

How to calculate cash flows on index-linked gilts

Index-linked gilts pay semi-annual cash flows indexed to the Retail Prices Index (RPI). In practical terms this means that both the coupons and the principal are adjusted to take account of accrued inflation since the gilt's first issue date. The precise details of the method of indexation for each bond are set out in the corresponding prospectus (all recent prospectuses are available on the DMO website).

Depending on the date of first issue, index-linked gilts have different indexation lags, and hence different methodologies for calculating cash flows. All index-linked gilts first issued prior to 2005 have an eight-month indexation lag, while all issued from 2005 onwards use a three-month indexation lag methodology.

This paper illustrates the method of calculation that the Bank of England and the DMO¹ employ when calculating coupon and redemption payments on both eight-month and three-month lag index-linked gilts.

Gilts with an Eight Month Indexation Lag (first issued before 2005)

Interest payments

The rate of interest for each payment is determined by taking the annual coupon quoted in the title of the bond (e.g. 2½% Index-linked Treasury Stock 2020) and applying an adjustment to take account of the movement in the RPI. The coupon element is fixed while the RPI adjustment varies from payment to payment, as described below. The resulting rate of interest, when applied to the nominal amount of the bond held, gives the amount of interest to be paid.

¹ The Bank of England is responsible for determining the cash flows on all index-linked gilts with first issue dates before 2002, whilst the UK Debt Management Office is responsible for calculating the cash flows on all gilts with first issue dates of 2002 onwards. The press releases announcing the sizes of the cash flows for all index-linked gilts appear on the DMO's website.

In order to calculate each half-yearly inflation adjustment, two figures are required: the RPI applicable to when the bond was originally issued (the “Base RPI figure”) and that relating to the interest payment concerned. In each case, the RPI figures used are those relating to the month eight months before the relevant dates. Two months of this indexation lag is to allow for the compilation and publication of the RPI, and six months is to ensure that the nominal size of the next coupon payment is known at the start of each coupon period for accrued interest calculations. Depending on their date of first issue, interest and redemption payments per £100 nominal for index-linked gilts are rounded to a different number of decimal places. Details of the rounding convention for current and redeemed index-linked gilts are provided in the Annex.

For example, the Base RPI figure for 4½% Index-linked Treasury Stock 2030 (first issued in June 1992) is 135.1 – the RPI figure for October 1991 (published in November 1991). This gilt pays interest in January and July for which the relevant RPI figures are those relating to the previous May and November respectively. So, the rate of interest for the payment in January 1998 was calculated as:

$$\frac{4.125}{2} \times \frac{\text{RPI for May 1997}}{\text{RPI for Oct 1991}}$$

For a holding of £10 million nominal of this bond the coupon payment would have been:

$$\left(\frac{4.125}{2} \times \frac{\text{RPI for May 1997}}{\text{RPI for Oct 1991}} \right), \text{ rounded down to 4 decimal places, then}$$

multiplied by $\frac{£10,000,000}{100}$

$$= \frac{4.125}{2} \times \frac{156.9}{135.1} = \text{£}2.3953 \quad (\text{when rounded down to 4 decimal places}),$$

$$\text{multiplied by } \frac{\text{£}10,000,000}{100} = \text{£}239,530.00$$

Redemption payment

Similarly, the redemption proceeds on maturity in July 2030 per £100 nominal of this bond will be:

$$\text{£}100 \times \frac{\text{RPI for Nov 2029}}{\text{RPI for Oct 1991}} \quad (\text{which will be rounded down to 4 decimal places})$$

Gilts with a Three Month Indexation Lag (first issued from 2005)

Index Ratio

The method of indexation for index-linked gilts with a three-month indexation lag is significantly different from the previously described eight-month lag methodology.

Rather than using a month's particular RPI figure to calculate the rate of interest for each payment, a three-month lag index-linked gilt uses an interpolated RPI figure, which is specific to a particular day in the month, called the 'reference RPI'.

With the new three-month indexation lag, the Reference RPI for the first calendar day of any month is the RPI for the calendar month falling three months earlier. For example, the Reference RPI for 1 June corresponds to the RPI for March, the Reference RPI for 1 July corresponds to the RPI for April, etc.

The Reference RPI for any other day in the month is calculated on a straight line basis between the Reference RPI for the first calendar day of the month

in which the day falls and the Reference RPI for the first calendar day of the month immediately following.

The formula used to calculate this Reference RPI for a certain coupon date can be expressed as follows:

$$\text{Reference RPI for First Day of Coupon Month} + \left(\frac{\text{Day of Month of Coupon} - 1}{\text{Days in Coupon Month}} \right) \times \left[\begin{array}{l} \text{Reference RPI for first day of the month after the coupon month} \\ - \text{Reference RPI for first day of coupon month} \end{array} \right]$$

So, taking account of the 3 month lag, this is equal to

$$\left(\begin{array}{l} \text{RPI relating to the month three} \\ \text{months prior to coupon month} \end{array} \right) + \left(\frac{\text{Day of Month of Coupon} - 1}{\text{Days in Coupon Month}} \right) \times \left[\begin{array}{l} \text{RPI relating to the month two months before after the coupon month} \\ - \text{RPI relating to the month three months before the coupon month} \end{array} \right]$$

rounded to the nearest 5th decimal place

For example, the Reference RPI for 20 July 2001 is calculated as follows.

As the Reference RPI is for a day other than the 1st of the month, the straight line method is used.

The Reference RPI for July 2001 is therefore based on the reference RPI for July and August:

$$\text{Ref RPI}_{20 \text{ July } 2001} = \text{Ref RPI}_{1 \text{ July } 2001} + \left(\frac{19}{31} \right) \left[\text{Ref RPI}_{1 \text{ August } 2001} - \text{Ref RPI}_{1 \text{ July } 2001} \right]$$

The Reference RPI for 1 July 2001 is the RPI for the month three months prior (April 2001), while the Reference RPI for 1 August 2001 is the RPI for two months prior (May 2001).

$$= \text{RPI}_{\text{April } 2001} + \left(\frac{19}{31} \right) \left[\text{RPI}_{\text{May } 2001} - \text{RPI}_{\text{April } 2001} \right]$$

$$= 173.1 + \left(\frac{19}{31}\right)[174.2 - 173.1] = 173.77419,$$

when rounded to the nearest 5th decimal place.

In order to calculate interest payments on three-month lag index-linked gilts, an 'Index Ratio' is applied, using particular Reference RPIs. The Index Ratio is the ratio of the Reference RPI for the date of the cash flow divided by the Reference RPI at the date of first issue:

$$\text{Index Ratio} = \left[\frac{\text{Reference RPI on cash flow date}}{\text{Reference RPI on first issue date}} \right],$$

rounded to the nearest 5th decimal place.

The Reference RPI for the first issue date for a given bond remains constant over its life. However, different index-linked gilts should have different values for it, depending on when they are first issued.

For example, if we have a hypothetical three-month index-linked gilt, first issued on 20 July 2001, then the Index Ratio for a transaction settling on 5 August 2005 would be:

$$\text{Index Ratio} = \left[\frac{\text{Reference RPI for 5 August 2005}}{\text{Reference RPI for 20 July 2001}} \right]$$

$$= \left[\frac{192.02581}{173.77419} \right] = 1.10503$$

when rounded to the nearest 5th decimal place

Interest Payments

The semi-annual interest payments per £100 nominal are calculated as the product of the coupon per £100 nominal and the relevant value of the Index Ratio:

$$\text{Interest Payment}_{\text{Interest Payment Date}} = \frac{\text{Coupon}}{2} \times \text{Index Ratio}_{\text{Interest Payment Date}}$$

Interest payments are rounded to the nearest 6th decimal place per £100 nominal.

Using our Index Ratio for the previous example, and assuming a coupon of 2.5%, the interest payment per £100 nominal that would be due on 5 August 2005 would be equal to:

$$\text{Interest Payment}_{5 \text{ August } 2005} = \frac{2.5}{2} \times 1.10503 = \text{£}1.381288$$

when rounded to the nearest 6th decimal place

Redemption Payments

The redemption payment, per £100 nominal, is calculated in a similar manner:

$$\text{Redemption Payment} = 100 \times \text{Index Ratio}_{\text{Redemption Date}}$$

rounded to the nearest 6th decimal place

If the Index Ratio for the redemption date were, say, 4.38391, then the redemption payment per £100 nominal would be

$$\text{Redemption Payment} = 100 \times 4.38391 = \text{£}438.391000$$

when rounded to the nearest 6th decimal place

Re-basing of the RPI: Gilts with an Eight Month Indexation Lag

In July 1986 the then Department of Employment announced that the RPI series would be re-based. The re-basing took effect in January 1987, when the value of the index was adjusted from 394.5 to 100. Many index-linked gilts were first issued before this re-basing. The prospectus for each index-linked gilt describes the procedures to be followed in order to calculate payments of interest and principal after a re-basing of the RPI.

These procedures can be illustrated by calculating the interest payments due in April 1987 and October 1987 on a holding of £100 nominal of 2½% Index-linked Treasury Stock 2020. As this bond was first issued in October 1983, its Base RPI is the RPI for February 1983 (eight months before the first issue date). The calculation of the April 1987 payment was effected using the RPI for August 1986 (eight months prior to April 1987). As the RPI for August 1986 was from the old series, no re-basing adjustment was necessary.

So for a holding of £100 nominal of 2½% Index-linked Treasury Stock 2020 the April 1987 coupon payment (determined from the August 1986 RPI) was:

$$\begin{aligned} & \frac{2.5}{2} \times \frac{\text{RPI for Aug 1986}}{\text{RPI for Feb 1983}} \\ & = \frac{2.5}{2} \times \frac{385.9}{327.3} = \text{£}1.4738 \end{aligned}$$

(when rounded down to 4 decimal places)

For a holding of £100 nominal the October 1987 coupon payment on this bond (determined from the February 1987 re-based value of the RPI) was:

$$\frac{2.5}{2} \times \frac{\text{RPI for Feb 1987 (New Series)}}{\text{RPI for Feb 1983 (Base RPI)}} \times \frac{\text{RPI for Jan 1987 (Old Series)}}{\text{RPI for Jan 1987 (New Series)}}$$

$$= \frac{2.5}{2} \times \frac{100.4}{327.3} \times \frac{394.5}{100.0} = \text{£}1.5126$$

(when rounded down to 4 decimal places)

Similarly, the calculation of the redemption proceeds on maturity in April 2020 per £100 nominal of 2½% Index-linked Treasury Stock 2020 will be:

$$\text{£}100 \times \frac{\text{RPI for Aug 2019 (New Series)}}{\text{RPI for Feb 1983 (Base RPI)}} \times \frac{\text{RPI for Jan 1987 (Old Series)}}{\text{RPI for Jan 1987 (New Series)}}$$

Details on all index-linked gilts including the first issue date, Base RPI and maturity date appear elsewhere in the index-linked section of the DMO's website.

Annex: Rounding Conventions for Interest and Redemption Cash Flows for Index-linked Gilts

The following rounding conventions apply for interest and redemption cash flows for index-linked gilts, per £100 nominal.

Round down to 2 decimal places

2% Index-linked Treasury Stock 1996
2% Index-linked Treasury Stock 2006
2½% Index-linked Treasury Stock 2011

Round down to 4 decimal places

2% Index-linked Treasury Stock 1988
2% Index-linked Treasury Stock 1990
2% Index-linked Treasury Stock 1992
2% Index-linked Treasury Stock 1994
4⁵/₈% Index-linked Treasury Stock 1998
2½% Index-linked Treasury Convertible Stock 1999
2½% Index-linked Treasury Stock 2001
2½% Index-linked Treasury Stock 2003
4³/₈% Index-linked Treasury Stock 2004
2½% Index-linked Treasury Stock 2009
2½% Index-linked Treasury Stock 2013
2½% Index-linked Treasury Stock 2016
2½% Index-linked Treasury Stock 2020
2½% Index-linked Treasury Stock 2024
4¹/₈% Index-linked Treasury Stock 2030

Round to the nearest 6 decimal places

All other index-linked gilts – i.e. all index-linked gilts first issued from 2002.