, perhaps to correct an error; where the nominal amount is unchanged the effect of lines (c) and (d) combined is the same as line (a), no change.
- 11.4.8 For the amalgamation of an A gilt with the main gilt, where the nominal for the combined gilt is the sum of the previous nominals, the effect of lines (d) and (e) combined is also the same as line (a), no change.
- 11.4.9 It is possible, at least theoretically, though very seldom in practice, for multiple changes to apply to one gilt on one day. A gilt might "slide" between sectors on the same day as the nominal amount is changed or an amalgamation occurs.
- 11.4.10 The mean prices,  $P_{i,m}$ , used for the calculations for "sliders", are calculated as

$$P_{i,m} = (1 - k)(P_{y,i} - XD_{t,i}) + kP_{i,t}$$

where the interpolation factor,  $k$ , is calculated as

$$k = \{\sum(N_{i,y} \times E_{i,t}) - \sum N_{i,y} \times (P_{i,y} - XD_{i,t})\} / \{\sum(N_{i,y} \times P_{i,t}) - \sum(N_{i,y} \times (P_{i,y} - XD_{i,t}))\}$$

where the summations are for all sliders in the sector today, and  $XD_{i,t}$  is the ex-dividend interest amount (if any), defined Rule 8.6.

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**SECTION 11**


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Table 11

Contributions to the numerators and denominators of the adjustment factors made by gilts subject to different types of change.

	$D_1$	$N_1$	$D_2$	$N_2$	$D_3$	$N_3$
(a) Gilts not changing today ( $N_t = N_y$ so numerators equal corresponding denominators)	$N_y \times P_y$	$N_y \times P_y$	$N_y \times P_m$	$N_y \times P_m$	$N_y \times P_t$	$N_t \times P_t$
(b) Redemptions and early leavers and shorteners out	$N_y \times P_y$	0	0	0	0	0
(c) Late shorteners in	0	$N_y \times P_y$	$N_y \times P_m$	$N_y \times P_m$	$N_y \times P_t$	$N_t \times P_t$
(d) New issues, entrants, replacements in and shorteners in	0	0	0	0	0	$N_t \times P_t$
(e) Amalgamations (A gilt), replacements out and shorteners out	$N_y \times P_y$	$N_y \times P_y$	$N_y \times P_m$	$N_y \times P_m$	$N_y \times P_t$	0
(f) Changes of nominal amount, amalgamations (combined gilt) ( $N_t \neq N_y$ )	$N_y \times P_y$	$N_y \times P_y$	$N_y \times P_m$	$N_y \times P_m$	$N_y \times P_t$	$N_t \times N_t$
(g) Sliders in ( $E_t =$ equilibrium price today, see Rule 9.2)	0	0	0	$N_y \times E_t$	$N_y \times P_t$	$N_t \times P_t$
(h) Sliders out ( $E_t =$ equilibrium price today, see Rule 9.2)	$N_y \times P_y$	$N_y \times P_y$	$N_y \times E_t$	0	0	0

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**APPENDIX 1**

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**A1 GILTS EXCLUDED FROM THE CALCULATION OF FITTED YIELDS**

The FTSE Bond Indices Committee has decided that the following gilts should be excluded from the calculation of the Fitted Yields for Conventional gilt gilts:

5½% Treasury 2008-12

## APPENDIX 2 - Daily Layout in Financial Times

Data available at [www.ft.com/marketsdata](http://www.ft.com/marketsdata)

FTSE UK GILTS INDICES																
Price Indices	Wed	Day's	Month's	Year's	Total	Return	Return		Wed	Day's	Month's	Year's	Total	Return	Return	
UK Gilts	Aug 17	chge %	chge %	chge %	Return	1 month	1 year	Index-linked	Aug 17	chge %	chge %	chge %	Return	1 month	1 year	
1 Up to 5 years (11)	107.35	+0.02	+0.16	-0.29	1661.39	+0.16	-6.05	1 Up to 5 years (2)	262.72	+0.04	-0.49	+3.18	1616.90	+0.49	+5.78	
2 5-10 years (6)	161.00	+0.08	+0.47	+3.33	1852.59	+0.47	+9.05	2 Over 5 years (7)	310.55	+0.11	+1.45	+7.12	1972.81	+1.80	+9.61	
3 10-15 years (4)	175.80	+0.11	-0.06	+4.39	2015.89	+0.79	+10.49	3 5-15 years (4)	287.05	+0.08	+0.83	+6.64	1813.54	+1.36	+8.85	
4 5-15 years (10)	164.97	+0.09	+0.23	+3.61	1898.14	+0.61	+9.56	4 Over 15 years (3)	336.48	+0.17	+2.66	+8.13	2147.28	+2.66	+10.99	
5 Over 15 years (7)	225.72	+0.22	+1.51	+5.88	2156.96	+1.51	+11.14	5 All stocks (9)	302.51	+0.10	+1.33	+6.56	1926.00	+1.63	+9.07	
6 Irredeemables (1)	345.66	+0.34	+2.46	+8.68	2738.65	+2.46	+13.57									
7 All stocks (29)	154.96	+0.11	+0.64	+3.08	1871.57	+0.75	+8.90									
Yield indices	Aug 17	Aug 16	Yr ago					Real yield	---- Inflation 0% ----				---- Inflation 5% ----			
5 yrs	4.25	4.26	4.96	Up to 5 yrs	1.96	3.59	1.97	2.39	Aug 17	Dur yrs	Aug 16	Yr ago	Aug 17	Dur yrs	Aug 16	Yr ago
10 yrs	4.28	4.29	4.97	Over 5 yrs	1.62	12.09	1.62	2.01	1.16	3.59	1.16	1.55	1.38	12.21	1.38	1.77
15 yrs	4.29	4.31	4.89	5-15 yrs	1.73	9.01	1.74	2.20	1.41	9.05	1.42	1.86	1.41	9.05	1.42	1.86
20 yrs	4.29	4.30	4.80	Over 15 yrs	1.51	18.17	1.52	1.90	1.35	18.28	1.36	1.72	1.35	18.28	1.36	1.72
Irred	4.31	4.33	4.71	All Stocks	1.62	11.41	1.63	2.02	1.37	11.54	1.38	1.76	1.37	11.54	1.38	1.76

Stocks with 0 - 1 year to maturity are excluded from the yield &amp; duration indices.

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